Bill Barden Reviews Tandy's New CC EDTASM+

November 1982
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80micro

A WAYNE GREEN PUBLICATION

the magazine for TRS-80 users*

Computer Alchemy:
Science Embraces the Micro

Star-Gazing with the CC

How Micros Might Save Your Life

The Genius of Charles Babbage

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Features

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Cover by William Giese

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The left bracket, [, replaces the up arrow used by Radio Shack to indicate exponentiation on our printouts. When entering programs published in *80 Micro*, you should make this change.

80 formats its program listings to run 64 characters wide, the way they look on your video screen. This accounts for the occasional wrap-around you will notice in our program listings. Don't let it throw you, particularly when entering assembly listings.

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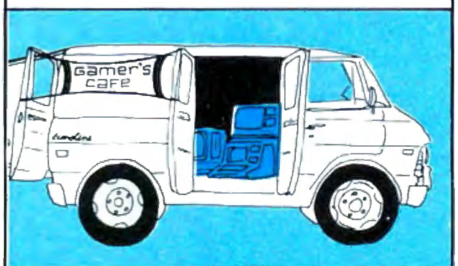

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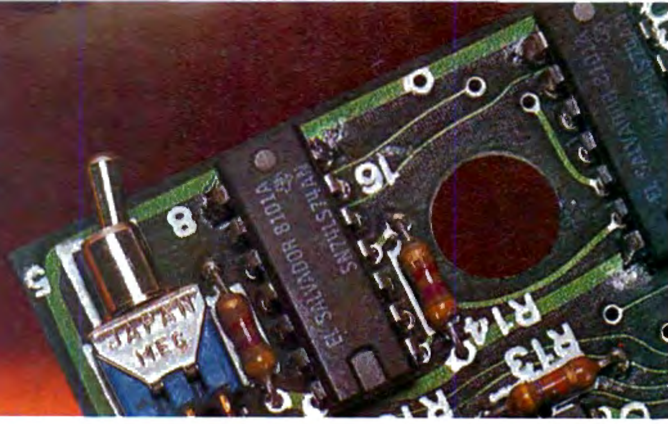
THE SWITCH



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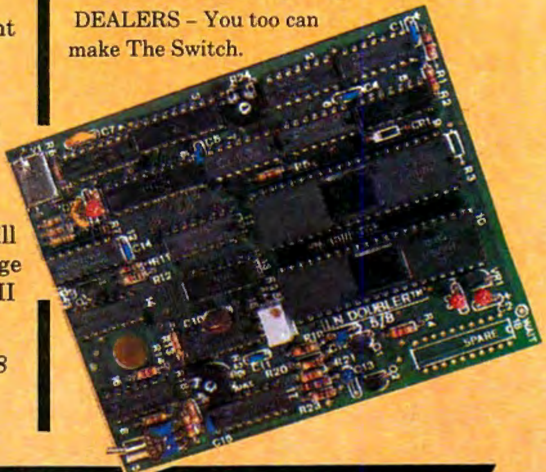

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by Wayne Green

Schools stink, but computers can help

Education in the future—now there's a subject that should be good for a whole book. Golly, could I get into the things that are wrong with education today and should be changed... such as the laws on compulsory education that are packing our high schools with kids who hate being there and are determined to make it impossible for anyone else similarly trapped. Or I could get into a chapter or two on what happened to education in America when the government took control, an object lesson in what happens when the socialist ethic takes over a field.

Let me be blunt—education in America today is a disaster. It's expensive, it's not doing the job. It's a fine example of what happens when one gets the government into a business.

Well, with the computer "revolution" we may have an edge toward getting government out of the education business. If you're interested in the field of education you've read plenty about problems compulsory education has caused...and you already know what feeding at the public trough has done to the quality (dare I use the word?) of education.

Since none of you knows any better than I what to do about these situations, let's go on to some sorting out of the situation, looking for ways in which computers may bring some relief.

I happen to think the future is exceptionally bright for everyone. I believe that computers are eventually going to help us provide a far more effective education for people than anything we have today. Kids will learn because they want to learn, not because they are sent off like slaves to schools and are regimented into the three Rs.

Let's tackle one of the major problems of education: making the material interesting enough to the student so he or she learns out of self-interest instead of being a prisoner of the system. Suppose we used a medium such as the Nova series on Public Broadcasting and presented all of the material now being taught in school in this manner. We would use whatever props or locations were needed, with expense being irrelevant. We would have the best of teacher/actors. There have been a number of such series on PBS such as Connections, Discovery and so on. With that quality of presentation we might find people learning because it is fun.

Sure, that's an expensive way to go. Each hour of material could well cost several million dollars. But if we were able to make these courses available to millions, tens of millions, or perhaps with some translation into other languages, hundreds of millions of people, the cost per person would be miniscule.

This is where the video tape—or, even better, the video disk—comes in. This quality of teaching could be made available to the poorest parts of the world via such a medium. Many third-world countries have so few teachers and so little money for education that nothing even remotely comparable to our U.S. educational system is available.

Okay, then we have one more major hurdle to solve. In the ever-growing classes, there is no way for a teacher to gear the material to the learning speed of *any* student, much less all students. I don't know about you, but in many classes I was bored to tears and in others I had a tough time keeping up. Neither was any fun and neither inclined me to appreciate education or to particularly cooperate.

Now let's suppose that we are able to build in an interactive computer program into our video disk program, one that will stop every so often and see how I'm doing. This system could be programmed to go into much greater depth for slow students and skim lightly over things for those who get it the first time. This approach could go even further toward making education fun.

Of course once we got started with such a system we would find that education was no longer limited to kids, but of interest to and desired by all age groups. And education would expand to cover all aspects of our world, including training for just about every type of professional and business work.

Yes, I hear the fear in your trembling voices and see the terror in your eyes—if we have this utopian educational system, who will need teachers? Well, you just aren't sitting there with your thinking caps on, that's all. Calm down for a moment and remember that not all of education can be brought to students via superannuated television, even with a computer in the act. No, there are a lot of *skills* people will need—and want. And these are going to take teachers.

Kids of the future may be far better skilled than kids today because they will not have to spend as much time (perhaps waste is a better word) on academic subjects and rote learning. They will be able to develop high degrees of skill at things such as woodworking, sculpting, metal working, glass blowing, foundry, electronic servicing, skating, skiing, driving, flying, riding, musical instruments, juggling...oh, the list is a long one. Add to that work in labs of all kinds—mechanical, chemical, cooking, physics, radio, electrical—and so on. The world is getting increasingly complex and the kids of the future are going to have to have a far more efficient educational system to successfully cope with it.

With these sorts of approaches to education I expect that we would be able to generate high degrees of interest in students in many subjects. I think we would find kids getting deeply involved in computer programming, computer design, communications equipment design, astronomy, and so on. Students who get involved emotionally in these things early in life are the ones who go on to make the most valuable contributions to the world with new inventions, new ideas and pioneering.

Will future students do their video-based learning at school or at home? Reason would seem to dictate that most of this could well be done at home, just as computers and the advanced communications they are going to bring us will also allow far more people to do a large part of their "work" at home. Who knows—we might just be heading for a rebuilding of families. When parents can be at home, there is less need for the baby-

sitting function of schools—which is an important function today, since most homes have two working parents.

Colleges Stink

Hold tight—I have another big one for you. This has to do with our colleges. They stink. The sooner we can start getting our educational system geared to providing fun ways to learn, the sooner we may be able to trash liberal-arts courses. I sat recently at a Chamber of Commerce breakfast and listened to an "educator" try to explain that students should spend four damned years of their lives with liberal arts so they will be able to appreciate the beauty of trees. Sure, and then they can come to work for me emptying wastebaskets. I wish I was exaggerating, but I've had several such people doing just that.

Education should, in my estimation, gear a person to do what he wants in the way of being a productive member of society. If he wants to be an engineer, fine. If he wants to write music, no problem. If he wants to spend his life making hand-made silver services, I have no objection—providing there is a market for the silver services and the chap is not going to come pleading to me for a handout because he is making something no one wants.

Okay. We have several problems that I think I can solve with a new type of college. Our country is in desperate need of more technical people. Here we are in the middle of a computer revolution—and on the verge of a communications revolution—and we have virtually no technicians or engineers. By not infecting our teenagers with technical hobbies, we have cut off the flow of these career people into college.

The college I envision would be geared to the enthusiastic high school student who is anxious to pursue a technological career. It would be set up with almost total concentration on gearing that student for business. The education would include the fundamentals of the technology, such as electricity for the computer buff. The student would go on to electronics, integrated circuits, gates, microprocessors, computer design, memory systems, programming, operating systems, applications software, and so on.

> *"Our country is in desperate need of more technical people."*

But that would be only half of it. America is built on the strengths of entrepreneurs, so my college would also teach all of the business courses the person is going to need either to start or run a business. There would be courses in reading, writing, talking, selling, purchasing, finance, accounting, taxes, advertising, printing, typesetting, pricing, marketing, personnel management, and so on.

The concept is simple—a campus with an industrial park on it where students would be able to spend half of their day in school and the other half working for on-campus businesses. They would be trainees working in development labs, doing routine accounting (computerized), selling, marketing, advertising, and so on. Being career-interested kids, they would be fantastic workers. I've found that the very best computer programmers and technicians I can get are teenagers. They will work night and day at a project and get it done. They usually work rings around older technicians. Thus kids would have the benefits of both professional work and the school at the same time. Problems in business could be brought into class. Solutions in class could be brought to business. Synergistic, with everyone winning. Teachers would be helping students cope with practical business problems, thus stretching their skills. Students would get the best of both the academic and business worlds. But what about the trees? Let's get into poetry, music and the arts via video disks for the time being. Or, if kids want to pursue art careers, fine—let's set them up with an appropriate college where they sell their art and music...or silver service sets.

There, that's enough for one sitting. ■

PROOF NOTES
The editors look at the issues

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What micros can give to science

Science, medicine, and microcomputers—is there a connection? This issue of *80 Micro* may reveal an unanticipated one.

The need to perform scientific calculations faster with accuracy was the impetus for the invention of the electronic computer. Technological advances in miniaturization spurred by America's space program made semiconductor devices like microprocessors possible. Microcomputers, then, owe a debt to science, but is the reverse ever likely to occur?

Science, and society, could owe a future debt to the development of microcomputers. These marvels of silicon just may provide the link between the process of scientific discovery and the masses of people who are increasingly aware that science does not exist in a vacuum—that its discoveries affect society in a myriad of ways.

But first, our culture needs to tune back into science, to make an effort to understand rudimentary scientific concepts and the process of science—the scientific method. Microcomputers can play a vital role in this endeavor.

In a 1962 issue of *American Behavioral Scientist*, Alan T. Waterman, then director of the National Science Foundation, asserted, "Science, in its pure form, is not concerned with where discoveries may lead; its disciples are interested only in discovering the truth." Philosophers also search for the truth, as do judges, private eyes, and comic book heroes. But do any of these people who struggle so valorously ever find what they seek? Do they even know where they are going?

Or is the struggle the real challenge? Is the journey, with all of its thrills and spills, more important than any possible destination?

It is an interesting quirk of the scientific method that, in the cyclical process of forming hypotheses, testing them experimentally and forming new ones, it is easiest to come up with the hypotheses. Each idea that a scientist formulates gives birth to a plethora of new ideas. For most gifted scientists, a lifetime provides the time to test only the tiniest fraction of the ideas that the man can easily formulate.

One could argue that, because it produces a never-ending stream of explanations for why things are as they are, science contributes to the chaos and instability of society rather than providing any solutions to important problems. This gives credence to the notion that most scientists are along for the ride rather than concerned with the destination.

The answer to this dilemma may ultimately be to involve society more fully in the search for scientific truths. It is obvious that there are moral and social ideas that must be accommodated in the search. How can we raise the consciousness of the mass culture to tune everyone in to the processes of science? Maybe this is the connection between science and microcomputers.

Micros can teach people about science—electronics, chemistry, astronomy, and more—and can help them do the research that yields scientific truths. Micros, because they are complex technological tools, which are accessible enough to be understood by most anyone, can help people overcome their fear of science and technology. These miniature electronic marvels can help people tune in to technology and explore it.

Most of us who have been exposed to microcomputers have experienced the joy, the thrill, that comes from getting that Basic sort routine to work after hours of trial-and-error programming. Many of us have known the triumph of creating a better algorithm or finding an undocumented feature of our machines. These experiences are tuning us in to science. After all, they call it computer science!

* * * * *

On the following pages, you'll read about a genius of the last century, a man named Charles Babbage and his

continues on page 500

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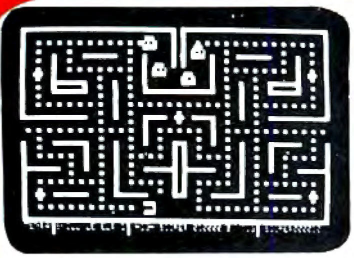
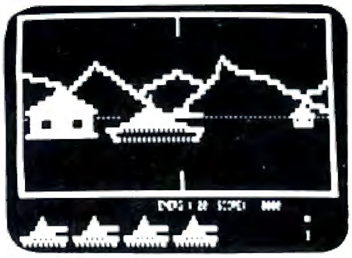


SCARFMAN

This incredibly popular game craze now runs on your TRS-80! It's eat or be eaten. You run Scrarfman around the maze, gobbling up everything in your path. Try to eat it all before nasty monsters devour you. Excellent high speed machine language action game from the Cornsoft Group. With sound. Price: A

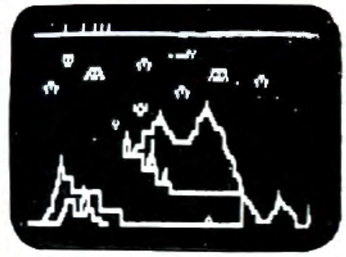


ARMORED PATROL

A realistic tank battle simulation. Your view is a 3--D perspective of an alien landscape. Maneuver your T-36 tank to locate and destroy enemy tanks and robots that lay hidden, ready to assault you. Clever graphics create the illusion of movement and dimension. From Adventure International. With sound. Price: B

REAR GUARD

Deadly waves of enemy Cyborg craft attack your fleet from the rear. You are the Mothership's sole defender. You have unlimited firepower but the Cyborgs are swift, nimble attackers. Your abilities are tested hard in this game or lightening fast action and lively sound from Adventure International. Price: B



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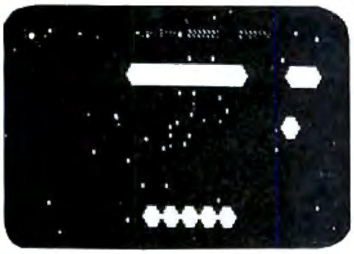
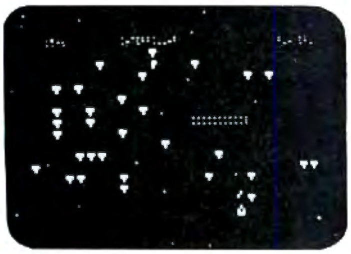
As the primary defender of a world of cities under deadly alien attack, your weaponry is the latest: rapid fire missiles, long range radar, and incendiary "star shells." Your force field can absorb only a limited number of impacts. A complex game of strategy, skill and reflexes from Melbourne House. Price: A



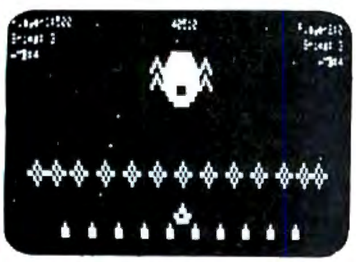
BOUNCEOIDS

Huge boulders careen off the walls. You're in the middle, in danger of being flattened. Keep your wits about you as you blast these "bounceoids" from the screen. Large ones break into many small ones. Clear a screen, and enter a fast-paced challenge stage with a chance for big bonus points. From the Cornsoft Group. Price: A



CATERPILLAR

An arcade favorite! Stop these multi-sectioned crawlers before they creep down through the mushrooms. Zap one and it splits into two smaller bugs, each with its own sense of direction. There are moths and tumble bugs too. It all adds up to lots of fun for kids and adults alike. From Soft Sector Marketing. With sound. Price code: A



DEFENSE COMMAND

The invaders are back! Alone, you defend the all important nuclear fuel canisters from the repeated attacks of thieving aliens, repeatedly. An alien passes your guard, snatches a canister and flys straight off. Quick! You have one last chance to blast him from the sky! With sound and voice. Price: A

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METEOR MISSION II

As you look down on your view, astronauts cry out for rescue. You must maneuver through the asteroids and meteors. (Can you get back to the space station?) Fire lasers to destroy the asteroids, but watch out, there could be an alien Flagship lurking Includes sound effects! Price: A

OUTHOUSE

You are the mighty protector of this small (but important) wooden structure. For reasons unknown, a bizarre gang of miscreants wish to vandalize, loot and otherwise destroy the little "half moon house." Your patrol craft has lasers and smart bombs to deal with this terror. From SSM with sound. Price: A

SUPER NOVA

Asteroids float ominously around the screen. You must destroy the asteroids before they destroy you! (Big asteroids break into little ones). Your ship will respond to thrust, rotate, hyperspace and fire. Watch out for that saucer with the laser! As reviewed in May 1981 Byte Magazine. Price: A

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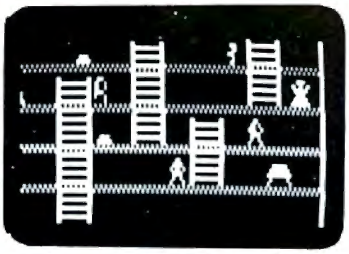
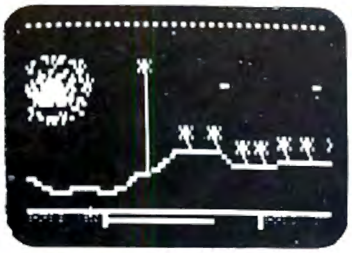


PANIK

Trapped at an enemy building site, your fate seems certain. Your laser is empty and evil Mzors are closing in. You'll have to climb ladders and think one step ahead of the various monsters. A challenging game for agile minds. From Fantastic Software with voice (Disk has larger vocabulary). Price: B



SEA DRAGON

Your submarine, the U.S.S. Sea Dragon, penetrates a mined enemy channel. Armed with missiles and torpedos, you engage the enemy while navigating unknown waters. Succeed or come to a salty end in this game. 29 screens of horizontally scrolling seascrape and sound from Adventure International. Price: B

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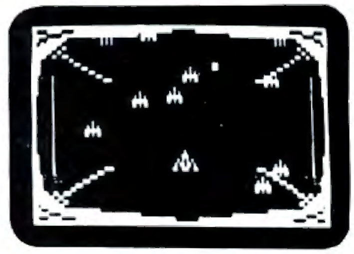
TOP TEN

1. SCARFMAN - *All time favorite*
2. ARMORED PATROL - *Super 3D graphics*
3. PENETRATOR - *Rave reviews*
4. STELLAR ESCORT - *Fast and Challenging*
5. CRAZY PAINTER - *Unique game concept*
6. PANIK - *Remarkable Voices*
7. DEFENSE COMMAND - *Tough struggle*
8. CATERPILLAR - *Good rendition*
9. ROBOT ATTACK - *With voice*
10. SEA DRAGON - *Amazing "Seascape"*

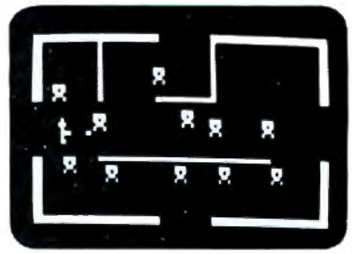
STELLAR ESCORT

The latest super action game from Big Five. As the Federation's top space fighter you've been chosen to escort what is possibly the most important shipment in Federation history. The enemy will send many squadrons of their best fighters to intercept. With sound. Disk version has voices. Price: A



ROBOT ATTACK

Talks without a voice synthesizer, through the cassette port. With just a hand laser in a remote space station, you encounter armed robots. Some march towards you, more wait around corners. Careful, the walls are electrified. Zap as many robots as you dare before escaping to a new section. More robots await you. Price: A



LUNAR LANDER

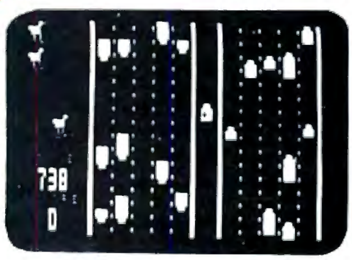
As a vast panoramic moonscape scrolls by, select one of many landing sights. The more perilous the spot, the more points scored -- if you land safely. You control LEM main engines and side thrusters. One of the best uses of TRS-80 graphics we have ever seen. From Adventure International. With sound. Price: A

GALAXY INVASION

The sound of the klaxon is calling you! Invaders have been spotted warping toward Earth. You shift right and left as you fire your lasers. A few break formation and fly straight at you! You place your finger on the fire button knowing that this shot must connect! With sound effects! Price: A

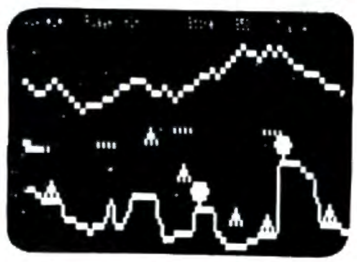
LASER DEFENSE

In this game of ICBM's, high-energy lasers and particle beams, you control the U.S. strategic defense satellite system. From your viewpoint high above the globe, you intercept Soviet nuclear missiles in flight and attempt to destroy their scattered missile silos. With sound from MED Systems. Price: B



CHICKEN

Will the chicken cross the road? That's up to you. Can you guide these helpless little chicks across the perilous 10 lane super highway to safety? Or will you bumble, littering the blacktop with a storm of chicken feathers? A humourous yet challenging game of nerves from SSM with sound. Price: A



PENETRATOR

Soar swiftly over jagged landscape, swooping high and low to avoid obstacles and enemy missiles attacks. With miles of wild terrain and tunnels to penetrate, you're well armed with bombs and multiple forward missile capability. From Melbourne House. Features sound, trainer mode and customizing program. Price: C

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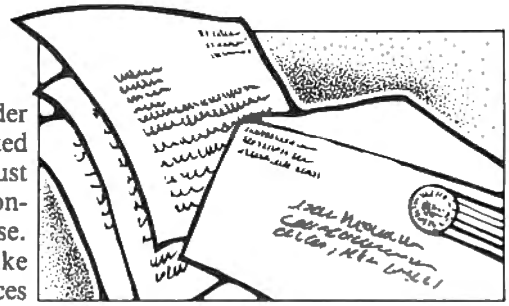

To Copy Or Not To Copy

Whenever I receive my mail-order software and I find it is on a protected disk, I feel like I would if I had just bought a book but was told I could only keep it in a particular bookcase. Utilities are a special pain, since I like to spread them around in handy places on several disks.

A protected disk is only an aggravation until the company producing it turns belly-up and you can no longer buy a backup. Then it is a fraud.

One such product is the particularly sophisticated and excellent Super-Utility Plus from Powersoft Inc. It comes on one of the most locked-up of all locked disks, but its author has the audacity to include an unlocking routine for disks other than his own.

In the event that Powersoft Inc. should go the way of Braniff Airlines, I have devised a copying procedure for this valuable work that I will make available free for a stamped, self-addressed envelope. However, not wishing to rain on Powersoft's parade, I will not do so until they can no longer make available their $5 copy. In the meantime, to all the persevering among you, rest assured that copying this baby is indeed possible. Just stick with it and in less time than you think you'll have lots of copies, just like I have.

If you've passed up purchasing this product because you too hate the prospect of eventually being stuck with a worn out disk and no way to get another, be concerned no longer.

This letter caused us a lot of consternation. To print or not to print? Those of us with a zest for the fray voted to side with the lunch-bucket computerist and publish, despite negative feedback from anti-piraters. Those of us with more conservative inclinations felt that to publish would be to condone and promote an illegal (and perhaps immoral) act.

So we compromised (some might say, chickened out). We decided to print the letter without the name, and let you readers tell us what we should do. We've also contacted several software manufacturers to get their views.

What do you think? Do you agree with the letter-writer about protected disks? Should the person offer to tell other people how to break the lock? And should 80 Micro *be the forum? Let us know; we'll publish a sampling of responses in a later issue.—Eds.*

Please do not submit any letters longer than 300 words for the Input, Aid, and Debug columns. *80 Micro* reserves the right to edit any letters submitted.—Eds.

Profile Update

We are the authors of the Profile II and Profile+ programs, distributed by Radio Shack, which Craig Hilton reviewed in the April issue ("80 Reviews," pp. 48-50). We greatly appreciate his review. However, we noticed a few mistakes that we think may confuse readers.

First, the Profile+ program is not $220 more than Profile II, just $120. In fact, readers with Profile II who want the Plus features can buy a Plus enhancement package for $120; Profile II users can upgrade their systems as their needs become more sophisticated, rather than be forced to buy new software and lose the data (and work) they'd put into their old systems.

Also, Profile+ is simply an enhanced Profile II, not a wholly new and different program. The review implied this by comparing them to each other instead of to other data base management programs.

Second, in the chart starting on page 48, the maximum number of 500-byte records on a four-drive system in Profile II is 1875, not 1800; the corresponding Profile+ number is 3000. There are five, not four, screen formats per file, and seven sort comparison criteria (add EQ and NE) for both programs. On page 50, Profile II has 1-6 line labels, not 6-99; and both systems can be expanded onto hard (fixed) disks. Also, page totals (subtotals) can be generated in both programs; however, grand totals are then not generated. Under Speed, Profile+ has an indexing function which speeds up selection during inquire or update operations even more.

We have a few questions. What, for instance, does Mr. Hilton mean by "layered sort capability?" Does he mean sorting by multiple fields? Or does he mean disk-based sorting—doing sorts that are larger than memory? Both functions are available in our new Model II Profile extension program Prosort, available directly from us. (Prosort also allows 16-field selection and report and label-printing indexes.) Also, both Profiles can write to and be read by Basic programs.

We did not write the original Model I or III Profile programs, and neither is compatible with our Profile III+.

We agree that the documentation on Profile+ has been poor, but Radio Shack's new user's manual should solve that problem.

Howard Wolowitz,
President
The small Computer Company
New York, NY

Craig Hilton Replies

Thanks for the clarification. I'm glad to hear a new user manual is on the way. A system with these capabilities deserves broad-based documentation. In preparing the review, I used the first public release of Profile II+ (August), which did not include references to many of the benchmark standards used in the comparison.

A layered sort capability is disk-based sorting on nested multiple fields using standard Boolean comparisons. As this is a very useful option in powerful data base management systems, I am glad to learn you have added the capability in your Prosort enhancement. Although Profile II+ can read and write Basic programs, which is a very significant improvement over Profile II, it still cannot directly access non-Profile data files. However, from what I have seen of the fielding algorithms, there is no reason this feature cannot be added.—Craig Hilton

IRA Error

The Program Listing for Mr. Ryder's "Make a Fortune" letter (80 Input, June/July 1982, p. 17) certainly

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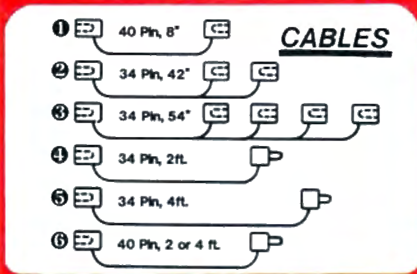

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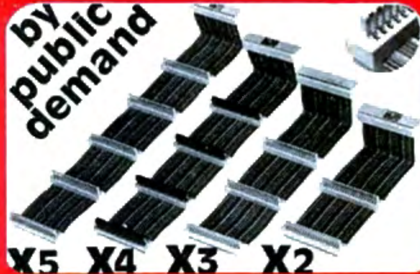

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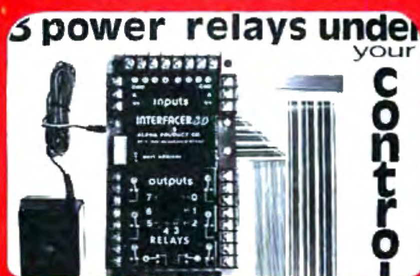

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GREEN SCREEN WARNING

IBM and all the ''biggies'' are using green screen monitors Its advantages are now widely advertised We feel that every TRS-80 user should enjoy the benefits it provides But **WARNING**: all Green Screens are not created equal Here is what we found.

•Several are just a flat piece of standard colored Lucite The green tint was not made for this purpose and is judged by many to be too dark Increasing the brightness control will result in a fuzzy display

•Some are simply a piece of thin plastic film taped onto a cardboard frame The color is satisfactory but the wobbly film gives it a poor appearance

•One ''optical filter'' is in fact plain acrylic sheeting

•False claim: A few pretend to ''reduce glare'' In fact, their flat and shiny surfaces (both film and Lucite type) ADD their own reflections to the screen

•A few laughs. One ad claims to ''reduce screen contrast'' Sorry gentleman but it's just the opposite One of the Green Screen's major benefits is to increase the contrast between the text and the background.

•Drawbacks: Most are using adhesive strips to fasten their screen to the monitor This method makes it awkward to remove for necessary periodical cleaning All (except ours) are flat. Light pens will not work reliably because of the big gap between the screen and the tube

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•The filter material that we use is just right, not too dark nor too light The result is a really eye pleasing display

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A last word. We think that companies, like ours, who are selling mainly by mail should •list their street address•have a phone number (for questions and orders)•accept CODs, not every one likes to send checks to a PO box•offer the convenience of charging their purchase to major credit cards How come we are the only green screen people doing it?

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Error Trap

The Series 2000 UPS (from Exide Electronics), a small uninterruptible power supply system, which we listed in our August 1982 New Products section is *not* intended for home use or with personal microcomputers. It is intended for use with minicomputer systems.—Eds.

The Readers' Choice Awards in our August issue lists several programs for the Color Computer by MPP Graphics. This company is actually Superior Graphic Software, who publish a program called MPP Graphics (Motion Picture Programming). We apologize for any confusion this may have caused any of our readers.—Eds.

will make a fortune. Unfortunately, the banks won't pay what it calculates.

The calculation method is in error and as a result the program overstates the value of IRA.

Mr. Ryder's program shows a $100 per month, 15 percent, 20 year IRA to be worth $141,372.14. The actual value is somewhat less, $132,707.34. People selling IRAs must, by law, be as accurate as possible.

Make the changes shown in Program Listing 1a; these changes cause the program to be accurate only for the following case: Investments where monthly deposits are made to an account that pays interest compounded annually and credited at least monthly. (Beginning of period payment is assumed.)

Some additional revisions of the input format and the formula make this program applicable to all IRAs.

G. Peter Czok
Dept. 'G' Software, Inc.
212 S. Oak St.
Owatonna, MN 55060

```
10 CLS:FORI=0TO127:SET(I,1):NEXTI
20 PRINT@10,"IRA/SAVINGS/INVESTMENT ACCOUNT CALCULATOR ":PRINT:P
RINT:PRINT
30 'FOR MOD III ONLY
40 CLS:L=0:INPUT "MONTHLY INVESTMENT $";A
50 INPUT "ANNUAL INTEREST RATE PERCENTAGE";B
60 INPUT "NUMBER OF YEARS TO BE CALCULATED";C
75 G=C*12:H=((1+(B/100))[(1/12))-1:L=A*(1+H)*((((1+H)[G)-1)/H)
90 PRINT"YOUR ACCOUNT BALANCE WILL BE $";L:PRINT
100 P=A*G:K=L-P:PRINT"YOUR TOTAL INVESTMENT WAS $";P
110 PRINT"INTEREST YOU EARNED WAS $";K:PRINT:PRINT
120 INPUT"HIT 'ENTER' FOR ANOTHER CALCULATION";A$
130 IFA$=""THENGOTO40ELSECLS:END
```

Program Listing 1a

Ryder Replies

I received Mr. Czok's letter concerning the inaccuracy in my "Make a Fortune" program; and to him I say "I stand corrected."

My original program assumed that all monthly inputs would have the same interest. That's wrong; only deposits that have been invested one year will receive the annual interest percentage.

See Program Listing 1b for the corrections.

Howard D. Ryder, Jr.
6241 51st Terrace North
St. Petersburg, FL 33709

```
10 CLS:FORI=0TO127:SET(I,1):NEXTI
20 PRINT@10,"IRA/SAVINGS/INVESTMENT ACCOUNT CALCULATOR ":PRINT:P
RINT:PRINT
30 'FOR MOD III ONLY
40 CLS:L=0:INPUT "ANNUAL LUMPSUM DEPOSIT $";E
50 INPUT "ANNUAL INTEREST RATE PERCENTAGE";B
60 INPUT "NUMBER OF YEARS TO BE CALCULATED";C
70 F=B/100+1:FORX=1TOC
80 L=(E*F+(L*F)):NEXTX:PRINT
90 PRINT"YOUR ACCOUNT BALANCE WILL BE $";L:PRINT
100 P=E*C:K=L-P:PRINT"YOUR TOTAL INVESTMENT WAS $";P
110 PRINT"INTEREST YOU EARNED WAS $";K:PRINT:PRINT
120 INPUT"HIT 'ENTER' FOR ANOTHER CALCULATION";A$
130 IFA$=""THENGOTO40ELSECLS:END
```

Program Listing 1b

Infinite Inflation

I've written a program for the Color Computer that shows the effect of inflation on the value of your savings by also calculating a typical annual salary as the years go by (see Program Listing 2). This program is based on and prompted by Howard D. Ryder, Jr.'s program in the June/July 1982 80 Input column, page 17.

Andrew Shorter
2578 Sylvan Road
Cuyahoga Falls, OH 44221

```
0 'THE ANNUAL INTEREST RATE HAS HISTORICALLY BEEN ABOUT 3% GREAT
ER THAN THE INFLATION RATE
1 'THIS PROGRAM SHOWS THE EFFECT OF INFLATION ON SAVINGS
2 'USE THE TYPICAL ANNUAL SALARY AS AN INDICATOR OF THE VALUE OF
 YOUR SAVINGS
3 'THIS IS IN RESPONSE TO HOWARD D. RYDER JR.'S LETTER IN THE JU
NE/JULY ISSUE OF 80 MICRO
4 'ANDREW SHORTER
5 '2578 SYLVAN RD.
6 'CUYAHOGA FALLS, OH 44221
10 CLS:D$="$$###,###,###.##":PRINT@5,"IRA CALCULATOR":PRINT
40 BB=0:INPUT"MONTHLY INVESTMENT $";M
50 INPUT"ANNUAL INFLATION RATE (%)";R
55 INPUT"TYPICAL ANNUAL INCOME $";AI
60 INPUT"NUMBER OF YEARS TO BE CALCULATED";NY
70 A=M*12:PRINT"ASSUMED INTEREST RATE =";R+3:F=(R+3)/100+1:FORY=
1TONY
80 BB=A*F+BB*F:AI=AI*(1+R/100):NEXTY:PRINT
90 PRINT"YOUR BANK BALANCE WILL BE":PRINTUSINGD$;BB
100 T=A*NY:I=BB-T:PRINT"YOUR TOTAL INVESTMENT WAS":PRINTUSINGD$;
T
110 PRINT"INTEREST EARNED WAS":PRINTUSINGD$;I
120 PRINT"TYPICAL ANNUAL INCOME AT END OF "NY" YEARS IS";:PRINTU
SINGD$;AI:PRINT:INPUT"HIT ENTER FOR ANOTHER CALCULATION";A$
130 CLS:RUN
```

Program Listing 2

A Timely Directory

I welcomed with interest the article "Lost and Found" (*80 Micro*, June/July 1982) by Robert Athanasiou on a disk directory for the Model III. I've added two lines to the program to make it more useful.

```
3215 LPRINT "DIRECTORY PRINTED ";
LEFT$(TIME$,8):LPRINT
```

```
3425 LPRINT ":DIRECTORY PRINTED ";
LEFT$(TIME$,8):LPRINT
```

In this manner each printout is automatically dated with the current date (if it is put in correctly at the start of the day).

Alan P. Brockway
7146 Inca Way
Denver, CO 80221

We have received many letters from readers and advertisers telling us that we forgot to include this program or that program in the Readers' Choice Awards (August 1982), so we have compiled an addendum to fill in some of the blanks.

A final addendum will be published with the results in the January 1983 issue.—Eds.

Program	Company	Machine	Category
ACCT-3	Micro Architect	I/III	Accounting
AR (Accounts Receivable)	Micro Architect	I/III	Accounting
Autofile	Snappware	III	Utility
Automap	Snappware	III	Utility
Billing System	Computer Shack	I/III	Accounting
Boss III	Soft Sector Marketing	III	Utility
CCA Data Management	F/S Associates	II	Business
Checkwriter	Computer Shack	I/III	Accounting
Color Accountant	Programmer's Institute	CC	Accounting
Color Wordclone	IMB	CC	Word Processor
COLORCOM/E	Eigen Systems	CC	Data Communications
Colorzap	Software Options	CC	Utility
COPSYS	Computronics	I/III	Utility
Copy-Tape	Modtec	I/III	Utility
Data Ace	Computer Software Design	II	Word Processor
Data Writer	Software Options	I/III	Data Base Manager
DSM	Racet Computes	I, II, III	Utility
DSMBLR	Misosys	I/III	Utility
Flex	Frank Hogg Laboratory	CC	Utility
Forthwrite	MMSFORTH	I/III	Word Processor
GL (General Ledger)	Micro Architect	I/III	Accounting
IDM	Micro Architect	I/III	Data Base Manager
Inventory Control System	Micro Architect	I/III	Business
Invoice System	Computer Shack	I/III	Accounting
KFS-80	Racet Computes	I, II, III	Utility
Microproof	Cornucopia	I/III	Spelling Checker
Money Manager	Acorn Software	I/III	Business
Payroll	Micro Architect	I/III	Accounting
Personal Finance	Radio Shack	CC	Business
Pilot	Barker Software	I/III	Utility
Postman Mass Mailing	Soft Sector Marketing	I/III	Business
Programmer's Program	Programmer's Institute	CC	Education
Remodel + Proload	Racet Computes	I/III	Utility
RSTERM	Radio Shack	I/III	Data Communications
Small Business Accounting	Howe Software	I/III	Accounting
Smart Terminal Program	Mumford Micro Systems	I/III	Data Communications
Stockchart-1	Micro Investment Software	I/III	Business
Super Directory	Computer Shack	I/III	Utility
Superscript	Acorn Software	I/III	Utility
System Three	Contract Services Associates	I/III	Business
Taxplan	Contract Services Associates	I, II, III	Business
The Stripper	Eigen Systems	CC	Utility
Versa Payroll	Computronics	I, II, III	Accounting
VisiCalc	VisiCorp	I/III	Business

Novices Turned Off

I applaud your new column "For the Novice" (*80 Micro*, June/July 1982). Unfortunately, if the first one is any indication, more novices will be turned off by them than will learn anything useful. Mr. Lemley's merge routine sounds extremely useful and would fill a need which everyone, novice or not, has from time to time.

As printed, however, the program does not work! After typing in the 16K routine, CSAVEing and verifying it, the Run command got only an "?OD ERROR IN 20" message. Counting the data items yielded 115 numbers. Subtracting 32595 from 32712 yields 117. This means the loop needs 118 numbers. Further checking revealed the same figures in the 32K and 48K routines. Changing the loop to read only 115 items allowed me to run the program but attempts to use it via the USR( ) call bombed out. When I tried to delete the garbage resulting from the unsuccessful USR call, the entire system crashed all the way to "MEM SIZE?".

You owe your readers something better than this. Some of us may be capable of correcting minor errors in a Basic listing, but for a machine-language listing, errors of this magnitude are inexcusable.

Bud Myers
2 Church St.
Box 498
Washburn, ME 04786

Bruised Routine

In reference to Jay Chidsey's article "For the Novice" (*80 Micro*, June/July 1982, p. 148), I've discovered an error. Line 20 reads: READ Y:POKE X,Y. For a 32K or 48K machine this line should be READ Y:POKE X−65536,Y.

William C. Hardin, Jr.
6613 Summerline Place
Charlotte, NC 28211

Jay Chidsey Replies

Mr. Myers and others who have written me directly are right. Only 115 items appear in the merge program as printed, and there should have been 118. Line 60 as printed occupies two

Convert to CP/M and Save.

Unprecedented Sale for Model III Customers. Call for Details.

The Trouble with TRS-DOS.

Although TRS-DOS is an excellent operating system, it has one major disadvantage. When compared with CP/M, TRS-DOS locks you into a limited and possibly dead-end course. When you are ready to upgrade to a new computer, it is likely that none of your present software will run on the new machine. All of the time and money you have invested in TRS-DOS software will be lost.

CP/M for the TRS-80.

Converting to CP/M offers the TRS-80 owner many advantages. The TRS-80 immediately becomes capable of running twice the software of any other computer on the market. Perhaps more importantly, CP/M permits software portability. Unlike TRS-DOS programs, CP/M programs can be directly transferred to your next computer. The savings in time and software costs can be quite significant. CP/M conversion can easily pay for itself with the money saved on one or two software purchases. The sooner you convert to CP/M, the more you stand to save.

CP/M Acquires Unprecedented Support.

Over the past year, a number of powerful competitors have introduced new microcomputers. Most people will instantly recognize the names of Xerox, IBM, Hewlett-Packard, Digital Equipment and Zenith. The Japanese companies, Sony, NEC, Sanyo, Toshiba and Sharp, are equally well-known. Together, these companies have committed over a billion dollars to compete effectively in the micro market. TRS-80 owners should be aware that every one of these companies has chosen CP/M for their standard operating system. Over the next few years, these companies will sell millions of CP/M computers. Considering these facts, it is clear that CP/M is the operating system of the future.

Apple and Commodore Offer CP/M.

In a recent press conference, the Apple Computer Company stated, "The largest installed base CP/M system in the world today is the Apple II with the Z80 card from Microsoft." In a recent full page ad in the Wall Street Journal, Apple announced CP/M for the Apple III. Commodore, refusing to be left behind, has recently announced their "Emulator" series of computers that support CP/M. There are even rumors that the new Tandy 16 will support a version of CP/M.

Plan Ahead.

The Omikron "Mapper" offers the ideal step to upgrading to a newer, more powerful computer. With the "Mapper," your TRS-80 can run both CP/M programs and TRS-DOS. With CP/M, you can build a software library that's fully compatible with the newest CP/M business computers. All of the time and money you spend on selecting, purchasing, and learning CP/M software can be considered an investment in the future. In addition, your old TRS-80 can gain a new lease on life as a fully compatible back-up unit. Consider all these points carefully. The Omikron "Works" package offers the best solution for protecting your investment in the TRS-80. By choosing the "Works," you can purchase a "Mapper" and also receive over $1,000 worth of top-quality CP/M software. Value, Utility, performance — Omikron offers you more than ever before.

COUGAR ... Omikron's Users Group.

CP/M has always been the standard for business and professional use. This market has always demanded high quality and high performance. The high prices for CP/M programs reflect the additional effort required to develop top-quality software products. To help our customers afford CP/M software, Omikron has formed Cougar, our official users group. Through Cougar, Omikron can purchase software products in large volume. This allows us to offer our customers some of the best CP/M software in the industry at greatly reduced prices.

Omikron Puts It All Together.

Omikron has sold more CP/M conversions than all of our competitors combined. Omikron was the first in the market with a CP/M conversion. Omikron has continued to lead the market for one simple reason — our total commitment to our customers. Only Omikron offers a "Works" type introductory package. Only Omikron has a "Cougar" type users group for long-term savings. Our hardware has always been designed with reliability first. Our software is well designed, complete, and bug free. Our technical hot line assists those with problems. Finally, our exchange policy has enabled our customers to upgrade to our new designs for much less than the cost to new customers. When you buy from Omikron, you buy from a company with a proven record of dedication and success.

OMIKRON Products that set Precedents
1127 Hearst Street, Berkeley, CA 94702 (415) 845-8013

MEM	SIZE	FOR X =	TO	POKE	DATA
16K	32649	32650	32767	138	127
32K	49033	− 16502	− 16385	138	191
48K	65417	− 118	− 1	138	255

Table 1

lines of type. The last three entries of the top line are 1, 174, 124. Insert the missing entries, 181, 40, 13 following these. The three entries following the missing ones are 175, 25, 229, on the second printed line of line 60.

James L. Friddle of Van Buren, AR, writes to protest that he is the original author of this program. It appeared in the May 1981 issue of Popular Electronics *on pages 82–83 under his name. Thanks and profound apologies to Mr. Friddle. Apologies also to Ziff Davis, publishers of* Popular Electronics.

Mr. Friddle has these tips for using the program. When you use the routine on a Model III change the last data item in line 50 from 66 to 67. He adds "Cassette tapes made under Disk Basic will not work unless you first CLOAD them and then CSAVE them again; this allows the TRS-80 to correct the addresses on the tape."

The problems with using the merge routine on 32K or 48K machines can be solved by reference to Table 1. MEM is the amount of RAM (Random Access Memory) in your computer. SIZE is the figure to be entered for MEMORY SIZE. FOR X = is the start number in line 10, and TO is the end number. For a 48K machine line 10 would read FOR X = −118 TO −1.

If you change the POKE addresses in line 80 from 16526 and 16527 to 16780 and 16781 you can use the Disk Basic Merge command, even though you do not have disks, instead of the USR command specified in my column. Just tee up your second, to-be-merged tape, depress the play key on the cassette recorder, and enter MERGE.

Jay Chidsey
205 East Adams St.
Green Springs, OH 44836

In a Loop

I purchased my TRS-80 (4K, Level I) when it had just hit the market. I chose the TRS-80 because I wanted to be able to expand and upgrade it for a future small business. When I purchased the machine I was promised that any further hardware and software modifications would always be compatible with the Model I and that upgrading would be no problem.

After reading the open letter from Mr. Stein ("Expansion Interface Worries," 80 Input, June/July 1982) and the response from Mr. Juge, you can imagine my fix!

I would appreciate any information from you or readers regarding the pros and cons of expansion of my Model I system without Radio Shack's support. Should I take some microelectronics classes? How can I tell if a used expansion interface is good?

Carnella Gordon
171 Caine Ave.
San Francisco, CA 94112

We'll be looking in detail at hardware modifications for your TRS-80 in a future issue.—Eds.

CC Speaks?

I have heard, and know for a fact, that the Color Computer (with 16K and Extended Basic) has an internal program for voice synthesizing. I have heard this on Radio Shack's Slalom cartridge and I'm sure it uses machine language. How can I access this hidden voice and use it in my programs? Spectral Associates makes Compuvoice, but paying $45 to access something that's already in the computer is a little steep.

Michael A. Hesser
21101 W. 71st Street
Shawnee, KS 66218

No, Michael, the Color Computer has no on-board voice synthesizer. Extended Color Basic does *have sound and music commands, however, which can be used to simulate voice-like sounds. Obviously, this sound capability is built into the CC and can be accessed by machine-language routines in addition to the EC Basic commands. But to obtain true voice synthesis, you will have to buy some additional hardware. By the way, look for an article on how to simulate voice with the CC in an up-coming issue.—Eds.*

Faster Lōc-Editor

Since there was an unexpected response to my program Lōc-Editor (*80 Micro*, April 1982, p. 206) I wish to pass along a small fix to enhance execution speed.

Change the DIM in line 31000 to read DIM GJ%, L!, JU%, XP!, YP!, KU%, ZW!, BZ$, UU$, B$(145).

If you wish to renumber the program so you can use Lōc-Editor with program lines higher than 32767 change the following: ZW to ZW! XP to XP! YP to YP! L to L!

Jon Mark O'Connor
56 Eustis Parkway
Waterville, ME 04901

Lazy Fingers

To use my program "Telephone Dialer" (*80 Micro*, June/July 1982, p. 161) on the Model III simply change OUT 255,4 to OUT 236,2 and OUT 255,0 to OUT 236,0.

Jim Hickey
P.O. Box 3123
Clearlake, CA 95422

Adding Lines

The article "Lost and Found," a disk directory for the Model III (*80 Micro*, June/July 1982, p. 294) needs two lines added to the program to achieve the desired results. These lines are 3215 POKE 16427,78 and 3425 POKE 16427,78

The default value for paper width will result in printing on the roller if 8½-inch paper is in the printer. The columns will not line up under the headings without these additions.

Charles C. Wright
P.O. Box 1151
San Ysidro, CA 92073

Speed-up kit for Mod III

Since you have recently published some other correspondence about a 4MHz speed-up kit sold by Archbold Electronics for the Model I (*80 Micro*, June/July 1982), I would like to offer a

✓See List of Advertisers on Page 455

comment about speeding up the Model III. I've made a few inquiries about speed-up kits from various sources and found that some of them do not offer the ability to switch clock speed from the normal (approximately 2MHz) speed supplied by Tandy to the high speed supplied by the modification. Failure to provide this switch-controlled speed option apparently means that the user has to avoid using some of the popular disk operating systems that are not compatible with 4MHz.

J.E.S. Graphics, of Tulsa, OK, offers a 4MHz modification for the Model III that has this switch feature. Their three-position switch offers normal 2MHz operation, high-speed operation at all times, or high-speed operation except for during disk I/O. I have used one of these modifications supplied by J.E.S. Graphics for several months now. It has been very satisfactory, so much so that I would hate to have to go back to 2MHz operation. In fact, now that the warranty has run out on my second Model III, I have ordered a second 4MHz modification from J.E.S. Graphics for my other computer.

Thomas H. Ledford
2322 West Highmeadow Court
Baton Rouge, LA 70816

Cheater

The article "Cheater's Poker" by Richard Davies (*80 Micro*, December 1981, p. 356) is a very nice program to automatically generate data statements. I've added a small segment for those who don't own disassemblers yet.

Converting decimal memory values to hex code (so that you can do a manual disassembly) is, at best, boring and at worst, prone to error. My addition (Program Listing 3) does this task and sends the output to a line printer.

Lines 12 and 15 select the DATA MAKE segment (the original program) or the hex-equivalent add-on. In lines 20 and 30 I have added the "IF ASC(S$)>70" test to eliminate hex addresses beginning with G–Z. I added line 35. Line 65 selects the program sequence.

Line 240, GOSUB 10000, is where the PEEKed contents are converted to a four-character hex code. In lines 250–280 the two leading zeros are stripped and the resultant two-character code is printed, 20 to a printer line.

Nate Salsbury
608 Madam Moore's Lane
New Bern, NC 28560

```
1 REM      Supplement to "Cheater's Poker"
2 REM      80 Micro, December 1981
3 REM
4 REM      Nate Salsbury
5 REM      608 Madam Moore's Lane
6 REM      New Bern, NC  28560
7 REM
12 PRINT "(1) MAKE DATA STATEMENTS FROM MEMORY (2) PRINT HEX EQU
IVALENTS"
15 PRINT: INPUT X1: IF X1<>1 AND X1<>2 THEN 12
20 LINEINPUT "START ADDRESS (DECIMAL OR HEX) = ";S$: IFASC(S$)>7
0THEN 35 ELSE IF RIGHT$(S$,1) = "H" THEN IN$ = LEFT$(S$,(LEN(S$)
)-1): GOSUB 20000: SD=D: SH$=S$: ELSE D = VAL(S$): GOSUB 10000:
SH$=B$+"H": SD=D
30 LINEINPUT "END ADDRESS (DECIMAL OR HEX) = ";E$: IF ASC(E$)>70
 THEN 35 ELSE E = VAL(E$): IF RIGHT$(E$,1) = "H" THEN IN$ = LEFT
$(E$,LEN(E$)-1): GOSUB 20000: ED=D: EH$=E$ ELSE D = VAL(E$): GOS
UB 10000: EH$=B$+"H": ED=D
35 PRINT "ERROR - INVALID ADDRESS(ES)": GOTO 20
65 IF X1=2 THEN 200
200 INPUT "TURN ON PRINTER. HIT ENTER TO CONTINUE.";X$
210 LPRINT "STARTING ADDRESS =" SD "(" SH$ ") ENDING ADDRESS ="
ED "(" EH$ ")":LPRINT:LPRINT
220 PA=SD
230 FOR C1=1 TO 20
240 D = PEEK(PA): GOSUB 10000
250 LPRINT " " RIGHT$(B$,2) " ";
260 PA=PA+1: IF PA>ED THEN C1=20: NEXT C1: GOTO 290
270 NEXT C1
280 LPRINT: LPRINT: GOTO 230
290 PRINT "(1) MORE TO DO  (2) FINISHED"
300 INPUT X: IF X=1 THEN 12 ELSE IF X<>2 THEN 290
310 END
```

Program Listing 3

TRS-80* COMPUTING EDITION

©1981 Percom Data Co., Inc. — The Percom Peripheral — 35 cents

Percom's DOUBLER II™ tolerates wide variations in media, drives

GARLAND, TEXAS — May 22, 1981 — Harold Mauch, president of Percom Data Company, announced here today that an improved version of the Company's innovative DOUBLER™ adapter, a double-density plug-in module for TRS-80* Model I computers, is now available.

Reflecting design refinements based on both theoretical analyses and field testing, the DOUBLER II™, so named, permits even greater tolerance in variations among media and drives than the previous design.

Like the original DOUBLER, the DOUBLER II plugs into the drive controller IC socket of a TRS-80 Model I Expansion Interface and permits a user to run either single- or double-density diskettes on a Model I.

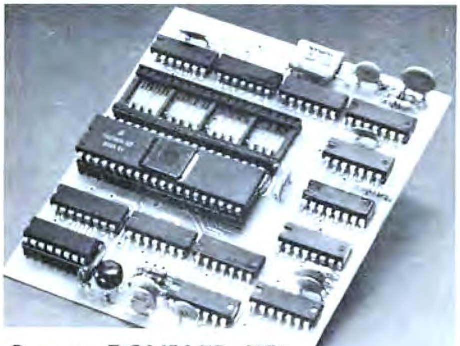
With a DOUBLER II installed, over four times more formatted data — as much as 364 Kbytes — can be stored on one side of a five-inch diskette than can be stored using a standard Tandy Model I drive system.

Moreover, a DOUBLER II equips a Model I with the hardware required to run Model III diskettes.

(*Ed. Note:* See "OS-80™: Bridging the TRS-80* software compatibility gap" elsewhere on this page.)

The critical clock-data separation circuitry of the DOUBLER II is a proprietary design *called a ROM-programmed digital phase-lock loop data separator*.

According to Mauch, this design is more tolerant of differences from diskette to diskette and drive to drive, and also provides *immunity to performance degradation caused by circuit component aging*.



Percom DOUBLER II™

Mauch said "A DOUBLER II will operate just as reliably two years after it is installed as it will two days after installation."

The digital phase-lock loop also *eliminates the need for trimmer adjustments typical of analog phase-lock loop circuits*.

"You plug in a Percom DOUBLER II and then forget it," he said.

The DOUBLER II also features a refined Write Precompensation circuit that more effectively minimizes the phenomena of bit- and peak-shifting, a reliability-impairing characteristic of magnetic data recording.

The DOUBLER II, which is fully software compatible with the previous DOUBLER, is supplied with DBLDOS™, a TRSDOS*-compatible disk operating system.

The DOUBLER II sells for $~~219~~.95, including the DBLDOS diskette. NOW $169.95!

The Percom DOUBLER II is available from authorized Percom retailers, or may be ordered direct from the factory. The factory toll-free order number is 1-800-527-1222.

Ed. note: Opening the TRS-80 Expansion Interface may void the Tandy limited 90-day warranty.

✓ 1

All that glitters is not gold

OS-80™ Bridging the TRS-80* software compatibility gap

Compatibility between TRS-80* Model I diskettes and the new Model III is about as genuine as a gold-plated lead Krugerrand.

True, Model I TRSDOS* diskettes can be *read* on a Model III. But first they must be converted and re-recorded for Model III operation.

And you *cannot write* to a Model I TRSDOS* diskette. Not with a Model III. You cannot add a file. Delete a file. Or in any way modify a Model I TRSDOS diskette with a Model III computer.

Furthermore, your converted TRSDOS diskettes cannot be converted *back* for Model I operation.

TRSDOS is a one-way street. And there's no re-treating. A point to consider before switching the company's payroll to your new Model III.

Real software compatibility should allow the *direct, immediate* interchangeability of Model I and Model III diskettes. No read-only limitations, no conversion/re-recording steps and no chance to be left high and dry with Model III diskettes that can't be run on a Model I.

What's the answer? The answer is Percom's OS-80™ family of TRS-80 disk operating systems.

OS-80 programs allow *direct, immediate* interchangeability of Model I and Model III diskettes.

You can run Model I single-density diskettes on a Model III: install Percom's plug-in DOUBLER™ adapter in your Model I, and you can run double-density Model III diskettes on a Model I.

There's no conversion, no re-recording.

Slip an OS-80 diskette out of your Model I and insert it directly in a Model III.

And vice-versa.

Just have the correct OS-80 disk operating system — OS-80, OS-80D or OS-80/III — in each computer.

Moreover, with OS-80 systems, you can add, delete, and update files. You can read *and write* diskettes regardless of the system of origin.

OS-80 is the original Percom TRS-80 DOS for BASIC programmers.

Even OS-80 utilities are written in BASIC.

OS-80 is the Percom system about which a user wrote, in Creative Computing magazine, "... the best $30.00 you will ever spend."†

Requiring only seven Kbytes of memory, OS-80 disk operating systems reside completely in RAM. There's no need to dedicate a drive exclusively for a system diskette.

And, unlike TRSDOS, you *can* work at the track sector level, defining and controlling data formats — in BASIC — to create simple or complex data structures that execute more quickly than TRSDOS files.

The Percom OS-80 DOS supports single-density operation of the Model I computer — price is $29.95; the OS-80D supports double-density operation of Model I computers equipped with a DOUBLER or DOUBLER II; and, OS-80/III — for the Model III of course — supports both single- and double-density operation. OS-80D and OS-80/III each sell for $49.95.

✓ 3

Circuit misapplication causes diskette read, format problems.

High resolution key to reliable data separation

GARLAND, TEXAS — The Percom SEPARATOR™ does very well for the Radio Shack TRS-80* Model I computer what the Tandy disk controller does poorly at best: *reliably* separates clock and data signals during disk-read operations.

Unreliable data-clock separation causes format verification failures and repeated read retries.

CRC ERROR—TRACK LOCKED OUT

The problem is most severe on high-number (high-density) inner file tracks.

As reported earlier, the clock-data separation problem was traced by Percom to misapplication of the internal separator of the 1771 drive controller IC used in the Model I.

The Percom Separator substitutes a *high-resolution* digital data separator circuit, one which operates at 16 megahertz, for the low-resolution one-megahertz circuit of the Tandy design.

Separator circuits that operate at lower frequencies — for example, two- or four-megahertz — were found by Percom to provide only marginally improved performance over the original Tandy circuit.

The Percom solution is a simple adapter that plugs into the drive controller of the Expansion Interface (EI).

Not a kit — some vendors supply an untested separator kit of resistors, ICs and other paraphernalia that may be installed by modifying the computer — the Percom SEPARATOR is a fully assembled, fully tested plug-in module.

Installation involves merely plugging the SEPARATOR into the Model I EI disk controller chip socket, and plugging the controller chip into a socket on the SEPARATOR.

The SEPARATOR, which sells for only $29.95, may be purchased from authorized Percom retailers or ordered directly from the factory. The factory toll-free order number is 1-800-527-1222.

Ed. note: Opening the TRS-80 Expansion Interface may void the Tandy limited 90-day warranty.

✓ 2

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✓ See List of Advertisers on Page 455

Baud Rate Fix

While testing the programmable baud rate modification (*80 Micro*, May 1982, p. 306) in my recently built LNW system expansion board I discovered a small bug.

For some 74LS151 ICs it may not be necessary to keep the strobe input actively low, but for my 74LS151 it was. The absence of low at the strobe input blocks the multiplexer (and the clock signal to the UART).

The cure is simple; connect a wire between pin 7 (strobe) and pin 8 (ground) of the 74LS151.

W.N. Tijman
Gen. Spoorlaan 21
2111 WS Aerdenhout
The Netherlands

Tic-tac-beep

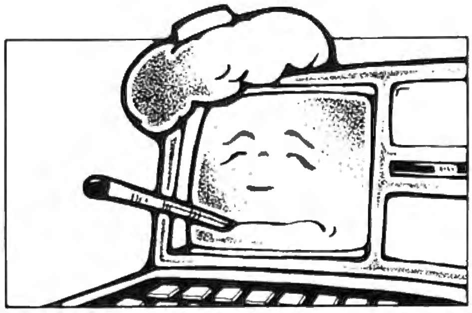
As soon as I ran the game featured in the article "You Light Up My Grid" (*80 Micro*, June/July 1982, p. 331) I realized that it was not accurate. When you enter 5 the middle square is processed twice, once by the vertical processor and once by the horizontal processor, which returns the middle square to its original state. This ruins most strategies I know of used for the game. The correction is simple. Change line 770 to read FOR X=16 TO 48 STEP 32. With this fixed, the Magic Square game is an excellent version of the original Merlin.

Adam Rose
5231 S. Dorchester Ave.
Chicago, IL 60637

Flesh It Out

Thanks to the mail and phone calls I've received, I now have a list of the omissions and errors and comments on "Bare Bones Communicator" (*80 Micro*, June/July 1982, p. 128).

Building the hardware interface is much easier if you know what the parts are. The missing parts are listed in Table 1.



"Building the hardware interface is much easier if you know what the parts are."

Some readers were having trouble with noise from the 555 (IC1). The problem can be reduced by connecting a 2.2 μF tantalum capacitor across the power pins; connect the positive end to pin 8 and the negative end to pin 1. D1 and D2 are drawn backwards in Fig. 1. As shown they short out the power supply (+12). Reverse both of them.

One of the most often asked questions concerns the use of Radio Shack's Modem I. This modem works with UTERM through the cassette port without using the special hardware adapter. The only restriction is that the XRX cassette mod (if present) will have to be disabled (see *80 Micro*, January 1982, p. 348).

There have to be at least 117 dots in A$ in line 30 of Program Listing 2. The lines of data starting at line 290 must be entered with the letters in pairs. Do not indent or attempt to make the screen look like the magazine listing. After the REM, type: space letter letter space letter letter space letter letter and so on.

The HHC codes listed in Table 1 of the article are transposed. B should be coded as BD and not as DB, Z should be JE and not EJ. Use these codes if you want to change the sign-on message.

If you need help, feel free to write. To ensure a speedy reply, include a stamped self-addressed envelope. If you want to save a lot of typing, send a blank disk or cassette and $3 for the Basic loader and assembler source code. The program is still available on the Medford Forum-80 but you have to register a password before you can use the download feature (two phone calls required).

Bob Hart
2946 Merriman Road
Medford, OR 97501

Q1	2N3904 or RS 276-2034 (PNP silicon)
Q2	2N2222 or RS 276-2016 (NPN silicon)
D1, D2	1N914 (general purpose silicon signal diode)
R8	390 ohm ¼ watt resistor

Table 1. Parts List

Compiler Wanted

Is there a Basic/Fortran compiler for Z80 code that will run on an IBM 370 under MBS(DOS) or on VAX?

Richard Kainz
307 NE 5th St.
Gainesville, FL 32601

Two Many

I found an error in Program Listing 2 of the "Tee For Six" program (*80 Micro*, August 1982, p. 164). Line 760 contains two 414s in the data statements. The first 414 should be 412.

Carl Bevington
1857 East Third St.
Salem, OH 44460

PHONFIND Fix

The program PHONFIND from the June/July 1982 issue (page 358) requires initialization before use. Simply run the following one-line program:

```
10 OPEN"O",1,"NUMBER/SEQ.BOB":
CLOSE:END
```

Then use PHONFIND exactly as printed in the magazine.

PHONFIND will run out of string space if you store long names and numbers. The following changes will also allow you to store more names:

```
25 CLEAR5000'For 48K, CLEAR 6384
1000 ?TAB(24)"SELECT FUNCTION"
```

Add line 3015 to prevent a Bad Subscript error in 3020.

```
3015 IFKK=200THEN?
"ArrayFull.":GOTO3040
```

—Eds.

For Sale

I am writing in response to a plea for information regarding a card reader for a Model III ("80 Aid," March 1982). I don't know of any companies that produce such a product but I have built one on my own. I have also designed a 512K byte interface for the TRS-80 Model I. I also have developed a modification for the Model I that increases cassette I/O up to 5000 baud.

At the moment I am looking for a company that will produce these products at a low cost. Since I am only 15 and spend most of my time with my 512K Model I TRS-80 with one Winchester hard disk and five drives, I would never be able to hold a job that wasn't computer oriented. I will sell plans to all of the aforementioned items plus an operating system that I wrote last year and a speed-up modification that gets the Model I going at about 4.65 MHz. I am now working on a plotter-printer which uses a simple language to operate it.

If anyone is interested in any of my products, feel free to write me.

Paul Posner
17 Durham Drive
Dix Hills, NY 11746

Unwanted Spaces

I have a request for aid concerning TWOHAF: renumbering works well, but it adds one, two, or three spaces after each transfer statement (GOSUB, GOTO, and so on); it even adds them when the transfer is at the end of a line. How can I stop the renumbering from adding the spaces?

Jack Baker
Rt. 1, Box 19-H
Morningview, KY 41063

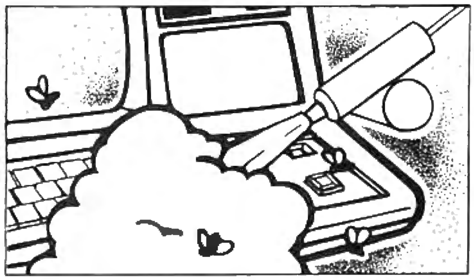
Missing Listing

It looks like the cutting room bugs are at work again! In "Tee For Six" (August 1982, p. 156, Program Listing 5) the end of line 300 got hacked off. See Listing 1 for the rest of the listing.

Joseph Cook
6618 Airline Ave.
Urbandale, IA 50322

```
300 FORI=58TO68STEP2:SET(I,13):NEXTI:A=34:FORI=34TO58STEP4:SET(I
,A):SET(I+34,62-A):A=A-1:NEXTI:A=25:FORI=70TO78STEP4:SET(I,A):SE
T(I-21,48-A):A=A-1:NEXTI:A=20:FORI=90TO106STEP4:SET(I,A):SET(I-7
0,36-A):A=A-1:NEXTI
```

Program Listing 1



Paper Tiger Hunt

I would like information on interfacing a Model I to an IDS-125 printer (the Paper Tiger people). *Microcomputing* ran an article on interfacing an IDS-440, but the IDS-125 is slightly different. I would appreciate any help.

Charles M. Greenawald
24 Bay View-Paradise Bay
Bradenton, FL 33507

Replacement Parts Needed

I own a Base-2 Model 800 dot matrix printer. The belt that drives the print head's roller cam is worn and is in need of replacement. Unfortunately, Base-2 is no longer in business. Where can I find replacement parts for my printer?

Bryan Headley
5808 Melstone Drive
Arlington, TX 76016

10, 9, 8...

One of my hobbies is model rocketry. I'm having trouble devising a program for the Pocket Computer that finds the center of pressure and center of gravity in my rockets. Can anyone help?

Rudy Arispe
139 Idell Ave.
San Antonio, TX 78223

MX-80 Aid

MX-80 users have probably found that the form feed button doesn't advance the paper to where they want it. The solution is to use the line feed button to step paper to the stopping point wanted; turn the printer off, then on again. Presto! Form feed where you want it.

If anyone knows how to program the MX-80 to line-feed increments of 1/72", I would appreciate knowing how it's done.

John Wilson
3 Kelldon Drive
Felton, CA 95018

TRS-80 Interface Wanted

I am interested in a software/hardware modification and interface package which will make the TRS-80 Models I and III simulate an IBM 3278 CRT in a SNA and SDLC environment using dial-up facilities.

If anyone has such a modification or anticipates developing one, please contact me.

Carl Hess
1105 Hamilton St.
Allentown, PA 18101

Powerful Printing

I am responding to Al Peponis' letter "Automatic Troubles" ("80 Aid," June/July 1982, p. 23). The solution to his problem is to enter SX in the subsystem of Electric Pencil. This eliminates the extra line feed.

I've used the technique suggested by John Parker ("Print Whiz," *80 Micro*, February 1982) with my Model I and MX-100 to send printer control codes to the printer while in Electric Pencil. It really works great for condensed or expanded print insertions, double strike, and so on.

I created a module describing the control functions, then zapped the hex values to the disk file using Disk Editor by Instant Software. I load this module first, then transfer the codes down to my text as I need them. Right justification and line length have to be forced by carriage returns because the program assumes normal word length. It gives more class and emphasis to a letter.

R.G. Brooks
9701 Meadowview Road
Richmond, VA 23229

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(cassette or diskette) . . $19.95
Asylum I & Asylum II
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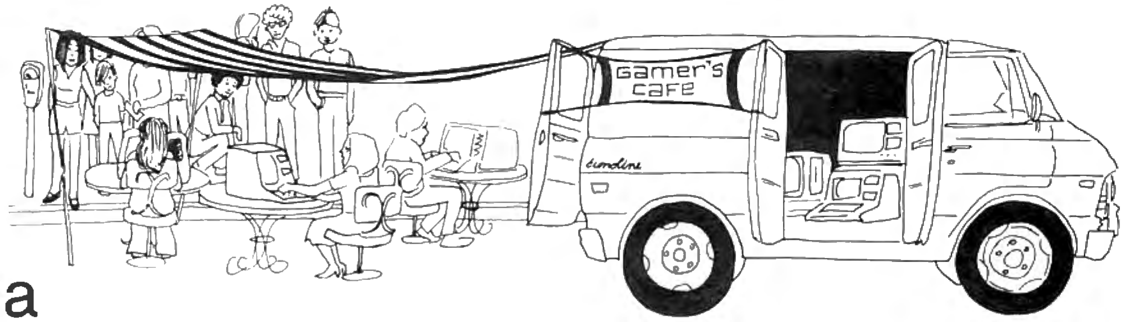
by Rodney Gambicus

They came from beyond Missoula



So there we were, in Winthrop's old Ford Econoline van, with computers on top of computers in the back. We had trouble adjusting the weight load. To even things out, we bought another Model III and four more Color Computers. The dealer was so enthusiastic about our purchases that he threw in two Pocket Computers to boot. We put those in the glove compartment. I think they're still there.

With the van packed, we were on the road. As we traveled from Boston to Montana, we stopped at every software store on the way and bought every game imaginable. We took turns reading documentation and driving. We met lots of people on the way. We were pulled over 27 times by knowing motorists who spotted our bumper sticker, "Honk If You're a Beeper." We were honked at 1,249 times—1,248 for the bumper sticker and once for running a red light. That was in Chamberlain, SD. The kid on the bicycle who honked at us was wearing a cowboy outfit and a sheriff's badge. Not being sure of his range of authority, we kept going and didn't stop until we got to the Radio Shack store in the Rushmore Mall in Rapid City, SD.

We opened the first Gamer's Cafe in Missoula, MT. We picked a storefront location on South Higgins Ave. in the city's downtown section, parked at a meter in front of a sporting goods store, opened the back and side doors of the van, put a few card tables in the parking space behind us, plugged the computers into a diesel generator, and raised our grey and black Gamer's Cafe banner.

KGVO, a local radio station, interviewed us and ran a small piece about the cafe on their noon news. By 12:30 every computer was in use. The people waiting in line for a computer read our pamphlet describing the difference between adventure games, arcade-style games, strategy games, and simulations. By the time a computer was free, they understood all they needed to know about playing games on our TRS-80s.

We were in business... for a short while.

* * * * *

While they played, Winthrop and I opened the mail:

Help!!!!!! I recently bought Balrog from Adventure International's Maces and Magic series for my Model III. As you probably know, you buy the Model I disk and use TRSDOS's Convert command to use it on the Model III.

The instructions for converting the first disk are good, but all they tell you for converting the second disk is, "Do the same for disk B." This is where the problem starts. There is a data file on disk B that is password protected and the instructions do not include the password needed. Can you help?

Tim McGrath
1617 Washington St.
Newton, MA 02165

Of course we can help. That's why we're here, no matter where "here" happens to be. Winthrop and I know more about TRS-80 games than Carter knows about peanuts.

Winthrop got right on this one, and called his secret connection in AI's technical department. This techie, Shallow Tongue, told Winthrop that you should have no problem converting the two files, Rooms and Situatio, using TRSDOS 1.2 or 1.3 if when the password is asked for you just press enter.

Adventure International has a technical assistance line. If Tongue's advice doesn't help, call (305) 830-8194, AI's technical line and they'll work the problem out with you.

* * * * *

Jim Daniel (no relation to Jack) (Winthrop made me put that in) sent us a patch for using the Alpha Products joystick with Leo Christopherson's (hail King Leo) (Winthrop again) Voyage of the Valkyrie. When keyed in this patch will let you use the Alpha joystick to control the arcade part of the game:

```
248 GOSUB10000:CLEAR:AA%=20000:
GOSUB2000
10000 A=PEEK(16548)+256*PEEK(16549)+
286:POKEA+56,219:POKEA+57,0:POKEA
+58,47:POKEA+60,16:A=A+382
10010 FORI=A+5TOA+61:READB:POKEI,
B:NEXT:RETURN
10020 DATA219,0,47,230,15,14,20,254,1,202,
37,64,12,254,9,202,37,64,12,254,8,202,37,64,
12,254,10,202,37,64,12,254,2,202,37,64,12,254,
6,202,37,64,12,254,4,202,37,64,12,254,5,202,
37,64,14,15,201
```

Jim tells us that if your joystick has not been modified, the 16 POKEd in line 10000 should be changed to a 3. And, of course, save the modified program before running it. Thanks Jim. Say hi to Jack.

* * * * *

Winthrop was laughing as he handed me this next letter:

I am struggling through my first adventure, Raaka-tu. It took me three weeks to get into the temple and get out with loot worth 25 points. What infuriates me is that doggone door in the second room. I can't get to it because of the snake pit in the way. The great bronze gates on the west wall are unopenable, too. I've tried everything I can think of. I'm getting desperate. Please help. I'm going crazy... crazy ... crazy.

David Rood
Route 9 Box 265
Cumming, GA 30130

Now, Winthrop was laughing because he was once in the same predicament, but worked his way out of it. When we first opened the Gamer's Cafe, we decided not to hand-hold anyone through an adventure. Winthrop's argument was, "No one helped me." True. But there is only one Winthrop, and sometimes normal people need help getting out of a tight situation.

Your problem is less of a problem than you think. The door and bronze gates are useless to you. Winthrop says you are sniffing up the wrong tree. Yeah, well, Winthrop also says that a penny earned is not much of a profit margin. Some day we might compile a book called *The Not Very Famous Sayings of Winthrop Luzerdraw*. Then again maybe we won't.

By the way, David, how would you like to double your points? After you get out of the temple go back to where you began the game. Then go west four times, and south another four times. Oh—Winthrop says that the dense, dark and damp jungle will get important to you at that point.

* * * * *

I think we're in trouble. The Gamer's Cafe van has attracted quite a crowd in the street and on the sidewalk. The police are talking to Winthrop about vendor's permits, creating a disturbance, and interfering with all sorts of things.

Common sense tells me we don't have much time, so quickly: Shallow Tongue told Winthrop about some new AI games in the works. Last Days of Saigon will be AI's first realistic adventure. It is based on the actual events leading up to the American withdrawal from Vietnam in the 1970s. Last Days of Saigon was written by Jyym Pearson, author of Escape from Traam, Curse of Crowley Manor, and Earthquake: San Francisco 1906.

Starflite fans (and there are many of us): AI will soon do a bit of customizing. Shallow Tongue tells us that the program will remain the same, but the packaging will be dressed up to include all kinds of goodies to make playing the game even more fun.

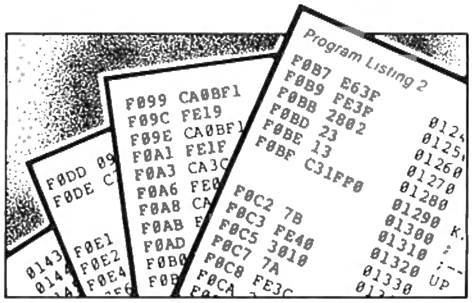
Also in the planning stages is an interactive story called Nightwalker—da dee dum dum. The plot places you at a drug-infested waterfront. Your assignment is to provide the local police with enough evidence to make a successful bust...

And speaking of busts, Winthrop and one of the police officers have struck an agreement. We can either fold our tent and go, or they'll fold our tent and take us. Winthrop wisely opted for the first choice. So it's off again, fellow game players. See you next month from somewhere in America. ■

✓See List of Advertisers on Page 455

SOFT BITS

by Roger Fuller



Print Using explored

One of the most powerful features of Level II is the ability to format printing with a Print Using statement. As useful as this statement is, it does not allow left justification of a formatted number. The routine presented here illustrates one way of solving this problem.

The ROM Call 0FBEH formats the binary number loaded in the reserved area of RAM starting at 411DH, or 4121H if it is an integer. The type (length) of the binary number must be stored in 40AFH. Upon exit, the Print Using buffer that starts at 4030H contains the ASCII string. The accumulator contains the format information. The following table is a list of the format bits.

Bit	0	Exponential notation
Bit	1	Reserved
Bit	2	Trailing sign
Bit	3	Sign
Bit	4	Leading $
Bit	5	Leading *
Bit	6	Commas
Bit	7	Edit

Setting the bits sets the edit option. You can experiment with different combinations by changing the appropriate data elements in your Basic program.

The machine code gets the data addresses from Basic via the CALL 0A7FH. This information is then transferred to the ARITH area. The ROM Call that does this for single-precision numbers is 09B1H. If you want to transfer an integer or a double-precision number, you must use another Call.

After the binary number is loaded into the correct place in RAM, the NTF (Number Type Flag) at 40AFH must be set. A ROM Call at 0AEFH sets the NTF for a single-precision number.

Now the accumulator must be loaded with the format information. I used a 192, which is bit 7 and bit 6 set to format commas. Finally, the format spacing must be loaded into the BC register pair. The B register contains the number of spaces to the left of the decimal point and the C register contains the number to the right plus one.

A Call to 0FBEH lets the ROM do its work. And work it does. Print Using can be the most time consuming of all the non-I/O Basic statements. After the formatting is done, the buffer contains the right-justified ASCII string. The next task is to find the first nonblank character. We finish by outputting the string followed by the appropriate number of spaces.

The HL register always contains 4130H upon exit from 0FBEH, and the ASCII string is always terminated by a zero byte. This allows CALL 28A7H to handle the output easily. But that would be for a right-justified, not left-justified output.

To accomplish this task, the accumulator is loaded with a space and a nine count is placed in the B register. CKSPS1 scans for the nonblank character. If the first character output is not to be a space, add a LD A,(HL) to reset the accumulator after the loop falls through.

PRINT1 uses 033AH to print the characters on the screen and update the cursor location. The ASCII string is sent out until it finds the zero byte. Since the output length is nine and was reduced one for each character sent out, it is used to determine the number of spaces to send out. The CP checks for the no-spaces-to-send condition.

This routine can help you explore the mysteries of the Print Using statement. The code has to be placed in a single-precision array for a change of pace. You can build it into a Basic string since it is relocatable and meets the other requirements of "no zero byte" or "32 byte" in its code. Also, I left the code capable of being shortened two bytes.

So you can help me meet your needs better, please answer the following questions and send them to me at 630 E. Springdale, Grand Prairie, TX 75051. Your responses will be sincerely appreciated. ■

SOFT BITS Reader Survey

1. **Which TRS-80 do you own?**
2. **Do you own a monitor program? Which one?**
3. **Do you own an assembler? Which one?**
4. **Do you own any books on Assembly language? Please list them in order of their usefulness.**
5. **What do you like best about my column?**
6. **What do you like least about my column?**
7. **What would you like to see in future columns? (Be specific.)**
8. **How many lines of Assembly code have you written?**
9. **What is your education?**
10. **What do you use your computer for?**

Program Listing 1

```
10 'PRINT USING FORMAT DEMO     BY ROGER FULLER   PUBLIC DOMAIN
20  GOSUB 100                  'LOAD MACHINE CODE
30  DEFUSR1 = VARPTR( A(0) )   'USE POKE FORMAT IF NOT DOS
40 '
50 A = RND(9) * 1000 - 1000 + RND(32767)/100
60 IF USR1(VARPTR(A)) THEN PRINT
70 GOTO 50
80 '
100 DIM A#(12)                 'RESERVES 52 BYTES
110 A = 0 : X = 0 : SUM = 0    'INITIALIZE VARIABLES
120 FOR X = 0 TO 51
121                 READ A
122                 SUM = SUM + A
123                 POKE VARPTR( A(0) ) + X, A
124 NEXT
130 IF SUM <> 4775 THEN PRINT "ERROR" : STOP ELSE RETURN
200 DATA 205, 127, 10, 205, 177,   9, 205, 239,  10,  62
210 DATA 192:'FORMAT TYPE
211 DATA 1
220 DATA 3  :'DIGITS AFTER DECIMAL POINT INCLUDING POINT
230 DATA 5  ::d99 PRINT "NUMBER IS TOO LARGE PLEASE REENTER":GOT
O 220
240 CLS:PRINT "THE ANSWER IS ":S=15
250 FORN=1TOLEN(A$)
260 A#=VAL(MID$(A$,N,1))+C#:D#=A# :A#=A#/B#
270 IF A#=INT(A#) THEN C#=0:GOTO 300
280 IF A#<1 THEN C#=D#*10:A#=0:GOTO 300
290 IF A#<>INT(A#) GOSUB 330
300 C$=STR$(A#):PRINT@S,RIGHT$(C$,1):S=S+1
310 NEXT
320 GOTO 370
330 A#=INT(A#)
340 C#=D#-(A#*B#)
350 C#=C#*10
360 RETURN
370 PRINT@S,".";:S=S+1:A#=0
380 A#=A#+C#:D#=A#
390 IF S=800 PRINT "THATS THE ANSWER TO 800 DIGITS!":END
400 A#=A#/B#
410 IF A#=INT(A#) :C$=STR$(A#):PRINT@S,RIGHT$(C$,1):END
420 IF A#<>INT(A#)C$=STR$(INT(A#)):PRINT@S,RIGHT$(C$,1):S=S+1:C#
=D#-(INT(A#)*B# ):C#=C#*10
430 A#=0:GOTO 380
440 **** SUBTRACTION 1 DIGIT AT A TIME**************************
450 DEFINT A-Z:DIM A(105),B(105)
460 PRINT "ENTER ANY POSITIVE WHOLE NUMBER UP TO 105 DIGITS LONG
:"
470 INPUT A$
480 IF LEN(A$)>105 PRINT "THE FIRST NUMBER ENTERED IS LONGER THE
N 105 DIGITS PLEASE REENTER":GOTO 460
490 PRINT"ENTER THE SECOND POSITIVE WHOLE NUMBER UP TO 105 DIGIT
S LONG:"
500 INPUT B$
510 IF LEN(B$)>105 PRINT "THE SECOND NUMBER ENTERED IS LONGER TH
AN 105 DIGITS PLEASE REENTER": GOTO 490
520 IF LEN(A$)>LEN(B$) THEN B$=STRING$(LEN(A$)-LEN(B$),"0")+B$
530 IF LEN(B$)>LEN(A$) THEN A$=STRING$(LEN(B$)-LEN(A$),"0")+A$
540 FOR N=LEN(A$) TO 1 STEP-1
550 A(N)=VAL(MID$(A$,N,1))
560 B(N)=VAL(MID$(B$,N,1))
570 T=A(N)-B(N)-B
580 IF T<0 THEN B=1:T=T+10 ELSE B=0
590 C$=RIGHT$(STR$(T),1)+C$
600 NEXT
610 IF B=1 THEN H$=A$:A$=B$:B$=H$:B=0:C$="":S$="-":GOTO 540
620 PRINT "THE ANSWER IS "S$+C$
630 END
640 ***** ADDITION 1 DIGIT AT A TIME (2 ARRAYS)***************
650 PRINT "ENTER THE FIRST POSITIVE WHOLE NUMBER UP TO 105 DIGIT
S LONG"
660 INPUT A$
670 IF LEN(A$)>105 PRINT "NUMBER IS TOO LARGE PLEASE REENTER":GO
TO 650
680 PRINT "ENTER THE SECOND POSITIVE WHOLE NUMBER UP TO 105 DIGI
TS LONG"
690 INPUT B$
700 IF LEN(B$)>105  PRINT "NUMBER IS TOO LARGE PLEASE REENTER":G
OTO 680
710 DEFINT A-Z:DIM A(105),B(105)
720 IF LEN(A$)>LEN(B$) THEN B$=STRING$(LEN(A$)-LEN(B$),"0")+B$
730 IF LEN(B$)>LEN(A$) THEN A$=STRING$(LEN(B$)-LEN(A$),"0")+A$
740 FOR N=LEN(A$) TO 1 STEP -1
750 A(N)=VAL(MID$(A$,N,1))
```

Listing continues

Listing continued

```
760 B(N)=VAL(MID$(B$,N,1))
770 T=A(N)+B(N)+C
780 IF T>9 THEN T=T-10:C=1 ELSE C=0
790 C$=RIGHT$(STR$(T),1)+C$
800 NEXT
810 IF C=1 THEN C$="1"+C$
820 PRINT "THE ANSWER IS "C$
830 END
840 ******* MULTIPLICATION 15*90: METHOD 15*1 90 TIMES ******
850 DIM A#(90)
860 PRINT"ENTER THE FIRST POSITIVE WHOLE NUMBER UP TO 75 DIGITS
LONG"
870 INPUT A$
880 IF LEN(A$)>75 PRINT "NUMBER IS TOO LARGE PLEASE REENTER":GOT
O 860
890 PRINT "ENTER THE SECOND POSITIVE WHOLE NUMBER UP TO 30 DIGIT
S LONG"
900 INPUT B$:IF LEN(B$)>30 PRINT "NUMBER IS TOO LARGE PLEASE REE
NTER":GOTO 890
910 IF LEN(B$)>15 THEN F$=LEFT$(B$,LEN(B$)-15):B#=VAL(RIGHT$(B$,
15)):GOTO 930
920 F$="":B#=VAL(B$)
930 FOR N=LEN(A$) TO 1 STEP -1
940 A#(N)=VAL(MID$(A$,N,1))
950 NEXT
960 FOR N!=LEN(A$) TO 1 STEP -1
970 T#=A#(N)*B#+C#
980 T$=STR$(T#)
990 C$=RIGHT$(T$,1)+C$
1000 C#=VAL(LEFT$(T$,LEN(T$)-1))
1010 NEXT
1020 C$=STR$(C#)+C$
1030 A$(X)=C$:X=X+1
1040 IF F$=""PRINT "THE ANSWER IS "C$:END
1050 IF F$="DONE" THEN A$=RIGHT$(A$(0),LEN(A$(0))-1):B$=RIGHT$(A
$(1),LEN(A$(1)) -1)+STRING$(15,"0"):B#=0:T#=0:C$="":GOTO 710
1060 B#=VAL(F$):F$="DONE":C#=0:C$="":GOTO 960
1070 END
1080 ************** REVISED DOUBLE PREC ROOTS**************
1090 PRINT "ENTER ANY POSITIVE NUMBER UP TO 16 DIGITS LONG"
1100 INPUT A#
1110 IF A#>9 999 999 999 999 999 PRINT "NUMBER IS TOO LARGE PLEA
SE REENTER":GOTO 1090
1120 B#=A#/2
1130 T#=B#*B#
1140 IF T#>A# THEN B#=B#/2: GOTO 1130
1150 IF T#=A# PRINT "THE ANSWER IS " B#:END
1160 H#=B#*2
1170 L#=B#
1180 G#=(H#+L#)/2:T#=G#*G#
1190 IF G#=H# THEN 1220
1200 IF T#>A# THEN H#=G#:GOTO 1180
1210 IF T#<A# THEN L#=G#:GOTO 1180
1220 PRINT "THE ANSWER IS "G#
```

```
                00010 ;         LEFT JUSTIFY PRINT USING DEMO     PUBLIC DOMAIN
                00020 ;
0000            00030           ORG     0H              ;RELOCATABLE
0000 CD7F0A     00040           CALL    0A7FH           ;GET VARPTR
0003 CDB109     00930           CALL    09B1H           ;MOVE TO ARITH
0006 CDEF0A     00950           CALL    0AEFH           ;SET SNG
0009 3EC0       00960           LD      A,128+64        ;FORMAT COMMAS
000B 010305     00970           LD      BC,0503H        ;FORMAT ##,###.##
000E CDBE0F     00980           CALL    0FBEH           ;FORMAT
0011 212F41     00990           LD      HL,412FH
0014 3E20       01000           LD      A,' '
0016 0609       01010           LD      B,9
0018 23         01020 CKSPS1    INC     HL
0019 BE         01030           CP      (HL)
001A 28FC       01040           JR      Z,CKSPS1
001C CD3A03     01050 PRINT1    CALL    033AH
001F 7E         01060           LD      A,(HL)
0020 05         01070           DEC     B
0021 B7         01080           OR      A               ;CHECK FOR ZERO
0022 2803       01090           JR      Z,SPACE1
0024 23         01100           INC     HL
0025 18F5       01110           JR      PRINT1
0027 B8         01120 SPACE1    CP      B
0028 2807       01130           JR      Z,EXIT
002A 3E20       01140           LD      A,' '
002C CD3A03     01150 SPS1      CALL    033AH
002F 10FB       01160           DJNZ    SPS1
0031 C39A0A     01450 EXIT      JP      0A9AH           ;RETURN VALUE LAST CHAR
0000            01460           END
```

Program Listing 2

KITCHEN TABLE SOFTWARE, INC.

by David Busch

Kitchen Table Inc. first became well-known for its line of user-hostile hardware. Undocumented reset keys, monitors emitting x-rays at random intervals, and keyboards which sometimes became energized with 110 volts made the early model TLS-8E computers exciting to use.

Now, KTI has introduced another innovation whose time has passed: "manufacturer-friendly" business and utility software. For example, the KTI accounting package automatically generates a check payable to Kitchen Table Inc. and locks up the computer keyboard until the check clears.

Kitchen Table has also introduced a new release of DROSSDOS (Version 7.6) which gives a whole new meaning to the term "user support." Purchasers are expected to supply KTI with a telephone number the company can dial to reach the user if Kitchen Table has any problems or questions. You are required to develop your own documentation, help debug the operating system, and then share your efforts with the Kitchen Table research and development staff.

KTI pulls wraps off hostile-ware

Single Dysfunction Operating Systems

One of the first of these "manufacturer-friendly" products is the new line of Kitchen Table "Single Function" Disk Operating Systems. Kitchen Table Inc. research has revealed most TRS-80 owners rarely can use or understand all of the sophisticated features of most modern DOSes, such as NEWDOS80, LDOS, or DROSSDOS. The average user needs nothing more than an operating system allowing booting and loading the latest implementation of Kangaroo or Dig Dug.

Single Function DOS was conceived by KTI's head programmer, Zero "One-Tooth" Ree, a transplanted Sri Lankan now living in the United States. His first effort was UNODOS, which has a single function, TRACE.

Other SFDOS products are equally simple to use. Each can only perform one function, so the user does not have to worry about complicated syntax or disk-cluttering system overlays. Compare a typical program copying session with NEWDOS80, DROSSDOS, and KTI's new COPYDOS:

NEWDOS80—COPY:1TO:2 11/12/82,NDMW,FMT,SPW=PASSWORD,NDPW=SECRET,KDN,KDD,SN=DISK1,CBF,USR,/CMD,UPD,ILF,CFWO,DDSL=17,DDGA=2

We won't waste time here explaining what all those options mean. I certainly don't understand them. If Apparat was unable to provide a concise explanation in the NEWDOS80 documentation, there is little point in attempting it at this point.

DROSSDOS—COPY :1 TO :2,PLEASE,NFSD,URTS,KTUPEE,IPS,DUF,WDD,HDIBS,AGAR

These copy options are relatively straightforward:

- PLEASE—Mandatory obeisance to system.
- NFSD—No Format Source Disk.
- URTS—Use Recognizable Track Structure.
- KTUPEE—Keep Trying Until Parity Errors Eliminated.
- IPS—Ignore Protection Scheme.
- DUF—Delete Useless Files.
- WDD—Write Defective Directory.
- HDIBS—Hide Directory In Boot Sector.
- AGAR—Allocate Granules At Random.

With COPYDOS, the process is much simpler. The correct syntax is COPY. This is used for both full-disk and single file copying. There are absolutely no options. The operating system will select a source and destination disk at random, choose a program (or group of programs) to COPY, and perform the function. We found this DOS to be a real time saver. Unfortunately, it cannot be used with systems having fewer than three drives.

Other Single Function DOSes are equally easy to use. DICEDOS does nothing but simulate the rolling of six-sided or n-sided dice. NANODOS is like MICRODOS, only smaller. NILDOS is tinier yet, while the often-talked about NULLDOS has yet to be seen on the market.

User-Hostile Business Software

The first of these programs is "No Accounts," a comprehensive Very General Ledger/Accounts Payable-Receivable package. The program comes with a hardware interface to a BSR appliance controller module. I failed to see the need for such a feature, but blithely connected the controller, following KTI's instructions.

When the Accounts Payable module is initialized, the first thing it does is issue a check for $249.95 payable to Kitchen Table Inc. Then, the program seizes control of the lights and appliances in your home (including air conditioners, the furnace, and your automatic garage door opener) until the check clears, and the proper entry has been made in the General Ledger.

I judged this to be a fairly foolproof way of ensuring the software vendor is paid for his efforts. However, KTI has finally come up with a practical anti-piracy measure as well. Any time the program is copied, Accounts Payable senses this and issues another $249.95 check.

No Accounts is the firm's first effort at penetrating the burgeoning small business market. Other less successful software companies have insisted on marketing packages conforming to accepted accounting practices. Kitchen Table did extensive market research and found most business users prized flexibility over accuracy.

All in all, No Accounts is an unusual package. It is designed for the small business person who has found it difficult to keep two sets of books using old-fashioned manual methods. These programs automate the task, provide greater control, and lend an air of legitimacy to the phoney set of figures.

Eight programs make up the package. Four are used to generate the "public" set of books used for tax audit purposes. They are called "General Ledger," "Accounts Payable," "Accounts Receivable," and "Inventory Control."

Four other programs exist on the same disk, under the names "INVADERS/BAS," "HANGMAN," "WUMPUS," and "STARTREK/CMD." These may be made invisible in the disk directory if desired. They are actually just ordinary business accounting programs, except they encrypt all data files so that they are virtually unreadable, even by the programs themselves. Some additional self-destruction features have been built in, but we were unable to test them. The documentation advised having a fire extinguisher on hand, so we balked.

For partially debugged Basic code, the No Accounts programs worked well. Options abound. The operator may generate as many as six different audit trails for the same transaction. Petty cash in amounts up to $999,999.99 may be accounted for in several imaginative ways. Trial balances may be performed in reverse—the user can insert the desired trial balance, and the program will adjust all the other figures to match.

Posting to the General Ledger is extremely simple, and does not require operator intervention or time-consuming key entry. Instead, the program takes entries from the legitimate Accounts Payable file, and a certain percentage of the Accounts Receivable data, and generates a General Ledger entry that more or less cancels out. If desired, the operator can specify a small loss or profit for any given month, quarter, or fiscal year. Accounts Payable and Accounts Receivable files are also developed automatically.

Various dummy reports are also supplied, including a tongue-in-cheek breakeven analysis, balance sheet, and cash flow and budget analysis. Depreciation of non-existent assets is allowed.

I found the Owner Expense Account module to be very impressive. I supplied it with dummy data (which it prefers to the real thing) about an imaginary business trip to Walt Disney World in Florida. The program produced a plausible printout accounting for travel expenses (two Monorail rides), special clothing expenses (Mickey Mouse T-shirts), and a four hot-dog business luncheon with Walt Disney himself.

The Inventory Control module was most interesting. Entries may be made for "Number of Item On Hand," "Number of Item Really On Hand," "Lost Through Pilferage," "Lost To Brother-In-Law," and "Never Officially in Our Warehouse."

Feedback Welcome

Since my exposé on CompuServe's CB simulator in the June/July issue of *80 Micro*, I have been receiving a flood of e-mail from irate users of Kitchen Table products. You may continue to send these comments to me in care of User I.D. 70060,137. All will be ignored. ■

✓See List of Advertisers on Page 455

★★★★

Learning TRS-80 Basic
for Models I, II/16 and III
by David A. Lien
CompuSoft Publishing
Box 19669
San Diego, CA 92119
softcover, 544 pp.
$19.95

by Arthur Huston
***80 Micro* Staff**

Learning TRS-80 Basic for Models I, II/16 and III will give the beginner an easy start into the Basic language. It is written by Dr. David A. Lien, the noted author of many computer books, including the *TRS-80 Level I User's Manual*, the revised Epson MX-80 printer manual, and *The Basic Handbook*. Dr. Lien is one of the best documentation writers in the business, and *Learning TRS-80 Basic* may be the best beginner's book for the TRS-80.

The book is written in an informal, humorous style and is liberally sprinkled with cartoons. It manages to be readable without being cute, yet it is thorough and precise without overdoing any one subject. The complex problems that might throw beginners are either treated very lightly or not gone over.

Organization

The table of contents provides details on five major sections. The first section is the meat of the book—420 pages of instruction on the Basic keywords and programming techniques. The second section contains answers to the exercises given in the first section. The third is 16 ready-to-use programs, each less than two pages long. The fourth is a series of appendices with information specific to the Model I, III, or II/16. And the fifth section is an index that cross-references the Basic commands and terms used in the book.

The organization of this book, into instruction to appendices and index, is what makes it useable; the nature of the instruction makes it enjoyable. Lien covers all the Basic keywords used in a TRS-80 Model I or III operating without Disk Basic. Each one is examined thoroughly: the ways to use it, and the ways to avoid misusing it. In each chapter, examples demonstrate how the keywords relate to each other in a Basic program.

The last 30 pages of the tutorial are devoted to program control. Lien covers flowcharting, and debugging programs. Included is a short memory test for times when the hardware seems to be at fault. These chapters alone are worth the price of the book. Too many books teach only the Basic keywords and nothing about programming; this book teaches you to write programs, and then what to do when they do not work correctly.

The answers to the 79 questions in the tutorial tend to be a little short. An English explanation of what is happening in the program could have been used more often than it was.

The Appendices

The ready-to-run programs serve as examples of what the Models I and III can do with competent programming. The appendices, however, are much more useful. To some they may be of more use than the tutorial. Appendices A–H cover 68 pages and include separate ASCII Code Tables for the Model I/III and II/16, and explained listings of the error messages for the I/III and II/16.

The important parts of the appendices are tutorials on using disks and on setting up the hardware. Turning on the system, turning off the system, entering Disk Basic, returning to the DOS Ready prompt, and taking a directory are covered in five pages each for the Model I, II, and III. The appendix on setting up the Model I Expansion Interface is interesting for its thoroughness, as is the section on using the real-time clock without Disk Basic, information that is hard to find. Finally, a section on using two cassette recorders with the Model I is invaluable.

Also included is a section reviewing the Basic keywords that are peculiar to the Model II/16, essential to any book that purports to explain Basic for all TRS-80s, Color Computer excluded.

Weak Points

Learning TRS-80 Basic is not without flaws. Its biggest is that in trying to ease the beginner into computing it sometimes neglects the advanced programmer. Keywords like PEEK, POKE, USR, and VARPTR are covered too briefly.

Lien states that the book was written for the Model III, but that it can be used equally well on the Model I, II, and 16. I think it was written for the Model I and III with the II/16 thrown in as an afterthought. To his credit, Lien thoroughly documents the multitude of small differences between the machines in the margins of the book. I came away impressed with the book's completeness, but felt that the overall effect was a little busy.

The only Disk Basic commands documented are CMD"S" (return to the disk operating system), Save and Load. However, anyone with disk drives who is just learning Basic would still benefit greatly from this book.

Learning TRS-80 Basic is one of the best introductions to Basic you can buy. In readability and thoroughness it far surpasses the Model I, III, or II/16 Basic manuals. ■

REVIEW CONTENTS

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"Penetrator is a state-of-the-art game for the TRS80.†

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"The graphics are about as good as is possible on the TRS80...the display you get after destroying the bomb cache is something like Fourth of July fireworks.

"The sound is great; you get snappy little tunes at the beginning of each game and a triumphant number after blowing up the bomb cache.

"Penetrator is a very well done game program and worth the asking price."*

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★★★★★

Extended muMATH
Microsoft
10700 Northup Way
Bellevue, WA 98004
Models I and III
$250

by Bruce Powel Douglass

MuMATH is a symbolic mathematics package for microcomputers. An abbreviated version of this package has been available for some time, but it is much weaker than the CP/M version. Microsoft finally released their extended muMATH package and it is worth the wait!

muMATH uses symbolic mathematics and is written in muSIMP, an RLISP-like cortex parser for an internal Lisp structure. It performs exact arithmetic (to 611 digits) and does not normally attempt to reduce fractions—3/7 remains 3/7, not some floating-point approximation like 0.4285714. Hence, muMATH arithmetic is *exact*. Extended muMATH can print answers in decimal notation to any number of digits you like. This presents the interesting possibility of essentially infinite-precision mathematics printed out either as a fraction or as a decimal number. It is very simple, using a Taylor series, to calculate LN(2) to 200-digit accuracy.

muMATH allows mathematical manipulation of symbols, like X, without assigning them a value (or binding). The use of unbound variables gives muMATH its great power. You can assign non-numeric values to a variable. You can bind A to (X+2*Y)/Z-Q. You can evaluate A by temporarily assigning X, Y, Z, and Q numerical values, using the EVAL or EVSUB functions. muMATH has this ability since it is essentially an implementation of Lisp, in which data and programs have the same format and are interchangeable.

The extended muMATH package has several enhancements to the original abbreviated TRS-80 version including:

- allowing decimal output of numerical results in addition to the standard rational arithmetic output;
- an enhanced integral calculus package for more sophisticated integration;
- fast loads and saves of muSIMP environments to and from disk;
- a Limit package to evaluate limits;
- a Sigma package to evaluate sums and products (including infinite sums and products when combined with the Limit package);
- a complete Matrix package including matrix addition, transposition, inversion, and division;
- an equation-solving package for solving various types of equations (including simultaneous equations when combined with the Matrix package);
- a Trace package used for debugging muSIMP and muMATH functions;
- EDIT80, a line and character-oriented editor for creation of your own function files for muMATH;
- interactive lessons on disk for learning to use muMATH;
- an improved manual; and
- all the files (with some updates) that came with the abbreviated TRS-80 version.

First, the manual is better than the one for the abbreviated TRS-80 version. It includes a complete listing with explanations of the muSIMP and muMATH functions, and the location for the jump vectors for interfacing machine-language programs. (The expanded version now honors protected memory, allowing you to put your machine-language programs there.) The manual also includes references for those interested in learning more about computer algebra and symbolic mathematics, a nice table of contents, and two indices.

A complete tutorial on muSIMP would be helpful as none are available anywhere on muSIMP or its cousin RLISP. And better distinction could have been made in the differences in usage between Function and Subroutine. The former is *call by value* and the latter is *call by name*. The manual will help the uninitiated, but advanced applications will have to be self-taught. (The folks at the Soft Warehouse, creators of muMATH, have been quite receptive and helpful to my queries for information.)

The Modular Approach

muSIMP, when you first get your four disks (for the Model I; two disks for the Model III), is uncombined with the parts to make the muMATH package work. Since there are many separate files, and they won't all fit into memory at once, you can create your own applications packages. The manual explains the procedure quite well. muMATH users now have save and load functions for saving the current files in memory to disk in a special distilled format (D-code, just as it is stored in the computer's memory), rather than in the ASCII source-code format. The ASCII source-code format takes a long time to load in. (The creation of one particular package took half an hour to load the files, but once the environment is saved in D-code form, it takes about 10 seconds.) muMATH still lacks a function to save user-created functions to disk in ASCII form, hence the inclusion of the EDIT80 text editor.

The result of this modular approach is that I have several application versions of muMATH, one for solving equations, one for calculus applications, and one for matrix calculations, all of which can be easily and quickly loaded by muMATH. Also, much more user memory is available for user functions. Reclaim( ) is a function that forces a garbage collection to occur and returns the number of bytes of free space. Whereas in the abbreviated TRS-80 48K version only about 2,000 bytes are free for user programs, a typical amount of memory in my applications packages is 10K to 20K.

muMATH contains a decimal-output function controlled by the value of a variable called Point. When Point is false, rational arithmetic is displayed (1/2+1/3=5/6). When Point is true, the value of Point determines the number of digits displayed to the right of the decimal point. You may print out 300 decimal places with complete accuracy since the internal storage remains rational rather than floating point. This is a very valuable addition to muMATH, since 1755376/1928477 is less meaningful than 0.91023953. Anyway, the capability is there and enhances the utility of muMATH considerably.

The Packages

The Trace facility is used for debugging functions and works much like the standard Lisp Trace function. The output is controlled by the variable Mathtrace; when Mathtrace is true, mathematical notation is used, when it is false, list notation is used. The output lists the names of the functions called with their passed arguments shown, and result in leaving each of

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these functions, complete with indentation, to show the depth of the function calls.

The EQN/ALG and Solve/EQN packages solve equations. A muMATH equation is an expression with the == symbol standing for the equal sign within the expression. Thus A: X*2–3==2/(X–10)+3 assigns the equation on the right of the colon to the now bound variable A. You can solve the equation by entering the command Solve(A,X), where A is the equation and X is the variable for which the equation is to be solved. Real and complex roots are returned.

Sometimes division by zero occurs because muMATH tries to cancel and simplify as much as possible. muMATH may occasionally divide by some unbound variable that may later turn out to be zero. So it pays to check your answer.

The Array/ARI and Matrix/ARR packages give muMATH the ability to handle matrix algebra and matrix calculus. Since the TRS-80 character generator does not have square and curly brackets used in the CP/M version of muMATH, << and (< replace them. Some of the operations programmed into the matrix package include matrix multiplication, addition, transposition, division, powers, and inversion. These operations can be performed on ragged matrices as well.

IDMAT( ) is a special function that returns the identity matrix. To divide matrix B by matrix A, you can simply use the MDV command: A MDV B. Solutions with parameters are returned with singular matrices. The Matrix package also includes a function to calculate the determinant. It uses a Gaussian elimination method that will sometimes fail to adequately reduce the expressions. The reason for this is that this method requires extensive division, and muMATH will sometimes miss simplifications. A better method is minor expansions (although it is not better in numerical mathematics), and with the recursive power of muMATH, it is easy to program. The only problem with the expansion of minors is that it takes a lot longer and uses more stack space than the elimination method.

The Integral Calculus Package

The integral-calculus package is enhanced as well, with the inclusion of INTMORE/INT. A function to perform definite integration (DEFINT) is also provided. I found what I consider to be a small bug in this DEFINT function. Even if the integration results in a simple answer, if the control variable is true it will try to use the Limit package to evaluate the definite integral. It should recognize the need for simple substitution and evaluation. As it is, you need only remember to set the control variable #LIM to false, if you know the integral to be a proper one. A true fix is printed in the Soft Warehouse Newsletter #6.

You can use the Limit package to help evaluate some integrals. The class of integrands that muMATH can handle is still limited, but it is significant.

A Taylor-series function is contained in a separate package for the evaluation of Taylor series truncated to any number of terms desired. I have rewritten the function to yield a solution based not on the number of terms evaluated, but on the accuracy of the answer. Both forms are easy to use and program in muSIMP.

The Limit package, LIM/DIF, provides the ability to find the one-sided limit of a mathematical expression as one of its variables approaches some value. It can be used to evaluate a variable as it approaches a finite value of either minus or positive infinity. You may specify whether you wish to approach the value from the "left" or the "right."

SIGMA/ALG provides closed-form summation and products. Certain applications may require use of the LIM/DIF package for the sum or product to be evaluated, as with infinite limits. Noninfinite limits normally require the summation (or production) and simplification of the terms, something muMATH excels at.

The expanded version of muMATH provides a number of other enhancements. MEMORY(X,Y) is similar to POKE X,Y. TRS-80 graphics functions are supported including CLS to clear the screen; Cursor to position the cursor; Point, Set and Reset to test, turn on, or turn off any graphics pixel on the video screen. TRS-80 ROM routines can be called either by assigning the jump vectors correctly, or with the PUTD command. You should use this capability with care however; the ROM has many exits to Disk Basic, and if one is taken, it's off to Neverneverland.

Conclusions

Overall, I am quite impressed with the expanded version. It is powerful and can handle more sophisticated integration problems, compute limits, finite or even infinite sums and products, and contains very powerful matrix manipulation abilities.

The package lacks a function to save ASCII files from the muMATH environment. This would let you debug functions within muMATH and then save them directly on disk. Further, it would be nice to be able to save the functions in the distilled D-code onto disk for quicker loading. Currently, single functions and entire packages must be loaded and are incrementally compiled during the load. The exception is entire muSIMP environments that can be saved and loaded.

Even with these reservations, the expanded version of muMATH is one of the few programs that, by itself, warrants purchasing a computer.

Who should buy this package? Parents and educators wanting to teach mathematics to students; students who want to learn more about mathematics in an interactive environment; professionals who work with mathematics on a daily basis, and would like to save time performing time-consuming mathematical manipulations; and the curious, who want to know more about the topics of artificial intelligence, computer algebra, structured programming, or symbolic mathematics. ■

★★★★

CCForth
Frank Hogg Laboratory Inc.
130 Midtown Plaza
Syracuse, NY 13210
Color Computer
$99.95

by Jake Commander

Software support for the Color Computer is beginning to move. The CCForth package written by Chuck Eaker and published by Frank Hogg Laboratory Inc. is an example of the software beginning to appear for Color Computer users.

Forth is one of those languages with a following of fanatic programmers. It's a stack-oriented interpreter and is one of the lower-level languages around. Low level means that certain functions (such as floating-point numbers) aren't available as standard features in the language. This isn't as bad as it sounds and is outweighed by the speed advantages offered.

The lower-level language interpreters have less work to do interpreting and syntax-checking the programmer's code than high-level languages. They can therefore interpret the code faster and feel closer to machine code.

Stack-oriented means that the language is structured around a last-in, first-out (LIFO) stack as used in machine-code programs. Most number manipulations are performed on the stack, which is simply a list of bytes in memory with the characteristic that the last number on the stack is the first removed.

Numbers are computed by pushing, pulling, and otherwise bullying the numbers in this list. Forth is dependent on the stack, and has many commands that allow simple manipulation of the numbers placed there. For example, there are commands that allow numbers to be duplicated, rotated, swapped, and other desirable functions.

Even though the stack has such a central importance in Forth, variables are easily defined and are used much as in Basic. Forth programmers, however, guard the stack's use and frown on the unnecessary use of variables when a stack technique could be used. This isn't just snobbery; speed is the advantage and Forth is a fast language. Neatly stacked numbers can be dealt with faster than an untidy list of variables that have to be searched and the desired variable fetched into a convenient position.

The fact that it's interpreted gives you the same advantages as languages such as Basic where you enter the code in a form readable by the programmer and it is then stepped through and interpreted by the language interpreter. Code can be entered, edited, tested, and debugged without converting it to machine code and handing it over to the processor. Thus, if your code contains a bug, it won't be wiped out by a crash (although in Forth, if you try hard, you can do it).

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If you don't want to stick with the interpreter, you can drop down into machine code. For this purpose, CCForth contains a 6809 assembler enabling you to link machine code with the interpreted CCForth code.

The highlight of the Forth language is that you can define your own words and can enter them into the Forth dictionary and save them if required. Subsequent use of the new word causes it to be interpreted as if it were a standard feature. You could define a word that accomplished a floating-point conversion (for example) and use that word in your code every time you need floating point.

It doesn't stop there though; if you want to define another word, you can use the word you just defined as part of the new definition. In effect, you can create your own language and in doing so, you raise the language from lower level to higher level. This gives you great power and flexibility. If you don't like something in Forth you can just rewrite it!

"The highlight of the Forth language is that you can define your own words and can enter them into the Forth dictionary."

More than half the words used in CCForth can be redefined because they're provided in source code on the disk. The language can actually be used to write itself!

CCForth comes on disk with a user's manual. The disk contains the interpreter and some goodies to experiment with. These include games, music generators, an assembler, source listings for two editors, and various samples for a total of nearly 90 screens.

You call the CCForth interpreter by using Disk Basic's LOADM command followed by entering EXEC; CCForth then takes over.

The world of CCForth is now open to you with all the benefits I've described. Accomplished users of Forth find themselves on familiar ground as CCForth was written around the Forth-79 standard published in late 1980. The only unfamiliar sight can be the use of screens 32 characters wide instead of the usual 64. This was the only sensible course in view of the Color Computer's screen limitations. Screens are the method Forth uses to store material on disk. If you've never used Forth before, you have a pleasurable learning experience ahead of you.

The user's manual is a gem. If you want a perfect example of technical writing, this is it. My small gripe is that although this manual is the right size (8½ x 11 inches), it comes as a bound book with the pages glued at the spine. It's impossible to insert updates, and Frank Hogg Labs are stuck with whatever errors crop up between the covers. To bear this out, within a week of reviewing this software, a new version was released with nowhere to insert the updates. In Forth fashion, I redefined the manual by slicing the pages away from the spine and punching holes for a three-ring binder.

Now for the best part; the style and layout are perfect. For beginners there are step-by-step explanations that teach the Forth techniques without becoming dull or boring and without insulting the reader's intelligence. There's a delightful touch of humor here and there that keeps the author in touch with the reader. Neither conciseness nor accuracy are compromised by this technique—just a twist here and there to enliven over 200 pages of text.

As you become more familiar with the language you can use the glossary at the back of the book instead of searching through the examples. In fact, the whole manual becomes more serious towards the latter half, a touch that makes the book functional as both a tutor and reference. The manual has five sections, going from preliminaries to the user's manual and glossaries at the end.

Frank Hogg Laboratory Inc. appears to have the best intentions as regards user support. As already stated, a second version was rushed to early purchasers of the package when it was realized some preproduction releases of the software had found their way onto the market. This bodes well for future support.

I heartily recommend this package. It will win a lot of support for the Forth language, and justly so. ■

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★★★★★

Sole
Misosys
5904 Edgehill Drive
Alexandria, VA 22303
Model I with double density
$25

by Charles Knight

Sole; sounds like something you'd have filet of, but it's actually the name of a new software package from Misosys for use with LDOS, the Model I, and an appropriate double-density adapter.

Sole eliminates the need for Model I double-density users under LDOS to use single-density disks throughout the entire booting process. With Sole, this shortcoming is a problem of the past.

The ROM bootstrap routine requires a disk be formatted in single density. It reads sector 0 from cylinder (track) 0, which contains the code to load in the rest of the operating system (SYS0, CONFIG/SYS, and SYS1 in that order). The ROM doesn't under any circumstances read a double-density disk. It doesn't even present the user with the annoying no system or disk error messages. The way around this is to format cylinder 0 in single density and the rest of the disk in double density. The reason this hasn't been done sooner is related to the large variety of different hardware configurations supported by LDOS. For example, the Lobo interface boots on either single density or double density by reading in sector 1 of cylinder 0.

The problem is not solved by simply reformatting the track. The code loaded from the boot sector must be capable of reading double density, so a whole new boot routine must be written. In addition, SYS0 must be stored in only one extent. Sole takes care of the boot code, and the documentation allows you to take care of the other easily.

Once the disk is formatted in double density, a program called SOLE1 runs on it, allocating the entire boot cylinder to the file BOOT/SYS. This ensures that no other file will occupy any part of cylinder 0 since it will later be reformatted in single density. Then the single-density system disk is backed up to the double-density disk. This is done by first backing up SYS0, then SYS6 and SYS7; using three separate back-up commands ensures these files are stored in the fewest extents possible. SYS0 must only occupy one extent or the system won't boot in either density. Then the rest of the single-density system disk is backed up with a fourth back-up command, after which a program called SOLE2 is run on the resulting disk. The result is a double-density disk that can be booted on the TRS-80 Model I.

Now, this sounds like a lot of trouble, and it is. But it only needs to be done once. After you create the first double-density booting disk, you can file SOLE1 away and forget it. To back up this disk, format a disk in the usual manner for double density, run SOLE2 on it, then use the back-up program in the normal way. Your disk now has 70K more free space than before and on drive 0 where you need it most.

If you need to reconfigure your SYSGEN to change the HIGH$, run SOLE2 again on the System disk afterward to prevent conflicts in memory usage during booting. This is not inconvenient, as the SOLE2 program runs in about 10 seconds and only consumes 1.5K of your new disk space. (This is necessary only if you have done a SYSTEM(SYSGEN) and wish to boot the disk.)

Making Back-ups

There is one bug in the Sole program system: You cannot back up a double-density System disk using only a single drive. If you have flippy disk drives you'll have to copy to another disk, and then copy it to the original's backside. This is a problem in the back-up utility rather than in Sole and presents no problem at all to owners of two or more drives. The bug manifests itself when the back-up program says, "ALERT! That's not the same source disk" even though it is the same source disk. If you have a single-drive, double-density system, you can use LDOS in double density, but you'll have to borrow a drive to make back-ups of these system disks.

The documentation is short—only three pages—but meets the high standards of LDOS documentation. It presents its subject lucidly and discusses the program's technical aspects in an understandable manner. It even warns you that a particular section is a technical discussion and tells you where in the documentation to skip to if you're not interested.

Roy Soltoff is the author of Sole (he's also the author of LDOS) and he has certainly written a masterpiece. He offers a printed listing of the source of both SOLE1 and SOLE2 for an additional $25.

At this writing, Radio Shack's double-density adapter is not available for testing. LDOS intends to support this adapter with a driver and there is no reason to believe Sole won't work correctly with that driver as well. ■

★ ★ ★

Spectaculator
Tandy/Radio Shack
Fort Worth, TX
Color Computer
$39.95

by Scott L. Norman

Spectaculator is an electronic spreadsheet for performing budgetary or other tabular calculations on the Color Computer. It comes in the familiar ROM pack format, and can be used with either 4, 16, or 32K machines. You need a cassette recorder if you want to reuse your work, and a printer is handy.

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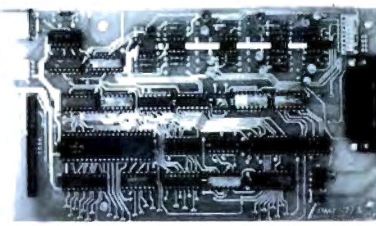

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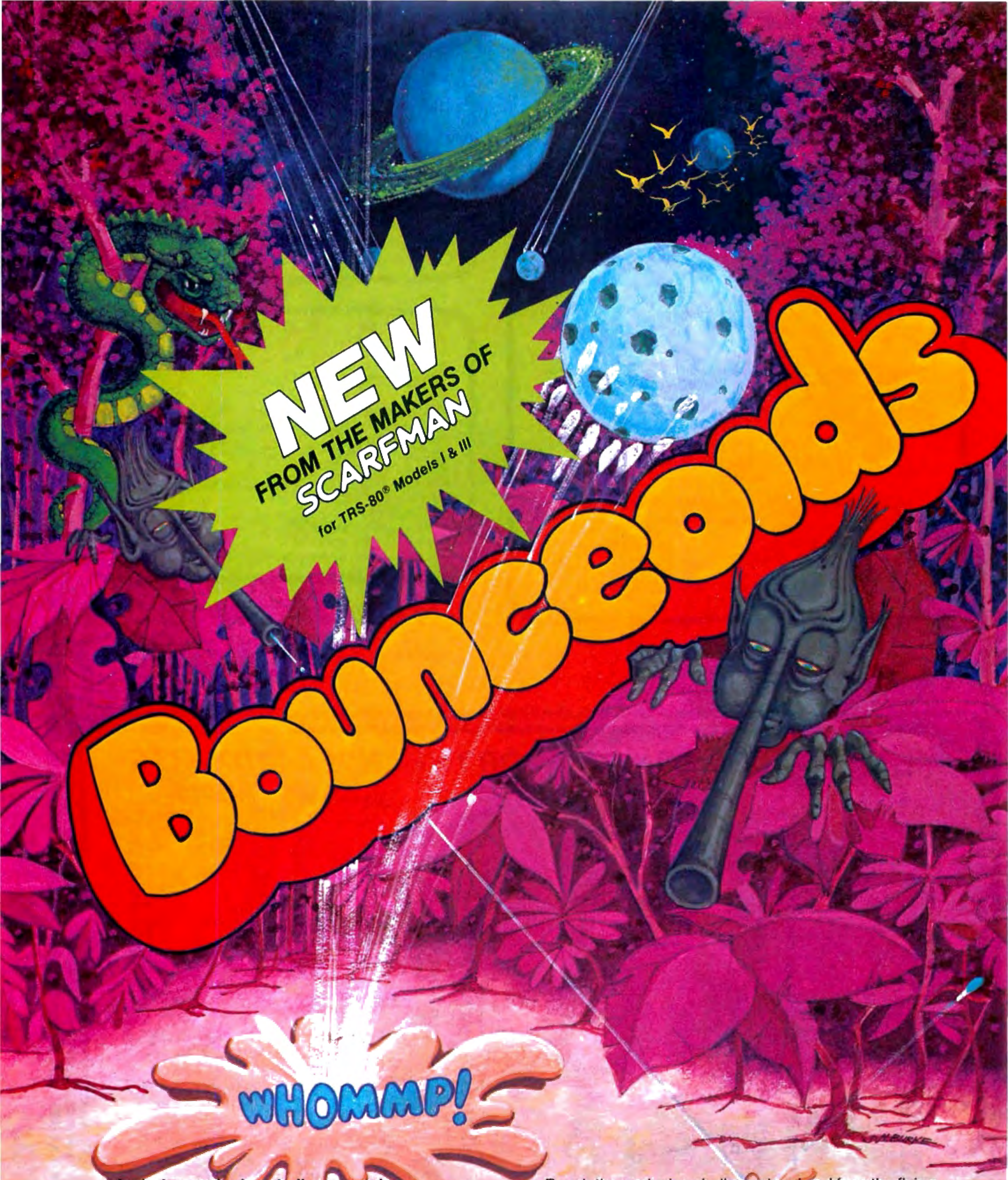

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The worksheet can be up to 99 columns wide by 99 rows deep.

Setting Up

Spectaculator comes with an 8½-by-11-inch, 43-page manual. The book leads you along very gently and can be read quickly. Almost half of it consists of sample sessions and command summaries. The Spectaculator vocabulary has 17 two-character commands, plus redefined meanings for a few individual keystrokes. The four arrow keys move the cursor over the worksheet for data entry or when you're defining formulas. The clear key backspaces the cursor and after you have entered a two-character command, the question mark displays a Help document on the screen. Two question marks cause an exit back to the worksheet. Finally, the break key returns you to the initial command mode.

Spectaculator "wakes up" in the command mode. The prompt is C>, accompanied by an orange block-cursor. Below the cursor, row and column identification numbers for the worksheet you are using are displayed.

When you turn the power on, the upper left-hand section of the sheet is shown on the screen. Normally, you will see 13 rows and as many columns as will fit the video display. You can specify column widths; the default value is seven spaces. When you move the cursor the row and column ID numbers change.

Table 1 shows the two-character commands. To enter numerical data, use the EN (enter numbers) command. It returns a prompt of EN with a dark blue cursor. You can now fill the worksheet with your data, using the arrow keys to move about as you like. To insert a number, just type the number and hit the enter key. The number will move from the command line to the marker position, while you stay in the EN mode. Entire rows and columns can be labelled with the ET (Enter Text) command.

A few peculiarities of the program become evident when you set out to spruce up a worksheet with labels. Numerical entries are right-justified when entered, while text entries are left-justified. Judicious use of the space bar is sometimes necessary to properly align column labels with the data they refer to. Also, with the ET command, text entries may exceed the width specification of the column they start in without affecting subsequent numerical entries. That's how you label worksheets with titles spanning several columns of data. You can create new blank rows and columns at any point with the IR and IC commands, so you always have the option of adding labels or data to an existing worksheet.

MM—Move marker
EN—Enter numbers
ET—Enter text
CF—Define column formula
RF—Define row formula
CA—Calculate (all formulas)
CC—Clear column of data
CR—Clear row of data
DC—Delete column (data + formula)
DR—Delete row (data + formula)
IC—Insert blank column
IR—Insert blank row
CW—Change column width
FR—Display free memory
SA—Save worksheet on tape
LO—Load worksheet from tape
LI—List worksheet to printer

Table 1. Spectaculator Commands

A shortcut to using the arrow keys to move about is the MM command. It lets you specify a location to jump to, in matrix notation: row, number, and column number (with no intervening spaces). When you press the enter key, the specified location appears at the upper left corner of the video window, with the entry marker in place. The row and column ID numbers are then updated to record your position. If you wish to return to the starting position at the upper left corner of the worksheet, the 1,1 position, type MM and hit enter twice.

If you make a mistake when entering data or text, just place the marker at the offending position and re-enter the correct information. If you have really fouled up, the CR and CC commands will wipe out all of the entries in the row or column in which the marker is situated. The DR and DC commands perform similar services for rows and columns whose entries were derived from programmed calculations. C commands erase numerical values; D commands not only erase numerical values, but any formulas associated with the row or column in question.

Worksheet Calculations

What makes electronic worksheets so special is being able to use predefined formulas, with numerical entries, to compute new entries, all of which can be easily updated or manipulated.

This program uses a convenient, easy-to-learn syntax for setting up formulas and is geared to straightforward financial calculations; not elaborate analysis of scientific data.

A typical Spectaculator application involves identical calculations (sums, ratios, and so on) on the corresponding elements of rows in a worksheet, the results of which are displayed in a particular column. Calculations can also be carried out vertically, with elements in different rows being operated upon to yield a results row.

In the first case, the marker is moved to the column position to be used for results. The CF command is now used to set up the formula to define how items in the column are to be derived from other entries in the worksheet. When writing Spectaculator formulas, the entry in column number n of each row is symbolized by Cn; numerical constants are written as usual. Thus, if you want each row of column 3 to contain 125 percent of the sum of that row's entries from columns 1 and 2, just move the marker to column 3, enter CF, and type in the formula: 1.25*(C1 + C2).

This is a recipe, not an equation; there is no C3 = because the marker's position specifies that column 3 is to be used for the results. Unfortunately, additional spaces may not be used to enhance legibility.

Once a formula is entered, the CA command calculates the computations. If you want to see what changing one or more entries will do enter the new values and repeat the CA command.

Spectaculator will add, subtract, multiply and divide as well as calculate square roots. Parentheses may be used freely. It also offers a SUM and SMT function. The first is a short way of forming, for each row, the sum from a designated starting column up to the column to the left of the marker's position. It's handy, but can't be used when intervening columns are to be excluded from the summation. The SMT function, followed by a column designation, calculates the total of a specified column, and displays the running subtotals in the column where the marker is positioned. For example, if the marker is set in column 10 and the formula SMTC5 is entered, the next CA will cause the first row of column 10 to contain the value from the first row of column 5; the second row of column 10 will contain the sum of the first two elements of column 5, and so on.

To differentiate those rows or columns in your worksheet that were computed, Spectaculator will display the associated formula whenever the entry marker is placed on such a row or column.

Normally, calculated results are displayed in a dollars and cents format with two decimal places. You can change this by prefixing formulas with an I for an integer display, or a D. The D causes calculations to be carried out to six decimal places, but only displays the results up to the first trailing zero. The program is inconsistent on this point; there are situations in which the first zero is displayed, and others in which it is suppressed. This makes worksheet formatting frustrating at times.

Spectaculator will automatically adjust the width of a results column, to fit as many as 10 digits (up to six to the right of the decimal point), to accommodate calculated values, even if you have predefined such a column's width.

All Spectaculator calculations can be carried out vertically across columns, as well as horizontally. To do this, place the marker somewhere on the desired results row, and define a formula as above, using Rn to denote a given column's entry in row number n. The two types of calculations can be used together in all sorts of financial work.

For example, the worksheet might contain budget information for a number of categories over several budgetary periods. If the categories are arranged vertically, calculating the sum across the rows would give the expenditures budgeted for each item for the entire time under study. If you calculated the sum down the columns, the total budgets for each of the time periods of interest would result.

In cases such as this, the CA command calculates the vertical and horizontal sums simultaneously. All results are displayed at once. If a number of columns are set up with different defining formulas, but all operate on the same initial data, then all results will be calculated and displayed simultaneously as well. There is one exception to be aware of, though.

Let's suppose that multiple results columns are set up, with one requiring the other for data. Suppose each row of column 5 is to contain the sum of that row's elements from columns 1 through 4, and column 6 is to express column 1's entry as a percentage of this total. The defining formulas would be: Column 5: SUMC1, Column 6: (C1/C5)*100. Here, everything would work just as described above, because the columns are defined in order, that is, everything is calculated before it is needed (if we read the columns from left to right). But suppose that the formula for column 5 called for a value from column 6, and column 6 was calculated from other data. Now, hitting CA would only give you the calculations for column 6. A second CA would be necessary to get column 5. Spectaculator seems to do what it can, skipping over those calculations for which the data is not yet available. This is preferable to getting an error message and having the program shut down, but it is something to keep in mind when changing an entry in the middle of a worksheet with such out-of-sequence calculations. To get all of the results updated properly in such a situation requires multiple CA commands.

This holds for row formulas, as well; the proper row sequence is from top to bottom. It is also true for larger numbers of out-of-sequence formulas than the two illustrated here. If you are accustomed to programming in Basic or other high-level languages you should have little trouble with this problem. Relative newcomers to programming, however, might have trouble, and it should be pointed out in the manual.

Other Features

Spectaculator worksheets can accommodate nearly 14,500 characters in a 16K computer, and nearly 31,000 in a 32K machine. You can save a worksheet to tape at any point, and reload it to resume work later. Data, labels, and defined formulas are all saved. You can assign a name to the tape file, and either use the name or ignore it when reloading (just as for Color Basic's CLOAD). One annoying point is that Spectaculator doesn't give any indication of the file name during the loading process.

Worksheets can be listed on a printer; the row and column numbers are automatically suppressed when this is done making for a more polished printout. You can select any portion of the worksheet for printing, consistent with an 80-character line. Merely place the marker on the upper leftmost element that you want to have printed, and enter the LI command and the row and column coordinates of the lower rightmost element. Everything in between will be printed; there is no provision for selectively skipping rows or columns in a printout.

Pros and Cons

I found Spectaculator to be useful for fairly simple budgeting, in which a few columns of results are derived from several columns of data and both horizontal and vertical summations are required. Because of its limited mathematical functions, calculations requiring operations such as exponentiation become awkward. This means that compound interest expressions have to be written out explicitly as a series of multiplications. It also prevents the taking of roots other than the square root.

One of my real-world test jobs was a multiyear budget projection for a number of technical programs, in which I was interested in finding the sums for 22 rows and five columns. I would juggle individual entries in my worksheet to stay within guidelines for the total annual budgets, and recalculate the sums as needed. At the end, I called for a printout of that portion of the worksheet that I actually used. This one example exercised most of Spectaculator's commands.

The program was fairly slow. Calculation times ranged from six to eight seconds, and increased noticeably for larger worksheets.

Several aspects of the system only emerge when you give it an actual test case. It wasn't until I had it sum 22 rows of data that I realized there is no way to exclude individual columns from the sum if they contain numerical data. This meant that not only did I get the total annual budgets for my 22 programs, I also got the sum of the 22 program ID numbers! There is an easy fix for this particular case: just enter such identifying numbers as text, using the ET command.

Another shortcoming is the lack of a desk calculator mode for changing individual entries in the middle of a worksheet. If you want to examine the consequences of increasing an item by

TELEWRITER™
the Color Computer Word Processor

TELEWRITER
Telewriter is the powerful word processor designed specifically for the Color Computer. It can handle almost any serious writing job and it is extremely easy to use. It has all the advanced features you need to create, edit, store, format and print any kind of text. With Telewriter you can quickly produce perfect, finished copy for letters, reports, term papers, articles, technical documentation, stories, novels, screenplays, newsletters. It is also a flexible and efficient way to take notes or organize ideas and plans.

51 × 24 DISPLAY
The Color Computer is an incredibly powerful and versatile computer, but for text editing it has some major drawbacks. The small 32 character by 16 line screen format shows you too little of the text and, combined with its lack of lower case letters, bears little resemblance to the way text really looks on the page. Reverse video in place of lower case just adds confusion.

Telewriter eliminates these shortcomings with **no hardware modifications required.** By using software alone, Telewriter creates a new character set that has **real lower case letters,** and puts 24 lines of 51 characters on the screen. That's more on-screen characters than Apple II, Atari or TRS-80 Model III. That's more than double the Color Computer's standard display.

FULL SCREEN EDITOR
The Telewriter editor is designed for maximum ease of use. The commands are single key (or single key plus control key), fast, and easy to remember. There is no need to switch between insert modes and delete modes and cursor movement modes. You simply type. What you type is inserted into the text at the cursor, on the screen. What you see on the screen is always the current state of your text. You can move quickly through the text with one key cursor movement in all 4 directions, or press the shift key simultaneously for fast, auto-repeat. You can jump to the top or bottom of the text, the beginning or end of a line, move forward or backward a page at a time, or scroll quickly up or down. When you type past the end of the line, the wordwrap feature moves you cleanly to the next.

You can copy, move or delete any size block of text, search repeatedly for any pattern of characters, then instantly delete it or replace it with another. Telewriter gives you a tab key, tells you how much space you have left in memory, and warns you when the buffer is full.

. . . truly a state of the art word processor . . . outstanding in every respect.

— The RAINBOW, Jan. 1982

The only one with all these features for your TRS-80 Color:

51 column × 24 line screen display
Sophisticated full-screen editor
Real lower case characters
Powerful text formatter
Works with any printer
Special MX-80 driver
Runs in 16K or 32K
Disk & cassette I/O
requires absolutely no hardware modifications

FORMAT FEATURES
When it comes time to print out the finished manuscript, Telewriter lets you specify: left, right, top, and bottom margins; line spacing and lines per page. These parameters can be set before printing or they can be dynamically modified during printing with simple format codes in the text.

Telewriter will automatically number pages (if you want) and automatically center lines. It can chain print any number of text files from cassette or disk without user intervention. You can tell it to start a new page anywhere in the text, pause at the bottom of the page, and set the Baud rate to any value (so you can run your printer at top speed).

You can print all or any part of the text buffer, abort the printing at any point, and there is a "Typewriter" feature which allows you to type straight to your printer. Because Telewriter lets you output numeric control codes directly (either from the menu or during printing), it works with any printer (LPVII, LPVIII, MX-80, Okidata, NEC 8023, C. Itoh 8510, Centronics, GE Terminet, Smith Corona TP-1, etc.). There's even a special driver for the Epson MX-80 that lets you simply select any of its 12 fonts and do underlining with a single underline character.

CASSETTE AND DISK I/O
Because Telewriter makes using cassette almost painless, you can still have a powerful word processor without the major additional cost of a disk. The advanced cassette handler will search in the forward direction till it finds the first valid file, so there's no need to keep retyping a load command when you are lost in your tape.

The Verify command checks your cassette saves to make sure they're good. You can save all or any part of the text buffer to disk or cassette and you can append pre-existing files from either medium to what you have in the buffer already.

The disk version can be simply customized to the precise number of drives in your system. From the disk menu, you can list any directory (including free space) to the screen or to the printer, rename or delete files, set the default drive and return to BASIC.

ASCII COMPATIBLE
Telewriter turns your Color Computer into the most powerful, lowest cost, word processor in the world today. But that's not all. The simple ASCII conversion program provided with Telewriter (for both cassette and disk) means you can use the full power of the Telewriter editor for creating and editing BASIC and assembly language programs. It means you can use Telewriter to prepare or edit text files used with any data communications program.

Telewriter costs $49.95 on cassette and $59.95 on disk. To order, send check or money order to:

Cognitec
704 Nob Ave.
Del Mar, CA 92014

Or check your local software store. If you have questions about Telewriter, call us at (714) 755-1258 weekdays, 7AM-4PM PST.

And now you can get a complete text processing/communications package direct from Cognitec.

Telemaster-1: gives you Telewriter along with Colorcom/E, the most flexible smart terminal program available for the Color Computer. Package price: $94.95.

Telemaster-2: gives you Telewriter plus Spell 'n Fix—the professional FLEX spelling checker, now available for the Color Computer. Package Price: $109.95.

Telemaster-3: includes Telewriter, Spell 'n Fix, and Colorcom/E—all 3 for $154.95.

Please specify cassette or disk. For disk versions add $10.00 to package price. Mastercard/Visa accepted. Allow 2-3 weeks for personal checks. Add $2.00 for shipping and handling. California residents add 6% state tax. Send SASE for copies of reviews from major Color Computer and TRS-80 magazines.

. . . one of the best programs for the Color Computer I have seen . . .

— Color Computer News, Jan. 1982

10 percent, you must figure out for yourself what 110 percent of the original is and re-enter the new number in the proper place in the worksheet. Then you can use the CA command to observe the impact on all your formula-derived quantities. Be aware, though, that even this manual updating will fail if you try to change an entry in a row or column that is itself found by calculation. The next CA command will cause the original defining calculation to be rerun, and the old value of the item in question will come back to haunt you.

Spectaculator's operation has an asymmetry that deserves mention. That is, you can erase a derived column, formula and all, with the DC command; you can erase the data in a column with CC; but you can't leave the data and just erase the formula. Spectaculator also lacks the ability to copy a single row or column. I also miss something like Basic's Print Using command. There really are times when you'd like calculated results to be displayed with exactly one decimal place, trailing zeroes or no!

In Conclusion

It is not for the elaborate analysis of scientific data, but if you need straightforward manipulations for home, business, or organization, give Spectaculator a try. ■

★★★½

The Sprinter II
Holmes Engineering
3555 South 3200 West
Salt Lake City, UT 84119
$99.50

by Richard C. McGarvey

The SPRINTER II is a speedup modification for the TRS-80 that requires no damaging alterations. With a few exceptions, you can plug in the Sprinter II and run it on your TRS-80, instantly giving you two variations of eight operating speeds. One variation contains wait states (pauses) that allow slower ROMs to keep up. The other is without wait states. The price on the Sprinter II may seem a bit high but that is because the kit includes the 6 MHz Z80B CPU.

Installation

The Sprinter II is simple to install. There are no traces to cut and no wires to solder. All you do is open your keyboard, pull out the Z80, and plug in the Sprinter II. After clipping four wires onto easy-to-find chips and resistors, the Sprinter II is ready to run. With luck you will get 5.33-MHz operation immediately.

Sprinter II is well made. There are a few minor problems, however, that may not be immediately evident.

Possible Difficulties

The first problems confronting most Sprinter II users is the need for high-speed memory. The 400-nanosecond Motorola memory present in most TRS-80s is not fast enough to handle the Sprinter II's acceleration. It is easy, however, to get 200-ns NEC chips that will rise to the challenge.

I had to replace my memory and so did a friend who bought the Sprinter II on my advice. Another friend who also purchased the Sprinter II was able to operate it with his Radio Shack memory. If needed, the faster memory is available through Holmes Engineering for $26 per 16K. Memory in the expansion interface is not usually a problem, but some obstacles emerge when you use an expansion interface.

"If you want to tackle the job yourself, you can depend on Holmes for support. . . . they will be happy to supply you with any reasonable assistance."

In later versions of the expansion interface Radio Shack removed the buffered cable and installed a delay line (actually a chip). This chip causes problems when you try to speed up. As a result of this delay line, you will most likely need to replace that chip in the expansion interface with a modifying chip provided with the Sprinter II (at the additional cost of $10). To find out if this modification is necessary, call Holmes Engineering.

A few other adjustments may be necessary. You may have to install resistors in the keyboard and in the expansion interface to help the memory keep up. At least two resistors are likely and the rest (about 16) are possibles. If after all of this modification you still can't get high speed, you may have to cut a trace.

How to Modify

I made all the modifications myself. I needed the expansion interface modification and that was no trouble. I also installed resistors because I thought it wise while I had the boards open. If you don't want to do the work yourself, you can send the system to Holmes and they will make the computer run at 5.33 MHz for a small fee. Their work is guaranteed.

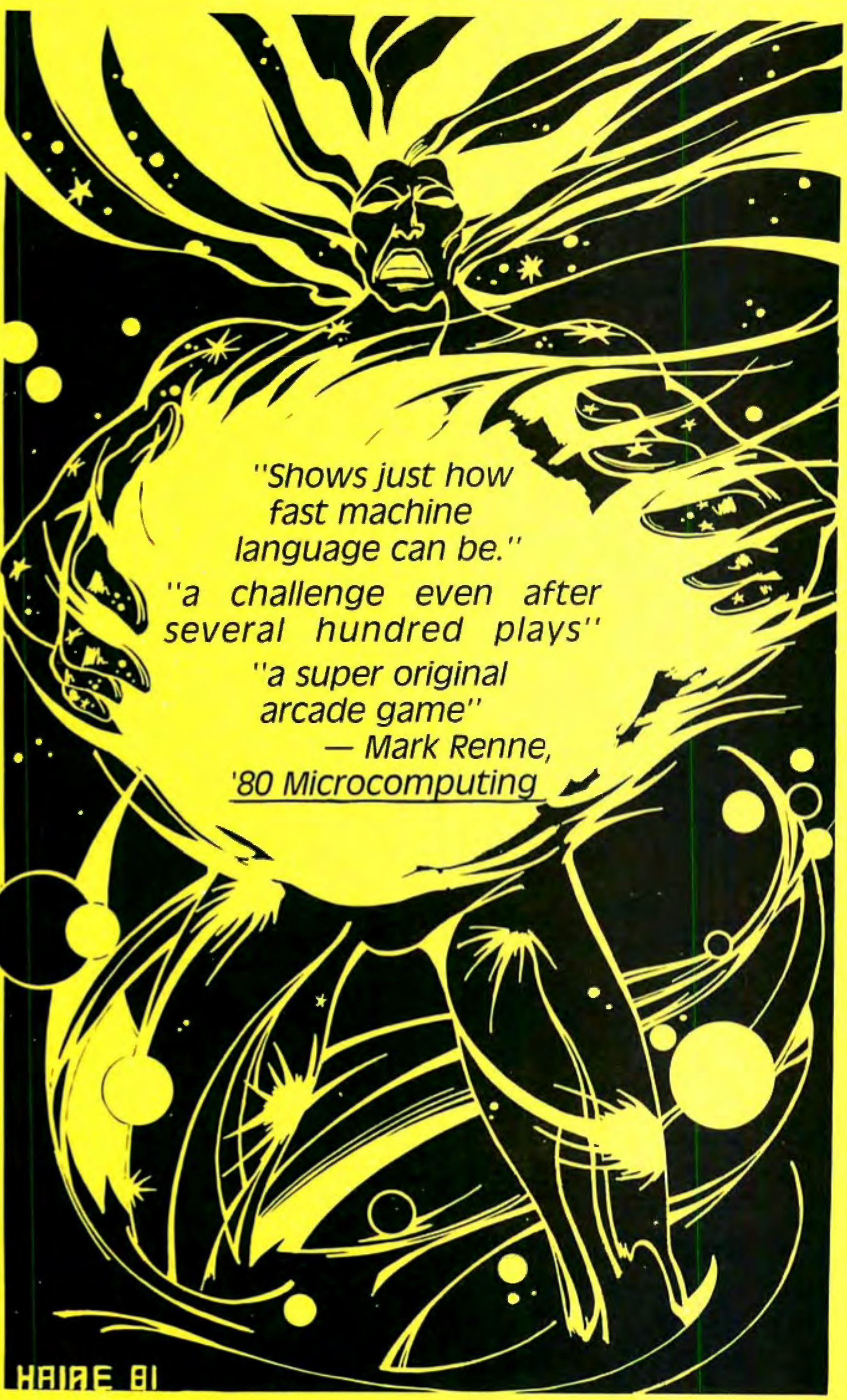
If you want to tackle the job yourself, you can depend on Holmes for support. They are good on the phone and they will be happy to supply you with any reasonable assistance. You can also call them before you buy to find out just which modifications you are likely to need.

Operating Options

An automatic slow down occurs when you access disk or cassette. This is the default, but it can be overridden. You can also decide whether you want the unit to start in the high-speed or normal-speed mode. Speed changes are software controlled by an OUT instruction to port 254. There are eight speeds, some slower than normal and others faster. Each has the option of operating with or without wait states to allow the slower ROMs to keep up. Top speed is 5.33 MHz without wait states, but a heavily modified computer is necessary to achieve this speed. The OUT254,12 instruction gives you 5.33 MHz with wait states. This speed should be available to everyone.

Holmes gives you a money-back guarantee. If you don't like the Sprinter for any reason, return it and get your money back, minus shipping charges. For this reason, they have an interest in your ability to get this little devil running to your satisfaction. ■

ARCADE EXCELLENCE



Med Systems' staff of programmers is known for producing some of the finest software available today. Now we announce two arcade games worthy of the Med Systems name: Laser Defense and Star Trap. Laser Defense: a totally original action game, not just an arcade ripoff! And Star Trap: the first home arcade game to allow two players to compete **simultaneously**! Both feature state of the art graphics, sound, one or two player options, and high score saving.

But don't take our word for it. See the review in the August, 1982 issue of *'80 Microcomputing*. And remember, Med Systems offers to refund your money if you aren't satisfied. Just return the game within 14 days of receipt.

Laser Defense
Your laser satellites must defend helpless cities against nuclear attack while attacking and destroying the enemy's launch silos. Particle beam weapons, nuclear power stations, the eradicator, and a two-map graphics system combine to produce one of the finest arcade creations available.

Star Trap
The first **two player** arcade game!

Bouncing between two gigantic 3-D hypergrids are the stars of a thousand worlds. Capture as many as you can, or use your nova to annihilate them! **Simultaneous** two player option allows players to compete head-to-head in real time!

Laser Defense and Star Trap are available on cassette or diskette and require 16K of RAM.

Laser Defense	Cassette	$15.95
	Diskette	$18.95
Star Trap	Cassette	$15.95
	Diskette	$18.95

Please add $2.00 for first class postage, $4.00 for overseas air mail.

MED SYSTEMS SOFTWARE

P.O. BOX 3558 CHAPEL HILL, NC 27514
TO ORDER, CALL 1-800-334-5470

✓83

OR SEE YOUR DEALER

★ ★ ★ ½

Finance—Loans & Investments
Computerware
Box 668
Encinitas, CA 92024
Color Computer
16K Extended Color Basic
$17.95 cassette
$22.95 disk

by Mark E. Renne

If you'd like your computer to figure interest on your loans or calculate how much you need to save to reach a goal, consider this program. Only three functions require a printer, so this utility is excellent for the beginner. It's good to see a program that uses the Color Computer as a computer and not as a video game.

Finance has two separate programs: Loans and Investments. Loans has nine separate functions dealing with often used loan calculations. Most functions calculate the missing variable. For example, if you are considering a two-year, 15 percent, $2,000 loan, Finance will calculate your monthly payment. This works for any missing variable by supplying the remaining variables.

You can also calculate commercial paper discount, if you can find a bank these days with a discount. You need a printer for receiving a mortgage amortization table indicating payment, interest and principal. You also have the option of a printed declining-interest loan table. This program includes most of the common calculations involving loans. You can even show how much of a loan is interest as opposed to principal in the first years of home buying.

Investments, the second program in this package, contains nine separate calculations used in investments. You can calculate the future value of an investment by giving initial investments, interest rate, compounding periods, and number of years. This is handy for calculating the value of your IRA in 2098, or determining how much you can withdraw from an annuity without damaging the principal.

Another function calculates the effective interest rate given the current and future value and period. The only function that requires a printer is an earned-interest table.

These two programs are a good example of a computer's projection abilities. Although they could be done on a hand calculator, the computer makes the process easy.

The program comes on a quality cassette with a program on each side or a disk. It loads with no problem and the programs are easily written and easy to understand. There's an excellent introduction discussing copyrighted material in an intelligent fashion as opposed to stern warnings about duplication.

If you have a need for calculating loans and investments, I recommend these programs. ■

★ ★ ★

Micro Mainframe Disk Controller
Micro Mainframe
2227 McGregor Ave.
Rancho Cordova, CA 95670
Model III
$279.95

by Jerry O'Dell

When I started shopping for disk drives for my Model III, I looked through the pages of this magazine to find the lowest possible price for the disk system.

To add one disk, you need a controller board, the drive itself, an installation kit, and 16K or 32K of extra memory. In addition, installation charges may enter the picture. I found prices from various sources as shown in Table 1.

My local computer shop, as the table indicates, has better prices than Radio Shack. The table's mail-order entries refer to the material prices I obtained from ads in *80 Micro*. As you can see, the mail price is $560 less than the Tandy price. The Tandy installation prices are estimates. Two mail-order drives would save you $734. If you can handle the service problems yourself, mail order is the way to go.

The chief contributor to the low mail-order price is the Micro Mainframe Model III floppy-disk controller. At $279.95, it's about $115 less than many other controllers listed in *80 Micro*. Micro Mainframe is not a well known company, but $115 is a substantial price difference, so I decided to order their unit.

The first difficulty was finding a dealer that stocked the kits. Micro

Source	Controller	Drive	Memory	Install.	Total
Tandy	$450	$399	$198	$50	$1,097
Local Dealer	$395	$235	$50	$30	$710
Mail Order	$280	$225	$32	---	$573

Table 1

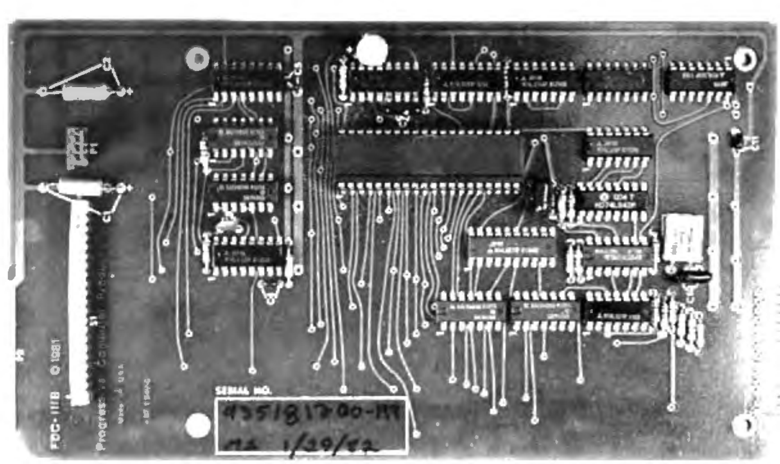


Photo 1. The Micro Mainframe Circuit Board

Convert your TRS-80* into a World Class Computer

ALSO.... UNIQUE RED & BLUE CRT'S AVAILABLE NOW!

NOW ALSO AVAILABLE FOR MODEL I AND OTHER 12" MONITORS

that REDUCES EYE FATIGUE AND DOESN'T FLICKER

...with LSI's new *Soft·View*™ Replacement CRT...

The black & white "TV Screen" CRT (picture tube) which came with your TRS-80*model II or III is an inexpensive rapid "P4" Phosphor CRT intended for TV use. The display is actually strobing 60 times a second. No amount of "green plastic" will stop this strobing or eliminate the eye fatigue it causes. But a new *Soft·View*™ CRT display tube with a slower decaying, colored Phosphor will.

- Available in slow-decay green (similar to new IBM* and APPLE III*monitors) or medium decay "European Orange" (easy on the eyes, elegantly beautiful, and the standard for CRT displays in Europe)
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- Easy installation – tube comes with pre-mounted hardware
- 30-Day Money-Back Guarantee
- Ideal for Word-Processing & Programming, fast enough for Games & Graphics
- Finest quality double-dark glass and phosphor fields make the letters seem to be coming out of black space

Try This Test:

LSI's new *Soft·View*™ CRT

Turn the brightness control on your TRS-80*all the way up. Wave your hand up and down in front of the screen. See how jerky it seems? Just like in front of a strobe light! That's because the screen actually is strobing at you. A slower-phosphor CRT will reduce that troublesome strobe effect. That's why most of the newer monitors, from IBM* to Apple III* are using the new slow-phosphor CRT's.

LSI SYSTEMS *Soft·View*™ CRT's: 80M-1182

- ☐ #GN42 Green Phosphor $79.95
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- ☐ #OR34 Orange Phosphor $89.95
- ☐ #OR34G Orange Phosphor with anti-glare $99.95

ADD $7 FOR PACKAGING AND UPS SHIPPING

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To Order Call: 1-800-221-7070

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132 West 24th Street, New York, N.Y. 10011 212-989-6876

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Mainframe in California put me in touch with three dealers. Two of them asked $100 more than Micro Mainframe's advertised price. However, BT Enterprises of New York had them in stock at the same price. The unit was delivered one week after I placed the order.

My initial uncertainty about the MM controller kit proved to be unfounded. The circuit board (see Photo 1) is well made, and is obviously well designed. For $279.95 you get the controller board, a switching power supply, almost all mounting hardware, all cables needed for installing two drives, and instructions. Only the four 32 by ¼ mounting screws for the drives are not supplied. I bought a Tandon drive from Soft Sector Marketing; *The Model III Service Manual* contains service instructions for it.

James Schaefer describes installation of Model III drives in the January 1982 issue of *80 Micro* (page 172). There is little need to supplement his writing on the topic; however, I included a few figures to show special features of the Micro Mainframe system.

To begin installation, remove the Model III cabinet top, and an internal shield over the CPU board. Install the new memory chips in the sockets on the right side of the board. Insert them precisely like the original eight above them. At this point, turn on the computer to make certain that it still works. Then, remove the CPU board, put in the disk controller board, install the hardware and cabling for the drives themselves, and reassemble the computer. It's a very simple job. The installation takes about an hour and a half. The instructions, unfortunately, are supplied on faded photocopies difficult to read. There are at least five serious errors, and the diagrams frequently don't match the text. For example, the instructions say to mount the power supply to the cabinet with the sticky tape on the bottom of the power supply; there wasn't any sticky tape on the bottom of the supply. You're supposed to install a long and a short mounting bracket, but they're both the same length. The cable diagrams are also incorrect. In spite of these errors, anyone with common sense can complete the installation.

There is one ambiguity in the instructions. This is with configuring the disk drive itself. The diagram in the instructions implies that the socket on the Tandon drive into which the shunt is placed has seven positions. Actually, there are spaces for eight.

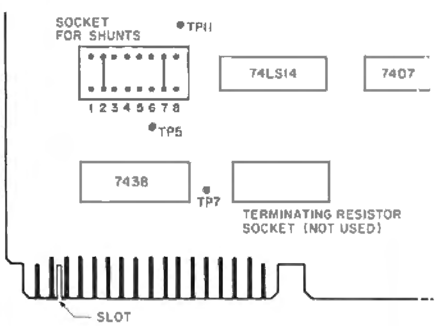

Figure 1

Figure 1 is a drawing of the drive board, showing how the connections are made. The connections shown are for drive zero, with shunts in positions 2 and 7, with all others open. Notice that no terminating resistors are plugged into the socket provided for them; they aren't required for internal drives. My dealer also cut the trace leading to pin 6 of the drive; according to Micro Mainframe's instructions, this isn't necessary, but the unit functions with or without the cut trace.

Photo 2 shows the completed installation. The drives fit well into the cutouts of the Model III, and nothing is force-fitted into place.

The system worked immediately. Data transfer to and from the drives seems to work well; I haven't encountered any disk errors. I've found one commercial program that refuses to load, though it loads on a Tandy controller. The program uses tricky encoding techniques, however, and may not be a fair test. All the Radio Shack software I have loads perfectly.

There is one serious drawback. No service manual is available for the unit, and no schematic diagram. Service is available for a $45 repair fee, but if you like to fix things yourself, you'll have to trace the circuit diagram on your own. Hopefully the company will change this troublesome policy as they gain experience. ■

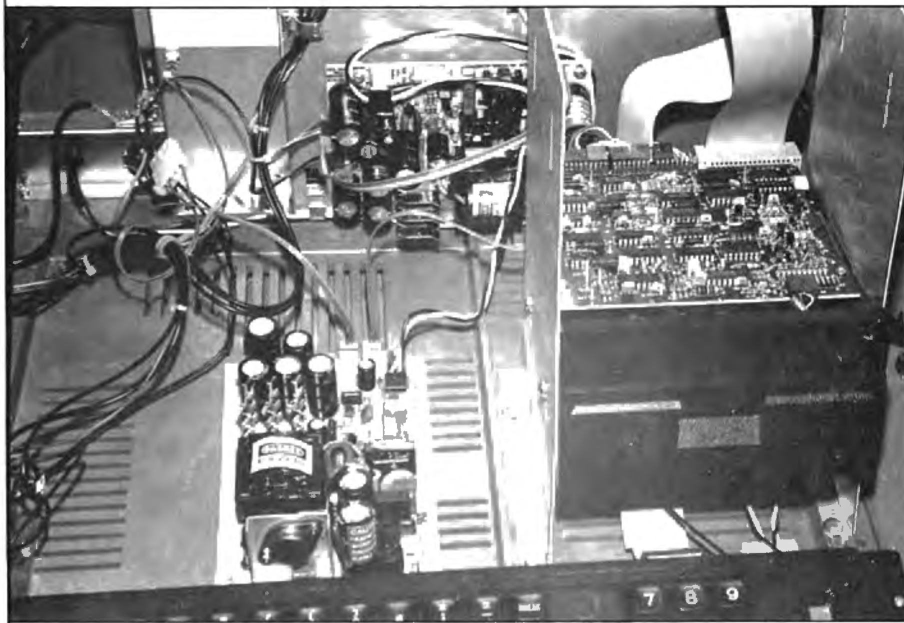

Photo 2. The Completed Installation.

★★★

Smith-Corona TP-1
Smith-Corona
65 Locust Ave.
New Canaan, CT 06840
$895

by Terry Kepner

Smith-Corona, best known for their high-quality, low-price typewriters, will soon become well known for their low-cost, high-quality computer printers. The TP-1 has a suggested retail price of $895, but I've seen it advertised in *80 Micro* for as low as $650, making it the cheapest letter-quality printer available.

What do you get for your $895? You get a well built, bare-bones, daisy-wheel printer. Most standard writing paper fits on the 13-inch paper carriage, but 15-inch computer paper won't. The actual writing line is 10.5 inches wide, giving you 105 printed characters with a 10-pitch printer, or 126 characters if you have the 12-pitch printer.

The line spacing can be set to 3, 4.5, or 6 lines per vertical inch, giving you 33, 49.5, or 66 lines per standard 11-inch-high paper. You can set the impression strength of the character-striking hammer to any one of five levels. The TP-1 supports the standard ASCII character set, but prints only 88 of them at the moment (the standard upper and lowercase alphabets, the numerals, and punctuation marks).

Special Features

The TP-1 has five special features: backspace, automatic underlining, programmable margins, programmable tab settings, and automatic forms control.

The backspace capability lets you overstrike a zero with a slash to differentiate zeros from the letter O, make boldface characters by backing up and restriking the same character, underline characters, or strike out characters.

There are two methods for underlining: using the backspace command to place the daisy wheel over the letter just typed, then typing an underline (recommended if you need only one letter underlined); or accessing the automatic underline feature, which underlines each character printed before moving the daisy wheel to the next print position.

The margins can be set by positioning the print head to the desired point and sending a hex 11 (decimal 17). Setting the right margin is similar, except you send a hex 13 (decimal 19). To clear a margin, position the print head and send a hex 18 (decimal 24). This feature means you can set the number of printed columns on your paper without having to use DOS Forms commands or a special machine-language program.

Similarly the tabs can be set and cleared using the hex codes 12 and 14, respectively.

The forms control is a front panel switch. In the normal position, the printer prints all 66 lines on a page. In the Forms position the printer prints 58 lines, then skips eight lines to the next page. This provides simple pagination for program listings and word-processing documents.

The TP-1 doesn't support proportional spacing, reverse line feeds, half line feeds, or reverse half line feeds. Incremental spacing isn't available; you can advance or reverse the daisy wheel in increments of one character only. Neither can you change the pitch you're using.

If you have a 10-cpi (characters per inch) printer, you can't change the print to 12 cpi. (You can put a 12-cpi daisy wheel on the 10-cpi printer, but you'll get only 10 characters printed per inch, which looks rather silly with a 12-cpi wheel.) The 10 cpi is equivalent to a pica typewriter and the 12-cpi printer is equivalent to an elite typewriter.

Compared with the more expensive daisy-wheel printers, the TP-1 seems slow, averaging 12 characters per second. (It sounds like a very fast typist at work.) Typing characters rarely used in English slows the unit down to about 10 cps, but typing more common characters, such as vowels, or repeating the same character lets the unit hit about 16 cps.

What are its advantages? It's inexpensive. It can be attached to almost any computer since it's available with either a standard Centronics parallel port or with an RS-232 port.

Setting the RS-232 port for stop bits is not required. The TP-1 will work with 1, 1½, or 2 stop bits; a 7 or 8-bit word length; and odd, even, or no parity. The data rate can be set to any one of 16 baud rates: 50, 75, 110, 134.5, 150, 300, 600, 1,200, 1,800, 2,000, 2,400, 3,600, 4,800, 7,200, 9,600, or 19,200.

Another advantage is that the inexpensive ribbons and print wheels are the same as those used on the Smith-

The TP-1

Corona Typetronic typewriter and are available through stores selling Smith-Corona electronic typewriters. The print wheels cost only $4.95. (Tandy's Daisy Wheel II's wheel costs $29.95.) One-time, 54,000-character, black-film ribbons retail for $2.95, and the TP-1 multistrike mylar ribbons cost $6.95, with a life of 250,000 characters. (Tandy's multistrike ribbons are three for $24.95.) The TP-1 can handle up to four-part forms. If you use NCR carbonless paper, you can use six-part forms.

And last but not least, the TP-1 is simple to use. When I received mine, the print wheel and ribbon were already in place. All I did was remove the packing foam and bands, plug in my printer cable, plug the printer into the electric socket, load the paper, and I was in business. The ribbon and print wheel are easily accessible and simple to change, and the manual is easy to understand. The TP-1 even includes a simple diagnostic routine that checks the motor every time you turn the printer on.

Disadvantages

At this moment there are two serious disadvantages to the TP-1. Because the print wheels were originally designed for the Typetronic typewriter they don't have the greater-than and less-than signs (left and right carets, <>). Since most Basic programs use the left and right carets in If... Then statements, this flaw practically eliminates the use of the TP-1 as a program-listing printer. I've been told by Daniel A. McCarthy, vice president of special markets at Smith-Corona, that ASCII print wheels will be available later this year.

The second problem is the lack of a tractor-feed mechanism for the printer. When running form-feed paper, what starts out as a nicely centered column on page one ends up printing on the left edge of the paper by page ten. Trying to print mailing labels was a complete disaster. I failed to print even one label with straight lines. This creeping also shows up in the vertical direction, but only if you're printing a few lines on each page with lots of repeating line feeds. McCarthy said he expects a tractor-feed mechanism to be available in the near future.

If you don't need proportional spacing or special features such as forward and reverse half line feeds that only more expensive printers can give you, consider the TP-1. It is an inexpensive letter-quality printer ideal for your personal correspondence or short documentation needs. ■

★★★★

Fast Basic
George and Thomas Gratzer
John Wiley Books
1 Wiley Drive
Somerset, NJ 08873
Softcover, 278 pp.
$14.95

by Bruce Powel Douglass

Fast Basic is a book on using machine-language subroutines to enhance TRS-80 Basic on the Models I and III. If you understand Basic, integers, floating point, and strings, this book should be easy to follow.

The book focuses on teaching you to let Basic do what Basic is good at—functions like I/O and floating-point computations. But tasks that Basic doesn't do so well, machine-language subroutines should handle.

Fast Basic assumes you understand Basic well enough to use PEEK, POKE, and print statements. Each chapter has a summary and self-help questions. The first chapter discusses the representation of data and programs in memory, including binary and hexadecimal numbers. A program called Tutor (also available on disk) allows you to look at the contents of any byte in memory and its binary or hex representation.

Chapter 2 takes a closer look at what's in memory and the various formats of Basic programs—how to PEEK and POKE to high addresses and the like. Chapter 3 discusses the organization of the TRS-80, as well as where and how Basic keeps the data tables, work areas, and address tables. The chapter has a table of addresses for reference and a procedure for merging non-ASCII files, checking for printer status, changing drivers, and so on, with some interesting examples. It also gives a program that tightens the TRON function, so it doesn't destroy the video screen.

"The approach taken in writing Basic programs in Fast Basic *is to first write them in a simplified form of Basic called Simple Basic."*

The book goes on to discuss how Basic operates, such as executing GOTOs, as well as recovering lost programs. The variable tables are discussed in detail, so you can get a variable out when you need it for *Fast Basic*. Chapter 5 talks about hardware, including devices, CPUs, and buses, with a tutorial on taking over the keyboard driver and programming other devices.

Chapter 6 begins the introduction to *Fast Basic* with the Z80 and its registers and how to perform a load of the registers or memory. This chapter also includes one of the simplest introductions to Z80 programming I have seen.

USR, ROM, and DOS calls are discussed next. The chapter covers software accumulators for integer, single, and double-precision numbers and gives addresses. Then it gives an in-depth look at ROM subroutines for the math routines, such as locating, moving, and performing manipulations on various formats of numbers.

The rest of the book discusses the implementation of various functions in machine language, mostly using the ROM calls. *Fast Basic* provides a benchmark program (a bubble sort) showing the Basic and *Fast Basic* versions, complete with comments.

The approach taken in writing Basic programs into *Fast Basic* is to first write them in a simplified form of Basic called Simple Basic. Then, translate this form into USR calls and machine code. The book gives three methods of storing the machine code in memory, including POKEs into reserved memory, packing into arrays or strings, and packing into remark lines.

The last chapter tells how to enhance *Fast Basic* to be even faster. It gives the Block Search and Move commands of the Z80 instruction set along with applications, and it demonstrates simple ways to set and reset the video graphics in machine language, as well as using the keyword jump table and how to take over the syntax-error routine to add commands directly to Basic.

The book also provides several appendices on entry points for a large number of ROM routines, the Z80 instruction set, and the source code for a few utility programs.

This book is well written and provides many useful techniques to enhance Basic programs. It contains much useful information on the organization of Basic, variable and work tables in the Basic environment, and how to properly enter and exit ROM subroutines. *Fast Basic* is well worth $14.95. ■

★ ★ ★ ½

Colorterm
Martin Consulting
94 Macalester Bay
Winnipeg, Manitoba
R3T 2X5 Canada
$34.95

by Scott L. Norman

Colorterm is a moderately priced cassette program that converts a 16 or 32K Color Computer into an intelligent terminal. It possesses an extremely important property: It lets you get "on the air" almost immediately by ignoring its advanced features. When used in this fashion, Colorterm is almost invisible, with no extensive set of commands to get in the way. Colorterm's advanced features can be learned at a later time. Be assured, this is a painless package to work with at almost any level of sophistication.

Bare-bones Features

Colorterm occupies less than 4,900 bytes of RAM, beginning at $1C00. It requires a high-resolution (6144 byte) video screen for the software-defined character set, one of its most distinctive features. The display memory employed starts at $400, so the Radio Shack disk system cannot be used in conjunction with the present version of the program.

That high-density character set featured in Colorterm's advertising gives you a true upper and lowercase display, 21 lines by either 51 or 64 characters (keyboard selectable). Lowercase characters have descenders. The 51-character display is somewhat less legible on my elderly black-and-white portable tv set than that used by my Telewriter word processor, even though the latter lacks descenders and crams 24 lines onto the screen. Colorterm uses the same characters for both line formats; spaces are just reduced for the higher-density display.

As you might expect, 64-character lines are a chore to read on any tv receiver that is very far out of alignment. This mode is usable with a well tuned set, though, and I am looking forward to using it with a wideband monitor and baseband video.

The normal Colorterm display is black on a green background. This can be reversed from the keyboard, although the legibility suffers a bit. This feature is useful for highlighting particular lines of text, such as operator instructions.

The Colorterm character set can be patched into other programs to dress up their output. The manual contains the details on calling several I/O subroutines from other Assembly-language programs; I assume that DEFUSR and USR calls would work from Basic. Martin Consulting makes the reasonable stipulation that you honor their copyright and restrict such applications to your own personal use.

"Be assured, this is a painless package to work with at almost any level. . ."

Operation

As far as the fundamentals of operation are concerned, Colorterm comes configured for the most common ASCII data format: 300 baud, 7 data bits per word, even parity, and 1 stop bit. This is the format employed by CompuServe and Telenet, and I presume that it suffices for The Source and other major services. More in line with my interests, it is supported by the IBM TSO (time-sharing option) installations.

Should your requirements be different, any of these parameters can be changed by loading (but not executing) Colorterm and then performing specific POKEs from Basic. The manual gives the relevant addresses, as well as the data for saving the modified program to tape. There is also a keyboard command for switching between full and half-duplex transmission; the default is half duplex.

Colorterm features auto-typing; if a key is held down for more than a second or so, it begins to repeat at a rapid rate. This function is also available for the four-way cursor control. The up, down, and left-arrow keys, together with the spacebar, are used to position the cursor, the right-arrow key being reserved as a special shift for Colorterm's advanced commands. A few keys are redefined when they are pressed at the same time as the regular shift.

Experimenters will quickly discover that there is a misprint in the Colorterm manual. The definitions of the shift, up-arrow and shift, down-arrow combinations are reversed. These give an underline and a left bracket, respectively. The underline is an independent character; it cannot actually be positioned under anything previously typed.

Advanced Features

When you're ready to use Colorterm, the right arrow gives you access to 18 predefined functions, each accessed by a single letter (upper or lowercase). In addition, you can define up to seven personalized functions using the arrow plus the letters T through Z; these functions generally take the form of ASCII control codes POKEd into the appropriate locations.

I have described the functions that I use most often in accessing an IBM 3033 mainframe via TSO, my principal application of Colorterm. To give you some idea of how broad my Color Computer's horizons have now become, since acquiring Colorterm I have written programs for the mainframe in IBM's VSBASIC, Pascal, and

Fortran IV, as well as using Script, an IBM text-processing package!

In logging onto TSO, you must supply an ID code, generally public knowledge, and a password, which is confidential. Colorterm's D (duplex change) function allows you to maintain confidentiality. Start your log-on procedure in the normal half-duplex mode, in which each character is echoed on the screen when it is sent to the host computer. Before entering the password, enter the right arrow and D together to switch to full duplex, and subsequent characters will not be displayed. This is a toggled command, so it should be used again after you have finished your password in order to make subsequent entries visible.

When not concerned with confidentiality, I generally send my entire log-on code (ID, password, account number, and desired workspace size) to the host as a predefined macro message; this takes two keystrokes. Colorterm has two buffers reserved for frequently used macros, each of which may be up to 128 characters long. The G command followed by the number of the buffer to be filled sets up the message-generation process; unfortunately, function commands such as right arrow, D cannot be embedded.

The M (macrosend) command, plus the buffer number, transmits the message when desired. Again, once you have customized Colorterm in this fashion you have to store it on tape and be sure to use the appropriate version in future work.

"One more interest is the ability to scroll through a mass of data down-loaded from the host to the Color Computer."

It is sometimes useful to preserve a window of data on the screen while the rest of the display scrolls. Colorterm allows you to do this at the top of the screen. The procedure is simple: Once you have the desired information in position, place the cursor at the beginning of the next line and enter the right arrow and P simultaneously. Everything from the cursor to the end of the screen is cleared and is subsequently used for the scrolling display, leaving your data in place.

Highlighting the preserved message with reverse video can be effective, too. To do this, you merely use the F (color flip) command before the P command. The F changes the entire display from normal to reversed video; the P changes everything in the scrolling portion of the display back to normal.

My TSO connection involves a local telephone call, so I am not normally concerned about the duration of my connection to the host. Since this is not the case for everyone using a time-sharing service, Colorterm allows you to compose a file of useful size off line and then upload it in one shot. Colorterm normally uses nearly all of memory above decimal 12055 as a buffer for incoming data; this input buffer can be limited to 512 bytes by the L command. Note, however, that a binary file of your own composition can be loaded above this buffer by a CLOADM command from Basic. This file can then be uploaded via the O (outsend) command. The file, which might have been prepared with an editor or text processor, can be about 3,500 bytes in length in a 16K computer, and nearly 20,000 bytes long in a 32K machine.

The whole process calls for close attention to loading offsets and addresses in general, a bit clumsy for my taste. You should be aware of the existence of this capability, though, because it is also employed in transmitting data from the buffer to a printer through the Color Computer's RS-232 port. To do this with any degree of grace requires a dual-port adaptor that allows both modem and printer to be hung on the port at once. The alternative is to switch connecting cables as needed, which can get a little frantic. None of this is Colorterm's fault but a limitation of the Color Computer.

One more interest is the ability to scroll through a mass of data down-loaded from the host to the Color Computer. You might want to receive data and go off line to examine it at your leisure, for example. Colorterm handles this easily. Before receiving the data, initialize the buffer with the right arrow, I command. Scrolling can be initiated with right arrow, S. The scrolling process starts at the beginning of the buffer, and can be interrupted and restarted in place by pressing any key; you may have to press a key several times in order to catch the attention of the keyboard scanning routine, however. Scrolling continues to the end of memory, or until the break key is pressed. Unfortunately, there is no provision for scrolling backwards.

All or part of the buffer can be saved to tape by returning to Basic with the reset button and executing a CSAVEM. Once again, the Colorterm manual contains the start, end, and transfer addresses for both 16 and 32K systems, as well as the PEEKs necessary to find the end of data in a partially filled buffer.

I have found Colorterm easy to use and quite flexible for my day-to-day requirements. It is moderately priced, and the text densities are high enough to allow doing some serious work. ■

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★ ★ ★ ★

Master Reversi
Instant Software Inc.
Peterborough, NH 03458
Models I and III
$29.95

★ ★ ★ ★ ½

Odin
Odesta Publishing
930 Pitner
Evanston, IL 60202
Models I and III
$34.95

by Bruce Powel Douglass

Master Reversi and Odin are two microcomputer versions of the popular board game Othello. The games, like Othello, are played on an 8-by-8 grid, similar to a chess board. Unlike chess, pieces are not moved after being set on the grid. Your object is to occupy territory by placing pieces on the board and trapping your opponent's pieces between them. Once trapped, an opponent's piece is flipped over reversing its color.

Master Reversi

Master Reversi requires a 32K Model I with one disk drive. It has nine skill levels, and an easy-to-understand manual. The game responds quickly up to the fourth or fifth level; but the response time increases for the higher levels, typical of heuristic, tree-searching algorithms. You can change the level of play at any time during the game. Master Reversi has a tournament clock and lets you play the computer or another person.

"Odin plays more competitively and beats me more often than Master Reversi. It doesn't, however, have the options found in Master Reversi. . ."

This game uses the arrow keys for positioning the flashing cursor. I prefer this to Odin's method, which uses numbers to choose the square. Options include taking back the previous move, forcing the computer (with the affectionate name Aldaron) to move immediately, displaying available commands, displaying legal moves, sending the current screen to a graphics or nongraphics printer, requesting advice, passing on your move, changing your name on the screen, toggling the flashing of the cursor, saving or recalling a game, and quitting. The nicest option is the output to the printer.

Master Reversi's thinking mode lets you see what Aldaron is thinking. What you see ranges from the last board positions, to the moves Aldaron is considering and how highly he values them. Aldaron also lets you set up possible board positions and analyze them. In fact, you can have five different board positions in memory at once. You can display or review the moves made during the game, either in standard Reversi notation or with the board itself.

Master Reversi's tournament mode is for serious players. In this mode, Aldaron thinks on your time, plays in accordance to tournament rules, and uses book openings. I prefer this mode.

Master Reversi plays a good game. Although its response time is slightly slower than Odin's, it is better than most Othello games I have seen.

Odin

Odin also requires a 32K Model I with a disk drive. Its well written manual includes a complete description of rules, history, and strategy. Interestingly, when you buy Odin you get a year's membership in the United States Othello Association and receive their quarterly magazine.

Odin automatically displays your possible legal moves when it is your turn and has a number of options, although not as many as Master Reversi. They include changing skill levels, changing sides during the game (with this option, Odin plays himself), starting a new game, displaying instructions, replaying the game, setting up new positions, a tutor mode, displaying the game record, taking back the last move, and an option called the principal variation.

The tutor mode displays all your moves, with Odin's opinion of their relative worth. This mode reflects Odin's opinion of the immediate situation without considering future moves, so it is of little help except to the novice. In the principal variation mode, Odin shows the move he thinks is best for you, what his counter move will be, and so on, for the number of moves equal to the depth of the search. Odin plays at levels 1–9, A–F, G, T, or X. The tournament level works only if you have a 3x speedup modification. Level B, however, plays approximately within the 25-minutes-per-player limit used in tournaments.

Odin plays more competitively and beats me more often than Master Reversi. It doesn't, however, have the options found in Master Reversi, and sorely lacks the printer-output option. I prefer Master Reversi's method of choosing squares for moves (moving the cursor with the arrow keys) to Odin's name-that-square approach. Both play a good, solid game and have ample skill levels to keep you busy for quite a while. ■

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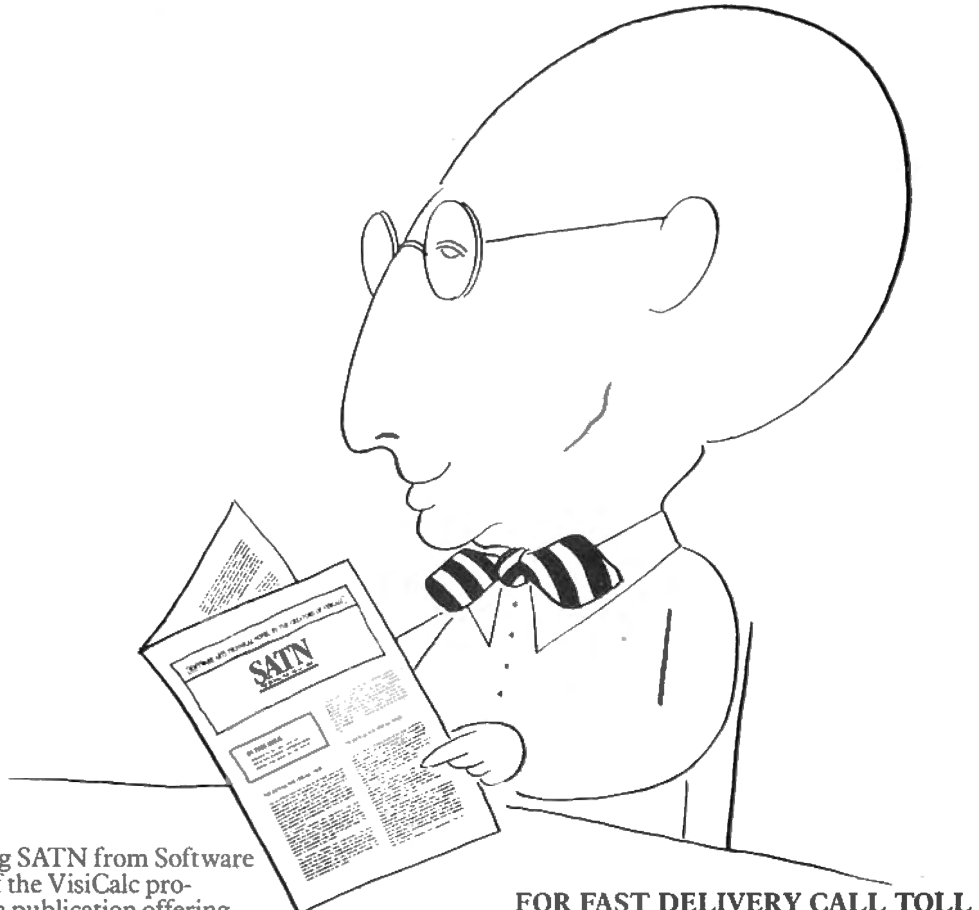

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★ ★ ★ ½

Spell 'N Fix
Star-Kits
P.O. Box 209
Mt. Kisco, NY 10549
$69.29 cassette or disk
$89.29 flex disk

by Scott Norman

Spell 'N Fix is a program for finding and correcting spelling errors in Color Computer text files. It compares each word with entries in a dictionary file, identifies words that do not appear there, and displays or prints them. You can mark suspect words for later correction in a new version of the text material, and you can customize the dictionary to reflect your vocabulary.

Spelling checkers are available for other computers, but to my knowledge Peter Stark of Star-Kits is the first to produce one for the Color Computer.

Spell 'N Fix is an adaptation of Magic Spell, a 6800-system program. It is unique in that it is also available in the Flex format; as devotees know, Color Computers with Radio Shack 32K conversions and fully functional 64K RAMs can be adapted to run under this popular operating system.

Spell 'N Fix operates on ASCII files, so it is compatible with most CC text processors. I have used it with Color Scripsit (using the print-to-tape option), CC Writer, Super Color Writer, and Telewriter. Telewriter doesn't produce ASCII material, but rather core-image (binary) files. Spell 'N Fix and the disk version of Telewriter include conversion programs to take care of the mismatch. I will frequently refer to tests with a particular Telewriter-generated text file.

I have used only the disk version of Spell 'N Fix. The cassette version is much less flexible, and I question its utility over the long haul; cassettes have too many restrictions for the kind of file shuffling that a program of this nature requires.

Preparing a File

My test file was just under 2,900 words (about 17,000 characters) long, typical of the material that I produce with my 32K machine.

I first converted my sample with BINCON, a Basic program included on the Spell 'N Fix disk. There is a syntax error in early versions of BINCON. Line 220 should be changed from NEXT I to NEXT S; this problem has been corrected in newer versions. When you run BINCON, it asks for the names of the original file and the ASCII output file. It then chomps away with the text scrolling by in a jerky fashion as conversion proceeds. The disk drive cuts in and out as segments of the ASCII file are built up.

BINCON is slow. It converted my file in just under 13 minutes. This seems to eliminate Spell 'N Fix from use with Telewriter. Fortunately, Cognitec's Howard Cohen has included CONVERT/XXX, his own machine-language conversion routine, with the Telewriter disk. This ran my file in 40 seconds. Convert can switch ASCII material back to core-image format, so Telewriter's output formatting can be used after spelling corrections have been made to an ASCII file.

Convert has one drawback: It leads off with a PCLEAR and Clear combination that upsets my computer's version 1.0 Basic ROMs. The solution is to issue the commands from the keyboard, and delete them from Convert itself.

Running Spell 'N Fix

Spell 'N Fix is easy to run, although there are many options to declare. It is a rather chatty program, with lots of screen prompts and an excellent manual to lead the user along. The disk contains nine files, but only three are involved in an elementary spelling correction run: SPELLFIX/BAS, the loader and interface program; SPELLFIX/BIN, the machine-language spelling checker; and DICT/DAT, the dictionary file, which contains just under 20,000 words in a special compressed format.

When you load SPELLFIX/BAS and try to run it, you get a syntax error. This may arise from a bug in Basic itself, according to Peter Stark. The fix is trivial: Enter a second Run command.

```
10 GOTO 100
20 GOTO 110
30 GOTO 20
```

Now the machine-language program is called, and you are presented with the first option, which is the use of a printer to record suspect words as you proceed.

Next, enter the text file name to be proofread. If you have a one-drive system, this is the first of several times you will have to switch disks (the text disk replaces the Spell 'N Fix disk). Things are more convenient for two-drive owners. Simply give the complete filespec (name/extension:drive) in response to each prompt for a file name.

Once the text file is located and opened, there is one more prompt—you are asked to specify the kinds of words that Spell 'N Fix is to examine. The choices are any group of characters (excluding certain punctuation marks) enclosed by spaces or carriage returns, or only what the program considers reasonable words. The latter is a more restrictive category, and is not as useful when first scanning text for errors. It may be useful, however, when adding new words to a customized dictionary.

Now Spell 'N Fix is ready to work. It reads the text file, constructing in memory an alphabetized list of all distinct words to be compared with the dictionary. This is the key to processing large files. English text is very redundant; the number of different words in a large sample is much smaller than the total number of words. The manual claims that Spell 'N Fix can handle files of up to 400,000 characters (about 70,000 words) in a 32K system. The program read my test file in about 1 minute, 50 seconds.

Next, Spell 'N Fix asks for the name of the dictionary file to be used; in the early going, this is DICT, the stock dictionary. You usually have to switch disks again. You are given the option of adding new words to the dictionary at this time. The program reads as much of the dictionary as fits into memory along with the list of distinct words, and when it has done so, it compares the two.

Words that do not match the dictionary are printed on the screen (and on the printer, if that option was chosen) in alphabetical order. The process is repeated in steps until all of the dictionary has been read and compared with the input text.

Several options are presented when the first misspelled word is encountered. You can ignore a given word, mark it for future correction, or mark all such findings in the remainder of

the text. The latter option is as close as Spell 'N Fix comes to fully automatic operation; using it, my file was processed in just under two minutes. The other options call for an operator decision every time a misspelling is detected. The decision to ignore such a finding is not always easy; the program recognizes specialized technical jargon, but proper names and control codes sometimes cause confusion.

Suppose you choose the M (mark as incorrect) option for at least some of the words flagged by Spell 'N Fix. When the entire dictionary has been read, you are asked whether you wish to create a new text file with such words either changed or marked. (The alternative is to quit the program entirely.) Assuming that you do want the new file, another disk switch is in order. Your original text file must be available, because Spell 'N Fix must reread it to properly locate the misspelled words in its alphabetized list.

If you have chosen the Mark option for the entire file, the program reads the old file and writes the new one alternately. This took just under three minutes for my sample. If you choose the Change option, it repeats the text up to and including the first marked word and then prompts you to enter the word correctly. This is repeated for every misspelling. The system returns to Basic when the last correction has been made.

If you examine a marked file, you find every misspelled word flagged by three asterisks. Unless you are a terrific speller, this provides a good reason not to push the limits of your computer's buffer capacity when composing your original material.

Operating Spell 'N Fix is not as cumbersome as it sounds. Here is a summary of the entire process for a one-drive system, assuming that an ASCII text file is available at the outset:

- Load Spell 'N Fix.
- Insert text file disk. Read in and process file.
- Insert Spell 'N Fix disk. Read in dictionary and prepare a list of misspellings.
- Insert text file disk. Reread original file and prepare a new one with errors changed or marked.

One step remains for Telewriter users at this point—conversion back to core-image format. Convert handled that job for me in less than 15 seconds for my sample. I was then able to use Telewriter's global editing feature to locate all strings of three asterisks to make the necessary corrections.

Customizing the Dictionary

The dictionary furnished with Spell 'N Fix contains not quite 20,000 words. This limit was originally chosen so there would be room for the user to construct a second customized copy on a dedicated dictionary disk.

Spell 'N Fix provides several ways to do this customization (with disks—cassette systems cannot have the required pair of files open simultaneously). Just before reading the dictionary file, it asks if you are going to build a new one. A Yes answer causes another pair of options to be available each time a misspelled word is detected in the source file. You may add the word to the dictionary as is, or add all flagged words. This gives you an easy way to merge a specialized vocabulary with the stock dictionary. Just construct a text file consisting of your specialized vocabulary (properly spelled), and run it against the Spell 'N Fix dictionary under the D (add all words) option.

You have to be careful with this to strike a balance between having an all-inclusive dictionary and keeping the running time down to acceptable levels. There is little point in loading the dictionary with words that will only be used in a single piece of writing.

It is also possible to construct a specialized dictionary from scratch with the D option. Again, you start with a file of properly spelled words, but this time you add it to a blank dictionary file. A blank dictionary contains one entry—12 up arrows, recognized by Spell 'N Fix as an end marker. The Spell 'N Fix disk includes a utility program, Build, that you can use to set up such a file.

Other Utilities

The Spell 'N Fix disk contains a number of utility programs. In addition to Build and BINCON, there are SAMPLE/DAT, a short piece of text used for teaching the system; LIST/BAS, which prints the contents of ASCII text files (after marking words, for instance); RESET/BAS, which flushes everything and returns the computer to its normal wake-up state; EXPAND/BAS, which converts the Spell 'N Fix dictionary from its normal compressed form to an expanded form in which it can be edited. This is the only way to remove words from the dictionary, but the manual points out that Expand may take several hours to perform the complete conversion.

How Does It Work?

The time Spell 'N Fix takes to process one of my files is not unreasonable, although its use on a single-drive system is unnerving. One solution is to copy my working dictionary onto each disk used for text files. This minimizes the disk swapping, at the cost of 31 or 32 grans per disk.

Spell 'N Fix does its job and adds a little more professionalism to Color Computer text processing. ■

We inadvertently printed an incorrect address for Compulink in the September review of Sooperspooler. The correct address is: Compulink, 1840 Industrial Circle, Longmont, CO 80501—Eds.

REVIEW DIGEST

edited by Janet Fiderio

Color Logo, Radio Shack, 32K Color Computer disk version, $99.

"The most interesting feature of Color Logo is its ability to create multiple (up to 255) turtles and have them send messages to each other. ...In general this looks like a nice Logo for children." *Byte*, August, p. 248.

Chextext, Apparat Inc., Denver, CO 80237, Model I or III, 32K, two disk drives, $59.95.

"Chextext runs smoothly and...efficiently. ...We would feel more comfortable...if we could see the word in context during review of the suspect word list. Any word encountered in which context might be a factor can be flagged, however, and examined in context during the correction process." *Desktop Computing*, September, p. 52.

Electric Webster, Cornucopia Software Inc., Walnut Creek, CA 94596, $80.50 TRSDOS standard, $149.50 CP/M standard.

"**Electric Webster** is a program that can mature and grow under your direction. It learns your words and helps you to use them. I am impressed with its responsiveness and features." *InfoWorld*, August 30, p. 36.

The UPI-3 Serial Interface, Model I, Binary Devices, Noblesville, IN 46060, $139.95.

"The interface is everything I expected and I am happier with this piece of hardware than any I have purchased for my TRS-80 Model I. Although the price may seem high, the product is excellent. Support from the manufacturer equals the excellence of the product. ...If you have the driver blues, the UPI-3 may be the best solution to your problem." *80 U.S.*, August, p. 101.

Space War, Spectral Associates, Tacoma, WA 98466, Color Computer, $21.95.

"Even if you spend a lot of time (not to mention money) mastering arcade games, you'll have to start from scratch when you pick up the joysticks of this new Spectral Associates game. ...I recommend it for two players, although one player could probably do all right with a little practice." *80 U.S.*, August, p. 104.

Basic Programmer's Notebook, Earl R. Savage, Howard W. Sams & Co. Inc., Indianapolis, IN 46206, $14.95.

"*The Basic Programmer's Notebook* is an excellent tool for people who want to learn shortcuts in programming to produce writing that is easier and, perhaps, even better than what they might write without using the book." *InfoWorld*, August 2, p. 15.

Basic Programs for Home and Financial Management, W.B. Goldsmith Jr., Prentice-Hall Inc., Englewood Cliffs, NJ 07632, 320 pp., hardcover $18.95, softcover $12.95.

"For anybody who might just need to computerize his entire home finances, this book provides a lengthy description of each program that includes background information, detailed documentation, and 'programming notes.' The writing is informal and simple enough for the near-beginner..." *Creative Computing*, September, p. 228.

Versafile, Radio Shack, Model I disk system, $29.95.

"What makes Versafile so unique is its versatility—its name is very appropriate. ...If you are looking for something that will make your computer more useful, Versafile from Radio Shack may be for you." *Creative Computing*, September, p. 69.

TRS-80 Graphics for the Model I and III, Byte Books, Peterborough, NH 03458, $12.95.

"*TRS-80 Graphics for the Model I and III* is an excellent introductory text to the field. Written in a breezy and generally conversational tone, this book, by authors David A. Kater and Susan J. Thomas, belongs on every TRS-80 owner's bookshelf. It's certainly the most fun computer book I've read in months." *80 U.S.*, September, p. 100.

The Basic Handbook, 2nd Edition, David Lien, CompuSoft Publishing, El Cajon, CA 92020, softcover $19.95.

"To the average TRS-80 owner, David Lien's name has become familiar. *The Basic Handbook, 2nd Edition*, will make it even more so. ...*The Basic Handbook* is an encyclopedia of the Basic language. It gives possible commands in alphabetical order with one or more pages devoted to what that command means." *80 U.S.*, September, p. 101.

Pascal Programs for Scientists and Engineers, Alan R. Miller, Sybex, Berkeley, CA 94710, paperback, 374 pp., $16.95.

"This book shows how far the microcomputer industry has come from its game-playing origins. ...The programs in the book are written in Standard Pascal; this has some advantages and some disadvantages. The programs can be used on any computer that has a Pascal implementation, but they can't take advantage of special features (such as graphics) which make some versions of the language so attractive." *Microcomputing*, September, p. 134.

At last count, more than a couple of million Americans owned personal computers. And that number is expected to triple by 1985.

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The Software Resource Book For Personal Computer Users

Micros in Medicine

by G. Michael Vose

A micro with a bedside manner? Read how the medical profession is using micros to diagnose, educate, and gather information.

When "Bones" McCoy, the chief medical officer on *Star Trek*'s Federation starship Enterprise, pulls a small tricorder sensor out of his pocket and scans the body of a fallen comrade to diagnose his injuries, he is using technology that doesn't exist today. But it may tomorrow.

The thrust of the engineering efforts in electronic design labs is to put more circuitry on a single silicon microchip. With each new breakthrough in microprocessor technology, the medical profession takes a step closer to the day when Dr. McCoy's tricorder will be a reality.

Of course, as Captain Kirk's good doctor has proven in times of interstellar crisis, technology will not replace the learned men of medicine nor will it make them infallible. But microprocessor technology can and will add to the tools the physician of tomorrow will use to cure the bodily ills of mankind.

Microcomputers are already making significant contributions to the practice of medicine. From streamlining the paperwork hassles in record keeping, to warning physicians of dangerous drug interaction, to interpreting the clinical measurements taken by other instruments, the microcomputer is a modern day Dr. McCoy. If you stir in a few projections about the future, you brew a mixture in which the practice of the medical arts may become one of the most significant applications of microcomputer technology.

Today's Medical Applications

Today, microcomputers are being used primarily to manage the vast amounts of information needed by a physician and his staff. Patient accounts, clinical histories, records of reactions to medications, scheduling of office and hospital visits, and billing must all be recorded for every patient. Every physician must also have access to the latest information about new treatments. All this constitutes an information explosion that micros can help manage.

But, doctors are also beginning to discover how computers can help in the clinical process. In the last few years, a new breed of physician has appeared—the physician programmer who identifies a clinical application and then writes a computer program for it. These physician programmers are adding a new dimension to their practices and are sharing these new tools and techniques with their colleagues.

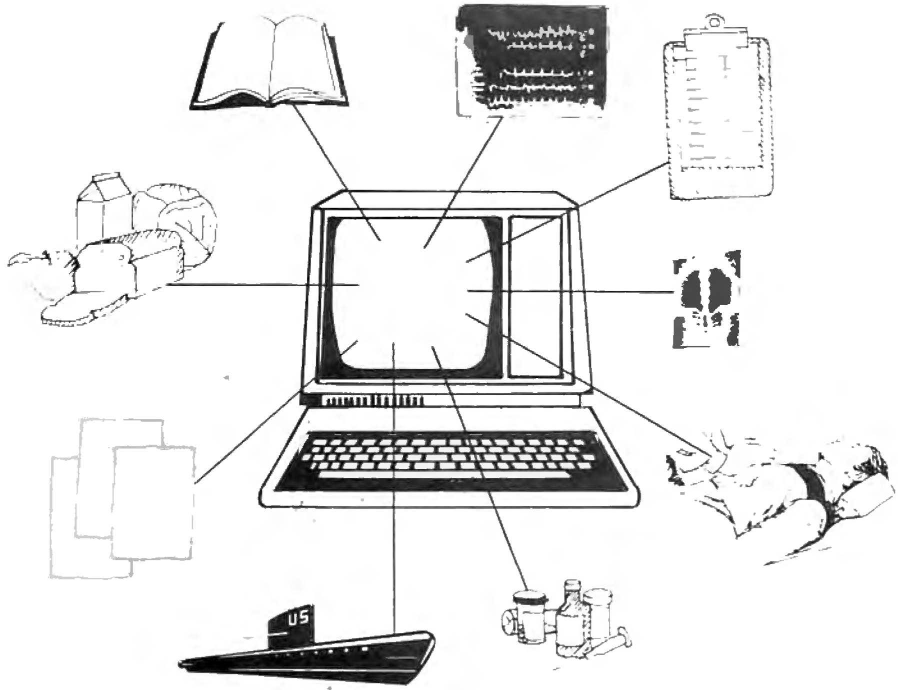
The staffs of the hospitals where these programming physicians work are also learning the new technologies. Increasingly, microcomputers are being used to help plan diets, analyze medical tests, and monitor patients in intensive care units. In many hospital applications, computers are being used by nurses, dieticians, and administrators.

Medical Micros

Many physicians are excited about microcomputers because of their accessibility, user friendliness, and ability to back up valuable data. Drs. Lee Blumenthal and John Waterson of the Department of Pediatrics and Communicable Diseases at the University of Michigan have chosen a TRS-80 microcomputer as the data-entry station for a data-base management system used on a mainframe computer. Data is entered into the TRS-80, saved on disk, and later sent to the mainframe computer by telephone modem. Blumenthal and Waterson say that this system is superior in many ways.

First, the computer is always available for data entry. Second, correcting errors is simple; in fact, the system in its entirety is easy to use as compared to the timeshared mainframe. And third, data can be transferred at night when the mainframe system is more readily available.

Availability is the major factor that has spurred the growing use of micro-



computers by the medical community. In the Cystic Fibrosis Clinic at Children's Hospital in Pittsburgh, PA, doctors and their young cystic fibrosis patients use a microcomputer to help them assess the caloric value, food variety, and vitamin C and vitamin A content of the patients' daily diets. The system not only provides specific information for clinical purposes but also educates the patients. Patients as young as 6 and 7 years old type in a list of the foods eaten in the most recent 24-hour period, and the computer calculates a score corresponding to the four categories. For each category, the computer displays a broad smile, a partial smile or a frown, depending on the scores calculated. Repetitive use of the system has improved the dietary consciousness of the children who have been exposed to it.

The University of Michigan developed a similar application, to help plan diets for diabetic patients. A dietician records a diet history for each patient, stores the information on a floppy disk, and then sends the data to a mainframe computer, where a special program writes menus based on each patient's special needs.

A LaJolla, CA, company sells software to perform nutritional analysis. Nutri-Comp Inc.'s program uses a data base of 616 food items to calculate the percentage of protein; fat; carbohydrates; cholesterol; alcohol; vitamins A, D, E, C, B1, B2, niacin, B6, B12, and folacin; and the minerals calcium, magnesium, phosphorous, zinc, sodium, and potassium for any given daily food intake. The program compares the daily percentages of these essential nutrients to the government's recommended daily allowance (RDA) and displays what percentage of the RDA for each nutrient the patient consumed that day.

Small Size—Big Capability

The small size of a microcomputer system makes it a versatile instrument in a clinical situation because it allows a doctor to perform tests that would otherwise require a special laboratory. At the Newark Beth Israel Medical Center in Newark, NJ, doctors use a microcomputer to perform pulmonary function tests—tests of the heart/lung machine at rest and during exercise. Using a microcomputer attached to monitoring devices via an analog-to-digital converter, the physician can do lung volume studies, single breath diffusion studies where the difference between the amount of particular gases inhaled and exhaled is calculated, and measurements of arterial blood gases. The system even has a remote unit, complete with its own terminal, connected to the microcomputer by acoustic modem. This setup makes it easy to perform tests on patients right in their hospital beds. (Scientists are using similar systems in biomechanical research —see the article about the Nike Shoe Company's research efforts on p. 188.

Microcomputers can help a physician solve immediate problems, as the Newark Beth Israel system shows, but the machines make their most significant contributions when they codify massive amounts of information. A Nashua, NH, surgical practice has developed a microcomputer data-base system to help surgeons review post-operative complications. After surgery, the surgeon prepares a report on any problems he met. The patient is monitored throughout post-operative recovery and any complications are recorded, as are any related treatments. Then, this information is added to the data base. Any surgeon may review the accumulated data at any time to anticipate potential problems with a particular surgical procedure.

One of the more serious problems in medicine is the possibility that two or more prescribed drugs will negatively interact. Compunet of Inglewood, CA, estimates that adverse reactions to drugs and combinations of drugs cause illness, death, and extended hospitalization to the tune of $4.5 billion a year.

With a tremendous variety of drugs available to the modern physician, this potential for adverse drug interaction becomes a serious information problem. A computer system that flags dangerous interactions can save physicians time and effort, not to mention patient suffering. One commercially available system, MedSafe from Compunet, uses a data base developed over four years from 4 million prescriptions written for 400,000 patients. In its first month of commercial use, it alerted doctors to five potentially lethal prescriptions.

Of course, the truly monumental information problem faced by medical practitioners is the amount of paperwork for every patient. Medical histories, records of past illness and treatment, insurance information, government records and financial statements, and in-house records are all part of the increasing crunch. A micro- or mini-computer is no longer a luxury in a physician's office, but a necessity to manage this record-keeping nightmare.

Many major software companies offer packages for managing the modern doctor's and dentist's office. The Medical Office System from Radio Shack enables a TRS-80 to produce insurance forms and bills, and keep a general ledger; it also provides a module to maintain clinical records for the small to medium-sized medical practice.

Body and Soul?

While the microcomputer helps many doctors in the office, laboratory, and pharmacy, it is also finding a place in the offices of psychiatrists and psychologists. Two midwestern researchers, Dr. David H. Gustafson and Bruce J. Tianen, have developed a microcomputer-based system for predicting the chance of death in a suicide attempt. The system was developed in conjunction with a study done for the University of Wisconsin's Departments of Psychiatry and Industrial Engineering. Using the data collected from clinical interviews of patients with emotional problems, the program evaluates the probability that the patient will attempt suicide and the probability that a suicide attempt will succeed.

The Wisconsin study recognizes that many emotionally disturbed people attempt suicide but subconsciously do not want to succeed. The program developed by the research team proved to be an accurate predictor of lethal suicide attempts when tested with historical profiles collected from several hospitals and clinics. The program may enable psychiatrists to identify potential suicides so that they can initiate therapy.

Dr. Myron L. Pulier of Teaneck, NJ, finds that a word processor is an invaluable tool in his psychiatric practice. Pulier records patient clinical information in a word processor-like Psychiatric Case Study file that is part of a commercial software package called Megatext (Megasoft Associates). The file contains all pertinent biographical information about a patient—the information can be entered by the psychiatrist, a nurse, or even the patient. After any therapy sessions, the file is updated to record the doctor's assessment of problems and treatment plans. The information can be printed out for hospital reports or third parties. Confidential information can be labeled so that it can be left out of printed reports.

In an ironic use of technology, the University of Minnesota has begun a program to help people who, alienated from one another in an increasingly isolated, technological society, have trouble interacting with other people. Learning to recognize and evaluate the facial expressions of others can help maintain domestic tranquility—so, one of the uses for the program is "husband-wife adjustment" (marriage counseling).

The Minnesota project, called ITT (Interpersonal Tracking Task), uses a video tape system and a microcomputer. Cameras record a patient's facial expressions during personal interactions. The participants type their reactions to questions about each situation into the computer. Then, the patient watches the video tapes of first himself and then his partner, and answers another series of questions posed on the computer screen. Finally, a therapist working with the patients compares and evaluates the two sets of responses.

The Computer as Stethoscope

At Texas Tech University, two medical researchers are using the microcomputer to help health care professionals treat patients in rural areas where frequent doctor visits are rare. When patients come to a clinic to be treated for a specific ailment, they are asked a battery of questions designed to discover secondary health problems. A micro

The Micro and the British Medical Profession

by Dr. Nicholas Robinson

Over the past year, general practitioners have shown a dramatic increase in interest in microcomputers and their use in family medicine. Increasing pressures from the computer industry, the government, and within the medical profession itself focus attention and increase confusion in the minds of the general practitioner.

Commercial pressures stem from the dozens of software and hardware firms in the market. The government has stepped in with the Information Technology Year 82 campaign, on which it has spent over a half million pounds. The campaign hopes to bring microchip technology into every aspect of modern life.

A special health section will be headed by Dr. John Dawson of the British Medical Association. Within the medical profession, General Practitioner User Groups, the Royal College of General Practitioners Working Party, the MEDIC Foundation, and the British Medical Association are all jostling for a say in what constitutes the proper use of computers in general practice.

What can a general practitioner gain from a computer in his surgery in terms of improved patient care and practice management? How can he best achieve these aims? Which equipment is most suitable for these purposes?

Before rushing out to buy a computer, the general practitioner needs to ask several basic questions about his practice: What does the practice do at present? How does it do it? How could it be improved? Would a computer make things better?

The computer can be applied to three main areas: practice management, communications, and patient management. Practice management and communications are simple applications (in terms of the size of machine needed and the financial commitment), whereas patient management is more complex because of the amount of information required.

Simple applications allow the gradual introduction of new ideas and working methods, thereby reducing staff hostility and relieving fears of redundancy. Practice management applications cover the less glamorous side of general practice, but let staffers use the machine almost immediately on installation. Typical among these applications are word processing, staff wages and salaries, rosters, practice accounts and financial modeling (using tools such as VisiCalc), and in dispensing practices, drug stock control and label printing.

Communications between a practice computer and the new videotext systems like Viewdata or Prestel are an area in which great progress has been made. Several drug companies have set up teaching packages, information services, and drug data bases that can be accessed free by medical Prestel users.

Currently this traffic is one-way, from source to recipient, but new developments will permit two-way traffic. This could allow a general practitioner to access drug data bases and send in "yellow-card" side-effects information. Drug research could be carried out more quickly and effectively. The computer would ease storage and transfer of information, and there-

Continues on page 78

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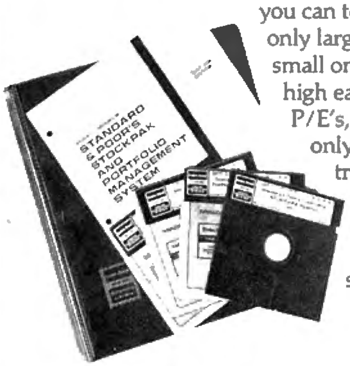

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analyzes the answers while the patient is being treated for the primary ailment, and the physician gets the results just before the office visit ends.

According to Blair Rowley and Dwane Anderson, developers of the system, the procedure discovered secondary health problems in 56 percent of the patients for whom complete data was collected. These secondary problems ranged from dental problems to heart disease, and over 50 percent of them would have required 1 to 12 months to discover using conventional diagnostic techniques. The Blair/Anderson system not only is an effective medical tool but saves time and money as well.

At Children's Hospital in Philadelphia, doctors are using a microcomputer as a teaching aid. The system, called CAMPS (Computer-Assisted Medical Problem Solving), teaches medical trainees the problem-solving approach to medical diagnosis and treatment. The student studies medical history information, physical examination results, and laboratory test results for a hypothetical patient and then asks the computer a number of questions before typing in his diagnosis. The diagnosis is compared to the correct answer and the student is graded. The student is evaluated not only on the basis of his final diagnosis but also on the questions asked and the reasoning involved.

Coming of Age

Can a computer help save someone's life? Computers can be valuable tools in the clinical and administrative setting. But can they make a difference in a crucial life or death situation?

Researchers at the University of California think so. They have developed a microcomputer "expert system" that can be used in hospital emergency rooms to help doctors analyze chest pain symptoms and quickly prescribe appropriate treatment.

Expert systems have evolved out of artificial intelligence research and use a rule-based, qualitative judgment approach to decision-making rather than numerical calculation. Using this system, UCLA computer scientists have created EMERGE to aid

Continued from page 76

by cut down on the phone bills.

"Post box" applications are also available; these facilitate rapid message transfer between subscribers. Hospitals are considering Viewdata computers for rapid access to bed states and discharge information.

Patient management applications revolve around repeat prescribing, records, patient recall, and audit. The general practitioner must decide whether the system should hold records on all patients or merely on selected groups. A system that holds only repeat prescriptions, children's vaccinations, and chronic-disease recall will clearly be smaller and cheaper than one that has complete records on every patient.

Finally, the general practitioner must consider how the records are to be input and the form they will take. Will the general practitioner type on a desktop VDU, or will he fill in a coding form for the secretary? Will he type, "Acute laryngitis," or code 2347? More importantly, for audit or screening purposes, disease definitions must be agreed upon; a survey into the incidence of tonsillitis is valueless if different partners have different definitions of the disease.

Hardware

The minimum system for a one or two-man practice management must be disk based. (A cassette-based system is slow and not as reliable.) A more fitting system for practice management, repeat prescribing and limited records would be a 48K or 64K double floppy-disk micro, a printer and some software. This kind of system would accommodate single users only, though the machines can be linked together to form a small network.

Larger practices require multi-terminal systems and hard-disk storage (10 megabytes plus). These machines allow full records, practice audit, screening facilities, and built-in drug interaction data bases. They cost from £8,000 to £20,000. ■

Dr. Robinson is a physician at The Residency at the Northwick Park Hospital, Harrow, Middlesex, UK.

emergency room diagnoses of chest pain symptoms.

When the patient arrives in the ER, the staff immediately enters information about his symptoms into the computer. The computer will examine the first symptom, make a decision on what further data is needed, and then ask only for other necessary data. Once the program has enough data, it will prescribe the required drugs and procedures. The program will also offer to display an explanation of its conclusions.

The advantages of this kind of system are many. The computer not only helps the physician confirm a diagnosis, but in emergency room situations —where the doctor on call is often not an internal medicine specialist—it can be instrumental in making the correct diagnosis.

When it comes to making a diagnosis, there is no more difficult a place than 300 feet below the surface of the ocean. Thanks to a Tektronix microcomputer, however, this task will be easier for hospital corpsmen aboard the U.S. Navy's fleet of nuclear submarines. The Navy uses these computers, when they are not being used to plot the trajectory of nuclear warhead missiles, to aid corpsmen in making health care decisions. In wartime in a submarine under attack, this technology could help to save a life.

"Can the tricorder be far behind?"

The Microcomputer as Dr. McCoy

In the *Star Trek* television series, millions of Americans became accustomed to seeing a patient's vital signs displayed graphically on a screen above the examination table in Dr. McCoy's sick bay. At the National Institute for Health in Bethesda, MD, a microcomputer is being used to produce such graphs. The system displays a variety of important data in single or multiple data representations. Temperature, pulse, respiration, and blood pressure can be shown on one graph for minutes, hours, or days, according to the needs of the physician. Other vital signs and laboratory data, such as blood leukocyte, hemoglobin, and platelet counts, can also be graphed. These graphs can be displayed on the microcomputer's screen or can be printed out.

Can the tricorder be far behind?

Tomorrow

Medical research is on the verge of dramatic breakthroughs in the field of noninvasive techniques for examining internal bodily organs and tissues. Ultra-sound and laser-light technologies may bring Dr. McCoy's tricorder into the clinic sooner than any of us could have imagined five years ago.

The practice of medicine in the 20th century has been a microcosm of the explosive growth of scientific knowledge and engineering expertise in our culture. It is unquestionably moving in the direction of the science fiction dreamers of yesterday. The reality of tomorrow's medical tools will likely be even more dramatic than any one person's dreams. After all, the goal is noble—making life as long and comfortable for humankind as possible.

There can be no question that microcomputers will help to make it happen. ■

G. Michael Vose is a technical editor for 80 Micro.

The Color Computer on Parade—Part II

by William Barden, Jr.

In this segment, author Barden explains the Line, Circle, Draw, Paint, Get and Put commands, as well as how to change the VDG.

Line, Circle, Draw and Paint are powerful Extended Color Basic graphics commands. Line is a misnomer. It should be called, in a rush of breath, "LINEBOXFILLEDINBOX." Line will draw a line between any two points of any angle and length, as in

```
100 LINE (X1,Y1)-(X2,Y2),PSET
```

which draws the line in the foreground color.

Line should impress those who have tried to implement a line routine in Assembly language. My tests indicate that the average line is drawn in about 96 milliseconds and that the worst case is about 192 milliseconds, about 20 times faster than the fastest Basic line drawing routine.

Line will also draw a box (rectangle) outline. In this case the two coordinates specify the opposing corners of the box. Line can also draw a filled-in box at speeds comparable to drawing four lines. The filled-in box (foreground color is used) takes slightly longer, over one second for large boxes.

Circle

Circle, the next Extended Color Basic command, was originally named CIRCLEELLIPSEARC, as it draws circles, ellipses, and arcs of circles or ellipses, as shown in Fig. 1.

The center must be within screen boundaries; this prevents all arcs from being drawn; an arc close to the edge of the screen, for example, is not possible, as the center of the circle or ellipse on which it lies is outside of screen boundaries, as shown in Fig. 2.

Draw

The next Extended Basic command is Draw. It draws a series of line segments of any length in multiples of 45 degrees, as shown in Fig. 3. In addition Draw will position the cursor to a specific spot on the screen, change the color of the line segment, rotate a figure in 90 degree increments, execute a substring, and change the scale of the lines to be drawn.

To draw the letter M, follow the code in Fig. 4. In the code, the color is changed for different line segments with the C subcommand.

To rotate the M through 90 degrees, add an A (angle) subcommand as part of the string before the Draw string, as shown in Fig. 5.

To change the size of the M, add an S (scale) subcommand before the Draw string, as shown in Fig. 6. You can change the scale factor from 1/4 to

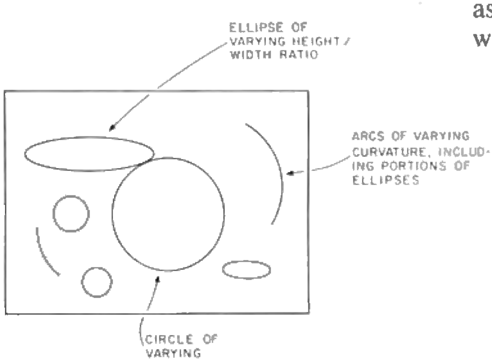

Fig. 1. Circle Action

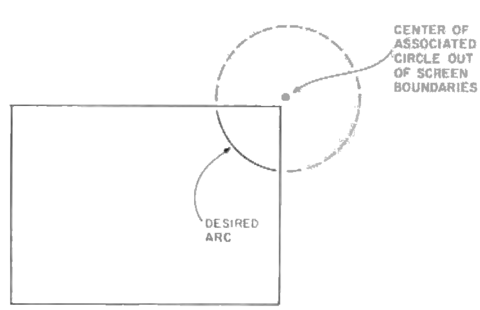

Fig. 2. Undrawable Arc

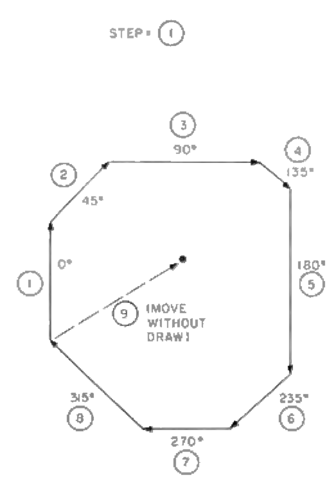

Fig. 3. Draw Line Segment Action

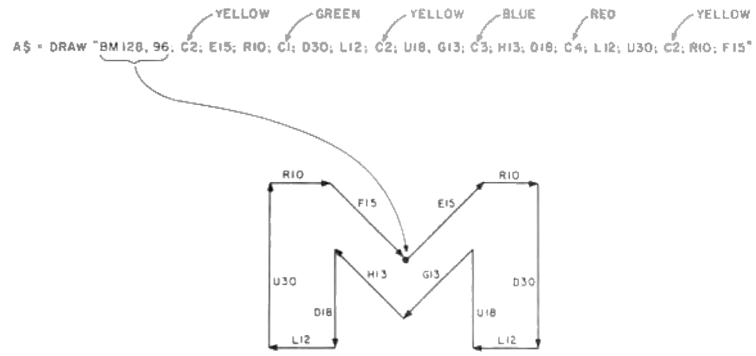

Fig. 4. Use of the Draw Command

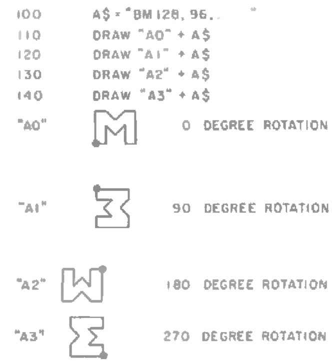

Fig. 5. Rotation of Figures Using Draw

62/4 of the original size. This can be an advantage in generating all types of figures that change size.

Probably the most powerful feature of Draw is its ability to execute substrings. We could define figure 1 as string A$, figure 2 as string B$, and figure 3 as string C$. A fourth string could then execute (by the X subcommand) the other strings to build composite figures, as shown in Fig. 7.

You can use Draw for applications such as defining different character sets for the Color Computer. With 256 pixels across the screen and 192 down, you can see how characters representing Greek, Latin, Kata-Kana or others could be defined by working with matrices of 8 by 12 pixels (32 characters by 16 lines) or larger matrices.

Paint

The Paint command is well-named. Instead of drawing a figure, it paints an existing figure, as shown in Fig. 8. The command specifies a starting coordinate, a color to be painted, and a boundary color. The color to be painted fills the entire area until the boundary color is encountered. Paint is a convenient way to draw a figure with the outline commands such as Line, Circle, and Draw, and then to fill in the figures with color.

Get and Put

The last and most complicated commands are Get and Put. Put takes a portion of a graphics screen and stores it into a two-dimensional array. Later Get retrieves the information from the array and reconstructs the segment elsewhere on the screen. This can be done rapidly enough for moving large figures for animation. Figure 9 demonstrates the process.

Get and Put are ideal for animation or for saving blocks of graphics which you can later call to construct composite figures. Since the number of arrays is limited only by RAM, you can

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have many different graphics blocks stored and available for display. The blocks could represent characters or a set of predefined figures. You could draw a logic diagram using one Put array as an AND gate, one as an OR gate, one as a NAND gate, and so forth.

```
100  A$="BM128,96, "
110  DRAW "S4"+A$
120  DRAW "S16"+A$
130  DRAW "S48"+A$
```

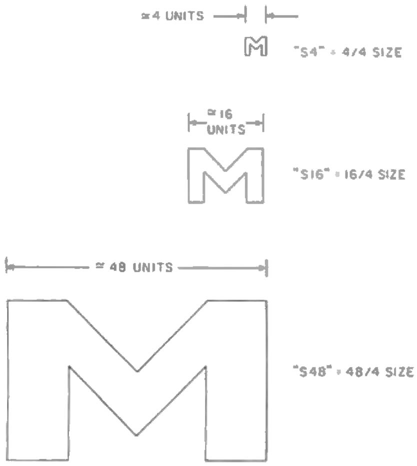

Fig. 6. Scaling with the Draw Command

Although Radio Shack documentation implies that the array must be the same size as the graphics block, thus eating up huge chunks of RAM, you can make the array smaller. A one-by-n array in the form AR(0,N), where N is determined by the method as shown in Fig. 10, can create much larger Get/Put areas in less space. Thanks to James Garon for this one.

Graphics Architecture

Figure 11 is a simplified diagram of the Color Computer graphics logic. You'll find a complete diagram in the Color Computer service manual.

The heart of the text and graphics generation is the Video Display Generator chip, the Motorola MC6847. This chip inputs RAM memory data from either the text or graphics page, converts it to a dot pattern of text or graphics, and outputs it to a color television via a video mixer chip and rf modulator.

The VDG is addressed indirectly, receiving its control signal from a Peripheral Interface Adapter (PIA) and a Synchronous Address Multiplexor (SAM) chip. These control signals determine the graphics mode. Data from RAM is received from eight additional inputs.

The SAM synchronizes all Color Computer system timing. It takes the master clock frequency and generates timing signals that control video display and refresh of the dynamic RAMs. It also acts as an address decoder that selects and enables ROM, RAM, or PIAs.

The SAM chip is set by a somewhat unique scheme, as shown in Fig. 12. Addressing locations $FFC0–$FFDF control SAM bits for map, type, memory size, CPU rate, page 1, display offset, and VDG mode. The only two fields that will concern us for graphics are display offset and VDG mode.

Even-numbered addresses for the SAM reset a SAM bit; odd-numbered addresses set a SAM bit. No actual zero or one is passed over data lines; the addressing action itself does the set or reset. The addressing can be done by a POKE (say, POKE $FFC0,0 to reset V0) or by an Assembly language store (STA $FFC0).

PIAs are general purpose input/output (I/O) devices that interface between the 6809E CPU and system internal devices or the outside world, such as cassette inputs and outputs. The PIAs used in the Color Computer have two sets of eight lines that you may program as inputs or outputs. Four additional lines control special functions. The PIA used with color graphics is a PIA with an address of $FF22.

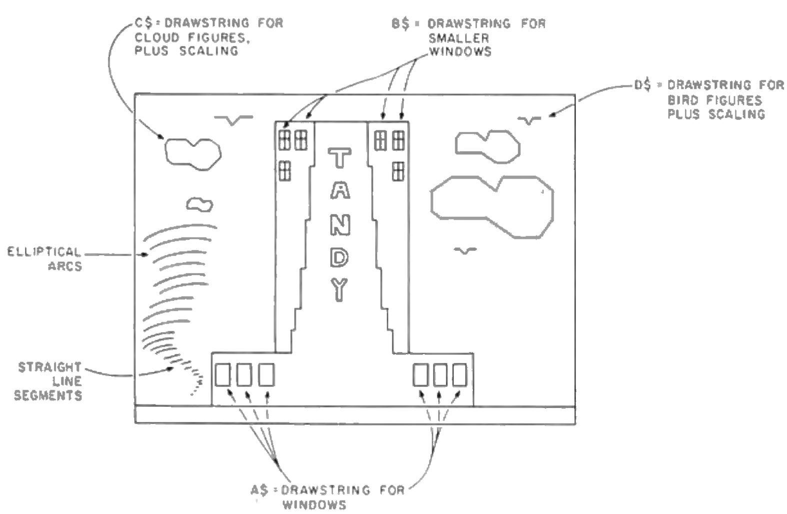

Fig. 7. Substring Use in Draw

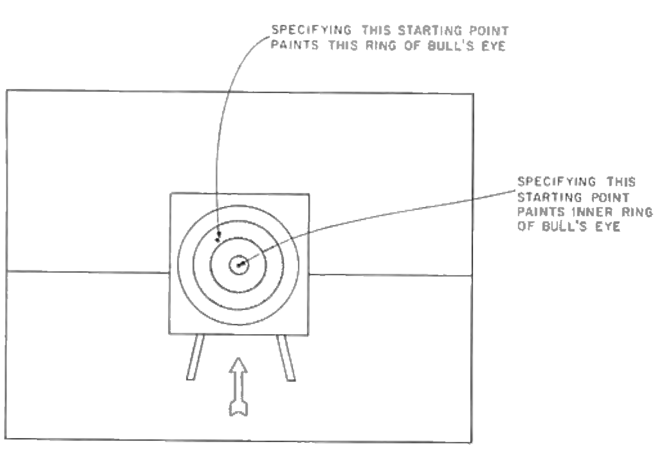

Fig. 8. Paint Command Use

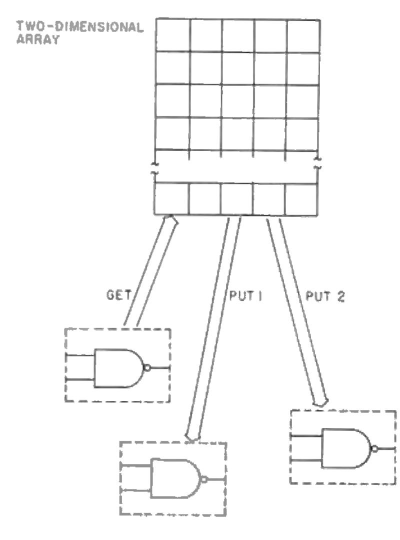

Fig. 9. Get/Put Action

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To output data to the graphics PIA at $FF22, you must execute a POKE or Assembly language instruction. The normal sequence, however, is to leave the bits used for other functions in the PIA undisturbed. In Basic use

```
100  A=(PEEK(&HFF22) AND 7)
```

```
110  POKE $FF22, (X*8 OR A)
```

where X is a value of 0–31 that corresponds to a VDG control value.

Changing the Display Offset

The display offset in the SAM determines which part of RAM will appear on the screen. If an alphanumeric mode is in force (by V2 = V1 = V0 = 0), then the display will be 512 bytes of a text page. If a graphics mode is in force, then the display will be the appropriate number of bytes of the graphic page. The Basic interpreter stores the proper address in the SAM depending upon the Screen command, the graphics page selected by PMODE, and the command mode or execution—command mode always returns to the text mode.

You can select any memory starting

```
100 PMODE 3,1
110 GET (42,42)-(106,106),A,G
```

Steps:

- Find Elements in GET:

$$\begin{array}{rr} 106 & 106 \\ -42 & -42 \\ \hline 64 & 64 \\ +1 & +1 \\ \hline 65 \;* & 65 \end{array} = 4225 \text{ elements}$$

- Find divisor D:

PMODE	"G" or not "G"	Divisor	
0	"G"	32	
1 or 2	"G"	16	
3 or 4	"G"	8	—This Example
0	Not "G"	32	
1 or 2	Not "G"	8	
3 or 4	Not "G"	16	

- Divide the number of elements by divisor D:
  4225/8 = 528⅛
- Round up the result:
  528⅛ rounded up = 529
- Find DIM by dividing result by 5, rounding up (5 is the number of bytes in array entry):
  529/5 = 105⅘, rounded up is 106
- Establish the array
  DIM AR(0,106)

The first dimension is always zero. The second dimension is from the result.

Fig. 10. Calculating Get/Put Array Size

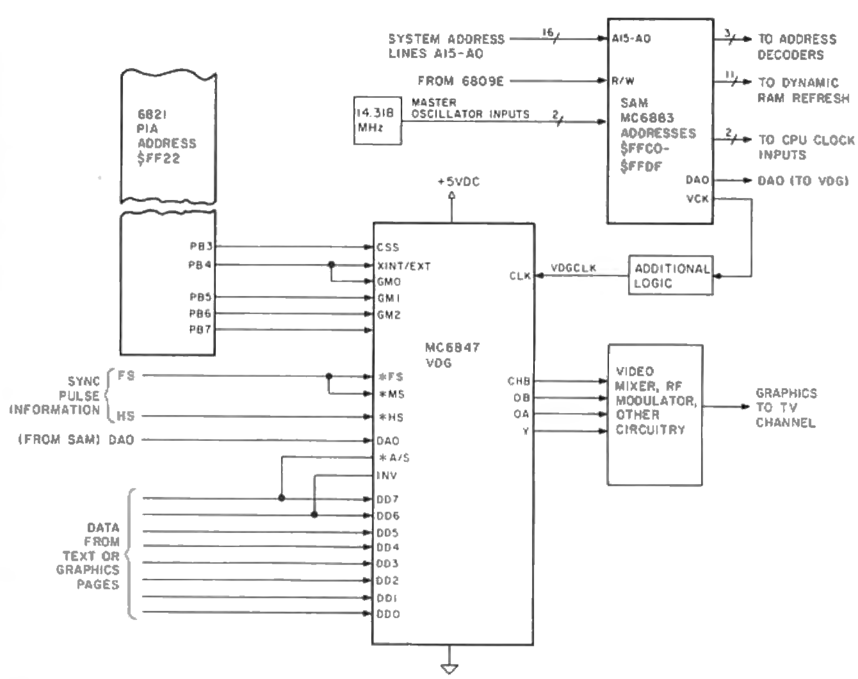

Fig. 11. Simplified Block Diagram of Graphics Logic

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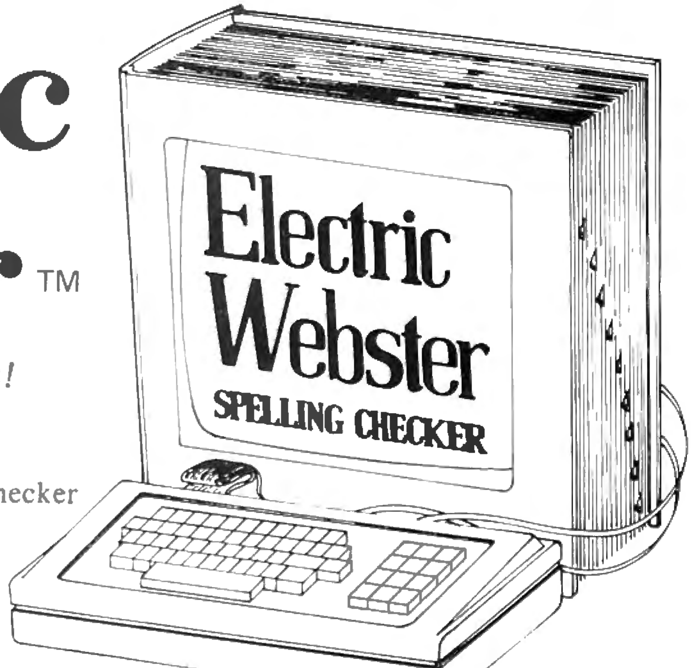

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address on 512-byte boundaries ($0000, $0200, $0400, and so on) by POKEing into locations $FFC6–$FFD3, as shown in Table 1. If you do this in the text mode, you can see any area of RAM or ROM displayed in color. The most interesting area is in page 0 ($0000), which shows the changing working variables in Basic. Color debugging!

You can change this starting address dynamically to display different graphics areas even if you do not have Extended Color Basic.

Setting the VDG Modes

You can bypass the Basic interpreter to set the VDG modes by POKEs from Basic or your own Assembly language program. You can then set some of the unimplemented VDG modes to see what they look like and implement all VDG modes even with only Color Basic.

POKE Addresses
POKEing into odd location sets bit, into even location resets bit

	FFD3,2	FFD1,0	FFCF,E	FFCD,C	FFCB,A	FFC9,8	FFC7,6	Starting Display Address Hex	Decimal
Seven most-	0	0	0	0	0	0	0	$0000	0
significant	0	0	0	0	0	0	1	$0200	512
bits of the	0	0	0	0	0	1	0	$0400	1024
display	0	0	0	0	0	1	1	$0600	1536
offset	0	0	0	0	1	0	0	$0800	2048
on the SAM	0	0	0	0	1	0	1	$0A00	2560
chip	0	0	0	0	1	1	1	$0C00	3072
			....					..	..
			....					..	..
	1	1	1	1	1	1	1	$FE00	65024

The following program will set the starting display address to $0600. The value POKEd in does not matter; the simple act of loading the location sets or resets a bit on the display offset.

```
10  'Reset first 5 bits
20  POKE &HFFD2,0:POKE &HFFD0,0:POKE &HFFCE,0:POKE &HFFCC,0:
    POKE&HFFCA,0
30  'Set last two bits
40  POKE &HFFC9,1:POKE &HFFC7,1
```

Table 1. Video RAM Starting Address

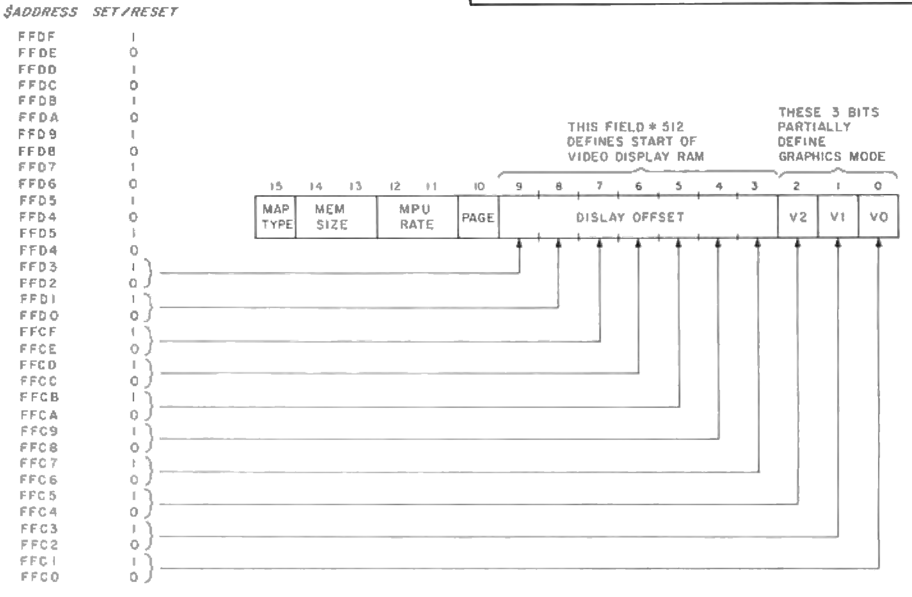

Fig. 12. SAM Control Bits

The three SAM outputs and five PIA $FF22 bits control the VDG modes (see Table 2). In addition, in some modes the most significant bit of the RAM byte determines whether the data is text or graphics.

To set any mode, output the proper configuration to the SAM by POKEing into addresses $FFC0–$FFC5 as described above. Next, set the five PIA bits, carefully retaining the least significant three bits. In some cases, bit 3 of the PIA determines the color set, 0 or 1. You should see the data on the screen change to represent the mapping, colors, and area of the VDG

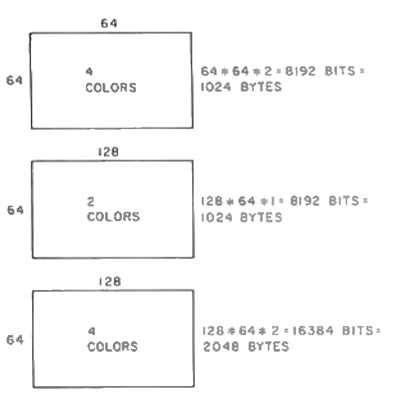

Fig. 13. Unimplemented Graphics Modes

SAM Bits V2	V1	V0	PIA $FF22 Bits 7	6	5	4	3	Data Bits 7	6	Mode
0	0	0	0	X	X	0	C	0	0	Alphanumeric
0	0	0	0	X	X	0	C	0	1	Alphanumeric inverted
0	0	0	0	X	X	0	X	1	X	Semigraphics-4
0	0	0	0	X	X	1	C	1	X	Semigraphics-6
0	1	0	0	X	X	0	X	1	X	Semigraphics-8
1	0	0	0	X	X	0	X	1	X	Semigraphics-12
1	1	0	0	X	X	0	X	1	X	Semigraphics-24
0	0	1	1	0	0	0	C	X	X	64X64, 4 Color
0	0	1	1	0	0	1	C	X	X	128X64, 2 Color
0	1	0	1	0	1	0	C	X	X	128X64, 4 Color
0	1	1	1	0	1	1	C	X	X	128X96, 2 Color
1	0	0	1	1	0	0	C	X	X	128X96, 4 Color
1	0	1	1	1	0	1	C	X	X	128X192, 2 Color
1	1	0	1	1	1	0	C	X	X	128X192, 4 Color
1	1	0	1	1	1	1	C	X	X	256X192, 2 Color
Set these by reference to Fig. 12.			Retain bits 2-0!					These bits are from data in video RAM.		X = Don't care C = Color set, 0 or 1

Table 2. VDG Mode Control

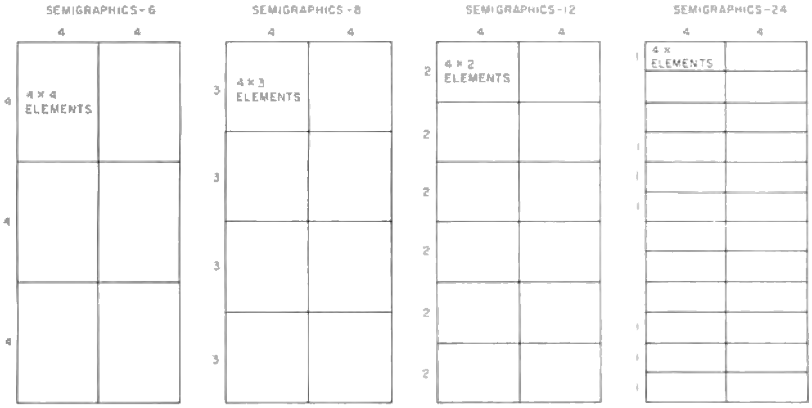

Fig. 14. Semigraphics 6, 8, 12 and 24 Character Position

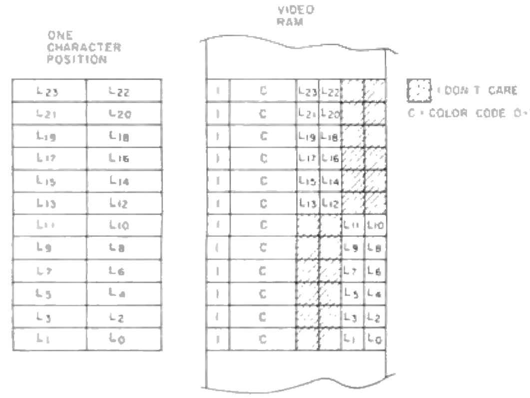

Fig. 18. Semigraphics 24 Mapping

mode you have set.

Semigraphics 24 Mode

The three unimplemented true (not Semigraphics) modes are 64 by 64 in four colors, 128 by 64 in two colors, and 128 by 64 in four colors, as shown in Fig. 13. These use the same memory mapping as the other graphics modes and are simply lower resolution modes that save memory. I don't think that we're missing much by not having these modes included as part of the Extended Color Basic. You be the judge.

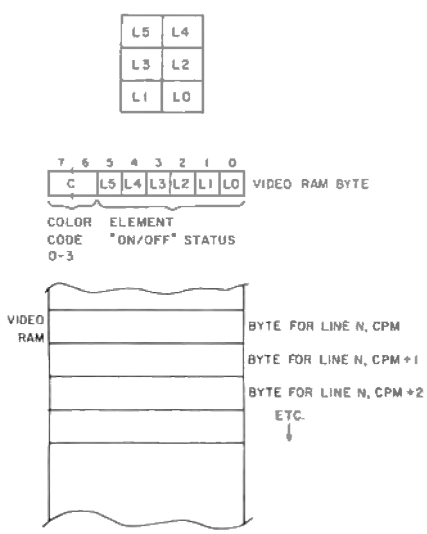

Fig. 15. Semigraphics 6 Mapping

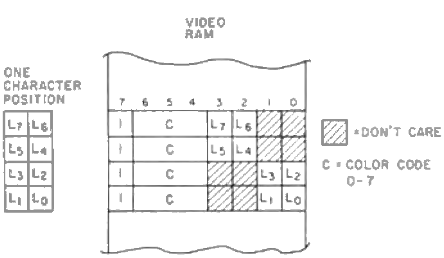

Fig. 16. Semigraphics 8 Mapping

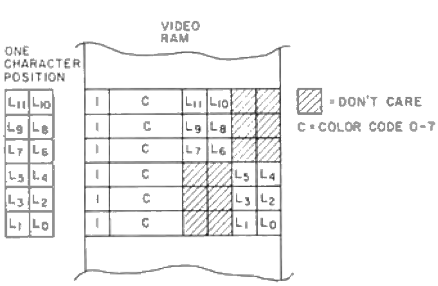

Fig. 17. Semigraphics 12 Mapping

Semigraphics 6, 8, 12 and 24 Modes

If you loved the graphics mapping of the TRS-80 Model I/III, you will be ecstatic over the Semigraphics 6, 8, 12 and 24 modes. These modes offer two things: many colors and horrendous memory mapping.

The 6, 8, 12 and 24 suffix comes from the number of elements into which each character position is divided. The basic character position is 8 by 12 pixels; the 6, 8, 12 and 24 modes divide this basic unit into two columns of 3, 4, 6 or 12 rows (see Fig. 14).

The Semigraphics 6 mode is the easiest. There are two colors in this mode, controlled by the two most significant bits in each memory byte. The six elements of the character position are turned on or off to this color by a 0 or 1 bit in the remaining six bits of the RAM byte (see Fig. 15). Thus each consecutive byte in RAM controls one entire pixel position. A total of 512 bytes therefore control the display.

The Semigraphics 8 mode is a little harder. It has eight colors; each row is color programmable, as Fig. 16 shows. The remaining halves of the four bytes control the on/off status of the elements. This mode requires four consecutive bytes in RAM to control one character position, making the total number of required bytes 2048.

The Semigraphics 12 mode is harder still. Colors in each row are controlled by three bits in six bytes as shown in Fig. 17. The remaining halves of the bytes control the on/off status of the elements. This mode requires six consecutive bytes in RAM to control one character position, for a total of 512*6 or 3072 bytes.

The Semigraphics 24, or the "Jumbo" mode, is shown in Fig. 18. Here again, color for each row is controlled by a separate byte, with the remaining portion of the byte controlling the on/off status.

The Semigraphics 6, 8, 12 and 24 suffer from lack of horizontal resolution. Resolution is only 64 elements, and each set of two must be the same color. On the other hand, they offer eight colors in 12,288 pixels, which you will not find in the other graphics modes.

A complicated algorithm sets or resets each element. Remember that you are working outside of the bounds of the Basic interpreter and will have to calculate the RAM byte and bit for each element. This will slow down the display operations. These modes would be most useful for Assembly language subroutines where the set/reset action could be done at acceptable rates.

Where Do You Go From Here?

There is great potential in Extended Color Basic programs thanks to the high-speed graphics commands. For real-time displays, consider Assembly language graphics. You could generate games programs to rival any arcade game with a moderate amount of blood, sweat and numb typing fingers. (Just don't poach on my territory when you write your Great American Game—*I'm* doing "Tandy Tornado!") ■

William Barden Jr., (28122 Orsola, Mission Viejo, CA 92692), former "80 Assembly Line" columnist, has over 20 years programming experience.

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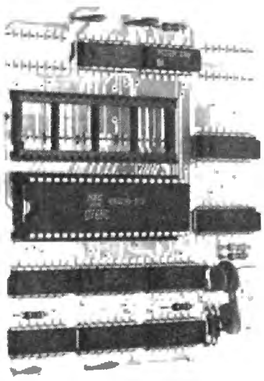

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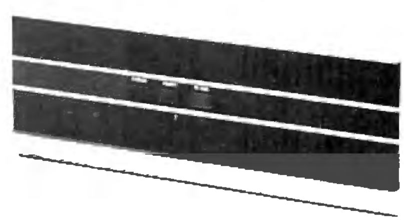

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Program Listing

```
10 REM"PROGRAM NAME (MEDHIST - VERSION 1.1 - 12/81)
20 REM"MIGUEL DIAZ  :  P.O. BOX 8475  :  PONCE, P.R.
30 REM"PROGRAM INITIALIZATION
40 CLEAR15000:DEFINTB-Z:Q$=CHR$(13):M$="######.##-":Z$=CHR$(191)
50 A$(1)=" 1. ENTER VACCINATION DATA":B$(1)="VACCINATION"
60 A$(2)=" 2. ENTER PEDIATRIST VISIT":B$(2)="PEDIATRIST"
70 A$(3)=" 3. HOSPITALIZATION DATA":B$(3)="HOSPITALIZATION"
80 A$(4)=" 4. HOME-STAY-ILLNESS DATA":B$(4)="HOME-STAY"
90 A$(5)=" 5. AMBULATORY-CARE DATA":B$(5)="AMBULATORY"
100 A$(6)=" 6. SELECTIVE FIELD DISPLAY"
110 A$(7)=" 7. PRINT COST-DATA SUMMARY"
120 A$(8)=" 8. PRINT HISTORICAL RECORD"
130 A$(9)=" 9. EXIT PROGRAM"
140 REM"DISPLAY PROGRAM MENU"
150 CLS:PRINTCHR$(23)" *** - PROGRAM SELECTOR - ***"
160 PRINTSTRING$(31,176):PRINTZ$;TAB(30)Z$
170 FORL=1TO9:PRINTZ$;A$(L);TAB(30)Z$:NEXTL
180 PRINTSTRING$(31,131)
190 LINEINPUT"      ENTER YOUR OPTION > ";A$:IFA$=""THEN150
200 Z=ASC(A$)-48:IFZ<1ORZ>9THEN150ELSEIFZ=9THEN1090
210 IFZ9=0THEN1210ELSECLS:PRINTMID$(A$(Z),5):IFZ<6THENGOSUB1120
220 ONZGOTO230,330,400,470,540,610,820,990
230 REM"VACCINATION DATA ENTRY"
240 LINEINPUT"VACCINATION TYPE : ";V$:IFV$=""THEN240
250 LINEINPUT"DOCTOR/NURSE ID. : ";DN$:IFDN$=""LETDN$="N/A"
260 LINEINPUT"REACTION (IF ANY) : ";R$:IFR$=""LETR$=" "
270 LINEINPUT"COST : ";CO$:A1=VAL(CO$):C0$=""
280 LINEINPUT"ADDITIONAL INFORMATION : ";I$:IFI$=""LETI$=" "
290 PRINT:LINEINPUT"CORRECT (Y/N) ";Y$:IFY$="N"THENGOSUB1170:GOT
O220
300 PRINT#1,Y;Z;F$;Q$;V$;Q$;DN$;Q$;R$;Q$;A1;I$;Q$;
310 Y=0:F$="":V$="":DN$="":R$="":A1=0:I$=""
320 CLOSE:GOTO1240
330 REM"PEDIATRIST VISIT DATA ENTRY"
340 LINEINPUT"REASON FOR VISIT : ";V$:IFV$=""THEN340
350 LINEINPUT"DOCTOR/NURSE ID. : ";DN$:IFDN$=""LETDN$="N/A"
360 LINEINPUT"SPECIAL TREATMENT : ";R$:IFR$=""LETR$=" "
370 LINEINPUT"COST : ";CO$:A1=VAL(CO$):C0$=""
380 LINEINPUT"ADDITIONAL INFORMATION : ";I$:IFI$=""LETI$=" "
390 GOTO290
400 REM"HOSPITALIZATION DATA ENTRY"
410 LINEINPUT"REASON FOR VISIT : ";V$:IFV$=""THEN410
420 LINEINPUT"DOCTOR/NURSE ID. : ";DN$:IFDN$=""LETDN$="N/A"
430 LINEINPUT"# OF DAYS STAYED : ";R$:IFR$=""LETR$=" "
440 LINEINPUT"COST : ";CO$:A1=VAL(CO$):C0$=""
450 LINEINPUT"ADDITIONAL INFORMATION : ";I$:IFI$=""LETI$=" "
460 GOTO290
470 REM"HOME-STAY-ILLNESS DATA ENTRY"
480 LINEINPUT"REASON FOR STAY : ";V$:IFV$=""THEN480
490 LINEINPUT"DOCTOR/NURSE ID. : ";DN$:IFDN$=""LETDN$="N/A"
```

Listing continues

Position	Description	Variable Name
1	Record Number	Y / Y1
2	Transaction Type	Z / Z1
3	Date	F$
4	Diagnostic	V$
5	Doctor/Nurse Name	DN$
6	Treatment/Days Ill	R$
7	Cost Incurred	A1
8	Additional Information	I$

Table 1

the year.

Medhist requires at least one disk drive; a printer is optional. It runs under NEWDOS, and requires one data file (DOCUMED). The file is defined in Table 1.

The names and dates of birth of each family member are included as data lines in the program. This saves a data file. The first data item on line 1260 indicates the number of data records to be read: one for the name and one for the date of birth. The program is menu driven. A printer is handy for options 7 and 8 (Table 1).

"The program keeps records, and shows tendencies and variations on illness incidence."

There are five data-entry options: vaccination data, visits to the pediatrician, hospitalizations, home-stay illness, and ambulance services.

Option 6 (Selective Field Display) reviews records for each data field. You may review one person's record or all available records for a selected field. You can route the cost report (option 7) for printer output in addition to screen display.

The OPEN E feature (line 1240) allows you to add records to a sequential file.

If you select to enter vaccination data, the program will prompt for a vaccination type (tetanus, smallpox, and so on). If a reaction to the vaccination or any medicine develops, you can enter that fact as additional information. Cost data should include such charges as drugs, wheys, medicines, doctors' fees, room and board charges, X-rays, and so on.

If you think the date of birth is not important, you may substitute this field with the blood type or any piece of information you consider vital. ■

Miguel Diaz (P.O. Box 8475, Ponce, PR 00732) is a hospital EDP manager.

Listing continued

```
500 LINEINPUT"# OF DAYS STAYED : ";R$:IFR$=""LETR$=" "
510 LINEINPUT"COST : ";CO$:A1=VAL(CO$):C0$=""
520 LINEINPUT"ADDITIONAL INFORMATION : ";I$:IFI$=""LETI$=" "
530 GOTO290
540 REM"AMBULATORY-CARE DATA ENTRY"
550 LINEINPUT"REASON FOR CARE SERVICE : ";V$:IFV$=""THEN480
560 LINEINPUT"DOCTOR/NURSE ID. : ";DN$:IFDN$=""LETDN$="N/A"
570 LINEINPUT"# OF DAYS : ";R$:IFR$=""LETR$=" "
580 LINEINPUT"COST : ";CO$:A1=VAL(CO$):C0$=""
590 LINEINPUT"ADDITIONAL INFORMATION : ";I$:IFI$=""LETI$=" "
600 GOTO290
610 REM"SELECTIVE FIELD DISPLAY"
620 CLS:PRINT"SELECTIVE FIELD DISPLAY":PRINTSTRING$(60,131)
630 PRINT"AVAILABLE FIELDS ARE :":PRINT
640 PRINTTAB(5)"1. VACCINATIONS":PRINTTAB(5)"2. PEDIATRIST VISIT
S"
650 PRINTTAB(5)"3. HOSPITALIZATIONS":PRINTTAB(5)"4. HOME-STAY CA
SES"
660 PRINTTAB(5)"5. AMBULATORY-CARE CASES":PRINT
670 LINEINPUT"          ENTER YOUR OPTION : ";O$:O=VAL(O$)
680 IFO<1ORO>5THEN610ELSECLS
690 LINEINPUT"DO YOU WISH ONLY ONE PATIENT'S RECORD? (Y/N) ";Y$
700 IFY$<>"Y"ANDY$<>"N"THEN690
710 IFY$="Y"LETY=0:GOSUB1120
720 CLOSE:OPEN"I",1,"DOCUMED"
730 IFEOF(1)THEN800ELSEINPUT#1,Y1,Z1,F$,V$,DN$,R$,A1,I$
740 IFY$="Y"ANDY1<>YTHEN730
750 IFZ1<>OTHEN730 : REM"VARIABLE O, NOT ZERO"
760 PRINTSTRING$(63,"=")
770 PRINTN$(Y1):PRINTF$,DN$:PRINTV$:PRINTR$
780 PRINT"COST : ";USINGM$;A1:PRINTI$
790 PRINT:LINEINPUT"HIT (ENTER) TO PROCEED ... ";P$:GOTO730
800 PRINT:LINEINPUT"END OF FILE...  HIT (ENTER) TO PROCEED ";P$
810 Y$="":Y1=0:Z1=0:O=0:CLOSE:OPEN"E",1,"DOCUMED":GOTO150
820 REM"COST-DATA SUMMARY REPORT"
830 CLS:PRINT"COST-DATA SUMMARY REPORT":PRINTSTRING$(60,131)
840 LINEINPUT"DO YOU WISH OUTPUT TO PRINTER (Y/N) : ";S$
850 IFS$="Y"PRINT:PRINT"HIT (ENTER) WHEN PRINTER READY AND"
860 IFS$="Y"LINEINPUT"PAPER SET TO PROPER POSITION... ";P$
870 CLS:CLOSE:OPEN"I",1,"DOCUMED"
880 IFS$="Y"LPRINT"COST-DATA SUMMARY REPORT":LPRINT:GOSUB970
890 IFEOF(1)THEN940ELSEINPUT#1,Y1,Z1,F$,V$,DN$,R$,A1,I$
900 IFS$="Y"LPRINTN$(Y1);TAB(25)F$;TAB(35)B$(Z1);TAB(52)USINGM$;
A1
910 PRINTN$(Y1);TAB(25)F$;TAB(35)B$(Z1);TAB(52)USINGM$;A1
920 L0=L0+1:IFL0>50ANDS$="Y"GOSUB970
930 A2=A2+A1:GOTO890
940 IFS$="Y"LPRINT:LPRINT"TOTALS";TAB(52)USINGM$;A2
950 PRINT:PRINT"TOTALS";TAB(52)USINGM$;A2
960 A2=0:L0=0:S$="":LINEINPUT"HIT (ENTER) TO PROCEED..";P$:GOTO8
10
970 LETL0=0:LPRINT"NAME";TAB(26)"DATE       TYPE";TAB(55)"AMOUNT"
980 LPRINTSTRING$(62,"="):LPRINT:RETURN
990 REM"HISTORICAL DATA REPORT"
1000 CLS:PRINT"HISTORICAL REPORT...":GOSUB1120:CLOSE
1010 OPEN"I",1,"DOCUMED":LPRINT"HISTORICAL REPORT FOR ";N$(Y):LP
RINT
1020 IFEOF(1)THEN1080ELSEINPUT#1,Y1,Z1,F$,V$,DN$,R$,A1,I$
1030 IFY1<>YTHEN1020
1040 LPRINTSTRING$(60,"=")
1050 LPRINTB$(Z1):LPRINTF$;TAB(20);DN$
1060 LPRINTV$:LPRINTR$:LPRINT"COST : ";USINGM$;A1:LPRINTI$
1070 GOTO1020
1080 LPRINT:GOTO810
1090 REM"EXIT PROGRAM"
1100 CLOSE:CLEAR50:CLS:PRINT"THANK YOU ...":END
1110 REM"SELECT RECORD ROUTINE"
1120 PRINTSTRING$(60,131):FORL=1TOX:PRINTL;N$(L),D$(L):NEXTL
1130 PRINT:PRINTL;"RETURN TO MENU":PRINT
1140 LINEINPUT"    ENTER CODE > ";A$
1150 Y=VAL(A$):IFY<1ORY>LTHEN210
1160 IFY=LTHEN150ELSEIFZ>5PRINT:RETURN
1170 PRINT@128,CHR$(31);N$(Y);D$(Y):PRINTSTRING$(60,131)
1180 LINEINPUT"ENTER DATE (MM/DD/YY) OR (END) : ";F$
1190 IFF$="END"THEN150
1200 IFLEN(F$)<>8THEN1170ELSERETURN
1210 REM"DATA FILE INITIALIZATION"
1220 CLS:PRINT"DATA FILE INITIALIZATION
1230 READX:DIMN$(X),D$(X):FORL=1TOX:READN$(L),D$(L):NEXTL
1240 OPEN"E",1,"DOCUMED":Z9=9:GOTO210
1250 REM"DATA LINES, EACH RECORD IS TWO DATA ITEMS : NAME & BIRT
HDATE
1260 DATA 5 : REM "THIS DATA ITEM REPRESENTS NUMBER OF RECORDS
1270 DATAMIGUEL,04/05/49,ANA,01/23/50,YANIRA,07/07/74
1280 DATAMICHAEL,11/07/75,JAVIER,11/21/77
```

Bit Smitten—Part IV

by Jay Chidsey

Use this real-estate program to learn about Basic's Read...Data function. It's easy to use, and can save you memory space and time.

People who are just getting started writing their own programs seem to avoid using the TRS-80's Read...Data functions for quite a while. When I was writing my first program called Clipper Ship Captain, I had many variable values to enter into memory, and I used A=27, B=35 and so on. Since my Clipper Ship called at eight different ports, and there were 20 different cargo values at each port, I used 160 variables and about twice as much memory space as the Read...Data function would have required.

There are a number of circumstances in which you can use the Read...Data function. Use it when you have a large number of variables and want to save memory. A second circumstance is illustrated both by Clipper Ship (where I had use for only one of the eight sets of cargo price data at a time) and a business program I've written in which I want to access and screen data for any quarter or, for that matter, any three-month period. Use Read...Data when you want to get at different parts of the data in storage as the program progresses.

A third circumstance is illustrated by a poetry program of mine. The user inputs 10–1,000 each of nouns, verbs and adjectives, and the program randomly selects one of eight or 10 frameworks and then randomly selects nouns, verbs and adjectives as required to write the poem. It doesn't write very good poetry most of the time, but once in a while a gem appears. You can use the Read...Data function when you want to select one or several numbers or (especially) words at random out of a large number of same.

The simplest use of the Read...Data function is where you have a long list of similar entries that you want to scan through one by one, and select from that long list a few which meet some criterion. This might be a list of members of a PTA or a church or a computer club or of all the dwellings a small-town volunteer fire department may have to deal with or a list of *80 Micro* articles with your notes as to subject covered, system usable on, and so on.

My real estate program shown in the listing illustrates this use of the Read...Data function. Lines 1-99 are reserved for programming, and listings are stored in data statements beyond line 100. There is no particular need to enter properties alphabetically by seller's last name, or to coordinate line number with listing number. Since most real estate offices already have card files alphabetized and have established listing numbers in a range of 100–300 per letter (300 numbers are reserved for C or S, 100 numbers are reserved for X,Y,Z for example), you can follow that pattern in entering the data. Give last names beginning with A listing numbers 101–300, Bs 301–500, Cs 501–800, and so on. Making line number identical to listing number makes locating listings easier when you want to alter or erase a listing.

The data for each listing of property, PTA or church or computer club member, dwelling, and so on can be entered in any order and in either letters or numbers on the same line, so long as each data line is consistent, and no commas are used inside the strings. If there are six or 16 or 60 entries in one listing, all must be occupied in every listing in every data line.

In your real estate listing you may be using only 10 entries: 1) listing number, 2) name and address of owner, 3) asking price in hundreds of dollars, 4) number of bedrooms, 5) number of baths, 6) frontage in feet, 7) lot size in

The Key Box

Cassette Basic
Model I or III
16K RAM

✓See List of Advertisers on Page 455

hundreds of square feet, 8) schools, 9) taxes, and 10) year constructed. There would be 10 or 15 more categories in an actual real estate computer listing, but these 10 illustrate data usage.

A sample entry (coded by the realtor) would look like this: 518 DATA 518, CALDERONE CHARLES 452 S ABERNATHY ST TIFFIN OH, 853, 4, 2, 127, 486, 8, 102, 48.

Note that there are no commas within the name and address entry. A comma would signal a new data unit entry. Charles wants $85,300 for the property, and it has four bedrooms, two baths, is 127 feet on frontage and 48,600 square feet in total area. Other items are similarly coded.

It will help you in visualizing the data storage in your computer if you think of it as a high stack of information. The first data entry anywhere in the program is the topmost item on this stack, and the very last data item is the one on the bottom. Your TRS-80 reads this stack from top to bottom, in order, one item for each execution of a command. The data is read only as far down the stack as you provide for in your program. At any time, when you have found the datum or set of data you were searching for you can restore the stack to its original state through the program command Restore. The whole stack is available for reading again then from the top.

The Program Listing presents the operating program, plus one entry, that of Mr. Calderone. Lines 100–9999 are reserved for other such data entries of 10 items each. Line 10 identifies the program and clears the screen.

Line 20 reads the first data item by itself so that an ending data unit can be placed at line 10000 to bring the search to an end. Depending upon how many entries have been made, line 20 reads item 1, item 11, item 21, and so on. The last one read is 0, located at line 10000. Line 30 ends the search after all data entries have been read.

Line 40 reads the next nine entries after the listing number, and assigns these values to variable. Note that the alphabetic variable (Calderone's name and address) is read into a string variable, N$, and the other eight numeric variables are read into variables A–H.

Line 50 is the heart of the program, and must be written anew for each search. We'll come back to it. If the data units read by line 40 match the criteria set up in line 50, the program GOSUBs to line 70 to put information on your screen or printer. Otherwise the program continues to line 60.

Line 60 sends the computer back to line 20 to check out the next set of ten data units. As each new alphabetic or numeric value is read into the variables (L, N$, A, B and so on) the former content is erased and the new values are entered for testing at line 50. This saves you a lot of memory space.

Line 70 prints information about any listing that passed the If test at line 50. In this case, I have it set to print listing number, name and address, and asking price, but you could set it to print all or any part of the data. Note that asking price, which was coded in hundreds of dollars, is multiplied by 100 to give actual price. To output directly to your printer change the Print in line 70 to LPRINT.

Line 80 picks up the X = X + 1 from the line above and halts screen printing when 12 listings have been presented there. Pressing enter clears the screen and resumes the search. You can copy from the screen before pressing enter or use one of the screen dump routines I offered last month to copy the monitor screen to printer. Line 90 returns the successful search to line 50, and from there through line 60 to line 20, just like the unsuccessful search.

Line 518 is the specimen real estate listing; line number and listing number are the same—518. Line 10000 ends the search, no matter how many listings have been entered between lines 100–9999.

You must end line 50 with GOSUB 70 for the program to work, but the content of the If statement can be anything you like. Keep it simple by using only is greater than (>) or is less than (<) or equals (=). There are several other logical operators you can use, but start simply and go to more complicated statements later. If you're searching for a house that costs $50,000 or less, has at least two bathrooms and at least three bedrooms, and has at least 200 feet of frontage then type in line 50 IF A<510 AND C>1 AND B>2 AND D>199 GOSUB 70. That's for a house under $51,000 with more than one bathroom, more than two bedrooms, and over 199 feet of property frontage on the street.

Let's look at a slightly more difficult case, one in which only a specific portion of the data is required by the program at a particular stage. This situation is commonly found in game programs. In my Clipper Ship Captain program only one of eight sets of data, each consisting of 20 items, is required at any one time. How do you get at it? Let's say that you want to get at and use data set 7. That means you have to peel off the overlying six sets consisting of 20 items each, 120 altogether, to get at the 20 you want to use in the program at this point.

Visualize that stack of data again. You want to peel off 120 data entries. Do it at line 700 FOR I = 1 TO 120: READ A: NEXT: A = 0. The first six sets of data are peeled off in short order. The A = 0 nullifies the last reading in case A has been used as a variable somewhere else in the program. Now read off the 20 numeric variables for the Port of London: 710 READ A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T: RESTORE.

You can now print these variables in any form you wish, probably tabular. The Restore makes the stack of data ready once again to be read from the top on its next usage.

Random access to data, as in my poetry writing program, is more difficult still, and is best accomplished by spinning data into an array. I'll discuss this next month, and show you how easy it is to use the TRS-80's powerful array capability to put hundreds and even thousands of information units into memory the easy way. ■

Writer and businessman Chidsey uses his Model III in both activities. He can be reached at 205 E. Adams St., Green Springs, OH 44836.

```
10 CLS: PRINT @470, "PROGRAM NAME... YOUR NAME": PRINT @662, "";
: INPUT "PRESS ENTER TO CONTINUE"; Y: CLS
20 READ L
30 IF L=0 THEN PRINT "SEARCH COMPLETE": END
40 READ N$, A, B, C, D, E, F, G, H
50 IF A<900 AND B>2 AND F=8 GOSUB 70
60 GOTO 20
70 PRINT L " " N$ "  " A * 100: X = X + 1
80 IF X = 12 PRINT "";: INPUT Y: CLS: X = 0
90 RETURN
518 DATA 518, CALDERONE CHARLES  452 S ABERNATHY ST TIFFIN OH, 8
53, 4, 2, 127, 486, 8, 102, 48
10000 DATA 0
```

Program Listing

✓See List of Advertisers on Page 455

Practical Regression Analysis

by Delmar D. Hinrichs

Regression analysis lets you get the most from a set of data. Author Hinrichs will take you step by step through this useful technique.

Regression analysis is a powerful tool for getting a great deal of information from a set of data. When it is properly used, it can accurately find the interrelationships among many variables. The regression equation is a mathematical model that can be used to predict results under conditions that were not actually used. In addition, the importance and significance of each "independent" variable in predicting the "dependent" variable can be determined.

What does all this mean? What kind of data can be used, and how is it used? This article tries to answer these questions, and includes a flexible, comprehensive regression-analysis program.

Mean: Arithmetic average of a data variable.
Standard Deviation: Measure of the variability of a data variable. About 68 percent of all data points lie within plus or minus one standard deviation of the mean, assuming a normal distribution.
Correlation Coefficient: Range, −1 to +1. Perfect negative correlation to no correlation (0) to perfect positive correlation between any two variables. Ignores the effects of all other variables.
Matrix: A two-dimensional array of numbers formed from the variables, that represents relationships between them.
Inverse Matrix: The form that the original correlation coefficient matrix becomes after the process of matrix inversion.
Partial Correlation Coefficient: Similar to correlation coefficient, except corrects for the effects of all other variables.
Standard Error of Estimate: Ranges downward from the standard deviation of the dependent variable, the lower the better. Best measure of the significance of the fit of the regression equation to the data.
R Squared: Range, 0 to 1, the higher the better. No predictive value to perfect predictive value. Square of the multiple correlation coefficient. Measures the fraction of the variation of the dependent variable that is explained by the regression equation.
F Ratio: Range, zero to infinity, the higher the better. A test of the significance of an independent variable, or of the whole regression equation.
Probability: Range, 0–1, the higher the better. Indicates confidence, from none to certainty (based on the F ratio), that the regression equation or the individual coefficient could *not* have been obtained by chance from random data.
Beta Coefficient: Range, −1 to +1. A normalized equation coefficient, measuring the importance of its variable in affecting the value of the dependent variable. Also, the independent to dependent variable correlation, after correcting for (eliminating) the effects of all of the other independent variables. Sometimes called the "standard partial regression coefficient."
Inverse Diagonal: Range, one to infinity, the lower the better. Diagonal elements of the inverse matrix. Values above two indicate increasing error in the beta coefficients, and in the coefficient F ratios and probabilities of the affected variables. High values are caused by too much correlation between the supposedly "independent" variables.

Table 1. Explanations of Some of the Statistical Terms Used in the Article and Program

Data

The data must be in the form of numbers with a group of observations, each having two or more variables. One of the variables is designated as the dependent variable, and the rest are called the independent variables. Actually, regression analysis does not determine cause and effect (as the terms "independent" and "dependent" imply), but only finds relationships among the variables. Therefore, you need to know something about the real relationships in the system that the data represents before you can run a meaningful regression analysis on it.

A regression analysis fits the data to an equation of the form:

$$a + b(1)*V(1) + b(2)*V(2) = V(3)$$

where a is a constant, V(1) and V(2) are the independent variables, V(3) is the dependent variable, and b(1) and b(2) are the equation coefficients. In a real regression analysis, the number of variables (Vs) may range from two to several dozen. In the equation above, V(1), V(2), and V(3) are data variables, while a, b(1), and b(2) are calculated by the regression-analysis program.

This equation is linear in form, but it

The Key Box

Model I & III
16K RAM
Cassette Basic (CMD"T" for disk)
Printer

may be used to fit non-linear data by using non-linear transformations (logarithm, square root, and so on) on the data before they are entered into the regression analysis. A good regression-analysis program will run these preliminary transformations on the data before running the regression, so you do not have to do them manually.

The regression-analysis program fits the equation to the data by a least-squares method. That is, the values of a, b(1), and b(2) are calculated so that the sum of the squares of the deviations of the estimated value of V(3) from its measured value is minimized. In order

Variable #1 "Length"	Variable #2 "Width"	Variable #3 "Height"
2	5	15
13	6	22
7	1	12
5	10	8
14	3	12
6	5	19
16	1	0
1	9	3
4	4	15
15	8	20
0	0	5
10	6	21
11	7	22
12	9	20
3	2	12
9	4	18

Table 2. Sample Data for the Regression-Analysis Program

Program Listing

```
10 CLS :PRINT,"MULTIVARIABLE REGRESSION ANALYSIS"
20 PRINT,"(C)  BY DELMER D. HINRICHS  1981"
30 CLEAR 0 :A=(MEM-1400)/8 :H=100 :OUT254,1
40 FOR I=1 TO 10
50   M=(H+L)/2 :B=5*M+M*M :IF A>B THEN L=M ELSE H=M
60   NEXT I :M=INT(M) :POKE16554,M :CLEAR M*10+200
70 DEFINT I-N :DEFDBL P-Y :MV=PEEK(16554) :I=MV-1
80 DIM ID(49),R(I),SC(I,I),SD(I),SM(I),V(MV),VN$(I)
90 PRINT :PRINT :PRINT"DO YOU WANT TO:" :PRINT
100 PRINT"  1.  LOAD MATRIX FROM TAPE"
110 PRINT"  2.  LOAD RAW DATA FROM TAPE"
120 PRINT"  3.  ENTER RAW DATA FROM KEYBOARD" :GOSUB 2930
130 ON M GOTO 1340,150,150
140 GOSUB 3430 :GOTO 90
150 O$="USE TRANSFORMATIONS ON RAW DATA" :GOSUB 2890
160 IF Z$="Y" THEN IT=1 :GOTO 3460
170 IF M=2 THEN IR=1 :GOTO 400
180 O$="ENTER TITLE FOR OUTPUTS" :GOSUB 2890
190 IF Z$="N" PRINT :GOTO 230
200 PRINT O$;", UP TO 63 CHARACTERS"
210 INPUT TL$ :L=LEN(TL$) :IF L<64 PRINT :L=(64-L)/2 :GOTO 230
220 PRINT"TITLE TOO LONG" :GOTO 200
230 PRINT"MAXIMUM NO. OF RAW OR TRANSFORMED VARIABLES =";MV
240 PRINT :INPUT"NO. OF RAW VARIABLES ";Z$
250 M=VAL(Z$) :NR=M-1 :IF M<2 GOTO 3350
260 IF M>MV GOSUB 3430 :GOTO 230
270 O$="NAME RAW VARIABLES TO BE ENTERED" :GOSUB 2890
280 IF Z$="N" GOTO 330
290 CLS :PRINT"PUT DEPENDENT VARIABLE LAST" :PRINT
300 FOR I=0 TO NR
310   PRINT"RAW VARIABLE NO.";I+1,"NAME = "; :GOSUB 3000
320   NEXT I :CLS
330 O$="SAVE RAW DATA ON TAPE" :GOSUB 2890 :IF Z$="N" GOTO 550
340 IS=1 :K=0 :O$="RECORD" :GOSUB 3130 :PRINT"SAVING TITLE"
350 PRINT#-1,"DATA" :PRINT#-1, L,NR,TL$ :PRINT@ 7,"NAMES"
360 FOR I=0 TO NR
370   B$(K)=VN$(I) :K=K+1 :IF K>9 GOSUB 3190
380   NEXT I :IF K GOSUB 3190
390 GOTO 550
400 ' READ DATA FROM TAPE
410 O$="DELETE SOME OBS. FROM DATA" :GOSUB 2890
420 IF Z$="N" GOTO 490
430 CLS :PRINT"UP TO 50 OBS. MAY BE DELETED" :GOSUB 3330
440 FOR I=0 TO 49 :Z$=""
```

Listing continues

✓See List of Advertisers on Page 455

Listing continued

```
450    INPUT"OBS. NO. TO BE DELETED";Z$
460    IF Z$="" GOTO 490
470    ID(I)=VAL(Z$) :ID=I
480    NEXT I
490 K=10 :O$="PLAY" :GOSUB 3130 :PRINT"READING" :INPUT#-1, O$
500 IF O$<>"DATA" PRINT"*** WRONG FILE ***" :GOTO 490
510 PRINT@ 8,"TITLE" :INPUT#-1, L,NR,TL$ :PRINT@ 8,"NAMES"
520 FOR I=0 TO NR :IF K>9 GOSUB 3210
530    VN$(I)=B$(K) :K=K+1
540    NEXT I :IF IC=1 GOTO 2360
550 CLS :NT=NR :IF IT=0 GOTO 590
560 PRINT"NO. OF TRANSFORMED VARIABLES NOW =";NT+1,"NEW = ";
570 INPUT Z$ :M=VAL(Z$) :NT=M-1
580 IF M<2 OR M>MV GOSUB 3430 :GOTO 560
590 PRINT :PRINT"PRINT DATA ON PRINTER?" :PRINT
600 PRINT"  1.  RAW DATA"
610 PRINT"  2.  TRANSFORMED DATA"
620 PRINT"  3.  DO NOT PRINT DATA" :GOSUB 2930
630 ON M GOTO 650,650,680
640 GOSUB 3430 :GOTO 590
650 GOSUB 3070 :IF IP=0 THEN M=3 :GOTO 680
660 LPRINTTAB(L) TL$ :LPRINT :IF M=2 GOTO 680
670 LPRINTTAB(20)"NAMES OF RAW VARIABLES:" :NZ=NR :GOSUB 3170
680 G$="DATA FOR EACH OBSERVATION:" :IF M<3 LPRINTTAB(20) G$
690 N=N+1 :JD=0 :IF IR GOTO 800 ELSE IF IC GOTO 810
700 CLS :PRINT"ENTER ";G$ :GOSUB 3330
710 PRINT"OBS. NO. ";N
720 FOR I=1 TO NR+1 :Z$="" :IF IX GOTO 750
730    PRINT"  VAR. NO.";I,"'";VN$(I-1);"'","VALUE = ";:INPUT Z$
740    IF Z$="" PRINT"QUIT DATA ENTRY" :V(1)=-9999 :IX=1 :I=2
750    V(I)=VAL(Z$)
760    NEXT I :IF IX=0 OR NO>NT+1 GOTO 780
770 PRINT"TOO FEW OBS.  MINIMUM =";NT+2 :IX=0 :GOTO 710
780 O$="CHANGE DATA FOR THIS OBS." :GOSUB 2890
790 IF Z$="Y" CLS :IX=0 :PRINT"ENTER ";O$ :PRINT :GOTO 710
800 IF IR=0 GOTO 870 ELSE CLS :PRINT"READING OBS. NO.";N
810 K=10
820 FOR I=1 TO NR+1 :IF K>9 GOSUB 3310
830    V(I)=T(K) :K=K+1
840    NEXT I :IF V(1)=-9999 THEN IX=1
850 FOR I=0 TO ID :IF ID(I)=N THEN JD=1
860    NEXT I :IF IC GOTO 2410
870 IF IP=0 GOTO 900
880 LPRINT"OBS. NO.";N, :IF JD LPRINT"DELETED" :GOTO 690
890 IF M=1 THEN NZ=NR :GOSUB 3240
900 IF JD GOTO 690
910 IF IS=0 GOTO 960
920 K=0 :CLS :PRINT"SAVING DATA"
930 FOR I=1 TO NR+1
940    T(K)=V(I) :K=K+1 :IF K>9 GOSUB 3290
950    NEXT I :IF K GOSUB 3290
960 CLS :IF IX GOTO 1090
970 PRINT"UPDATING MATRIX"
980 IF IT GOSUB 5000
990 IF M=2 THEN NZ=NT :GOSUB 3240
1000 NO=NO+1 :R=CDBL(NO-1)/CDBL(NO)
1010 FOR I=0 TO NT
1020    R(I)=V(I+1)-SM(I) :SM(I)=SM(I)+R(I)/NO
1030    NEXT I
1040 FOR J=0 TO NT
1050    FOR K=J TO NT
1060       SC(J,K)=SC(J,K)+R(J)*R(K)*R
1070       NEXT K
1080    NEXT J :CLS :GOTO 690
1090 IF IT=0 GOTO 1160
1100 O$="CHANGE TRANSFORMED VARIABLE NAMES" :GOSUB 2890
1110 CLS :IF Z$="N" GOTO 1160
1120 FOR I=0 TO NT
1130    PRINT"VAR. NO.";I+1;"NOW = '";VN$(I);"'","NEW = ";
1140    GOSUB 3000
1150    NEXT I
1160 IF M<>2 GOTO 1190
1170 LPRINT :LPRINTTAB(20)"NAMES OF TRANSFORMED VARIABLES:"
1180 NZ=NT :GOSUB 3170
1190 IF IP LPRINT STRING$(8,138)
1200 CLS :PRINT"CALCULATING"
1210 FOR I=0 TO NT :PRINT@ 13, I+1
1220    R=SC(I,I)/(NO-1) :S=SQR(R)
1230    IF R=0 PRINT"VARIABLE";I+1;"IS CONSTANT" :OUT254,0 :STOP
1240    Q=S :S=(R/Q+Q)/2 :IF Q<>S GOTO 1240
1250    SD(I)=S
1260    NEXT I
1270 FOR J=0 TO NT-1 :PRINT@ 13, J+1
1280    FOR K=J+1 TO NT :PRINT@ 17, K+1
1290       R=SC(J,J)*SC(K,K) :S=SQR(R)
1300       Q=S :S=(R/Q+Q)/2 :IF Q<>S GOTO 1300
1310       SC(J,K)=SC(J,K)/S :SC(K,J)=SC(J,K)
```

Listing continues

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Listing continued

```
1320       NEXT K :SC(J,J)=1
1330    NEXT J :SC(NT,NT)=1 :GOTO 1530
1340 ' READ MATRIX FROM TAPE
1350 O$="PLAY" :GOSUB 3130 :PRINT"READING" :INPUT#-1, O$
1360 IF O$<>"MATRIX" PRINT"*** WRONG FILE ***" :GOTO 1350
1370 PRINT@ 8,"TITLE" :INPUT#-1, IT,L,NO,NT,TL$
1380 IM=1 :K=10 :PRINT@ 8,"NAMES"
1390 FOR I=0 TO NT :IF K>9 GOSUB 3210
1400    VN$(I)=B$(K) :K=K+1
1410    NEXT I :K=10 :PRINT@ 8,"MEANS"
1420 FOR I=0 TO NT :IF K>9 GOSUB 3310
1430    SM(I)=T(K) :K=K+1
1440    NEXT I :K=10 :PRINT@ 8,"STD. DEV."
1450 FOR I=0 TO NT :IF K>9 GOSUB 3310
1460    SD(I)=T(K) :K=K+1
1470    NEXT I :K=10 :PRINT@ 8,"MATRIX   "
1480 FOR I=0 TO NT-1
1490    FOR J=I+1 TO NT :IF K>9 GOSUB 3310
1500      SC(I,J)=T(K) :SC(J,I)=T(K) :K=K+1
1510      NEXT J :SC(I,I)=1
1520    NEXT I :SC(NT,NT)=1
1530 CLS :PRINTTAB(L) TL$
1540 H$="VAR. NO.          VAR. NAME           MEAN            STD. DE
VIATION"
1550 PRINT H$
1560 F$="####            %              %###########.##### ###########.#
####"
1570 FOR I=0 TO NT
1580    H=(I+2)/15 :IF INT(H)=H GOSUB 3040
1590    PRINTUSING F$; I+1,VN$(I),SM(I),SD(I)
1600    NEXT I :GOSUB 2870 :IF Z$="N" GOTO 1660
1610 GOSUB 3070 :IF IP=0 GOTO 1660
1620 LPRINTTAB(L) TL$ :LPRINT H$
1630 FOR I=0 TO NT
1640    LPRINTUSING F$; I+1,VN$(I),SM(I),SD(I)
1650    NEXT I :LPRINT STRING$(8,138)
1660 O$="VIEW MATRIX, INVERSE, PARTIALS" :GOSUB 2890
1670 IF Z$="N" GOTO 1700 ELSE IV=1
1680 G$="CORRELATION COEFFICIENT MATRIX" :IE=NT
1690 F$="%%%%%%%.######  " :H$="SIMPLE "+G$ :GOSUB 2590
1700 IF IM GOTO 1930
1710 O$="SAVE COEF. MATRIX ON TAPE" :GOSUB 2890
1720 IF Z$="N" GOTO 1930
1730 K=0 :O$="RECORD" :GOSUB 3130
1740 PRINT"SAVING" :PRINT#-1,"MATRIX" :PRINT@ 7,"TITLE"
1750 PRINT#-1, IT,L,NO,NT,TL$ :PRINT@ 7,"NAMES"
1760 FOR I=0 TO NT
1770    B$(K)=VN$(I) :K=K+1 :IF K>9 GOSUB 3190
1780    NEXT I :IF K GOSUB 3190
1790 PRINT@ 7,"MEANS"
1800 FOR I=0 TO NT
1810    T(K)=SM(I) :K=K+1 :IF K>9 GOSUB 3290
1820    NEXT I :IF K GOSUB 3290
1830 PRINT@ 7,"STD. DEV."
1840 FOR I=0 TO NT
1850    T(K)=SD(I) :K=K+1 :IF K>9 GOSUB 3290
1860    NEXT I :IF K GOSUB 3290
1870 PRINT@ 7,"MATRIX    "
1880 FOR I=0 TO NT-1
1890    FOR J=I+1 TO NT
1900      T(K)=SC(I,J) :K=K+1 :IF K>9 GOSUB 3290
1910      NEXT J
1920    NEXT I :IF K GOSUB 3290
1930 CLS :PRINT"INVERTING MATRIX"
1940 FOR I=0 TO NT-1 :PRINT@ 18, I+1;CHR$(30) :IF I=0 GOTO 1980
1950    IF SC(I,I)<=0 PRINT"MATRIX SINGULAR" :OUT254,0 :STOP
1960    X=1/SC(I,I) :SC(I,I)=1
1970    FOR J=0 TO NT :SC(I,J)=X*SC(I,J) :NEXT J
1980    FOR K=0 TO NT-1 :PRINT@ 22, K+1 :IF K=I GOTO 2010
1990      X=SC(K,I) :SC(K,I)=0
2000      FOR J=0 TO NT :SC(K,J)=SC(K,J)-X*SC(I,J) :NEXT J
2010      NEXT K
2020    NEXT I :IF IV=0 GOTO 2050
2030 H$="INVERSE OF MATRIX PLUS BETA COEFFICIENTS" :GOSUB 2590
2040 H$="PARTIAL "+G$ :IZ=1 :IE=NT-1 :GOSUB 2590
2050 ' REGRESSION RESULTS
2060 CLS :IE=NT-1 :PRINTTAB(L) TL$
2070 FOR I=0 TO IE :R2=R2+SC(NT,I)*SC(I,NT) :NEXT I :D2=NO-NT-1
2080 DR=(1-R2)/D2 :EE=SD(NT)*SQR(DR*(NO-1)) :FR=R2/DR/NT :F=FR
2090 F$="NO.IND.VAR.=###       DEP.VAR.=### %          %      NO.OB
S.=#####"
2100 PRINTUSING F$; NT,NT+1,VN$(NT),NO :D1=NT :GOSUB 2790 :D1=1
2110 D$="  R SQ.=.######    EQ.F=####.###    PROB.=#.###"
2120 PRINT"S.E.EST.=";EE; USING D$; R2,FR,FP
2130 G$="NO. VAR.NAME  BETA COEF.    EQ. COEF.    COEF.F    PROB.
 INV.DIAG"
2140 PRINT G$;
```

Listing continues

Listing continued

```
2150 H$="## %           %###.###### #######.###### ####.### ##.###
####.###"
2160 E$="    EQUATION CONSTANT =########.######"
2170 FOR I=0 TO IE
2180   SD(I)=SC(I,NT)*SD(NT)/SD(I) :SM(NT)=SM(NT)-SD(I)*SM(I)
2190   SM(I)=(SC(I,NT)/SQR(DR*SC(I,I)))[2 :F=SM(I) :GOSUB 2790
2200   H=(I+4)/15 :IF INT(H)=H GOSUB 3040
2210   PRINTUSING H$;I+1,VN$(I),SC(I,NT),SD(I),SM(I),FP,SC(I,I)
2220   NEXT I :PRINTUSING E$; SM(NT)
2230 GOSUB 2870 :IF Z$="N" GOTO 2310
2240 GOSUB 3070 :IF IP=0 GOTO 2310
2250 LPRINTTAB(L) TL$ :LPRINTUSING F$; NT,NT+1,VN$(NT),NO
2260 D1=NT :F=FR :GOSUB 2790
2270 LPRINT"S.E.EST.=";EE; USING D$; R2,FR,FP :LPRINT G$ :D1=1
2280 FOR I=0 TO IE :F=SM(I) :GOSUB 2790
2290   LPRINTUSINGH$;I+1,VN$(I),SC(I,NT),SD(I),SM(I),FP,SC(I,I)
2300   NEXT I :LPRINTUSING E$; SM(NT) :LPRINT STRING$(8,138)
2310 CLS :G$="RESIDUALS OF DATA VS. ESTIMATES"
2320 O$="CHECK "+G$ :GOSUB 2890 :IF Z$="N" GOTO 2560
2330 IC=1 :IP=0 :O$="PRINT "+G$ :GOSUB 2890 :IF Z$="N"GOTO 2350
2340 GOSUB 3070
2350 PRINT :PRINT"YOU MUST REREAD RAW DATA FROM TAPE" :GOTO 490
2360 IX=0 :N=0 :IR=0 :F$="####  " :CLS
2370 H$="OBS.#  DEP.VAR.  EST.DEP.VAR.    RESIDUAL         NORMAL
IZED"
2380 PRINTTAB(L) TL$ :PRINT, G$ :PRINT H$
2390 IF IP LPRINTTAB(L) TL$ :LPRINT, G$ :LPRINT H$
2400 GOTO 690
2410 IF IX GOTO 2520
2420 PRINTUSING F$; N; :IF IP LPRINTUSING F$; N;
2430 IF JD PRINT"DELETED" :IF IP LPRINT"DELETED"
2440 IF JD GOTO 690
2450 IF IT GOSUB 5000
2460 R=SM(NT) :FOR I=0 TO IE :R=R+SD(I)*V(I+1) :NEXT I
2470 RE=V(NT+1)-R :RS=RS+RE :EN=RE/EE
2480 PRINT CSNG(V(NT+1)),CSNG(R),CSNG(RE),EN
2490 IF IP LPRINT CSNG(V(NT+1)),CSNG(R),CSNG(RE),EN
2500 H=(N+3)/15 :IF INT(H)=H AND IP=0 GOSUB 3040
2510 GOTO 690
2520 F$="SUM OF RESIDUALS = "
2530 PRINTTAB(13) F$; CSNG(RS)
2540 IF IP LPRINTTAB(13) F$; CSNG(RS); STRING$(8,138)
2550 GOSUB 3040
2560 OUT254,0 :IF JP*IT LPRINTTAB(L) TL$ :CLEAR 50 :LLIST 5000-
2570 CLS :CLEAR 50 :PRINT"REGRESSION DONE"
2580 END
2590 ' PRINT MATRIX
2600 CLS :PRINTTAB(L) TL$ :PRINTTAB(13) H$ :I=2
2610 FOR J=0 TO IE :M=0
2620   FOR K=J+IZ TO IE :IF K>IE GOTO 2670
2630     H=(M/4+I)/15 :IF INT(H)=H GOSUB 3040 :M=0 :I=0
2640     GOSUB 2770
2650     PRINTUSING F$; RIGHT$(STR$(J+1),2),RIGHT$(STR$(K+1),2),
Z;
2660     M=M+1
2670     NEXT K :I=I+(M+3)/4:H=(IE-J-IZ+1)/4:IF INT(H)<>H PRINT
2680   NEXT J :GOSUB 2870 :IF Z$="N" RETURN
2690 GOSUB 3070 :IF IP=0 RETURN
2700 LPRINTTAB(L+8) TL$ :LPRINTTAB(21) H$
2710 FOR J=0 TO IE
2720   FOR K=J+IZ TO IE :IF K>IE GOTO 2750
2730     GOSUB 2770
2740     LPRINTUSING F$; RIGHT$(STR$(J+1),2),RIGHT$(STR$(K+1),2)
,Z;
2750     NEXT K :H=(IE-J-IZ+1)/5 :IF INT(H)<>H LPRINT
2760   NEXT J :LPRINT STRING$(8,138) :RETURN
2770 Z=SC(J,K) :IF IZ THEN Z=-Z/SQR(SC(J,J)*SC(K,K))
2780 RETURN
2790 ' PROB
2800 DX=D1 :DY=D2 :FF=F :IF F<1 THEN DY=D1 :DX=D2 :FF=1/F
2810 DX=2/9/DX :DY=2/9/DY
2820 DD=ABS(FF[(1/3)*(1-DY)+DX-1)/SQR(FF[(2/3)*DY+DX)
2830 IF D2<4 THEN DD=DD*(.08*DX[4/D2[3+1)
2840 FP=.5/(1+DD*(.19685+DD*(.11519+DD*(.000344+DD*.01953))))[4
2850 IF F>=1 THEN FP=1-FP
2860 RETURN
2870 ' PRINT?
2880 O$="PRINT THESE RESULTS" :IP=0
2890 ' (Y/N)
2900 PRINT"DO YOU WANT TO ";O$;" (Y/N)? "; CHR$(95); CHR$(24);
2910 GOSUB 2960 :IF Z$="Y" OR Z$="N" RETURN
2920 GOSUB 3430 :GOTO 2890
2930 ' CHOICE
2940 PRINT :PRINT"YOUR CHOICE? "; CHR$(95); CHR$(24);
2950 GOSUB 2960 :M=VAL(Z$) :CLS :RETURN
2960 ' GET CHAR
2970 Z$=INKEY$ :IF Z$="" GOTO 2970
```

Listing continues

Listing continued

```
2980 IF ASC(Z$)=13 THEN Z$="N"
2990 PRINT Z$ :RETURN
3000 ' VAR NAMES
3010 PRINT STRING$(12,46)+STRING$(12,24); :INPUT VN$(I)
3020 IF LEN(VN$(I))<11 RETURN
3030 PRINT"NAME IS TOO LONG","NAME = "; :GOTO 3010
3040 ' PAUSE
3050 PRINT"PRESS ANY KEY TO CONTINUE";
3060 GOSUB 2960 :PRINT CHR$(27); CHR$(30); :RETURN
3070 ' READY?
3080 IF PEEK(14312)<128 LPRINT CHR$(30) :IP=1 :JP=1 :RETURN
3090 O$="ABORT, AS PRINTER IS NOT READY" :GOSUB 2890
3100 IF Z$="Y" RETURN
3110 PRINT"THEN GET PRINTER READY AND PRESS <ENTER>"
3120 GOSUB 3060 :GOTO 3070
3130 ' PROMPT
3140 PRINT :PRINT"GET TAPE READY, PRESS '";O$;"', THEN <ENTER>"
3150 GOSUB 2960 :CLS :RETURN
3160 ' WRITE OR READ NAMES
3170 FOR I=0 TO NZ :LPRINT I+1; VN$(I); :GOSUB 3270 :NEXT I
3180 LPRINT CHR$(138) :RETURN
3190 PRINT #-1, B$(0),B$(1),B$(2),B$(3),B$(4),B$(5),B$(6),B$(7),
 B$(8),B$(9)
3200 FOR MI=0 TO 9 :B$(MI)="" :NEXT MI :K=0 :RETURN
3210 INPUT #-1, B$(0),B$(1),B$(2),B$(3),B$(4),B$(5),B$(6),B$(7),
 B$(8),B$(9)
3220 K=0 :RETURN
3230 ' WRITE OR READ DATA
3240 FOR I=1 TO NZ :A=V(I) :LPRINT I; A;
3250   IF LEN(STR$(A))<11 GOSUB 3270
3260   NEXT I :LPRINT NZ+1; CSNG(V(NZ+1)) :RETURN
3270 H=(I+1)/5 :IF INT(H)=H THEN LPRINT ELSE LPRINT,
3280 RETURN
3290 PRINT#-1,T(0),T(1),T(2),T(3),T(4),T(5),T(6),T(7),T(8),T(9)
3300 FOR MI=0 TO 9 :T(MI)=0 :NEXT MI :K=0 :RETURN
3310 INPUT#-1,T(0),T(1),T(2),T(3),T(4),T(5),T(6),T(7),T(8),T(9)
3320 K=0 :RETURN
3330 ' QUIT
3340 PRINT"(PRESS <ENTER> TO QUIT)" :PRINT :RETURN
3350 ' # RAW VAR
3360 GOSUB 3430 :PRINTTAB(25)"RAW VARIABLES" :PRINT
3370 PRINT"THE NUMBER OF VARIABLES TO ENTER IS THE NUMBER OF RAW
 VARIABLES,";
3380 PRINT"INCLUDING BOTH INDEPENDENT AND DEPENDENT VARIABLES, B
UT WITHOUT"
3390 PRINT"COUNTING THE DERIVED VARIABLES THAT MAY BE FORMED LAT
ER BY USING";
3400 PRINT"THE TRANSFORMATION ROUTINES.  THE MAXIMUM NUMBER OF
VARIABLES"
3410 PRINT"THAT CAN BE USED IS LIMITED BY THE AVAILABLE MEMORY T
O ";MV;"."
3420 PRINT :GOTO 240
3430 CLS ' ERROR
3440 PRINT"YOUR ENTRY OF '";Z$;"' IS ILLEGAL"
3450 PRINT :RETURN
3460 ' TRANS INSTR
3470 O$="ENTER NEW TRANSFORMATIONS" :GOSUB 2890
3480 IF Z$="N" GOTO 170
3490 CLS :PRINTTAB(24)"TRANSFORMATIONS" :PRINT
3500 PRINT"TRANSFORMATIONS ARE ANY CALCULATIONS PERFORMED UPON T
HE DATA TO"
3510 PRINT"CHANGE ITS FORM.  INCLUDED ARE SUCH THINGS AS SQUARE
S AND CUBES";
3520 PRINT"OF THE VARIABLES, CROSS PRODUCTS, SQUARE ROOTS, LOGAR
ITHMS, ETC.";
3530 PRINT"TO PERFORM THESE CALCULATIONS AUTOMATICALLY ON EACH O
BSERVATION"
3540 PRINT"ENTERED, THE APPROPRIATE 'BASIC' STATEMENTS MUST BE E
NTERED INTO";
3550 PRINT"THE SUBROUTINE THAT STARTS AT PROGRAM LINE 5000."
3560 PRINT"BOTH RAW AND TRANSFORMED VARIABLES ARE SUBSCRIPTED VA
RIABLE 'V'.";
3570 PRINT"I.E., TO ADD VARIABLE 3 TO VARIABLE 4 TO MAKE VARIABL
E 5 USE:"
3580 PRINTTAB(20)"V(5)=V(3)+V(4)"
3590 PRINT"THE NUMBER OF TRANSFORMED VARIABLES MAY BE GREATER TH
AN OR LESS"
3600 PRINT"THAN THE NUMBER OF ORIGINAL RAW VARIABLES.  DEPENDEN
T VARIABLE"
3610 PRINT"MUST BE LAST.  YOU WILL NOW BE SHOWN THE OLD TRANSFO
RMATIONS,"
3620 PRINT"AND RETURNED TO 'BASIC' TO ENTER YOUR NEW TRANSFORMAT
IONS."
3630 GOSUB 3040 :CLS :OUT254,0 :LIST 5000-
5000  ' TRANSFORMATION SUBROUTINE
5010 V(6)=V(3) :V(5)=(V(1)-7)*(V(2)-4.5) :V(4)=(V(2)-5)[2 :V(3)=
V(2) :V(2)=(V(1)-8)[2
9000 RETURN
```

Listing continues

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```
DO YOU WANT TO:

   1.  LOAD MATRIX FROM TAPE
   2.  LOAD RAW DATA FROM TAPE
   3.  ENTER RAW DATA FROM KEYBOARD

YOUR CHOICE? _
```

Fig. 1. The Initial Prompt

to do this, it is necessary that the number of observations be greater than the number of variables in each observation.

In addition to the regression equation, the program calculates various statistics on the data, and on the goodness of fit of the regression equation to the data. See Table 1 for a brief explanation of these statistics.

```
DO YOU WANT TO USE TRANSFORMATIONS ON RAW DATA (Y/N)? N
DO YOU WANT TO ENTER TITLE FOR OUTPUTS (Y/N)? Y
ENTER TITLE FOR OUTPUTS, UP TO 63 CHARACTERS
? REGRESSION ANALYSIS TRIALS

MAXIMUM NO. OF RAW OR TRANSFORMED VARIABLES = 13

NO. OF RAW VARIABLES ? 0_
```

Fig. 2. Next Prompts

```
YOUR ENTRY OF '0' IS ILLEGAL

                     RAW VARIABLES

THE NUMBER OF VARIABLES TO ENTER IS THE NUMBER OF RAW VARIABLES,
INCLUDING BOTH INDEPENDENT AND DEPENDENT VARIABLES, BUT WITHOUT
COUNTING THE DERIVED VARIABLES THAT MAY BE FORMED LATER BY USING
THE TRANSFORMATION ROUTINES.   THE MAXIMUM NUMBER OF VARIABLES
THAT CAN BE USED IS LIMITED BY THE AVAILABLE MEMORY TO  13 .


NO. OF RAW VARIABLES ? 3_
```

Fig. 3. Due to the previous illegal entry, instructions on the "No. of Raw Variables" to enter are given and you get a second chance to make your entry.

Sample Problem

The easiest way to show this is by an example. Table 2 shows 16 observations of three variables each. These variables are arbitrarily called length, width, and height. Length and width are designated as independent variables, and height is the dependent variable.

Now load the Program Listing. When run, the program presents the prompt shown in Fig. 1. Since we have nothing on tape yet, we press 3. Then answer the following prompts shown in Fig. 2, N (no transformations) and Y (enter title). Throughout the program, for all Y/N questions, pressing enter without any entry means N.

After we enter the title, the program checks the amount of memory available, and tells us that we can use up to 13 variables in the regression (for a 16K TRS-80). At this point, we enter zero (or a letter, or just press enter), and get the explanation of Fig. 3, and another chance to key in the number of raw (non-transformed) variables that we wish to enter.

After entering 3 in the original prompt, we have a chance to assign names to each of the variables. As shown in Fig. 4, each variable name may have up to 10 characters, as defined by the string of 10 periods. The dependent variable must be put last (either now, or moved to last later by using the transformations).

Normally, we will want to save the raw data on tape so it won't have to be keyed in again for later use. Also, it is necessary to have the data on tape to run a residuals analysis, a comparison of the actual and estimated values of the dependent variable.

The variables for each observation are entered in the form shown in Fig. 5; the observation number, variable number, and variable name are specified by the prompt, so you always know exactly which data you should enter. After the data for each observation are entered, you may check them for accuracy, and if necessary, change them. Pressing enter without entry of any number terminates data entry (with, of course, a chance for you to recover if enter was pressed by mistake).

After data for each observation are entered, they may be saved on tape or listed on a printer (Fig. 6), in addition to being used to update a matrix saved in memory. After the last observation has been saved on tape, the value of –9999 is written on tape as an end-of-data marker.

When all data have been entered, the program does some calculations, then displays a table of means and standard deviations for all variables. This and all subsequent display tables may be printed out. You may also display (and print) tables of correlation coefficients, the inverse matrix, and partial correlation coefficients (see Table 1 for explanations).

The correlation coefficient matrix must be inverted before the regression-analysis results can be calculated. Matrix inversion is analogous to taking a reciprocal, and like trying to take the reciprocal of zero, sometimes fails. If this occurs, a "matrix singular" message is given and the program halts. This may be caused by errors in data entry or in transformations; these may leave one variable that is actually constant, or two variables that are the same, or three variables that add up to a constant, and so on.

Both the preliminary calculations and the matrix inversion display changing numbers on the video display, representing the variables being worked upon, to reassure you that the program hasn't hung up. For large problems, these calculations may take several minutes.

Now back to our sample problem: The data that we have just entered appear amenable to a three-variable regression analysis, so let's try it. As shown in Fig. 7, this doesn't work very well; the standard error of estimate of 6.7 is almost the same as the standard deviation of 7.0 of the dependent variable (the "standard error" before the regression was run). An R squared of 0.21 shows very poor predictive ability, and an F ratio of 1.7 (probability of 0.78) indicates a 22 percent chance that equally good results could have been obtained from random data.

What do we do now? Well, we ran a linear regression, and most real data are not linear. One of the easiest ways to introduce non-linearity into the regression is to add power terms; in this case, let's try adding the squares of each of the two independent variables, making a

```
PUT DEPENDENT VARIABLE LAST

RAW VARIABLE NO. 1                  NAME = ? LENGTH....
RAW VARIABLE NO. 2                  NAME = ? WIDTH.....
RAW VARIABLE NO. 3                  NAME = ? _.........
```

Fig. 4. If you choose to assign "Variable Names" to the raw variables, you receive these prompts.

```
ENTER DATA FOR EACH OBSERVATION:
(PRESS <ENTER> TO QUIT)

OBS. NO.   1
  VAR. NO. 1     'LENGTH'          VALUE = ? 2
  VAR. NO. 2     'WIDTH'           VALUE = ? 5
  VAR. NO. 3     'HEIGHT'          VALUE = ? 15
DO YOU WANT TO CHANGE DATA FOR THIS OBS. (Y/N)? _
```

Fig. 5. The data entry prompt shows the observation number, the variable number, and the variable name for each number to be entered.

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five-variable regression. To do this, we use transformations. If we rerun the program and answer Y, we want to use transformations, and Y, we want to enter new transformations, we are shown the set of instructions in Fig. 8.

```
                    Regression Analysis Trials

                     NAMES OF RAW VARIABLES:
     1 LENGTH        2 WIDTH         3 HEIGHT

                     DATA FOR EACH OBSERVATION:
   OBS. NO. 1       1  2          2  5          3  15
   OBS. NO. 2       1  13         2  6          3  22
   OBS. NO. 3       1  7          2  1          3  12
   OBS. NO. 4       1  5          2  10         3  8
   OBS. NO. 5       1  14         2  3          3  12
   OBS. NO. 6       1  6          2  5          3  19
   OBS. NO. 7       1  16         2  1          3  0
   OBS. NO. 8       1  1          2  9          3  3
   OBS. NO. 9       1  4          2  4          3  15
   OBS. NO. 10      1  15         2  8          3  20
   OBS. NO. 11      1  0          2  0          3  5
   OBS. NO. 12      1  10         2  6          3  21
   OBS. NO. 13      1  11         2  7          3  22
   OBS. NO. 14      1  12         2  9          3  20
   OBS. NO. 15      1  3          2  2          3  12
   OBS. NO. 16      1  9          2  4          3  18
   OBS. NO. 17      1  -9999      2  0          3  0
```

Fig. 6. The title, variable names, and data for each observation may be printed out as the data are entered, or as they are being read from tape. The raw data are shown here, but the transformed data could be printed instead. Note that a dummy observation No. 17 has been added to the sample data, with the −9999 end-of-data marker.

```
                  Regression Analysis Trials
NO.IND.VAR.=  2      DEP.VAR.=  3 HEIGHT            NO.OBS.=   16
S.E.EST.= 6.69786   R SQ.=.209760   EQ.F=   1.725   PROB.=0.784
NO. VAR.NAME  BETA COEF.    EQ. COEF.   COEF.F   PROB.  INV.DIAG
 1 LENGTH      0.300947      0.404752    1.474  0.755     1.011
 2 WIDTH       0.315592      0.714453    1.621  0.776     1.011
    EQUATION CONSTANT =      7.189723
```

Fig. 8. The transformation instructions and the current transformation subroutine are shown if you want to enter a different set of transformations.

```
                          TRANSFORMATIONS

TRANSFORMATIONS ARE ANY CALCULATIONS PERFORMED UPON THE DATA TO
CHANGE ITS FORM.   INCLUDED ARE SUCH THINGS AS SQUARES AND CUBES
OF THE VARIABLES, CROSS PRODUCTS, SQUARE ROOTS, LOGARITHMS, ETC.
TO PERFORM THESE CALCULATIONS AUTOMATICALLY ON EACH OBSERVATION
ENTERED, THE APPROPRIATE 'BASIC' STATEMENTS MUST BE ENTERED INTO
THE SUBROUTINE THAT STARTS AT PROGRAM LINE 5000.
BOTH RAW AND TRANSFORMED VARIABLES ARE SUBSCRIPTED VARIABLE 'V'.
I.E., TO ADD VARIABLE 3 TO VARIABLE 4 TO MAKE VARIABLE 5 USE:
                  V(5)=V(3)+V(4)
THE NUMBER OF TRANSFORMED VARIABLES MAY BE GREATER THAN OR LESS
THAN THE NUMBER OF ORIGINAL RAW VARIABLES.   DEPENDENT VARIABLE
MUST BE LAST.   YOU WILL NOW BE SHOWN THE OLD TRANSFORMATIONS,
AND RETURNED TO 'BASIC' TO ENTER YOUR NEW TRANSFORMATIONS.
PRESS ANY KEY TO CONTINUE

5000  '  TRANSFORMATION SUBROUTINE
5010 V(6)=V(3) :V(5)=(V(1)-7)*(V(2)-4.5) :V(4)=(V(2)-5)[2 :V(3)=
V(2) :V(2)=(V(1)-8)[2
9000 RETURN
READY
>_
```

Fig. 7. A first, three-variable regression trial of the sample data, showing very poor fit to the data and poor significance.

```
VAR. NO. 1 NOW = 'LENGTH'          NEW = ? ..........
VAR. NO. 2 NOW = 'WIDTH'           NEW = ? LENGTH SQ.
VAR. NO. 3 NOW = 'HEIGHT'          NEW = ? WIDTH.....
VAR. NO. 4 NOW = ''                NEW = ? WIDTH SQ..
VAR. NO. 5 NOW = ''                NEW = ? HEIGHT_...
```

Fig. 9. If transformations are used, the variable names given when the data were entered will no longer be correct. You are therefore given a chance to change the variable names. If a name does not need to be changed, just press enter and that name will be left unchanged.

If we then replace line 5010 with something like:

```
5010 V(5)=V(3):V(4)=V(2)*V(2):V(3)=V(2)
     :(V2)=V(1)*V(1)
```

we are ready to go, using the raw data that we have already saved on tape. Since we are now using transformations, we are changing the variables that are to be used, and are given a chance to rename the variables (see Fig. 9).

Does this solve the problem? Well, no. As shown in Fig. 10, we have improved the standard error of estimate, the R squared, and the probability. However, the very high values for the inverse diagonal mean that we can't determine the importance (beta coefficients) or the significance (F ratios, probability) of the different variables.

What do we do now? The problem is that the way in which we formed the square terms caused them to be highly correlated with the original variables. If we can eliminate this correlation, we should be all right. One way to do this is to subtract the approximate mean from each variable before squaring it. The ideal value to subtract depends upon the variable's distribution, but that's another story. On this data, it so happens (was planned that way) that subtracting the mean does the trick. That is, make line 5010 in the transformation subroutine look like:

```
5010 V(5)=V(3):V(4)=(V(2)-5)^2
     :V(3)=V(2):V(2)=(V(1)-8)^2
```

Now we get the regression-analysis results shown in Fig. 11. The overall equation statistics are essentially the same, but now the low values for the inverse diagonal show that the beta coefficients and coefficient F ratios (and probabilities) actually give the importance and the significance of their respective individual variables.

Is this the best we can do? There is one more thing that sometimes helps: Check for interactions. See if the effect of one independent variable depends upon the level of another independent variable. To do this we form the product of the two variables and use the product as an additional independent variable. As before, we should subtract the approximate mean from each variable prior to multiplication to reduce the correlation between each variable and its product. The transformation equations to form this six-variable regression from the original three variables are shown in the Program Listing, line 5010. Note that the best values to subtract are slightly different

```
                    Regression Analysis Trials
NO.IND.VAR.=  4        DEP.VAR.=  5 HEIGHT             NO.OBS.=   16
S.E.EST.= 4.40458    R SQ.=.710835    EQ.F=    6.760    PROB.=0.994
NO.  VAR.NAME    BETA COEF.      EQ. COEF.     COEF.F     PROB.   INV.DIAG
 1 LENGTH         1.630431        2.192807      4.805   0.951     21.044
 2 LENGTH SQ     -1.477005       -0.120116      4.130   0.935     20.092
 3 WIDTH          1.942440        4.397385      8.068   0.985     17.790
 4 WIDTH SQ      -1.775188       -0.386407      7.113   0.979     16.854
    EQUATION CONSTANT =          -1.641156
```

Fig. 10. A second, five-variable regression trial of the sample data, showing a better fit than Fig. 7 due to the addition of non-linear "square" terms to the independent variables.

```
                    Regression Analysis Trials
NO.IND.VAR.=  4        DEP.VAR.=  5 HEIGHT             NO.OBS.=   16
S.E.EST.= 4.40458    R SQ.=.710835    EQ.F=    6.760    PROB.=0.994
NO.  VAR.NAME    BETA COEF.      EQ. COEF.     COEF.F     PROB.   INV.DIAG
 1 LENGTH         0.201460        0.270948      1.428   0.744      1.081
 2 LENGTH SQ     -0.373613       -0.120116      4.130   0.935      1.286
 3 WIDTH          0.235581        0.533318      1.930   0.810      1.094
 4 WIDTH SQ      -0.487776       -0.386407      7.113   0.979      1.272
    EQUATION CONSTANT =          15.706446
```

Fig. 11. A third, five-variable regression trial of the sample data, showing reasonable inverse diagonal values and accurate statistics on the variables.

```
                    Regression Analysis Trials
VAR. NO.          VAR. NAME            MEAN              STD. DEVIATION
   1              LENGTH             8.00000               5.21536
   2              LENGTH SQ         25.50000              21.81743
   3              WIDTH              5.00000               3.09839
   4              WIDTH SQ           9.00000               8.85438
   5              LEN X WID          2.06250              17.27800
   6              HEIGHT            14.00000               7.01427
```

Fig. 12. Final, six-variable regression results, showing the means and standard deviations of each variable. An interaction or cross-product term has been added, LEN X WID.

for the interaction term than for the square terms.

The final regression-analysis results are shown in Figs. 12, 13, 14, 15, and 16. The correlation coefficients in Fig. 13 show that there is zero correlation between each original independent variable and its square, and low correlation between each original independent variable and its product. Each variable is, of course, perfectly correlated to itself. The partial correlation coefficients of Fig. 15 show the difference between correcting for the effects of other variables versus ignoring them (Fig. 13).

The actual regression analysis, Fig. 16, shows far better results than any previous trial. The standard error of estimate is now less than 1.0 (versus 4.4 previously), and the R squared of 0.98 shows that over 98 percent of the variation of the dependent variable is now explained by the regression equation (versus 71 percent on the previous trial). The inverse diagonal elements are still near 1.0, indicating that the beta coefficients, coefficient F ratios, and probabilities are reliable.

Now that we have a good regression analysis of this data, we should check the residuals to see if any individual observation is in error. It is always possible that the value recorded for some variable is incorrect. To check this, let's examine the residuals, Fig. 17. To get these results, the program must reread the original raw data from tape and calculate the dependent variable as estimated from the regression equation. The residual is the difference between the measured and estimated values of the dependent variable, while the normalized residual divides the difference by the standard error of estimate, to put the residuals into a normal distribution scale. This should have 68 percent of its values between -1 and $+1$, 95.5 percent between -2 and $+2$, and only 0.3 percent outside the -3 to $+3$ range.

As you can see by looking at the last column in Fig. 17, approximately the correct number of normalized residuals (four versus an ideal five) are outside the -1 to $+1$ range, and none are very large. This is quite reasonable for this small number of observations.

Ideally, the sum of all the residuals should be zero. Since computer calculations are not perfectly accurate, we can only expect the sum of residuals to be a very small number. The -14 exponent to the sum of residuals in Fig. 17 does show that the value is close to zero. (The decimal point of the number must be moved 14 places to the left.)

After the residuals analysis is complete, the listing of the transformations used is printed out, see Fig. 17 (if both printer and transformations were used).

Evaluating Regression Results

In this sample problem, we had to add variables to the regression in order to get a satisfactory result. It is equally

```
                     Regression Analysis Trials
                 SIMPLE CORRELATION COEFFICIENT MATRIX
1 1   1.000000   1 2  0.000000   1 3  0.103140   1 4 -0.220881   1 5 -0.011837
1 6   0.333498
2 2   1.000000   2 3 -0.241621   2 4  0.388240   2 5 -0.069945   2 6 -0.619909
3 3   1.000000   3 4  0.000000   3 5  0.004359   3 6  0.346632
4 4   1.000000   4 5 -0.002832   4 6 -0.677326
5 5   1.000000   5 6  0.550364
6 6   1.000000
```

Fig. 13. Final, six-variable regression results, showing correlation coefficients of all pairs of variables. Note that the correlation of each original variable with its square is zero, and that the correlation of each original variable with its cross-product is low, due to the subtracting of constants before forming these terms.

```
                     Regression Analysis Trials
               INVERSE OF MATRIX PLUS BETA COEFFICIENTS
1 1   1.080990   1 2 -0.150953   1 3 -0.147984   1 4  0.297387   1 5  0.003725
1 6   0.203412
2 2   1.292870   2 3  0.327581   2 4 -0.535043   2 5  0.085700   2 6 -0.328689
3 3   1.094340   3 4 -0.159821   3 5  0.015939   3 6  0.243936
4 4   1.273330   4 5 -0.029600   4 6 -0.503292
5 5   1.005890   5 6  0.527293
6 6   1.000000
```

Fig. 14. Final, six-variable regression results, showing inverse matrix of the independent variables plus the beta coefficients. Note that the values are of roughly similar magnitude, indicating a well conditioned matrix.

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common to delete variables. But how do we know which variables to delete? That is easy; just look at the F ratio for each coefficient. If it is less than 1.00, that variable should always be deleted, as its inclusion will increase the standard error of estimate (even though it will *always* improve the R squared).

If it is greater than 1.00, you must use your judgement: How confident are you that the variable is actually significant? If you want to be 90 percent sure, use only those variables whose probability is 0.900 or higher. If it's lower, delete that variable and rerun the regression. Now aren't you glad that you saved the original data on tape? A number of runs may be needed to finally get a satisfactory regression.

Sometimes we have variables to evaluate that are not readily expressed as numbers—four different types of treatment, for example. How do we handle that? We could call them treatments 1, 2, 3, and 4, and then use linear, square, and cubic terms. A much better way is to set up three dummy variables, and then consider one of the treatments as "standard." Then if treatment 1 is used, all three dummy variables are set to zero; if treatment 2 is used, the first dummy variable is set to one, and the others zero. If treatment 3 is used, the second dummy variable is set to one, and the others zero. If treatment 4 is used, the third dummy variable is set to one, and the others zero. This can be done easily by using the transformation subroutine. Then the magnitude and significance of the difference of each of the other treatments from the "standard" treatment 1 is readily determined.

On your own problems, if some individual observations are outliers (have very large residuals), and appear to be in error, you may wish to rerun the regression analysis without them. To make this easier, it is possible to delete up to 50 different observations as the data are being read from the tape. These observations are noted as deleted on all outputs.

```
                Regression Analysis Trials
           PARTIAL CORRELATION COEFFICIENT MATRIX
 1 2  0.127689   1 3  0.136059   1 4 -0.253478   1 5 -0.003572
 2 3 -0.275400   2 4  0.417005   2 5 -0.075150
 3 4  0.135390   3 5 -0.015191
 4 5  0.026155
```

Fig. 15. Final, six-variable regression results, showing partial correlation coefficients of all pairs of independent variables. Note that these differ somewhat from those shown in Fig. 13, due to the complex interrelationship between variables.

```
                  Regression Analysis Trials
NO.IND.VAR.=  5      DEP.VAR.=  6 HEIGHT          NO.OBS.=   16
S.E.EST.= .970175   R SQ.=.987246   EQ.F= 154.815   PROB.=1.000
NO. VAR.NAME  BETA COEF.     EQ. COEF.    COEF.F   PROB.  INV.DIAG
 1 LENGTH      0.203412       0.273574   30.011  1.000    1.081
 2 LENGTH SQ  -0.328689      -0.105673   65.520  1.000    1.293
 3 WIDTH       0.243936       0.552233   42.634  1.000    1.094
 4 WIDTH SQ   -0.503292      -0.398699  155.976  1.000    1.273
 5 LEN X WID   0.527293       0.214063  216.726  1.000    1.006
    EQUATION CONSTANT =      14.891686
```

Fig. 16. Final, six-variable regression results, showing very good fit of the regression equation to the data, and very good significance of independent variables. Note that a probability of 1.000 does not mean certainty that the results could not have been obtained by chance from random data, but only better than a 0.9995 probability (due to rounding).

```
                    Regression Analysis Trials
                RESIDUALS OF DATA VS. ESTIMATES
OBS.#   DEP.VAR.   EST.DEP.VAR.    RESIDUAL        NORMALIZED
   1     15         13.8606         1.13938         1.17441
   2     22         20.6476         1.35241         1.39399
   3     12         10.8741         1.12591         1.16053
   4     8          8.50867        -.508673        -.524311
   5     12         12.7317        -.731744        -.754239
   6     19         18.7646         .235427         .242664
   7     0         -.0641159        .0641159        .066087
   8     3          2.79851         .201489         .207683
   9     15         16.4265        -1.42654        -1.4704
  10     20         20.6407        -.640652        -.660347
  11     5          4.90412         .0958779        .0988254
  12     21         21.0827        -.0827178       -.0852607
  13     22         21.3614         .638591         .658223
  14     20         19.8911         .108861         .112208
  15     12         12.7274        -.727388        -.749749
  16     18         18.8444        -.844352        -.870309
             SUM OF RESIDUALS = -3.59712E-14

                    Regression Analysis Trials
5000  '  TRANSFORMATION SUBROUTINE
5010 V(6)=V(3) :V(5)=(V(1)-7)*(V(2)-4.5) :V(4)=(V(2)-5)[2 :V(3)=V(2) :V(2)=(V(1)
-8)[2
9000 RETURN
```

Fig. 17. Final, six-variable regression results, showing comparison between the actual values of the dependent variable and those predicted from the regression equation, Fig. 16. Note that the transformation subroutine is printed following the last regression printout to give a permanent record.

Now that we have a good regression, what do we do with it? We can look at the beta coefficients to see which independent variables are important to the dependent variable (have greatest effect). A beta coefficient of 0.5 indicates that as that independent variable moves one standard deviation, the dependent variable will move 0.5 of its standard deviation. (A beta coefficient greater than 1.0 indicates an error in how the regression was run.) The coefficient F ratio and its probability then measure the significance of the effect shown by the beta coefficient. It is possible to have high importance with low significance, or the opposite.

Perhaps you want to see what value the dependent variable is estimated to have at some level (or levels) of the independent variables. You could calculate this manually, adding the equation constant, plus variable one times equation coefficient one, plus variable two times equation coefficient two, and so on.

This becomes tedious and error prone, especially if transformations were used. Why not let your computer do it? It's much simpler to key in synthetic data with the desired values for the independent variables, and save it on tape as a raw data file. Then use this synthetic data in place of the real data for a residuals analysis. While the other values will be meaningless, the Estimated Dependent Variable column will have the desired values.

A plot of the sample problem made in this way is shown in Fig. 18. Now you can visualize what the data mean.

A caution: Assuming that your regression equation is quite significant with an overall probability of nearly 1.0, interpolation (predictions with values within your data set) is fairly reliable. However, extrapolation (predictions using values beyond those included in your data set) becomes increasingly uncertain as you leave your known area.

Program Limits

Up to 9999 observations may be used. This limit is due to the formatted space for printing the observation number, not to a calculation limit. I thought that few users would wish to key in over 9999 observations!

On a 16K TRS-80, up to 13 variables (including the dependent variable) may be entered, or formed by using the transformations. If you need more, and do not wish to use transformations, you may delete lines 3350–9000 of the program, then enter up to 18 variables. If that still isn't enough, you may use the standard program compression techniques, such as deleting all spaces within the program and deleting all remarks. However, do not delete the lines containing the remarks, as they are referenced by GOTOs and GOSUBs.

A 32K TRS-80 tape system can accommodate up to 45 variables, and a 48K up to 63 variables. Disk systems hold fewer variables: 53 for a 48K disk system.

Actually, it would not be too practical to key in and run such large problems directly, due to the time delay to update the matrix after each observation has been entered. With 13 variables, it takes about four seconds to update the matrix for each observation. This time increases approximately as the square of the number of variables, to nearly a minute for 45 variables. A better way would be to use the transformation option to form a dummy three-variable matrix from your 45 variables while you are keying them in and recording them on tape. Then you can be doing something else while the program reads in all of the observations from tape and forms the matrix you will use.

"This program checks the available memory, then dimensions arrays and clears string space to fit."

Matrix inversion also takes appreciable time for large problems. While a 13-variable matrix will invert in only about 75 seconds, a 45-variable matrix requires nearly an hour; the time increases approximately as the cube of the number of variables.

Calculation accuracy should not be a problem with this program.

Calculations

The calculation of regression analyses is very subject to error. On ordinary-looking data, the results may end up having *no* significant digits accuracy. This is due to the very large number of calculations involved, especially those of subtraction. If even a little inaccuracy occurs during each calculation, a substantial error can accumulate.

If two numbers of widely varying magnitude are subtracted, the result is accurate only to the extent that the significant digits of the two numbers overlap. Conversely, if two numbers that are almost identical are subtracted, the result is accurate only to the extent that the leading digits of the two numbers are different.

In this program, two methods are used to improve accuracy: The most obvious is to use double-precision calculations. This increases the accuracy potential from six to 16 digits. In addition, accurate algorithms are employed. These methods seem self-evident, but are often ignored.

As an example of more accurate algorithms, this program does *not* accumulate a sums-of-squares-and-cross-products matrix, then try to invert it. Instead, the matrix is adjusted for each added observation, then converted to a correlation coefficient matrix before inversion. This minimizes both subtraction inaccuracies mentioned above.

In calculating standard deviations and correlation coefficents, it is necessary to find double-precision square roots. Since the Basic functions are only single precision, an iterative routine based on Newton's method is used to correct the square roots to 16-digit accuracy.

Though most calculations are in double precision, many results are given in single precision for output formatting; even though two to six digits accuracy are commonly lost during calculations, the results given will be correct.

For convenience, this program checks the available memory, then dimensions arrays and clears string space (for names of variables) to fit. This not only allows the program to be used unchanged for 16K, 32K, and 48K TRS-80s, but it also automatically adjusts for any machine-language printer driver, long transformation subroutine, and so on that you may be using.

The CLEAR 50 statement in lines 2560 and 2570 reduces the string space back to normal so the next program won't crash. ■

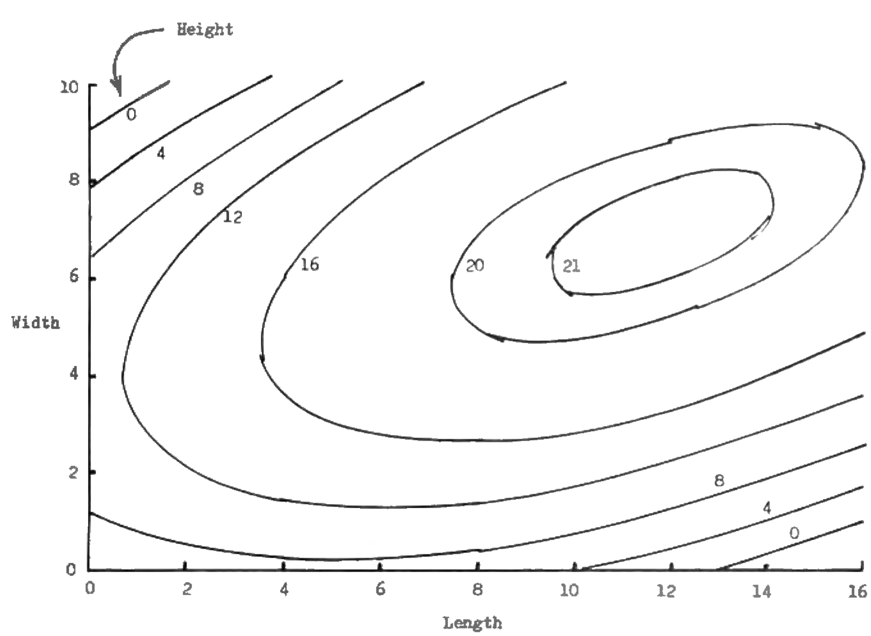

Fig. 18. Contour plot of the surface generated by the regression equation of Fig. 16. This gives a visual indication of what the sample data represented and shows why the preliminary trials failed to fit the data.

Delmar Hinrichs (2116 S.E. 377 Ave., Washougal, WA 98671) is a research chemist.

This month add 32K RAM.

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Add 32K memory to your 16K RAM Model I, Level II TRS-80 for a full 64K TRS-80: 16K of ROM, video memory, and reserved/keyboard addresses; and 48K of RAM. Combine this project with the Centronics-compatible printer interface (presented last month) or disk controller projects (to be presented next month) or use it alone with the TRS-80 to enhance the operation of your favorite programs.

Consider Scripsit: While Radio Shack advertises that the tape version of Scripsit functions with a 16K Level II system, they do not mention that 16K allows only about one page of text in resident memory at a time. You can output each text page to cassette as you type to accrue many pages, but manipulative ability (for example, global commands) is limited to the text currently in RAM. With this modification, you can store over eight pages of text in memory using Scripsit.

All circuitry for the modification (except the power supply) is contained on a single printed circuit (PC) board plugged into the 40-pin keyboard connector. You do not need to cut any TRS-80 circuit traces. If you have the older style keyboard (identified by key tops parallel to the desk top rather than contoured toward the operator) you may mount the circuit board inside the keyboard cabinet. The modification requires 16K of resident RAM; the 4K RAM addressing scheme is incompatible with this circuit. You can also install ½ the total RAM capacity now (doubling existing 16K RAM) and add the other half later.

The Key Box
Basic Level II
Model I
16K RAM

How the Circuit Works

The heart of this circuit is the 4116 random access memory (RAM) device. It is arranged in a 16K bit (actually 16,384 bit) by 1 bit pattern and has 16K storage bins for single binary bits. By applying a particular address to the 4116's seven address lines (A0–A6) we can access any individual storage bin. We may store a logic high or logic low bit at this address (i.e., write into this location) or see what is already stored there (read from this location). Since there are eight bits per byte in the TRS-80 eight RAMs allow 16K storage bins for the eight bit words.

To minimize the number of pins on the 4116 integrated circuit (IC), a multiplexing scheme is used for addressing. Storage bin selection is arranged in a column and row matrix. Figure 1 illustrates this arrangement. The row decoder decodes the row address coming from A0–A6 when told to do so by the row address strobe (RAS) signal. Seven address lines allow 128 possible binary combinations; each combination activates one of the 128 row decoder output lines. The column decoder activates the appropriate column output line.

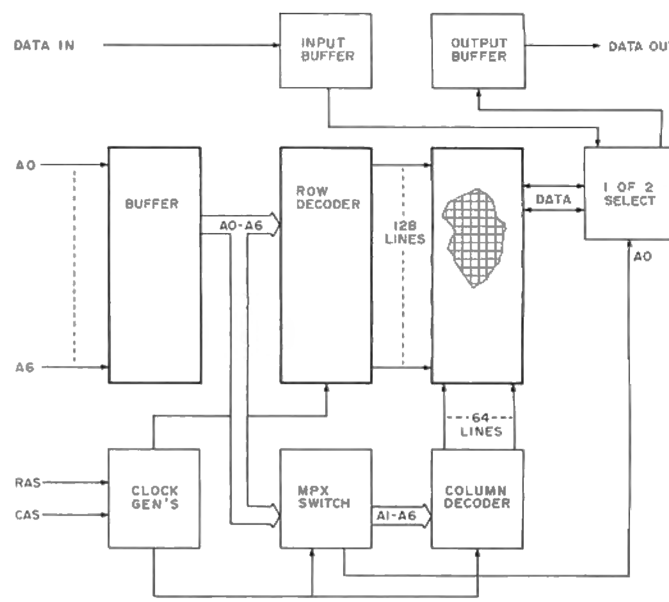

Fig. 1. Multiplexed addressing of the 4116 RAM

RAM Group	Lowest binary address for each group MSB … LSB																Highest binary address for each group MSB … LSB																Equivalent Decimal Address Range
	A15	A14	A13	A12	A11	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1	A0	A15	A14	A13	A12	A11	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1	A0	(Base 10)
(R/S Provided)	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	16384-32767
Lower (New)	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	32768-49151
Upper (New)	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	49152-65535

Table 1. A14/A15 status with respect to RAM group selection

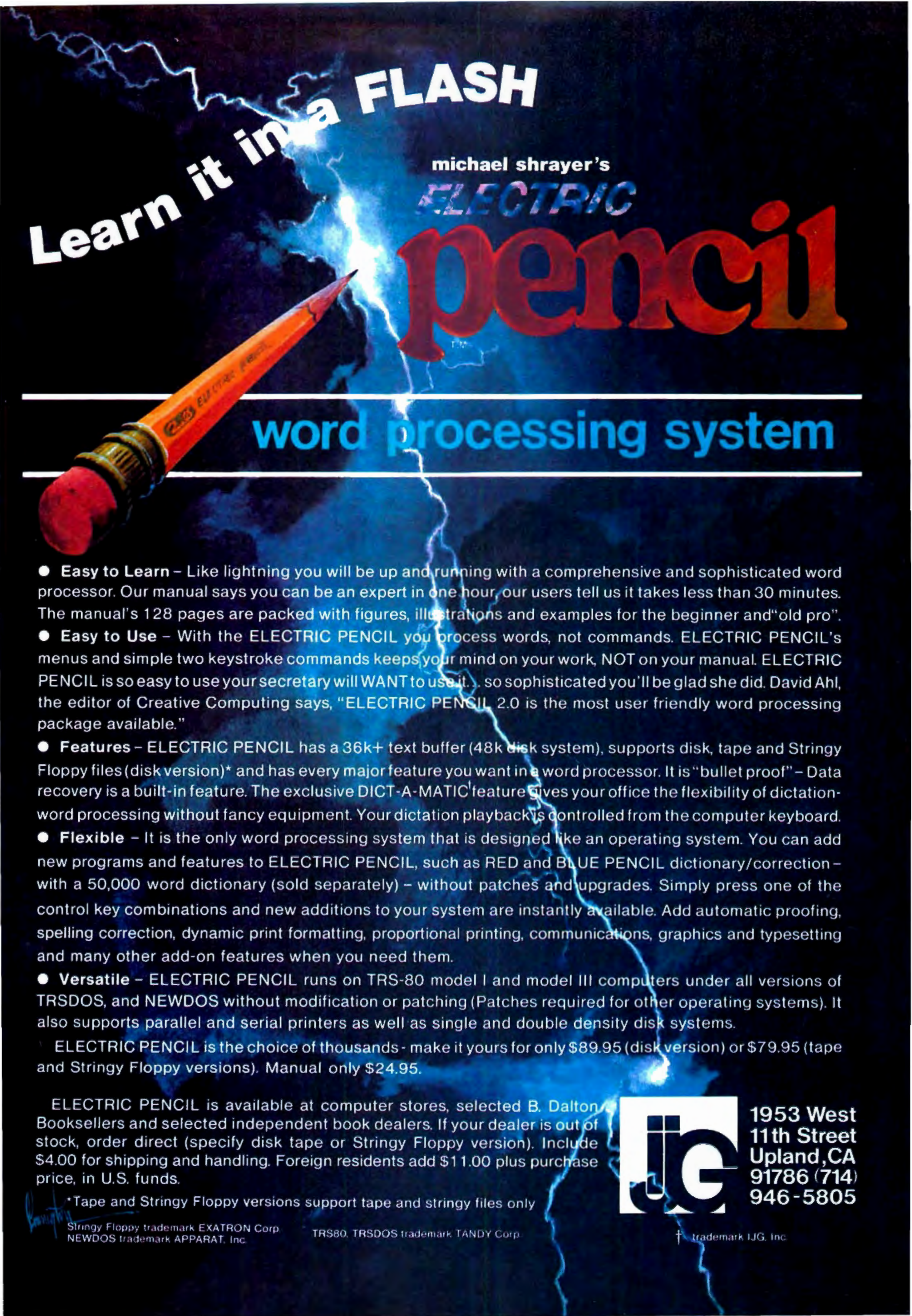
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Table 2. Parts List

32K Memory Board

U1–U16	TMS-25 or equivalent (use of "super fast" versions is not recommended)
U17,25	74LS367 IC
U18	74LS32 IC
U19	74LS00 IC
U20,26	74LS157 IC
U24	74LS139 IC
U27	74LS175 IC
R1–R4	4.7K ohm, ¼ W resistor
R12–19,22	1K ohm, ¼ W resistor
C15,18,21	10 uF, 16 V, tantalum capacitor
C11–14,16,17, 19,20,22	.1 uF, 50 V, mylar capacitor
C23,24,25,26	.1 uF, 50 V, ceramic disc capacitor
R20	270 ohm, ¼ W resistor
R21	470 ohm, ¼ W resistor

Power Supply

U21	LM340T-5 IC
U22	LM311N IC (do not substitute)
U23	LM340T-12 IC
SCR1	R122B (R/S 276-1067 or equivalent) SCR
LED1	diffused, red (Digikey NSL5053 or equivalent) LED
Z1	5.1 V, 5%, ½ W (1N5231B) zener diode
Z2	4.3 V, 5%, ½ W (1N5229B) zener diode
Z3	6.2 V, 5%, 1 W (1N4735) zener diode
C1	4700 uF, 25 V, electrolytic capacitor (or (2) 2200uF caps.)
C2	220 uF, 25 V, electrolytic capacitor
C3	220 uF, 10 V, electrolytic capacitor
C4	4.7 uF, 10 V, electrolytic capacitor
C5	.001 uF, 25 V, mylar capacitor
C6–C9	.1 uF, 50 V, ceramic disc capacitor
C10	10 uF, 25 V, electrolytic capacitor
R5,6	390 ohm, ½ W resistor
R7	2.2K ohm, ¼ W resistor
R8	1.2K ohm, ¼ W resistor
R9,11	1K ohm, ¼ W resistor
R10	100K ohm, ¼ W resistor
R23,24	10K ohm, ¼ W resistor
D1–D3	1A, 100 PIV, diode (1N4002 or equivalent)
T1	25 VAC, 2A center-tapped transformer
F1	1A, 3AG (fast acting) fuse
X1	MPS3705 transistor (general purpose, NPN)
S1	SPST switch

Miscellaneous

PC boards,* power supply cabinet, in-line fuse holder, 5-pin DIN plug/jack, ac line cord, IC sockets (optional—see text), hardware, heat sinks.

*Readers of *80 Micro* are welcome to use the etch patterns contained in this article to construct the memory add-on for their own personal use only.

Each PC board set consists of etched and drilled epoxy-glass PC boards for the memory add-on and the power supply. (The memory add-on PC board has plated-through holes to facilitate soldering and allow use of sockets.) The cost for each set is $32.95 postpaid *in the U.S.*

A complete kit of parts is also available, including PC boards (but without sockets due to keyboard cabinet height restrictions) as follows: $127.95 for the 32K memory mod; $114.95 for the 16K version, both postpaid in the U.S. These kits are tailored for the older style keyboards, which allow the memory mod PC board to be mounted inside the keyboard cabinet. If you have the newer style keyboard, you may purchase either kit without the power supply cabinet since you will have to provide a larger cabinet to house the memory mod PC board. Simply deduct $3.50 from the appropriate kit price. The cabinet provided in the kit is not pre-drilled.

PVP Industries, P.O. Box 35667, Tucson, AZ 85740.

Arizona residents add 4 percent sales tax.

CONNECTOR PIN NUMBER	32K MEM BD	TRS-80 LOGIC BOARD IC	PIN
25	A0	Z33	8
27	A1	Z33	7
40	A2	Z33	6
34	A3	Z33	5
31	A4	Z33	4
35	A5	Z33	3
38	A6	Z33	2
36	A7	Z33	1
11	A8	Z33	23
17	A9	Z33	22
4	A10	Z33	19
9	A11	Z33	18
5	A12	Z33	21
6	A13	Z35	3
10	A14	Z38	11
7	A15	Z38	9
30	D0	Z68	9
22	D1	Z68	3
32	D2	Z68	5
26	D3	Z68	7
18	D4	Z67	9
28	D5	Z67	3
24	D6	Z67	5
20	D7	Z67	7
15	$\overline{RD}$	Z49	5
1	$\overline{RAS}$	Z68	14
13	$\overline{WR}$	Z49	14
8	GND		

Table 3. TRS-80 logic function cross reference for memory board interface.

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Internal latching of the row address retains the row information while the column address is applied. The intersection of activated row and column lines is the desired address location. A one-of-two selection at the array output completes the selection process. Thus we have 128 times 64 times 2 (16384) possible address combinations using only seven input address lines.

See Fig. 2 for a block diagram and Fig. 3 for a schematic diagram of the memory add-on circuit. The address lines are common to all 16 RAMs, as are the RAS and write (WR) command lines. The RAMs are arranged in two groups of eight, each group operating over a different range of 16,384 addresses. Two column address strobe (CAS) inputs are supplied to the RAMs, one common to each group. This provides the means for selecting a particular group. This group selection technique and the 4116's tristate (capable of high, low, or high impedance states) output characteristic allow the data input and output lines to be paralleled between the two groups. The DO data line is connected in parallel to the DO RAM data input in both groups. All other data input and output lines are connected in a similar fashion.

The TRS-80 address bus is interfaced to the new RAMs via U20 and U26. These devices, called "quadruple 2-line to 1-line data selectors/multiplexers,"

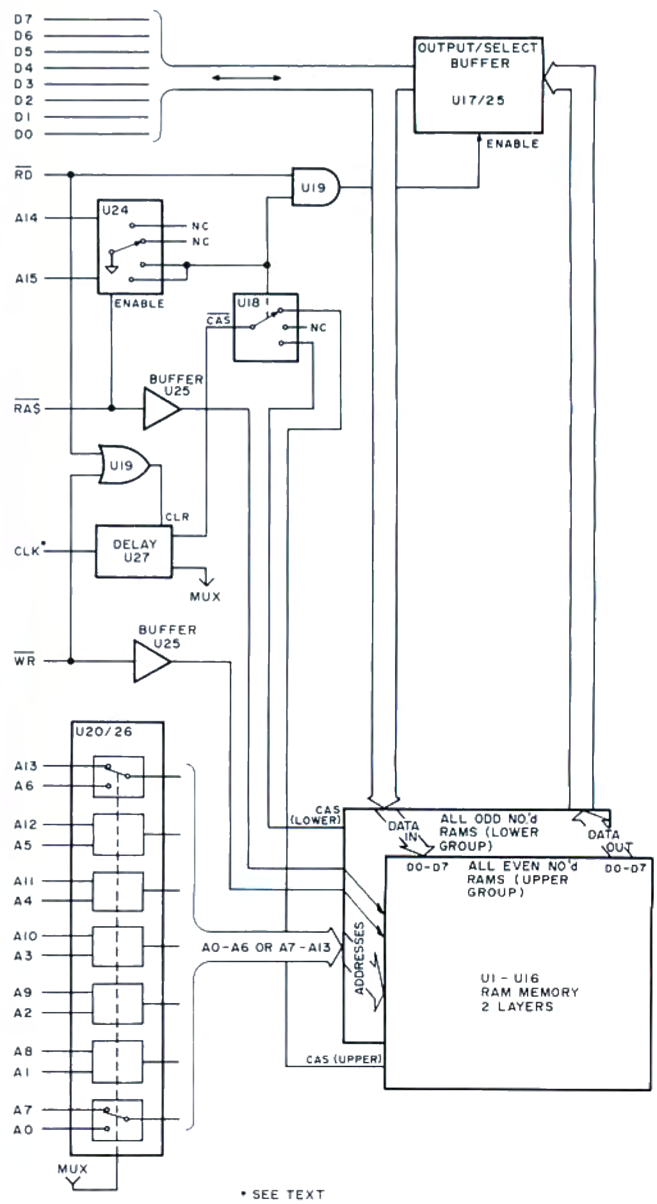
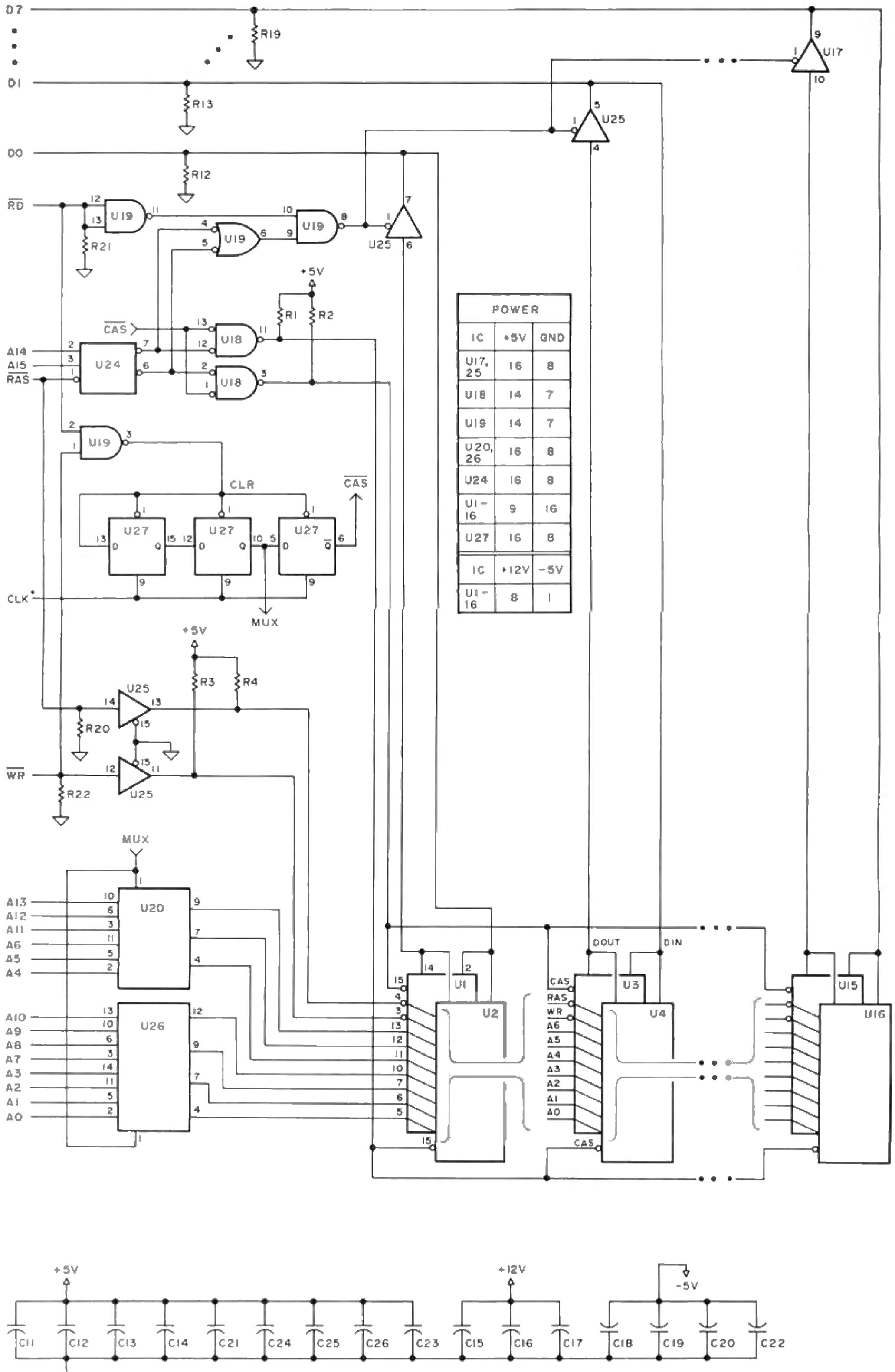


Fig. 2. 32K memory logic circuitry block



POWER		
IC	+5V	GND
U17, 25	16	8
U18	14	7
U19	14	7
U20, 26	16	8
U24	16	8
U1–16	9	16
U27	16	8
IC	+12V	-5V
U1–16	8	1

* SEE TEXT

NOT SHOWN

DATA LINE	RAM NO	OUTPUT BUFFER U17 (PIN NOs)		
		INPUT FROM RAMS	OUTPUT TO TRS-80	ENABLE
D2	U5, U6	12	11	15
D3	U7, U8	14	13	15
D4	U9, U10	2	3	1
D5	U11, U12	4	5	1
D6	U13, U14	6	7	1

Fig. 3. 32K memory logic circuitry schematic

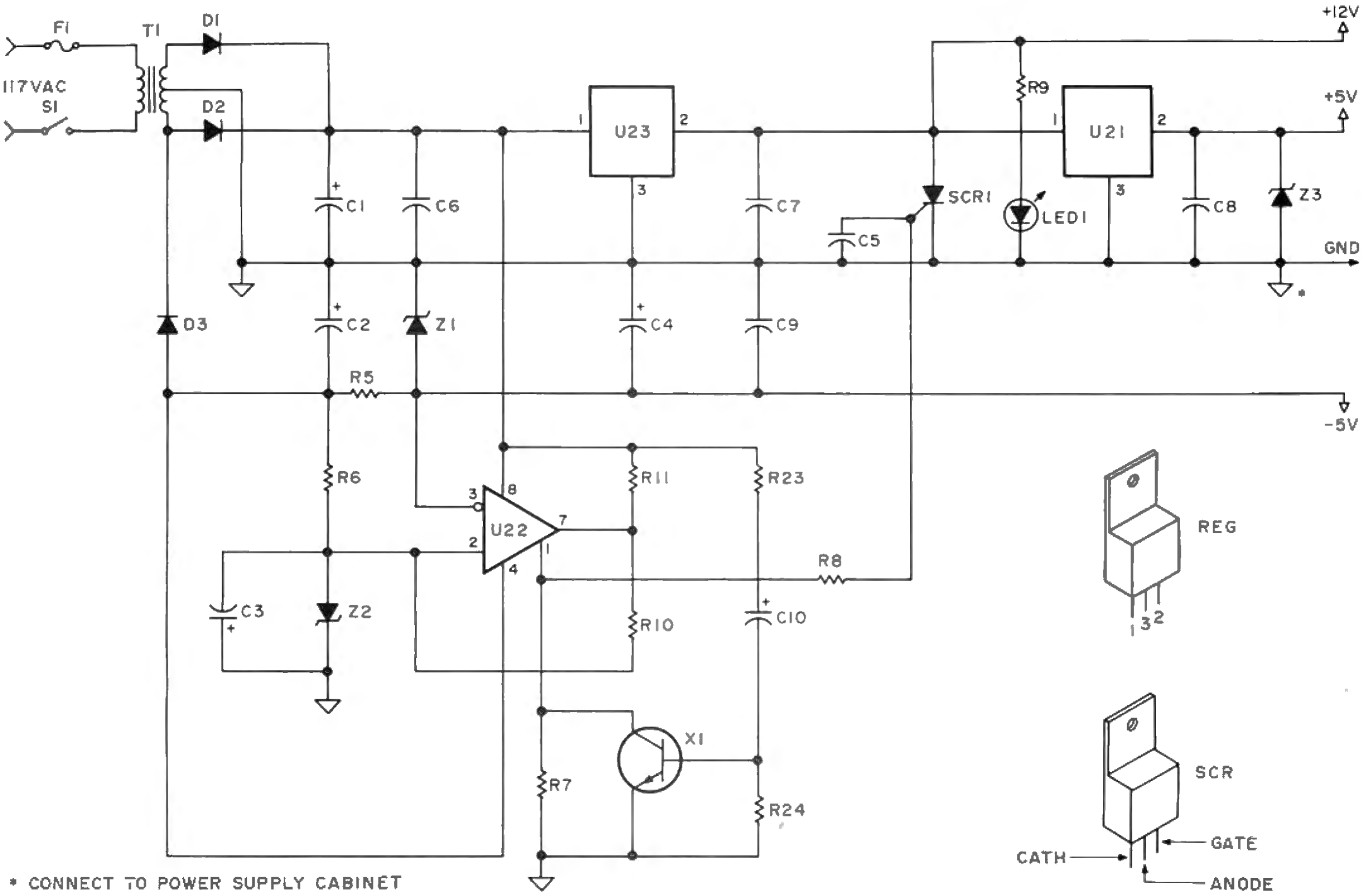


Fig. 4. Power supply schematic

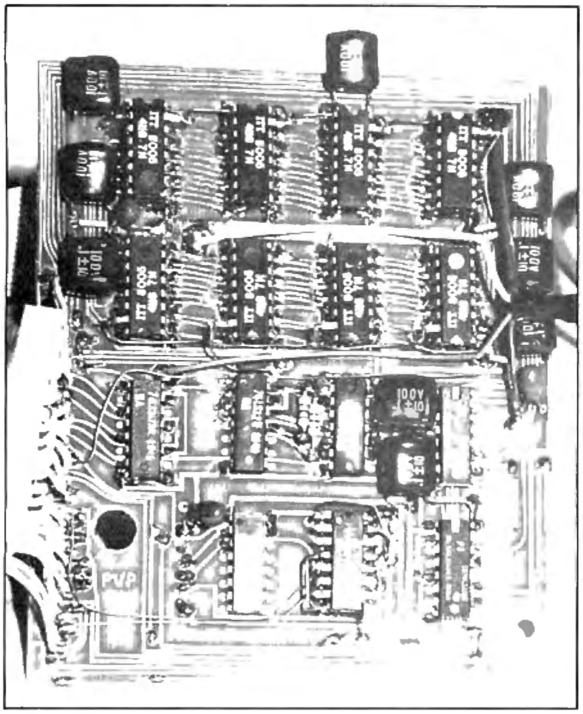


Photo 1. Piggy-back RAM wiring detail

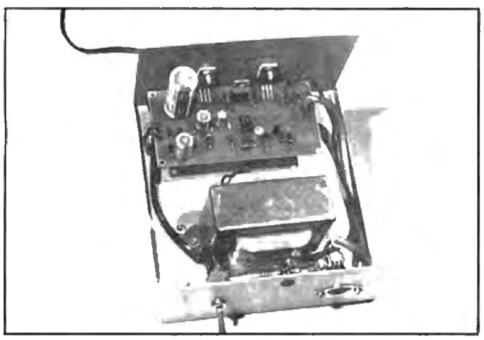


Photo 2. Typical component placement in the power supply cabinet

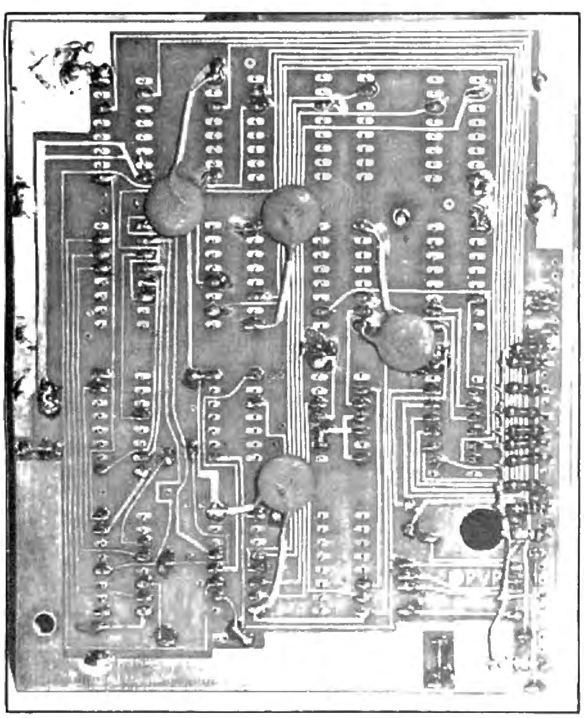


Photo 3. Typical placement of noise-suppression components

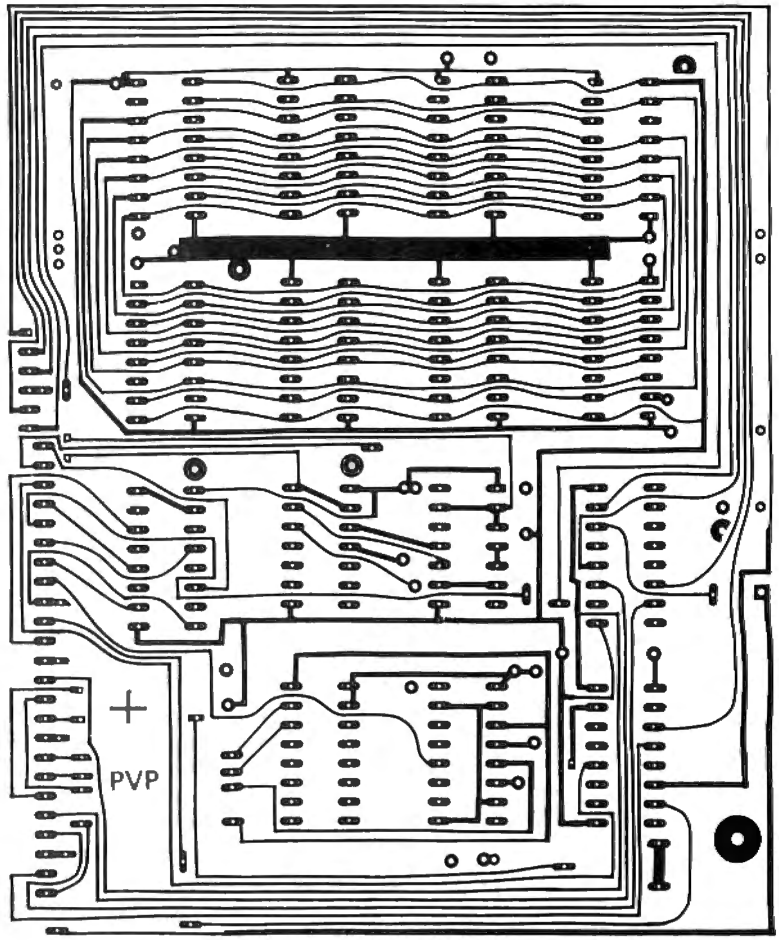


Fig. 5a. Memory board etch pattern, component side

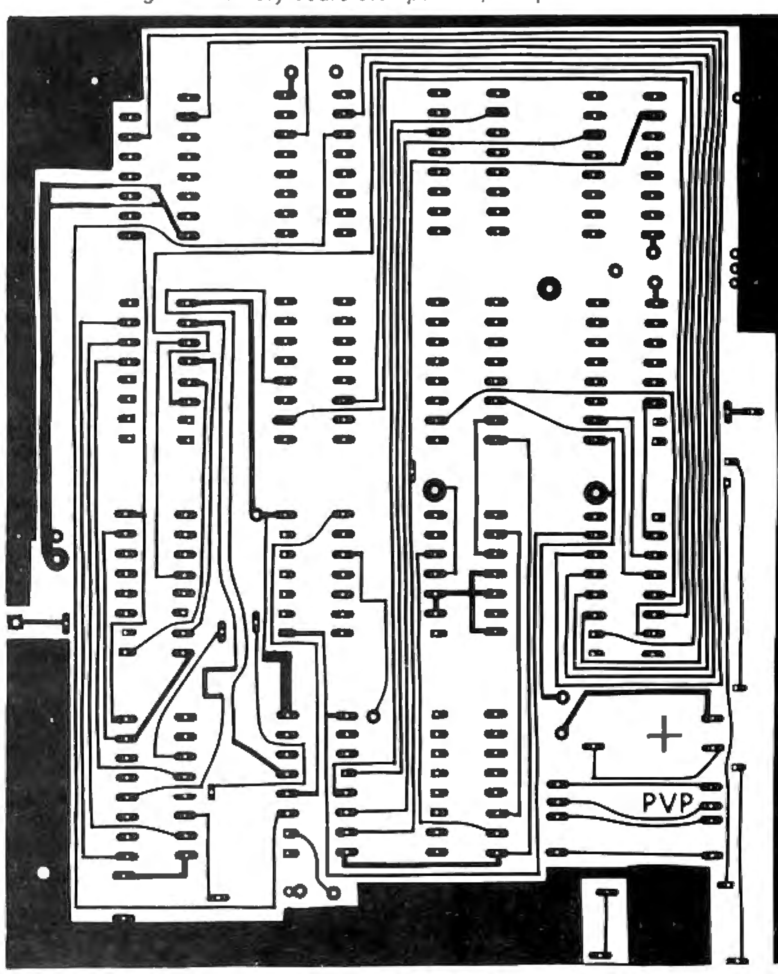


Fig. 5b. Memory board etch pattern, reverse side

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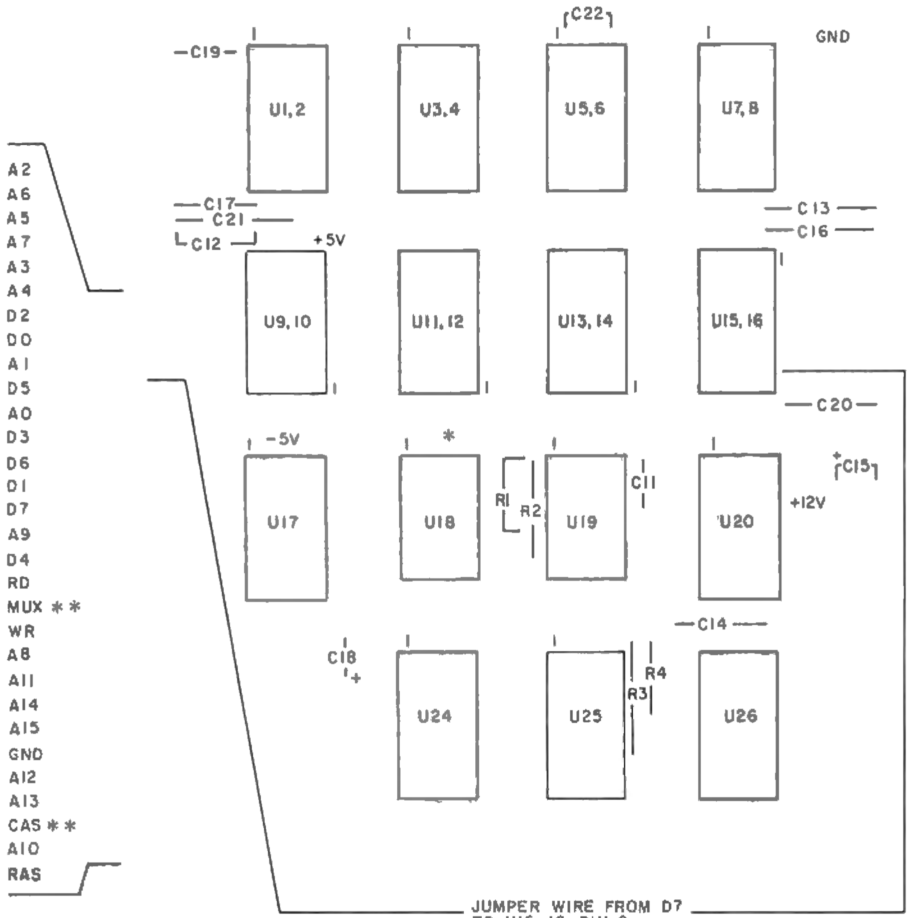

I PIN 1 IC ORIENTATION

* COMMON CONNECTION POINT FROM PIN 15 OF ALL UPPER-GROUP *RAMs*.

** NOT USED FOR RIBBON CABLE ATTACHMENT. SEE FIG. 6b AND TEXT.

Fig. 6a. Memory board parts placement and external connections. See Fig. 6b for U27 placement. Drill a 5/16-inch hole at the + location to allow passage of a keyboard housing post through the board. The large donut in the lower right corner denotes a board attachment site if the 32K mod will not be housed in the keyboard cabinet. Note that pin 1 orientation of IC's U9–U16 is opposite to that of the other ICs.

act like switches. For U20, picture the output pins 4, 7 and 9 as wipers of a 3-pole, double-throw (3PDT) switch. Similarly, picture U26 pins 4, 7, 9, and 12 as wipers of a 4PDT switch. Pin 1 of these ICs controls the position of the switches; since these pins are tied together U20 and U26 function together as a 7PDT switch. The multiplex (MUX) signal alternately provides the RAM address input terminals with A0–A6, then A7–A13. The lower address lines are selected when the MUX line is low, occurring at RAS time. The upper address lines are selected with MUX high, at CAS time.

The RAS input from the TRS-80 is buffered through U25, then directly connected to all RAMs. The CAS and MUX lines are not used due to potential noise and distorted signals by the time they reach the memory add-on board. Instead, new CAS and MUX signals are generated by U27 using existing WR and read (RD), plus a "borrowed" clock signal (more about the clock signal later). U27 is a quad D latch in which three sections effectively produce two delayed versions of the RAS signal. The first to appear is used as the MUX signal, the second is the CAS signal. A section of U19 prevents generation of the MUX and CAS signals unless either WR or RD signals are present. The frequency of the clock source determines the delay between RAS, MUX and CAS.

The new CAS input is divided into two signals. One enables the lower and the other enables the upper RAM group. U24 and U18 perform this function. U24 decodes the A14 and A15 address lines to determine when to enable one of the new RAM groups. The Radio Shack 8-RAM group is enabled for addresses 16384 through 32767. For these addresses A14 is high and A15 is low; thus neither of the new RAM groups are enabled. For addresses 32768 through 49151, A14 is low and A15 is high, enabling the lower RAM group. Addresses 49152 through 65535 result in A14 and A15 high, enabling the upper RAM group. Table 1 illustrates the binary/decimal relationships in these address ranges.

The RD input from the TRS-80 is inverted, then gated through U19 pin 8 before being directed to the enable input of all RAM data output buffers. The gating function prevents either RAM group from outputting data when addresses below 32768 are present. The data lines are bi-directional, providing data to RAMs during the write cycle, and directing data from RAMs during the read cycle.

The power supply is shown in Fig. 4. U22, X1, and SCR1 form a protection circuit for the RAM ICs. The 4116 RAM data sheet states that the −5 volt (V) supply must be applied before and removed after the +12 and +5V supplies. Otherwise, excessive dissipation may destroy the device. During powerup this situation is satisfied by the shorter delay time through the relatively simple −5V supply. During powerdown the very small load current on this supply allows it to drain off slower than the +12 and +5V supplies. But what if the −5V supply fails? The protection circuit provides the answer by sensing impending failure and immediately shutting down the +12 and +5V supplies via an SCR shunt. U22 and X1 function as an extremely fast logic level slicer detecting the failing supply at −4.3V and triggering the SCR.

Construction

The parts list for this project is in Table 2. I recommend a PC board for the 32K memory circuitry. While you could hand-wire or wire-wrap the circuit the wiring is rather complex. Wiring errors might be difficult to troubleshoot dynamically, and could cause IC failures. The power supply wiring is not critical, although the PC board will speed things up a bit.

Figure 5 contains a full-size etch pattern for the memory board (a double-sided PC board). If you decide to build your own include plated-through holes. This facilitates soldering and allows use of IC sockets. If you install the complete 32K RAM, a keyboard cabinet clearance problem could occur unless you use low profile sockets and very careful piggy-back solder techniques to assure minimum *height*. Do not attempt to install sockets on the memory board i

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it does not have plated-through holes; there would be no way to solder the pads on the component side. Without plated-through holes, insert a wire into all pads that do not contain component leads and solder the wire on both sides of the board. (This means of transferring the conductor path from one side to the other would otherwise be handled by the plated-through holes.) Figure 6 is a parts layout guide for the component side of the memory board. You must add several noise suppression components on the other side, as will be shown later. Carefully note the pin-1 orientation of the ICs before soldering. If you use sockets, line up the dot or notch on the socket with Fig. 6 to aid subsequent IC insertion. The RAMs are metal oxide semiconductor (MOS) devices, and must be carefully handled to avoid static electricity. Leave the RAMs in their conductive packaging until you are ready to insert them in the board. Use a grounded soldering iron and avoid shuffling your feet on the carpet.

The RAMs are piggy-backed in groups of two on the circuit board, saving space, and minimizing wiring complexity. (Before installing the upper group of RAMs complete all other construction, installation, and testing to be sure that you have not made any catastrophic errors. This limits your initial liability to eight instead of 16 RAMs.) Once you have plugged in (or soldered) the lower group of RAMs, slightly bend the leads of each upper-group RAM inward to form a snug fit when placed over each lower-group RAM. The only exception is pin 15 of each upper-group RAM, which must be carefully bent outward, perpendicular to the other leads. Once properly oriented over the lower group of RAMs, carefully solder all corresponding pin pairs except pin 15. Use only a minimum of solder (.030 inch or thinner, and a fine-tipped iron) to avoid bridging between adjacent pins. Interconnect pin 15 of all upper-group RAMs using fine gauge #30 or 28 American wire gauge (solid) insulated hook-up wire. Route this common connection to the component-side "donut" pad in Fig. 6. (Photo 1 shows a detail of the piggy-back/pin 15 wiring.) Then connect a jumper from the pad adjacent to U15/16 pin 2 to the pad adjacent to the D7 data line input as shown in Fig. 6a.

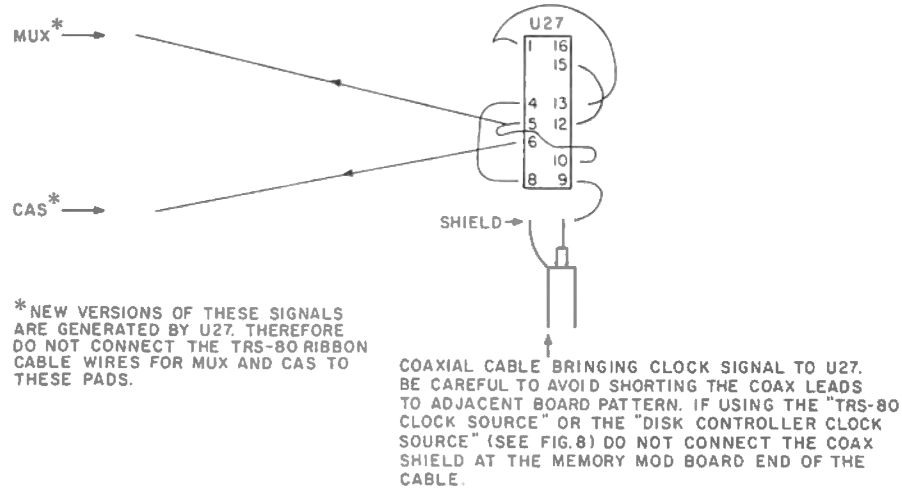


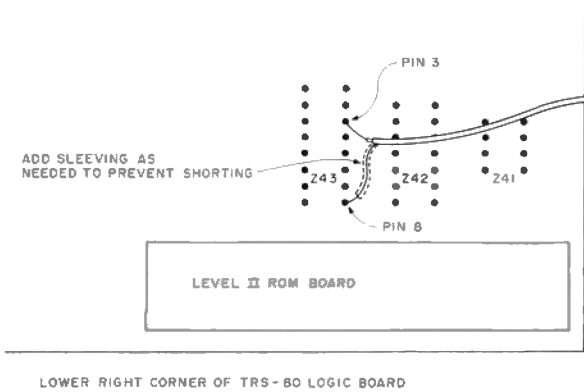
Fig. 6b. Detail connections for U27. The coaxial cable brings clock signal to U27. Avoid shorting the coax leads to adjacent board pattern. If using the TRS-80 or disk controller clock source (see Fig. 7), do not connect the coax shield at the memory mod board end of the cable.

You may add short pieces of insulated sleeving on some of the capacitor leads (depending on size and shape) before installation to prevent leads from shorting against adjacent copper foil traces.

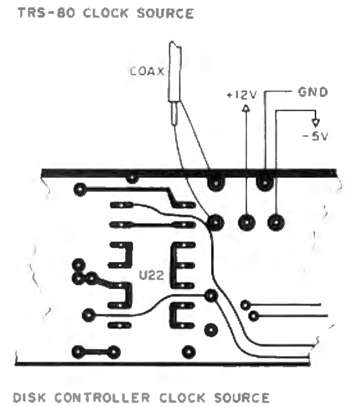
After installing all components shown on Fig. 6a, proceed to Fig. 6b. This figure shows the connections for U27. U27 is piggy-backed over U25, but only pins 8 and 16 (ground and +5V, respectively) are actually soldered to U25. Carefully bend all other pins outward before soldering U27 in place. Pins 2, 3, 7, 11, and 14, not connected to anything, may be trimmed off about one-eighth inch from the IC body. The jumper wire connections going to the MUX and CAS pads are the new MUX and CAS signals generated by U27. It is possible to make the memory mod work properly using TRS-80-generated MUX and CAS signals, but more reliable operation uses the U27 circuitry.

Figure 7 illustrates three methods of obtaining the U27 clock signal. Use the TRS-80 clock source if the memory mod is to be installed in the keyboard cabinet; use the disk controller clock source if the memory mod is to be constructed together with the disk controller (to be presented next month). If the memory mod is housed in its own cabinet, you must build a separate oscillator. Figure 7 is an example—just about any TTL-level oscillator in that frequency range should work.

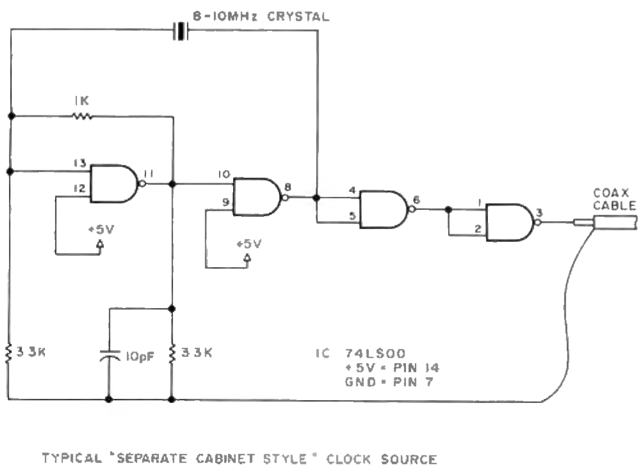
Figure 8 contains a full-size etch pattern for the power supply board. Parts placement is shown in Fig. 9. U21 and U23 require heat sinking but SCR1 does not. The U23 heat sink should allow about 4 watts dissipation. U21 and U23 may be directly mounted to the cabinet to provide the necessary heat sinking. Take care when mounting



a. TRS-80 clock source



b. Disk controller clock source



c. Typical "separate cabinet-style" clock source

Fig. 7. Clock signal sources for U27. Miniature coaxial cable such as RG174 is the preferred means of transferring the clock signal to the memory mod.

the rectifiers, polarized capacitors, ICs, SCR, transistor, LED and zener diodes that the orientation matches that of Fig. 9. R5 and R6 should be mounted about one-quarter inch above the PC board to aid heat dissipation.

Cabinetry for the power supply should be metal for shielding purposes. Photo 2 shows typical placement of the transformer, PC board, LED, and cabling. Mount a solder lug on one of the transformer screws to provide a ground connection from the circuit board to the cabinet. To avoid a ground loop, the power supply ground is isolated from its own 117VAC source, and rather, is tied to the main TRS-80 ground potential.

I chose a 5-pin DIN connector to provide the +5, −5, +12V supplies and ground to the logic board. Capacitors C15, 18, and 21 are memory board filters for local power supply; their values are based on a 30 inch cable length between the power supply and the logic board. Longer cable lengths may necessitate larger capacitance values.

Installation

Do not perform disassembly or internal work of any kind while the TRS-80 is connected to the ac line. Even with the keyboard power switch turned off ac and dc voltages are present in the keyboard housing as long as its external supply is plugged in. Check the no-load power supply voltages at the bare-wire end of the memory mod supply cable with a voltmeter before connection to the memory board. Faulty supply voltages or crossed wires can destroy the IC's; double-check these critical voltages through the entire system up to memory board connection.

Connections to the memory board consist of a power supply cable and a 40-conductor ribbon cable. All memory board connection points are identified in Fig. 6a. Solder appropriate power supply cable wires to the −5V, +5V, +12V, and ground pads. Refer to Fig. 10 and Table 3 to aid installation. Figure 10 shows the proper ribbon cable conductor usage. Only 28 of the 40 conductors are used. Table 3 lists the TRS-80 keyboard connector pin numbers and logic board destinations. After soldering these cables install the noise-suppression components as shown in Fig. 11 and Photo 3. These components include resistors R12 through R22 and capacitors C23 through C26. The memory board fits over one of the keyboard housing posts. No mounting is required, but be certain the cables are dressed to prevent pinching or shorting of the wires.

Operation

This circuit is an integral part of the computer memory hard

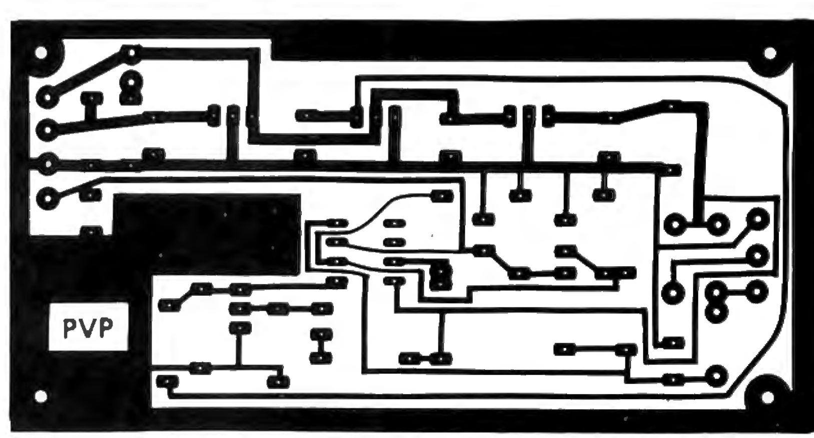


Fig. 8. Power supply etch pattern

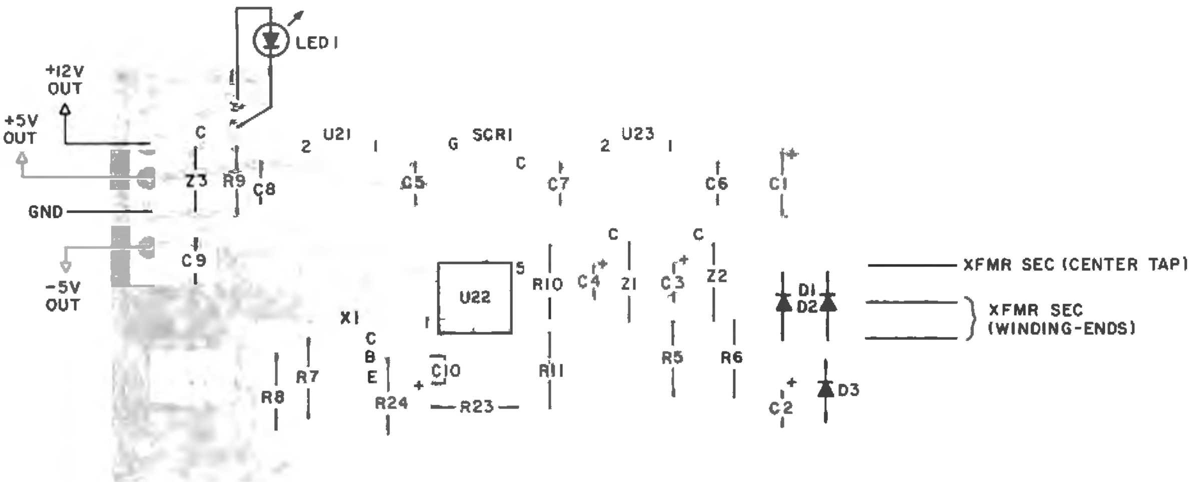


Fig. 9. Power supply parts placement

ware. After powerup the PRINT MEM command should reply with about 31956 for a 16K add-on, and 48340 for a 32K add-on. If it does not, shut down the power immediately and find the cause.

The TRS-80 power switch does not de-activate power to the memory board or completely de-activate power in the TRS-80. All computer-related power cords should be plugged into a common switchable ac power strip, off when the computer is not in use. Do not apply power to the memory add-on by plugging in the ac connector. Power is often connected and disconnected rapidly several times before the plug is fully inserted, causing detrimental voltage transients and conceivably fooling the −5V protection circuitry into firing the SCR. Instead, use a power switch on the power supply cabinet.

Leave it in the off position if you do not need the additional memory during a particular session. The powerup routine in the TRS-80 includes a subroutine to see how much RAM is available for use; subsequently, the TRS-80 ignores any additional memory switched-in via the memory mod power switch. Turn on the memory mod before powering up the TRS-80 whenever you might need the additional storage space.

The power supply LED should always be lit when the memory mod power switch is on, regard-

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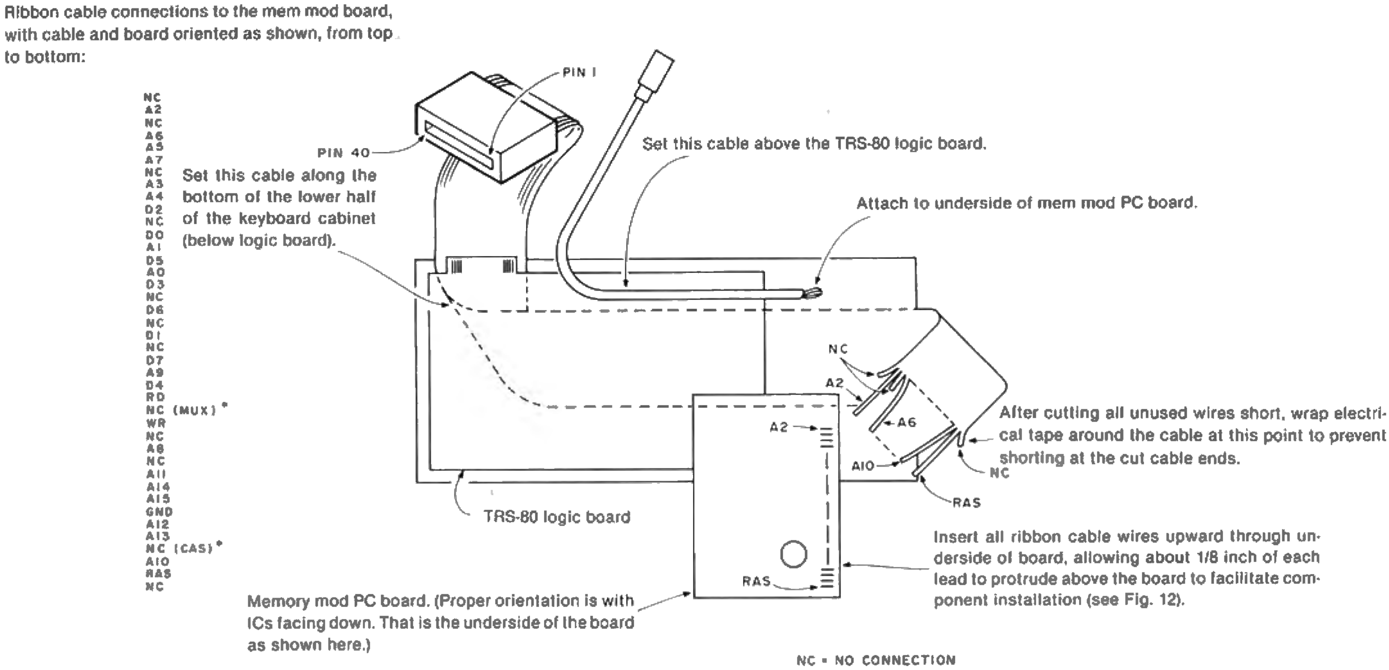


Fig. 10. Ribbon cable conductor usage. Using an insulation-displacement type connector (see the parts list), clamp cable to the connector using an ordinary vise. Total cable length should be 30 inches. The MUX and CAS ribbon wires are not connected to the board. However, MUX and CAS pads are provided on the board and must be skipped over when connecting the ribbon cable. Double-check Fig. 6b for the location of these pads.

Successful construction of this project does not require an extensive background in electronics or computer theory. However, it assumes a basic familiarity with electronic components and careful attention to detail. The importance of careful soldering and visual checkout after soldering cannot be overstated. Follow the instructions in the construction section with regard to RAM installation. Using good lighting and a magnifying glass, inspect each solder connection of the piggyback RAMs to be certain that no solder bridging exists from lead-to-lead or lead-to-copper foil.

less of the operating state of the TRS-80. If the LED is off when ac power is applied the power supply has failed or the memory board is short-circuiting the power supply output. In either case, remove ac power immediately. As with the TRS-80, do not connect or disconnect the memory mod's DIN power supply plug when ac power is applied.

The 32K memory board greatly enhances the power of your TRS-80 for both program and data storage. Welcome to the world of expanded RAM memory! ■

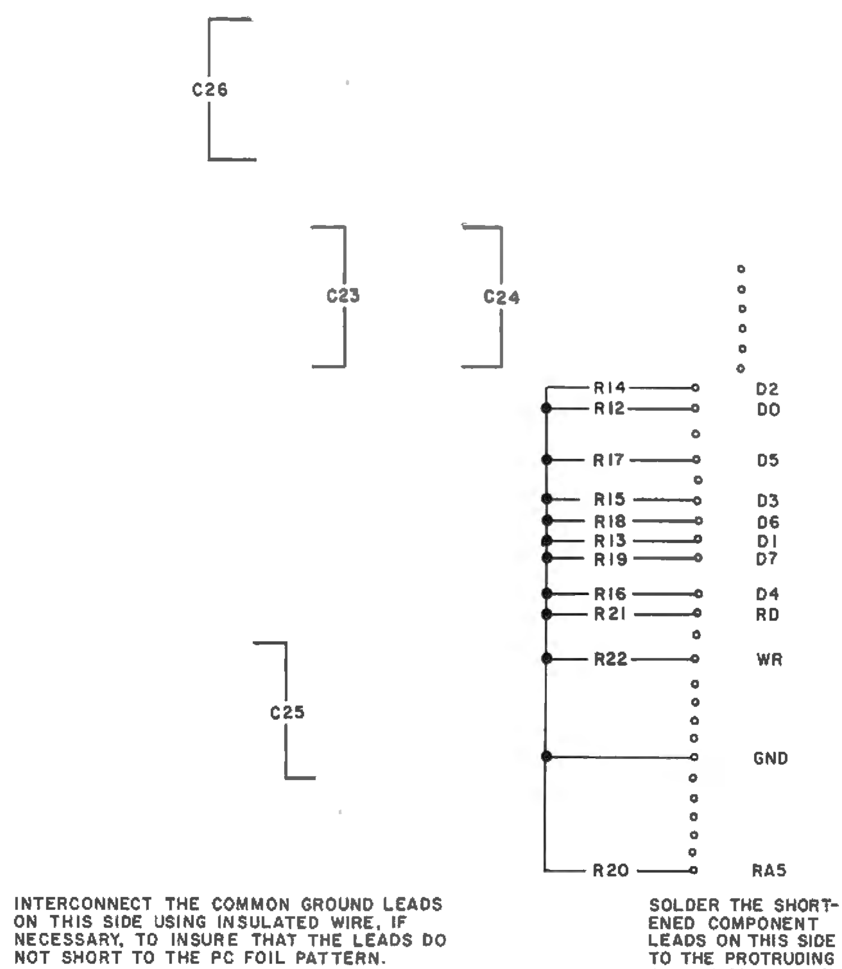
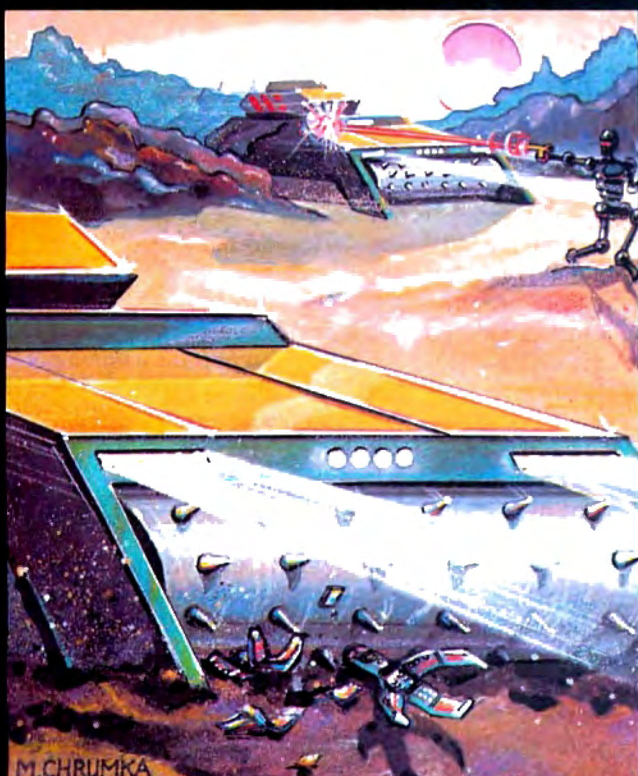


Fig. 11. Noise-suppression component placement. Install these after soldering ribbon cable to the other side of the PC board. Install C23–C26 close to PC board, keeping leads very short.



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The Calculating Genius—Part I

by Rick Cook

Charles Babbage invented the speedometer, the railway cowcatcher, and the occulting lighthouse—as well as the first digital computer.

Pick up any general book on computers and you will find Charles Babbage mentioned in the first chapter. Over and over the books will tell you this 19th-century British mathematician spent 50 years and thousands of pounds attempting to build a mechanical digital computer, but died with his machine unfinished. If you see a picture of one of Babbage's creations, you can easily believe that Babbage was doomed from the start by the complexity of his machine.

Most computer books don't discuss much more about Babbage. After all, Babbage's work led nowhere. When computers were developed, they were built as electrical devices rather than mechanical ones. Babbage is interesting, but he is not part of the mainstream of computer evolution. Questions nag at the curiosity, though. What sort of man was Babbage? How did he propose to build something as complex as a digital computer without electricity? Why did he want to do it? And most tantalizing of all, could it have worked?

The answers range from simple to complex. But one conviction emerges —he was one of the most original and modern thinkers of Victorian science.

Charles Babbage's secret was his modern approach to the science and engineering of the 19th century. His writings contain constant surprises.

A short note at the end of a religious tract outlines the science of dendrochronology (tree-ring dating). A couple of pages in his autobiography give the basic rules for teaching a computer to play a game. A few paragraphs in another book discuss the oxygen process for steel making. In another place he describes how he instrumented a railway carriage to gain information on the roadbed and the forces acting on trains in motion. On the next page he proposes fitting trip recorders to all locomotives to provide a record in case of accidents and to improve economy of operation.

And yet none of it goes anywhere. As brilliant and far-seeing as these notions are, they are not the foundation of later work. Although Babbage was a well known scientist and his books were widely read by other scientists, there was no further development of most of his ideas.

If we limit ourselves to what Babbage actually did and ignore what he conceived, we find his achievements limited to inventing the speedometer, the railway cowcatcher, the opthalmoscope, the occulting lighthouse, and helping to reform British mathematics. That is a respectable list of accomplishments and it earned him a secure niche in the history of science, but it falls far short of what he proposed.

The nature of Babbage's genius is one of the keys to his failures. Like a modern engineer, and unlike most of his contemporaries, Babbage understood the importance of quantifying knowledge, and much of his effort was devoted to doing just that. At a time when most engineering was cut-and-try and most scientists were only beginning to appreciate the advantages of controlled, repeated experiments, his method was not only revolutionary, it was nearly incomprehensible.

Babbage's other problem was that he kept answering questions no one was asking yet. The people around him couldn't understand what the fuss was about. This lack of comprehension plagued all his projects, especially his Analytical Engine.

Only a few of his contemporaries could understand the potential of a digital computer and they were not in any position to help him.

Early Life

Charles Babbage was born December 26, 1791, in London. His father was a member of a merchant banking firm and the family was well off. Young Charles was educated first by a series of tutors and then at a private school. By his early teens he had developed a considerable taste for mathematics, and by the time he entered Cambridge in October, 1810, he was familiar with all three of the notations used for calculus in his day.

There were three notations because three men working independently had developed calculus. Newton and Leibnitz had invented it more or less simultaneously and Lagrange had later gone back to first principles and tried to eliminate some intuitive concepts and make it more rigorous.

One result was that to be fully literate in calculus, you had to be able to work in Leibnitz's notation (dx), Newton's fluxions ($\dot{x}$), and Lagrange's system ($\bar{x}$). This was particularly hard on British mathematicians because they were trained in Newton's system and the most important work was being done in Leibnitz's notation.

This was a thoroughly unsatisfactory situation and Babbage and some of his friends resolved to do something about it. Babbage, George Peacock, John Herschel and several others formed the Analytical Society for the purpose of promoting Leibnitz's differential notation at Cambridge and making it the universal system of notation in England. The group published several books and papers, including Babbage's translation of Lacroix's *Differential and Integral Calculus.*

The Analytical Society won a major victory in 1817 when Peacock was appointed as one of the moderators for the mathematics examination at Cambridge. He prepared all the calculus questions in differential notation and anyone who wanted to pass the exam had to know the notation. The faculty conservatives didn't like it, but there was nothing they could do.

Eventually differential notation came to be universally accepted in the English-speaking world.

Continental ideas were free to flow into the musty world of British mathematics, and within his lifetime, Babbage saw the flowering of the field under such workers as Boole.

By the time Peacock pulled his coup, Babbage was no longer at Cambridge. He graduated in 1814 with a first in mathematics from Peterhouse College, and in June of that year he married Georgiana Whitmore, the daughter of a country squire. In November the couple moved to London where Babbage made his home for the rest of his life.

Over the next five years Babbage was involved in a number of projects. He did a study of the cost of mail service that convinced him that one-price postage was feasible—one of the first examples of what we now call operations research. He contributed an article on submarine navigation to the *Encyclopedia Metropolitana* that included a description of a military submarine. His work was diverse, ingenious—and unprofitable.

Babbage decided not to enter his father's bank, and looked instead for an academic position. He was repeatedly disappointed because he could not or would not bring the influence of highly placed friends to bear. He was a firm believer in advancement by merit and was rather shocked by the part connections played in obtaining such positions. He was hardly poor, but took his failures in bad grace and began to show signs of the streak of bitterness and cynicism that grew broader and deeper as the years went on.

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Later in his life he was offered a knighthood and a baronetcy and turned both of them down, in part because they were marks of favor and not accomplishment.

In 1820 Babbage helped found the Royal Astronomical Society and served on the committee to draw up its rules. Then, along with his college classmate John Herschel, he was appointed to calculate some astronomical tables for the Society. The experience was the genesis of his life's work.

Tables and the Difference Engine

There are two stories of how Babbage came to the idea of his first calculating machine—both involve mathematical tables.

According to Babbage in his autobiography, he was sitting in the Analytical Society's room at Cambridge one day in 1812, dozing over a book of logarithms. Another member came in and asked what he was dreaming about.

"I am thinking how all these tables might be calculated by machinery," Babbage replied.

The other and somewhat more authoritative version goes to the work that Babbage and Herschel did for the Royal Astronomical Society. At one point in the tedious business of checking their calculations, Babbage looked up and said in exasperation, "I wish to God these calculations had been executed by steam!"

"His work was diverse, ingenious—and unprofitable."

"It is quite possible," Herschel replied.

Whatever the origin of the idea, it was shortly after his work with Herschel that Babbage turned his mind seriously to the problem of building a machine that would calculate and record tables automatically.

Unlike most of Babbage's ideas, the use of this one was apparent to his contemporaries. The period between 1770 and 1850 was marked by the birth or wide acceptance of disciplines that demanded tables of continuous functions—more of them and more elaborate ones every year. In spite of the ingenious methods adopted to calculate them, mathematicians were in danger of falling behind the demand.

The growth of mathematical literacy went hand in hand with increased commerce and banking. Merchants needed tables of compound interest. Engineering was emerging as a profession and engineers needed log and trig tables for their work. More land was being surveyed scientifically and surveyors needed their books of tables too. Astronomers needed tables of the motions of newly discovered planets and asteroids; mathematicians needed tables of new functions.

But for the average Englishman, the most important need for tables came from mariners. The art of celestial navigation was increasingly practiced and this called for tables by the hundreds.

Every heavenly body used for navigation required a set of tables to show the navigator where it was at every instant. Theoretically, he could work from just one star or planet and get his position. In practice he needed tables for as many heavenly bodies as he could get. A single body might be below the horizon, obscured by clouds, or otherwise invisible for long periods of time. What's more, accurate navigation required double and triple-checking by comparing the sights taken on several bodies. To 19th-century England, which lived by commerce on the seas, accurate navigation and its attendant mass of tables was a matter of national importance.

Everyone made blunders in compiling tables. Calculators checked and rechecked their work before sending it to the printers, but the volumes still emerged festooned with errata notices. Frequently, there would follow further errata notices pointing out errors in the corrections and sometimes there would be corrections to the corrections of the corrections.

Babbage proposed to remedy the situation with a machine that would calculate the tables and prepare printing plates automatically. Nearly all the tables needed were for continuous functions or functions that were continuous within predetermined limits (sines and cosines, for example). In practice these were calculated by difference methods rather than successive computations from the formulas. Using differences, the calculations were reduced to a series of simple additions.

The French mathematician Prony took advantage of this during the 18th century when he set out to prepare a massive set of log and trig tables for the post-revolutionary French government.

Two skilled mathematicians were given the job of calculating the different formulas, six or seven highly trained calculators translated those formulas into numbers and 80 or so people who knew the rudiments of arithmetic did the actual calculation. It was this last group that Babbage proposed to replace with his Difference Engine. As he explained in his autobiography:

> "...The method of differences supplied a general principle by which *all* tables might be computed through limited intervals by one uniform process. Again, the method of differences required the use of a mechanism for addition only. In order, however, to ensure the accuracy of the printed tables it was necessary that the machine which computed the printed tables should set them in type, or else supply a mold in which stereotype plates of these tables could be cast.
>
> I now began to sketch out arrangements for accomplishing the several partial processes which were required."

The Method of Differences

Babbage's machine was designed to use the fact that each succeeding value in any continuous function on an interval can be approximated as closely as necessary by adding the appropriate differences to the value immediately previous.

Take for example the function $Y = X^2 + X$ (see Table 1). If you subtract each value of Y from the succeeding value, you get a regular progression called the first difference. Subtract each first difference from the succeeding difference and you get the second difference. If you continue this process long enough you get a constant. By adding that constant to the differences so obtained and that total to the previous value of the function you get either the next value or a number very close to it. How many differences it takes to get a constant depends on the highest power in the original polynomial function. In Table 1 the highest power is two (X^2), so the constant is obtained on the second difference.

To make the difference method work you do not need to know the polynomial. All you need is a sufficient number of successive values of the function and you can extract the difference.

Of more interest to small-computer users is the ability to save memory and computing time when working out successive values of a function. This is especially useful where the function is quite involved or you need to find the next value quickly, in computer graphics for instance.

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X	Y	One Difference	Two Differences
1	2		
		4	
2	6		2
		6	
3	12		2
		8	
4	20		2
		10	
5	30		

Table 1

If you do use difference methods, there are two things you need to watch out for. These are problems that also explain something of the nature of Babbage's design for his Difference Engine.

First, the method often only approximates the correct answer. In these cases the cumulative error builds up until it reaches an unacceptable level. When this happens, you need to change the constant difference used in the calculations. Typically, it has to be incremented or decremented by one. The higher the power of the approximating polynomial, the more accurate the approximation—and the more differences you have to take to get a constant difference.

The other thing is that you need sufficient precision in the numbers you are calculating. If you try this method with, say, a standard five-piece trig table, you will find that the final difference fluctuates at irregular intervals. This is the result of rounding off the values in making the tables. The more places you work to, the less chance there is of having this problem.

Design of the Difference Engine

The process of addition might be simple, but building a machine that would work to Babbage's exacting standards wasn't simple at all. For maximum utility it would have to be able to work to as many differences as possible, and to prevent problems with round-off error, it would have to work to as many decimal places as possible. These requirements took it very much out of the run of ordinary mechanical adding machines.

There had been mechanical adders before, of course (notably Pascal's four-function machine built around the middle of the 17th century). But most of them were just gear trains with numbers on the gears, the type that can be built into a child's pencil box today.

This type of mechanism was unsatisfactory on several grounds. For one thing, all the gears are constantly engaged, resulting in very long gear trains with a cumulative backlash that could cause errors in a machine the size Babbage envisioned. For another, the force needed to drive such trains is excessive, causing heavy wear on the parts and making backlash errors even more likely. Since Babbage was thinking in terms of a machine that worked in 15 places through six differences, these were major difficulties.

There was also the matter of speed. Babbage wanted something that had at least some advantage over a trained calculator. Rapid starting and stopping of long gear trains would mean large accelerations of the parts, making them even more prone to failure.

These were all problems that plagued the designers of mechanical office machines at the end of the 19th century. Babbage's solutions were, on the whole, more elegant and carefully thought out than the ones adopted by business-machine makers half a century later.

The definitive version of Babbage's machine met these difficulties by splitting the process of addition into subtasks. Intelligent design kept the masses to be put in motion at any one time small and the chains of driven parts short. There were never more than six moving parts in a driven chain; the motions required were small and masses light. Babbage paid special attention to compensating for wear and designed fail-safe mechanisms to prevent the machine from giving wrong answers due to misalignment.

To get maximum speed and keep down the masses in motion simultaneously, Babbage resorted to an ingenious method of phasing the motions together. Each cycle of operation was divided into four equal sections with tasks divided among the sections in the same way a computer divides the task of addition over several clock pulses.

To help him keep it all straight Babbage developed a sophisticated system of mechanical notation that allowed him to describe exactly the states and relationships of any mechanical device at any instant. It is a pity that this system was never popularly adopted because it is very difficult to describe how the Difference Engine operated without it.

Probably the best description of the fully developed engine is found in Dr. Dionysius Lardner's 1834 article in the *Edinburgh Review* (reprinted in *Charles Babbage and His Calculating Engines*—see bibliography).

The machine Dr. Lardner described was capable of working with 18 places of figures to six differences. This meant there were seven sets of figures displayed, counting the result or table figure.

Physically, the machine would have fit into a large closet. A person opening the door of the closet would have found himself facing a mass of gears and mechanism with seven columns of disks ranged one beside the other. Each disk was about five inches in diameter and 1½ inches high with the numbers zero to nine engraved on the edge. These were the display wheels and each column represented a number. The column furthest to the left was the difference column where the constant difference used in the calculation was set. Since it was used only to enter a number, it had no adding mechanism.

In operation the Difference Engine was as impressive as a pinball machine or an old Linotype. Something was happening constantly as parts moved, stopped, and moved again in response to the machine's program.

The machine added and carried in separate operations with the even columns working while the odd columns received the results of their work. As the main driving wheel moved from zero to 90 degrees, columns 1, 3, and 5 (counting from the right) moved, adding and entering the results in the even columns, but not carrying tens should any carriages be needed. From 90 to 180 degrees, the carriages for this sequence were performed. From 180 to 270 degrees, the even-numbered columns added to the odd columns and from 270 to 360 degrees, the carriages for this series of operations were carried out.

However, all the wheels in a column did not start moving at once. The ones on the bottom (units) row started first and each succeeding row started a little behind the one below it. The carriages were made the same way. This decreased the number of parts that had to be put in motion at any one time, making the operation smoother and cutting down on wear.

The result was that the machine added and carried in ripples, starting from the lower left corner (the units wheel in the constant difference column) and working up and to the right. The entire operation of calculating and printing a table entry was carried out in one cycle of the main driving wheel no matter how many differences or carriages were involved.

It would have been a sight to see in operation!

In spite of its complexity, the machine was composed of one fairly simple subassembly repeated over and over. Each column was composed of 19 such subassemblies stacked on top of each other and attached to the same three shafts. The shafts for each column were arranged one behind the other with the rear shaft carrying 19 metal fingers mounted in a spiral. These fingers, one per subassembly, provided the initial impulse on each cycle of the machine's operation. Arranging the fingers in a spiral provided the basic timing for operations in each column.

The heart of each subassembly was the counter mechanism on the middle shaft. This consisted of a pair of gears with teeth around the circumference and on one side, bottom side for the top gear and top side for the bottom gear. There was also a bolt that could be slid in between the side teeth by the action of the finger on the third shaft, and a cam on one of the gears that would slide the bolt back out again at a given point in the mechanism's rotation. Although the shaft all this rode on was turning, the counter mechanism itself didn't turn under its power until the bolt was slid home.

The front shaft carried the display wheel and part of the carry mechanism. Both addition and carriage were done in stages, Set and Execute. When a display wheel passed from nine to zero, it cocked a ratchet-sear mechanism mounted on the frame next to it. When the Carry part of the cycle was reached, the sear on the subassembly above would be tripped and the display wheel and associated

"In spite of its complexity, the machine was composed of one fairly simple subassembly repeated over and over."

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mechanism would advance.

An addition operation in a subassembly actually started during the previous addition segment of a machine cycle. That is, if the subassembly was in an odd column, it started during the even part of the cycle. As the display wheel in the even column advanced, it moved the lower gear in the counter mechanism in the column to its right (an odd column) forward by the appropriate number of places. If the display wheel showed a three, for instance, the lower gear in the adjacent column would move ahead three places. This had no immediate effect on the rest of the subassembly, but it entered the number in "memory" ready to be added to the number showing on the display wheel during the appropriate part of the cycle.

The upper wheel of the counter mechanism was geared directly to the display wheel, and its position reflected the number appearing on the display wheel of that subassembly.

As the addition cycle progressed, the finger on the third shaft would come into position and force the bolt home, locking the upper and lower gears together and both of them to the turning shaft. The wheels would advance together, advancing the display wheel and the lower gear in the counting mechanism to the right. After the counter mechanism had advanced the appropriate number of places, the cam on the lower gear would slide the bolt out, ending the addition.

The printing mechanism, which was attached to the final (or table) column, was equally ingenious. The printer used a lever to read a snail cam at the top of each subassembly in this column successively. The lever controlled the motion of a frame shaped like a sector of a circle, which in turn contained punches bearing figures from zero to nine.

The position of the cam controlled the position of the sector, and therefore which punch was presented to an impression lever. The impression lever pressed against the punch and forced it into a copper plate mounted on a platen. The read lever moved down to the next cam, a spring withdrew the punch and the process was repeated. The platen could be used as a printing plate or stereotypes could be made from it.

In addition to this basic mechanism, the Difference Engine included a system for alerting the operator when a preset number had been reached. This let the calculator preset the mechanism to the interval required by the difference formula.

Babbage discovered that he could use this feature to let the machine find the rational root of an equation by trial and error. It could also tell if the roots of an equation were imaginary. This discovery set him thinking about an Analytical Engine.

Developing the Difference Engine

When Babbage started designing in 1820, he didn't have anything this elegant in mind. His first model had three display wheels in the table column, two for the first difference column and one for the second difference. He had the parts constructed and assembled them himself. He had to rebuild the frame to make it stronger and had a new set of gears cut, but in 1822 he produced a machine capable of calculating 44 differences a minute and driven by a falling weight.

Forty-four calculations a minute wasn't any faster than a human could work, but it proved his principle.

On June 14, 1822, Babbage read a paper describing his work to the Royal Astronomical Society. He also proposed a much larger machine to calculate useful tables. The response from the members was overwhelmingly favorable.

On July 3 of the same year he wrote Sir Humphrey Davy, the president of the Royal Society, explaining his work in greater detail and asking Davy's aid in obtaining backing for his larger version. In his letter, Babbage mentioned he had designed several other calculating machines, including a device for doing multiplication, a machine for constructing tables that had no constant difference, and most intriguing of all, a machine that would calculate all the primes between one and 10,000,000. But Babbage told Davy that the Difference Engine was the furthest along of his designs and probably the most useful.

Babbage said that while the Difference Engine would be useful, it was unlikely ever to be a paying proposition. He said his personal resources weren't enough to build it and outside help would be needed.

Shortly after he wrote Davy, Babbage wrote to the Treasury asking for support to build the Difference Engine. The Lords of the Treasury kicked the matter back to the Royal Society, and that body established a committee to look into the proposal. On May 1, 1823, the committee reported they considered that Babbage's machine could be constructed and that it would be worthwhile. They urged that the government support the project.

The committee's verdict was not surprising. After all, Davy was solidly behind Babbage and most of the committee members were his friends. However, it was highly unusual.

It was almost unheard of in 1823 for any government to provide financial support for an inventor. The closest that the British government usually came to funding research and development was to offer prizes for useful inventions, but these were supposed to be granted only after the device was complete and tested.

Neither the government nor Babbage had any experience at making development agreements, and that was at the root of much of the trouble that followed.

In July, 1823, Babbage received a gold medal from the Royal Society for his work. That same month, he had an interview with Frederick J. Robinson, Chancellor of the Exchequer, on getting money for the Difference Engine. Incredibly, the results of that meeting were never reduced to writing and apparently there was never a complete understanding between them. Both of them later had different versions of what had been decided.

> *"Babbage expected to finish the Difference Engine in three to five years at a cost of 3,000 to 5,000 pounds."*

Babbage thought the government had agreed to pay the cost of building a Difference Engine, which would then be government property. Robinson thought the government had agreed to grant Babbage a fixed sum to let him build his engine and that that was the end of the government's obligation. Worst of all, neither Robinson nor Babbage realized at the time that there was a misunderstanding.

At the time it didn't seem to matter. Babbage expected to finish the Difference Engine in three to five years at a cost of 3,000 to 5,000 pounds. The Treasury had agreed to advance him 1,500 pounds, and he didn't expect to need more until after the machine was completed.

Even if things had gone well, Bab-

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"Babbage suffered from a chronic case of designitis—the inability to quit tinkering with a design."

bage's estimates of time and money were extremely optimistic. The first problem Babbage faced was working out the design fully. He quickly learned the folly of trying to skimp on this step. Several times he rushed ahead to construct parts of the mechanism, only to have to discard them because they were unworkable or superceded by a better way of doing things.

Although it is usual to speak of Babbage's Difference Engine as a single machine, the name actually refers to a succession of machines designed in overlapping sequence from 1832 to 1834. Much of this was justified as Babbage attempted to overcome design problems and to make the machine more efficient. But Babbage also suffered from a chronic case of designitis—the inability to quit tinkering with a design. It is an ailment not unknown to modern engineers, but unlike modern engineers, no one warned Babbage of the consequences: cost-overruns and schedule slippage.

While the design work was going on, Babbage employed Joseph Clement, one of the pioneers in the design and construction of machine tools, to help build the engine. Clement spent most of his time on the project building tools to make the parts. Babbage's indexing mechanism for the stereotype plates was adapted and applied to a crude shaping machine. A turret lathe was invented. Work was done on precision grinding of parts. A system of pressure casting was worked out to make gears for the machine.

Clement was a good match for Babbage. He was brilliant in his own right and famous for his ability to work to close tolerances. One of the men Clement employed on the project was Joseph Whitworth, who later made major contributions of his own to modern industry, including the first standardized system for nuts and bolts. Later, Babbage was fond of saying that he made Whitworth, and through him, modern industry. There is probably some truth in that.

But the work took time. Clement and his men could probably work as accurately as today's average machine shop, but not nearly as quickly. Not only were they inventing techniques as they went along, but metallurgy was in its infancy and high-speed steel hadn't even been thought of yet. The Difference Engine was being built to gauged standards—another first—but much of the final work had to be done by hand.

The End of the Difference Engine

By 1827, rumors were circulating in London that the engine was a failure, or worse, a fake. Babbage had his supporters, but even they had to admit the work was going slowly.

In August 1827, Babbage's work on the Difference Engine stopped completely. His wife, pregnant with their seventh child, died in childbirth.

The previous January Babbage's father had died, and before the year was out, two of his children died as well. Coming on top of the strain of his work and the growing mutterings, it was all too much. Babbage suffered a nervous breakdown and took an extended trip to continental Europe.

Babbage's sojourn on the Continent may have been good for his nerves and it certainly provided him with material for several books and scientific papers, but it was the kiss of death for the Difference Engine. Work continued after a fashion as Babbage corresponded with Clement about the project, but it was much slowed and the rumors continued to grow.

While Babbage was in Europe, an article appeared in the *Record* criticizing his handling of the work. The writer claimed that Babbage had been given money by the government to finish his engine and that it was long overdue. The writer demanded an accounting from Babbage or his friends.

John Herschel answered for Babbage in the *Times*, saying he was overseeing the project in Babbage's absence. Enormous progress had been made, Herschel said, and none of the money had been wasted. It was a forceful rebuttal and probably accurate, but the fact remained there was little to show for nearly six years of work.

Before Babbage returned to England in 1828 he came to the conclusion that more money would be needed. Accord-

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ingly, he wrote his brother-in-law, Wolryche Whitmore, a member of Parliament, asking him to talk to Robinson (now Lord Goderich) about another grant.

Now the confusion about the original agreement surfaced. Robinson refused to advance any more money and denied any obligation to do so. When Babbage returned to England, he went to see the Chancellor himself, but to no avail.

Babbage's next step was to apply to the Prime Minister, the Duke of Wellington, for help. Although the Duke was somewhat anti-intellectual, Babbage and Wellington seem to have gotten along very well and Babbage got his money.

But first another committee of the Royal Society was appointed to look into the state of the project. The group inspected the drawings, tools, and plans and came to the conclusion that the work was about 60 percent completed and could probably be completed in another three years. The project was unquestionably worthwhile, the committee said, and they expressed admiration for the work that had been done. Babbage's old friend John Herschel was the chairman of the committee.

On the basis of the report, the government granted another 1,500 pounds, but that was just a drop in the bucket. Babbage estimated he had spent 6,000 pounds of his own money up to that point.

In May of 1829, a group of Babbage's friends and supporters, including Herschel and the Duke of Somerset, met to discuss the work and Babbage's relations with the government. They came to the conclusion that it would cost at least 4,000 pounds more to complete the project and that the money ought, in justice, to come from the government. They decided to apply again to the Duke of Wellington.

The Duke inspected the work and recommended that the government pay out another 3,000 pounds. At the same time, Babbage sought to clearly establish just who had what rights and duties in respect to the engine.

After some negotiation, the government was willing to advance another 3,000 pounds, but they could not guarantee to complete the project. On the other hand, once the Difference Engine was finished, the government would be willing to consider any claims for additional compensation that Babbage might put forward.

This was better than the original agreement, but it did not completely settle the question of ownership and therefore left Babbage's role in the project unclear. Babbage believed he was acting as prime contractor for a government project, while the government officials still considered the Difference Engine Babbage's private project that was receiving government support.

"After 1834 the Difference Engine was dead."

For Babbage, a more immediate problem was the process of paying the bills. Under the scheme set up by the government, Clement submitted his bills to Babbage, who turned them over to a firm of government-appointed engineers for checking. The engineers returned the bills to Babbage, who forwarded them to the Treasury, which would issue a draft to Babbage, who would then pay Clement. Since there was no provision for advance payments, and the process could take months, Clement's pay was constantly in arrears.

The matter came to a head in 1833 when the workshop, offices, and fireproof storage building the government had constructed near Babbage's house were ready. When the time came to move everything, Babbage told Clement that from now on, he would not advance money for the work. This did not sit at all well with Clement and he demanded hefty compensation for moving the work out of his own shops and into the new buildings. Babbage felt the demands were exorbitant and refused to pay. Clement then shut down work on the project and dismissed the men.

In a letter to Babbage on March 26, 1833, Clement set out his case. He had dealt with no one except Babbage, he wrote, and as far as he was concerned, it was up to Babbage to see that he got paid on time. Babbage's arrangements with the government were none of his concern and unless Babbage or someone would be responsible for paying him on time, there would be no further work.

Clement's most ruinous step was to keep all the special tools and fixtures built to aid the project. Since these represented most of the work and much of the money spent so far, Clement's action effectively killed the Difference Engine.

Under the law of the time, Clement was within his rights. A workman owned any tools he had constructed, no matter who had paid for them. Before the century was out the law would be changed, but once again Babbage paid the price for being too far ahead of his time.

Babbage tried to salvage something from the situation. First he tried to set up a new payment scheme with the Treasury to get the bills paid more promptly. The government was agreeable but Clement wasn't. Then he tried to buy the tools and drawings for them back from Clement. Clement wouldn't sell at Babbage's price.

There the matter lay. After 1834 the Difference Engine was dead.

Babbage used some of the completed subassemblies to put together a small working model of the machine. The model, which worked to three differences of six places each, was used by Babbage for some preliminary calculations. Later it was placed in the Science Museum in London. This is the machine usually described as "part of Babbage's Difference Engine."

Dr. Lardner's description of the machine appeared in the July 1834 issue of *Edinburgh Review*. Several others made a stab at building the machine. An English clergyman built a small difference engine for his own amusement. Swedish printer and publisher Pehr Georg Scheutz built a machine that would work to four differences with 14 figures in each place and print the results on lead tape, which could be cut to length and used to make stereotype plates. It took Scheutz and his son nearly 20 years to finish their machine—its final design was very different from Babbage's.

When the Swedish machine was announced in 1855, Babbage did everything he could to promote it. He was instrumental in seeing that the machine was awarded a gold medal by the French government when it was shown at the Paris Exhibition that year. ■

This is the first of a two-part series. Part one covers Babbage's achievements through the Difference Engine. Part two will discuss his attempts to build the Analytical Engine.

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EDTASM + for the Color Computer is the offspring of EDTASM + for the Model I. It has a subset of the features found in its dad, but unfortunately, is not much like the old man.

Any $49.95 Color Computer editor/assembler sold by Radio Shack that is reasonably well done is going to sell. EDTASM + is reasonably well done, if not very well done. If you don't have a disk system, chances are EDTASM + will be your editor/assembler.

EDTASM + comes in a ROM cartridge. Its $49.95 price probably prevents all but the most dedicated hacker from relocating it to a RAM file on his 64K system.

EDTASM + is made up of three parts: the editor, the assembler, and a debug package called ZBUG.

The Editor

The editor contains standard Radio Shack editing commands, such as the ones in Extended Color Basic:

- D100:200—Deletes lines 100-200
- E100—Starts edit line 100
- FLEAX—Finds string "LEAX"
- H100:200—Prints out copy
- I121,1—Inserts line 121 and increments by one
- L FILE—Loads file "File" from cassette
- N100,10—Renumbers lines from 100 with an increment of 10
- P100:200—Displays lines 100-200 on screen
- Q—Returns to Basic
- R100—Replaces a line
- T100:200—Like H, but prints without line numbers
- V FILE—Verifies like Basic's SKIPF command
- Z—Goes to ZBUG.

The editor also contains two interesting commands not seen on other Radio Shack editors: C, which copies a block of lines; and M, which moves a block of lines. These are handy commands that should be in all editors.

Once in the edit mode (the E command), there are subcommands as in Extended Color Basic to manipulate the characters in the line—Change, Insert, List, and so forth.

Is this a good editor? Yes, I think so. It's compatible with the Basic editor (more or less) and contains 90 percent of what should be in an ultimate editor. One thing that might have been added is a replace on a string basis.

The Assembler

The assembler uses 6809E mnemonics only. This is not a detriment unless you have existing 6800 code that could be converted to a 6809E system, and that is not easily done given the configuration differences between systems.

The 6809E mnemonics are standard Motorola mnemonics for the instruction set. Pseudo-ops are also standard Motorola mnemonics.

The assembler uses the following pseudo-ops (for those of you who are new to Assembly language, pseudo-ops are simple commands to the assembler that instruct it to generate data or perform other functions):

- END—End program
- EQU—Equate label to expression
- FCB—Forms a constant byte (generates one data byte)
- FCC—Generates a text string
- FDB—Forms a double byte (generates one data word)
- ORG—Set origin
- RMB—Reserve memory bytes (reserves space)
- SET—Similar to EQU, but can be redefined
- SETDP—Sets DP (direct page) register.

These are all unexciting pseudo-ops that are standard for all assemblers (with the exception of SETDP, a 6809E-related pseudo-op).

One glaring deficiency is the lack of multiple arguments for FCB and FDB. In other words, to build a table, you would have:

```
TABLE  FCB  $82   ;A to D sine wave values
       FCB  $92
       FCB  $AA
       FCB  $DA
```

instead of simply:

```
TABLE FCB $82, $92, $AA, $DA,...
```

There are a large number of operators that you can use in the assembler. You cannot only do things like:

```
TABLE   FCB  $80+2
        FCB  $80+23
        FCB  $80+9
TABLSZ  EQU  .-TABLE              ;get table size
```

and use addition and subtraction, but you can also do shifting:

```
LOCA    FDB  MSB<8+LSB            ;MSB*256+LSB
```

✓See List of Advertisers on Page 455

division and multiplication:

```
TABLE    FDB   ADDR.DIV.256        ;get page
                                    number
         FCB   FLD*16+3            ;align field
```

modulus:

```
TABLEC   FCB   HRS.MOD.60          ;get minutes
```

and logical operations:

```
LOCB     LDA   #NXTWDP.AND.$F8     ;mask off 3 ls
                                    bits
         LDB   #LSTWDP.OR.4        ;set bit 2
```

In-memory Assembly

The most powerful feature that the assembler portion of EDTASM+ gives you is the ability to do in-memory assembly.

In-memory assembly lets you take the source code in the edit buffer, assemble it, and store the resulting object code in memory. The object code is stored after the edit buffer and symbol table, properly relocated without your having to specify any absolute origins.

After the Assembly listing on the screen, you'll see a dump of the symbol table, such as:

```
BASCN  098A
CDFIN  097C
TABL1  0CDC
TABL2  0CEC
```

Of course, you'll also have the symbols on any listing printout you have. You can use the symbols in ZBUG for symbolic references.

This in-memory assembly makes for very rapid debugging. Typically, you'd follow these steps to debug an Assembly-language program in many larger computer installations:

- Load the editor
- Key in your latest version and create a source file
- Load in the assembler
- Assemble. If errors, go to 1, otherwise create object file
- Load object file and debug package
- Debug and patch. When enough patching has been done, go to step one to get a new assembly, and so on.

With integrated editor/assembler/debug packages such as EDTASM+, though, you can go directly from one function to another. You don't have to laboriously patch the program, but you can simply type E, enter the editor, make the changes, type A/IM to assemble in memory, type Z to enter ZBUG, and voila! The object is there.

EDTASM+ is highly interactive, to say the least. I wish I'd had such a system 10 years ago on the Redcor RC-70.

Shortcomings

Sins of Omission Department: What happened to that beautiful macro capability of the Model I EDTASM+? There may be good reasons for not including macro capability in EDTASM+ (memory constraints? too sophisticated for most CC owners? $1,000 extra from Microsoft?), but I wish it had been left in.

For you beginners, macros are defined sets of instructions that can be invoked by a single macro call. Suppose you needed a macro for a disk I/O operation. You could define a macro like this:

```
DISKIO  MACRO  !ARG1,!ARG2,!ARG3,!ARG4,!ARG5
        LDA    #ARG1
        STA    DRIVE
        LDA    #ARG2
        STA    SECTOR
        LDA    #ARG3
        STA    TRACK
        LDA    #ARG4
        STA    FUNCT
        LDX    #ARG5
        STX    BUFFER
        LBSR   DISKIO
        ENDM
```

Thereafter, to call the macro, you'd have something like:

```
LOCN                    DISKIO 1,5,10,READ,$4000
```

The arguments in the DISKIO call would be put into the proper places in the macro definition, and the 11 instructions in the macro would be generated in-line.

You can get along without macros very well, but I'd be willing to pay double just to have the capability.

Another thing that would have been nice is conditional assembly. Conditional assembly lets you assemble bracketed code segments conditionally. If you had a cassette and a disk version of a program, for example, you might have an equate:

```
CDFLAG  EQU  0  ;0=cassette,  1=disk
```

Later in the source code, you'd have:

```
IF      CDFLAG  ;assemble this part if cassette
LDA     #12     ;for header
BSR     SETHD   ;write header
ENDIF
```

This is more of a frill, but on the other hand, including conditional assembly would not take much coding effort or memory.

Another feature that would have been nice is a pretty printing capability—things like Title, Page (to skip a page), and other amenities.

There are other features found in big assemblers, but the addition of these items would have the typical Assembly-language programmer less grouchy in the mornings.

Is the assembler a good assembler? Yes, except for the single arguments on the FCB and FDB. I haven't forgiven them for the macros, either.

ZBUG

The third segment of EDTASM+ is ZBUG, a debug package. ZBUG does a lot. Among other things, it gives you a disassembly capability that allows you to list any data area in memory, with the assumption that it contains 6809E instructions; the output is the equivalent 6809E mnemonics. Here is a sample listing:

```
#A7BD/   TRF A,B
0A7BF/   JSR<9F
0A7C1/   CMPB#00AA
```

Given the disassembly and several hundred hours, you too can uncover the secrets of the Extended Color Basic ROM.

Here's an overview of the ZBUG commands:

- C—Continue after breakpoint
- D—Display all breakpoints
- E—Re-enter editor
- G1000—Execute address 1000
- LNAME—Load machine-language file name from cassette
- PNAME 1000 1400 1000—Dump memory from 1000–1400 as cassette file name with start address 1000
- R—Display all registers
- T1000 1010—Display locations 1000–1010
- TH1000 1010—Print locations 1000–1010
- U1000 1200 100—Copy block at 1000–10FF to 1200 area
- VNAME—Verify file name on cassette
- X1000—Set a breakpoint at location 1000
- Y1000—Reset breakpoint at location 1000.

With the exception of the U command, these are all standard debug commands you'd find in most debuggers.

One command I'd like to see that is not included, is a Find command. This lets you find a specified byte or address value.

I implied previously that symbolic debugging was a powerful feature. It is. Imagine having a table called TABL1 in your source program. With the symbolic capability of ZBUG, you can examine the location by entering: #TABL1/ OFF. Furthermore, you can refer to locations TABL1-34, TABL1+$17, TABL1.DIV.2, or TABL1.AND.$FFFE. If the symbol is in your Assembly listing, ZBUG will find it from the symbol table and use it in any expression with any allowable operators.

You can also input in symbolic form. If you wanted to change a location that currently pointed to TABL1 to TABL1+2, for example, you'd have:

POINT/ TABL1 TABL1+2.

ZBUG allows a great deal of flexibility in input and output formats. You can display memory in the byte mode (one byte at a time), word mode (two bytes at a time, as in addresses), mnemonic mode (disassembly), or ASCII mode, and in numeric form or symbolic form. The input and output number bases can be octal (base 8, not too useful), decimal, or hexadecimal. You can enter data in mixed formats. ZBUG shines in this area.

With the exception of the Find command, I can't think of much to add to ZBUG. Oh, sure there are big system features such as tracing and snapshots that might be helpful, but the current features fulfill most Assembly-language needs.

Cassette-based System

If you have a cassette-based system, I definitely recommend EDTASM+, with no restrictions. It will be *the* standard for the Color Computer.

If you are a beginner, you'll find the EDTASM+ manual adequate in the operation of EDTASM+, but completely inadequate in descriptions of the 6809E instruction set and how to program. You'll need a good CC-oriented Assembly-language book on 6809E programming.

If you are an intermediate-level Assembly-language programmer, you'll find the EDTASM+ easy to work with, highly interactive, and generally adequate.

If you are an advanced programmer on a cassette-based system, you will be continually griping about EDTASM+'s omissions but you'll use it anyway.

Disk-based Systems

I hope Radio Shack comes out with a disk-based version of EDTASM+ by the time this hits the stands. If not you can always check out other editor/assemblers or use the inevitable patches to EDTASM+ to provide a disk capability (as Apparat did to the original EDTASM for the Model I). ■

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(213) 539-9140

Heat Stress Index

by Donald B. Heckenlively
T. Adams
S. R. Heisey
S. Mingela

Does your job get you hot under the collar? This program determines whether the heat from your workplace is harmful to your health.

Many workplaces impose a physiologically stressful heat load. Sometimes the stress is subtle—rooms on the south side of a glass-walled building can be exposed to enough solar thermal radiation to make them uncomfortable. More often, though, the heat load is obvious—high temperatures "come with the territory" for bakeries, steelworks, glass factories, and similar industries. People exposed to these conditions should know when their environment is merely uncomfortable and when it is thermally hazardous.

The Heat Stress Index (HSI) was developed by Belding and Hatch (*Heating, Piping, and Air Conditioning,* vol. 27, pp. 129–136, 1955) to assess levels of human heat stress using easily measured environmental factors and an estimate of work rate.

Application of the index is cumbersome, because its calculations are complicated, so programming the calculations was an obvious step.

The HSI program described here offers diagnostic and optimization graphing.

The Key Box

Model I or III
16K, 32K
Cassette or Disk Basic

Background Information

A stable body temperature results from a dynamic balance between factors of heat gain and heat loss, so that:

$$\Delta H = M \pm CD \pm CV \pm RD - E$$

where

ΔH	=	change in body heat content
M	=	metabolic heat production due to work
CD	=	thermal conduction
CV	=	thermal convection
RD	=	thermal radiation
E	=	evaporative heat loss.

When $\Delta H = 0$, body temperature is constant, and the person is in thermal balance. Physical work and exercise produce heat (M), which can be a significant source of heat stress during prolonged or intensive exertion.

Heat is transferred by conduction (CD) between objects in contact with one another, if they are at different temperatures. For example, if the surface of an object is cooler than that part of the body with which it is in contact, then the person loses heat. If the object is warmer, then the person gains heat, even to the point of raising tissue temperature enough to produce damage and pain. Heat exchange by conduction isn't evaluated in the HSI, because it usually is not a major factor for heat stress in humans.

Convection (CV) differs from conduction in that air that has been heated by the body can rise to be replaced by cooler air. Forcibly circulating air that is cooler than skin plays an important role in body heat loss by convection. It can be a significant source of heat gain if the air is warmer than the skin.

Radiation (RD) is the exchange of heat as infrared energy from a warm surface to a cooler one. It is an important source of heat gain for steelworkers, for example, who are exposed to hot surfaces of furnaces.

Evaporation (E) is only a means of heat loss, because heat is absorbed as a fluid changes from a liquid to a gas. For this reason, the evaporation of sweat (or any other liquid on the body surface) carries away heat. Evaporation requires, however, that the vapor pressure of the air be less than that at the body surface. Most people have experienced the discomfort of a muggy day when sweat doesn't evaporate readily. Many factors interact to influence net heat exchange. For example, increasing air flow not only increases heat transfer by convection, but it also increases evaporation, as felt by the increased cooling effects of a fan, even on a humid day.

Calculations for the HSI assume that evaporative heat loss must offset heat loading from other sources to maintain a stable body temperature, that is: E = M + RD + CV, and

$$\text{HSI} = 100 \cdot \frac{\text{Evaporation needed for stable body temp.}}{\text{Evaporation possible under the conditions}}$$

The HSI is calculated on the basis of five factors: dry-bulb (ambient) temperature, wet-bulb temperature, globe temperature (a measurement of thermal radiation), air flow, and heat production due to physical work (see Fig. 1).

Figure 2 relates an HSI score to the severity of the physiological strain. If the HSI is less than 100, an individual may be uncomfortable but is still able to maintain body temperature. If HSI exceeds 100, heat cannot be lost fast enough to keep body temperature constant, and safe exposure time is limited.

Using the Program

When you execute the program, the first video screen panel gives an introductory statement and then requests either metric or English units. Subsequent input prompts and the output are consistent with the declared units system, although there are opportunities later in the program for redesignating units. Input data are assumed to be based on actual measurements, so error traps are minimal at this stage. Figure 3 shows the input for a typical evaluation.

Output (Fig. 4) is divided into three video screen panels. The first panel summarizes test conditions, presents the HSI, and describes its severity. If the HSI exceeds 100, a nominal safe exposure time is given. At the end of the first panel, options are provided for either continuing to the second panel, terminating output, or recycling to the input phase. The second panel shows the relative importance of each avenue of heat transfer and its percentage of the total heat load. The third panel presents a diagnostic analysis of the test and recommendations for reducing heat strain.

Optimization Graphing

After the diagnostics output, the program provides an option for assessing the effect of each of its factors. HSI can be plotted as a function of air flow, relative humidity, or radiant temperature. Individually plotting each environmental factor provides a basis for predicting optimal changes that will alleviate net heat stress. For example, in Fig. 5a, increases in air flow above 600 ft./min. would have little additional effect on reducing HSI.

Error traps set a range for each variable. For example, minimum air flow is 20 ft./min. (0.12 m./sec.). Maximum air flow is checked only to ensure that it is greater than this so the graphing routine functions properly. Rela-

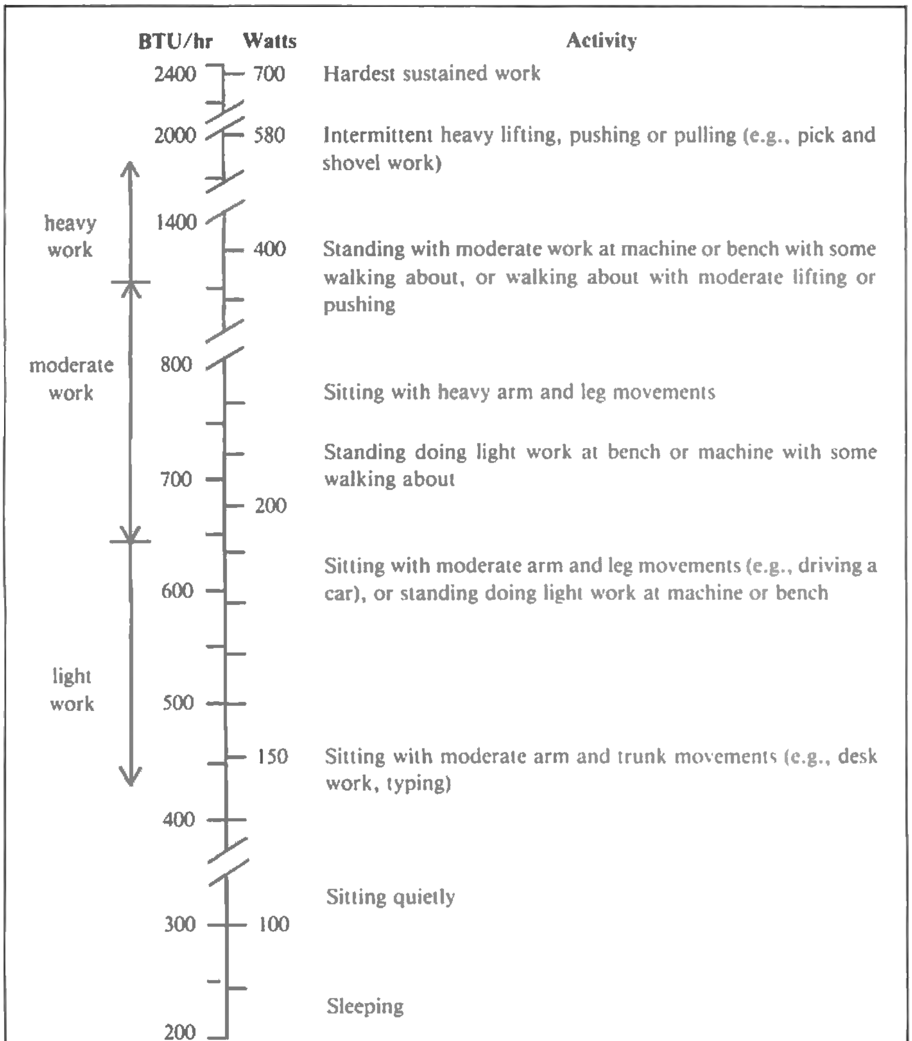

Fig. 1. Typical heat production rates for an adult male. Modified from The Etiology, Prevention, Diagnosis, and Treatment of Adverse Effects of Heat. *TB MED 157/NAVMED p-5052-S/AFOSH, Std. 161–162, Washington, DC, 1978.*

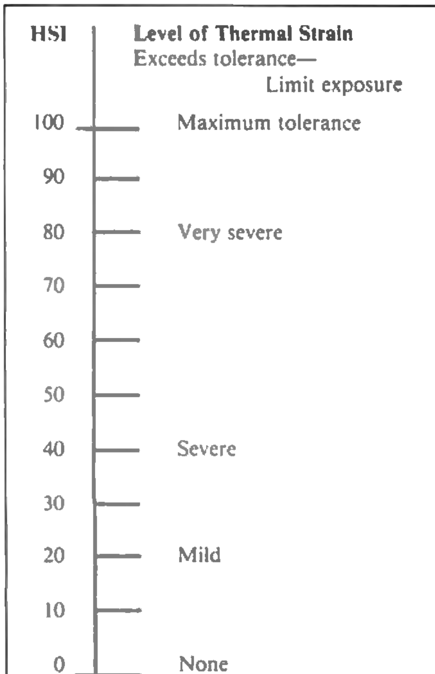

*Fig. 2. Heat Stress Index (HSI) evaluation. Modified from Belding and Hatch (*Heating, Piping, and Air Conditioning, *27:129–136, 1955).*

Program Listing

```
100 'H U M A N   H E A T   S T R E S S   I N D E X   ( H S I )
110 ' D. B. HECKENLIVELY, T. ADAMS, S. R. HEISEY, & S. MINGELA
      HILLSDALE COLLEGE, MICHIGAN STATE UNIVERSITY, AND FORD
      MOTOR CO.
      VERSION II.2 - 9/81
120 ' ADAPTED AND EXPANDED FOR TRS-80 FROM A PROGRAM FOR THE
      HP 41C BY ADAMS, MINGELA, AND HEISEY
      NO. 00755C, HP USER'S LIBRARY
130 ' CORRESPONDENCE ON PROGRAM DIRECTED TO:
        DR. D. B. HECKENLIVELY
        HILLSDALE COLLEGE, HILLSDALE, MI 49242
140 ' PROVIDES "HEAT STRESS INDEX" (HSI) AND NOMINAL
      EXPOSURE TIME, AS WELL AS CERTAIN INTERMEDIATE
      CALCULATIONS AND PROJECTIONS OF CHANGES IN
      PARAMETERS
150 ' PRINCIPAL REFERENCE:
      BELDING & HATCH, 1955. INDEX FOR EVALUATING HEAT STRESS
      IN TERMS OF RESULTING PHYSIOLOGICAL STRAIN.  HEATING,
      PIPING, AND AIR COND. 27:129-136.
160 '
```

Listing continues

(a.) Introductory panel calling for units and input:

HUMAN HEAT STRESS

THIS PROGRAM CALCULATES A 'HEAT STRESS INDEX' (HSI) AND NOMINAL EXPOSURE TIME FOR A PARTICULAR SET OF ENVIRONMENTAL AND WORK CONDITIONS.

DATA MAY BE ENTERED IN METRIC OR ENGLISH UNITS.
(SPECIFY: <M>ETRIC OR <E>NGLISH)? E

ENTER DRY BULB TEMPERATURE (DEG. F)? 85
ENTER WET BULB TEMPERATURE (DEG. F)? 80
ENTER GLOBE TEMPERATURE (DEG. F)? 90
ENTER AIR VELOCITY (FT/MIN)? 50
DO YOU NEED HELP TO ESTIMATE WORK RATE?
(ENTER: <Y>ES OR <N>O)? Y

(b.) Optional table of work in BTU/hr or Watts:

BTU/HR	WATTS	** ACTIVITY **
2400	700	* HARDEST SUSTAINED WORK
2000	600	* INTERMITTENT HEAVY WORK (LIFTING, SHOVING, PULLING)
1600	500	
	400	* STANDING, MODERATE WORK
1200		(MODERATE LIFTING, ETC.)
	300	* SITTING, HEAVY ARM & LEG MOVEMENT
800		* STANDING, LIGHT WORK
	200	* SITTING, LIGHT WORK (E.G., DRIVING)
400		* SITTING QUIETLY
	100	
		* SLEEPING
200		(PUSH SPACE BAR TO CONTINUE)

(c.) Continuation of input to get work rate:

DRY BULB TEMPERATURE 85 (DEG. F)
WET BULB TEMPERATURE 80 (DEG. F)
GLOBE TEMPERATURE 90 (DEG. F)
AIR VELOCITY 50 (FT/MIN)
ENTER ESTIMATED WORK RATE (BTU/HR)? 700

Fig. 3. Input for a representative case study. These conditions might be encountered in a commercial kitchen with poor ventilation. Water vapor given off by the cooking would elevate relative humidity. Air flow is low due to poor ventilation and air temperature is high. Stoves and ovens present a radiant heat load.

After three years of selling my Model I and Model III programs, I've earned back my development costs.

So I can lower the price.

Now I'm offering my Model I and Model III programs for $75 each.

They've been checked out by thousands of TRS-80* users, most of whom get in touch with me, Irwin Taranto. Thousands of phone calls later, these systems are completely developed, checked out, glitch-free.

When people call, we've heard all the questions and we can answer them right off. I don't have to get on the phone and work through problems like I used to.

Since I'm getting off so easy, the least I can do is drop the price—50% for General Ledger, 25% for the rest.

These are my Model I and Model III programs:

Accounts Payable It links to the General Ledger, calculates and prints checks and makes reports. It's an invoice-linked system.

Accounts Receivable It keeps track of billed and unbilled invoices, open and closed items and aging. It prints statements and links to the General Ledger.

General Ledger It keeps track of data by month, quarter, year and the previous three quarters. It even includes a Cash Journal.

Inventory Control It gives an immediate read-out on any item inquiry, including quantity and dollar total.

Invoicing It prints your detailed invoices and links to Accounts Receivable and the General Ledger.

Payroll It keeps the files, computes pay and deductions, prints forms and checks, figures taxes, overtime and piecework pay in any state tax routine, and prints the 941-A and W-2 forms.

They're all yours, for $75 each. You also need documentation when you run our systems. The Osborne books—one for Accounts Payable and Receivable, one for General Ledger, one for Payroll—cost $20 each. Our invoicing book costs $10.

Just send me the coupon, or call us toll free. We'll ship within 48 hours.

Please send me the following programs at $75 each:

		book ☑
Accounts Payable		
Accounts Receivable		
General Ledger		
Inventory Control		
Invoicing		
Payroll		
Add $4.50 per order for handling		
6% tax (California only)		
AMOUNT ENCLOSED		

If you need the books, add $20 each. The invoicing book is $10.

Mastercharge ☐ Visa ☐ No.________ Expires____

☐ Please send me information on other Taranto business programs, including TRS-80 Model II accounting systems.

Your name________

Company name________

Address________

City/State/Zip________

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Listing continued

```
      INITIALIZE

170 DIM TDB(2),TWB(2),TG(2),VEL(2),M(2),CV(2),RD(2),EREQ(2),
    EMAX(2),TP$(2),VL$(2),WK$(2),VL(2),VH(2),V7(2),V8(2),TL(2),
    TH(2),T7(2),T8(2),T5(2),T6(2)
180 TP$(1)="DEG. C":  TP$(2)="DEG. F"
190 VL$(1)="M/SEC":   VL$(2)="FT/MIN"
200 WK$(1)="WATTS":   WK$(2)="BTU/HR"
210 W1$="####.# %    %": W2$="####.## ": W3$="####.# %"
220 B$=CHR$(135)+STRING$(4,131): B1$=CHR$(135)+STRING$(8,131)+CH
R$(139)
230 A1$=CHR$(149): A2$=STRING$(4,45)+CHR$(43):
    A3$=CHR$(157): A4$=STRING$(4,140)+CHR$(156)
240 '
      INTRODUCTION & INPUT

250 CLS: PRINT,"HUMAN HEAT STRESS"
260 PRINT"THIS PROGRAM CALCULATES A 'HEAT STRESS INDEX' (HSI) AN
D NOMINAL
EXPOSURE TIME FOR A PARTICULAR SET OF ENVIRONMENTAL AND WORK
CONDITIONS.":PRINT
270 PRINT"DATA MAY BE ENTERED IN METRIC OR ENGLISH UNITS."
```

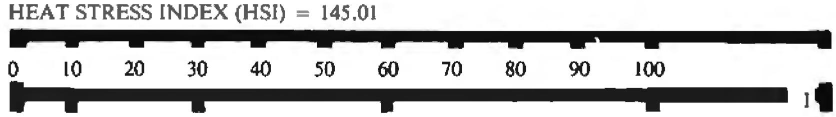
Listing continues

(a.) Summary of the conditions, with HSI and exposure time:

CONDITIONS

DB TEMP:	85.0 DEG. F	WB TEMP:	80.0 DEG. F
GLOBE TEMP:	90.0 DEG. F	AIR VELOCITY:	50.0 FT/MIN
WORK RATE:	700.0 BTU/HR		

HEAT STRESS INDEX (HSI) = 145.01



EXPOSURE: EXCEEDS MAXIMUM TOLERANCE
EXPOSURE TIME: 1 HR 17 MIN

DO YOU WANT INTERMEDIATE CALCULATIONS?
(ENTER: <Y>ES OR <N>O)? Y

(b.) Intermediate calculations and partitioning of heat load:

INTERMEDIATE CALCULATIONS

EVAPORATIVE HEAT LOSS REQUIRED FOR THERMAL BALANCE	626.0 BTU/HR
MAXIMUM EVAPORATIVE LOSS FOR CONDITIONS:	431.7 BTU/HR
RADIANT HEAT LOSS	-6.1 BTU/HR
CONVECTIVE HEAT LOSS	-68.0 BTU/HR
INTERNAL HEAT	700.0 BTU/HR
RELATIVE HUMIDITY	80.5%
PARTITION OF HEAT LOAD:	
DUE TO RADIANT EXCHANGE	-1.0%
DUE TO CONVECTIVE EXCHANGE	-10.9%
DUE TO WORK LOAD	111.8%

(HIT SPACE BAR FOR DIAGNOSTICS)

(c.) Diagnostics output with recommendations:

ANALYSIS AND DIAGNOSTICS

RELATIVE HUMIDITY IS VERY HIGH, AMBIENT TEMPERATURE MAY BE CALLED WARM, WORK LEVEL IS MODERATE, AND AIR FLOW IS SLIGHT. THE RESULTING HSI (145.01) IS IN AN INTOLERABLE RANGE.
CONDITIONS MAY BE IMPROVED BY:
REDUCING RELATIVE HUMIDITY
REDUCING AMBIENT TEMPERATURE
INCREASING AIR FLOW

OPTIONS FOR FURTHER ANALYSIS:
(0) = END ANALYSIS
(1) = SYSTEMATICALLY VARY ONE CONDITION
(2) = CHANGE CONDITIONS AND TRY ANOTHER ANALYSIS
(ENTER: 0, 1, OR 2)? 1

Fig. 4. Output Panels for the Case Study in Fig. 3

I've paid off the costs on my Model II TRSDOS* systems, too.

So now they're 50% cheaper.

A couple of months ago, I realized I'd paid off the development costs on my Model I and Model III programs. I could lower the price without cutting back one bit on my support.

The response was fantastic. Enough so that I can do the same for the TRSDOS versions of my Model II/16 programs.

These are my systems, and my new prices.

General Ledger
It gives year-to-year comparisons in dollars and percentages. It figures budgets and even has a report generator. It was $299, it's now $150.

Accounts Payable/Purchase Order
It generates purchase orders and posts the items to payable when the goods come in. It calculates and prints checks and aged ledger reports, linking fully to the General Ledger. Was $349, now $175.

Accounts Receivable
You can choose either an open item system or a balance forward system which works on a cash or an accrual basis. The open item system does invoicing and sales analysis by product code and figure in salesmen's commissions. They both generate mailing lists by customer code and zip code for up to 2000 customers. Open Item/ Invoicing was $349, it's now $175. Balance Forward was $399, it's now $200.

Payroll/Job Costing
A huge capacity. It accommodates up to 300 employees in multiple departments, with any state tax routine. It also figures piecework, overtime and tips. Was $299, now $150. With job costing option, was $399, now $200.

Inventory Control
It stores up to 5000 items. It reports by vendor, tells you when you're out of stock, or when you need to reorder. It updates price or cost automatically and integrates fully with my invoicing system. Originally $399, now $200.

These programs all work with one, two, three or four-drive and hard disk systems. They're designed to integrate with the General Ledger, and, where it helps, with each other.

They also get what I firmly believe is the most thorough support in the microcomputer industry. If you have a problem, call us and we'll straighten it out. Even if I have to do it myself, personally, right there on the phone.

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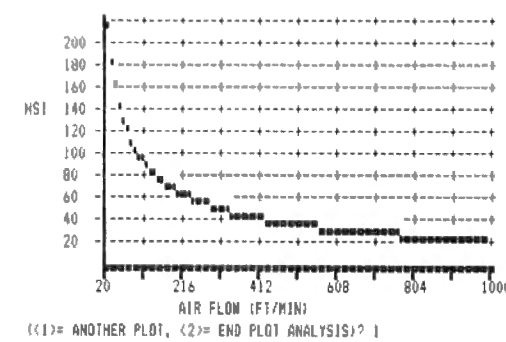
Listing continued

```
280 INPUT"(SPECIFY:  <M>ETRIC OR <E>NGLISH)";U$
290 IF LEFT$(U$,1)="M" THEN UF=1: GOTO 320  'UF = UNITS FLAG
300 IF LEFT$(U$,1)="E" THEN UF=2: GOTO 320
310 PRINT"ENTER EITHER 'M' OR 'E'...TRY AGAIN": GOTO 280
320 PRINT
330 PRINT"ENTER DRY BULB TEMPERATURE (";TP$(UF);")";
340 INPUT TDB(UF)
350 PRINT"ENTER WET BULB TEMPERATURE (";TP$(UF);")";
360 INPUT TWB(UF)
370 PRINT"ENTER GLOBE TEMPERATURE (";TP$(UF);")";
380 INPUT TG(UF)
390 PRINT"ENTER AIR VELOCITY (";VL$(UF);")";
400 INPUT VEL(UF)
410 PRINT"DO YOU NEED HELP TO ESTIMATE WORK RATE?"
420 INPUT"(ENTER:  <Y>ES  OR  <N>O)";Y1$
430 IF LEFT$(Y1$,1)="Y" THEN GOSUB 2830
440 PRINT"ENTER ESTIMATED WORK RATE (";WK$(UF);")";
450 INPUT M(UF)
460 '
       CONVERT UNITS FOR CALCULATIONS

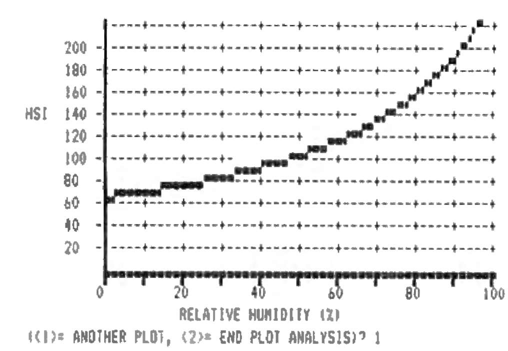
470 IF UF=1 THEN 480  ELSE 540
```

Listing continues

a. The Heat Stress Index as a Function of Air Flow:



b. The Heat Stress Index as a Function of Relative Humidity:



c. The Heat Stress Index as a Function of Radiant Temperature:

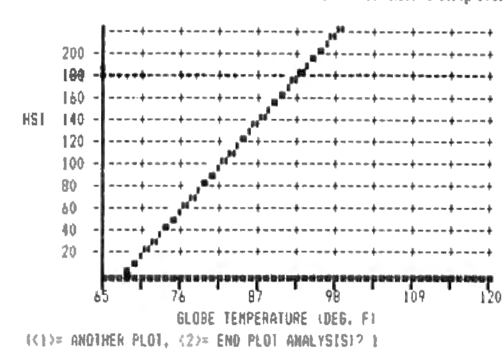


Fig. 5. Optimization graphing of HSI as a function of environmental conditions. In each case, all variables are kept constant at the values determined by the input in Fig. 3 except the factor being varied.

Listing continued

```
480 TDB(2)=(9*TDB(1)/5)+32     'METRIC
490 TWB(2)=(9*TWB(1)/5)+32     'TO
500 TG(2)=(9*TG(1)/5)+32       'ENGLISH
510 VEL(2)=VEL(1)/.00508
520 M(2)=M(1)*3.4144
530   GOTO 590
540 TDB(1)=(TDB(2)-32)*5/9     'ENGLISH
550 TWB(1)=(TWB(2)-32)*5/9     'TO
560 TG(1)=(TG(2)-32)*5/9       'METRIC
570 VEL(1)=VEL(2)*.00508
580 M(1)=M(2)/3.4144
590 IF VEL(2) < 20
    THEN VEL(2)=20:
    VEL(1)=VEL(2)*.00508      'STILL AIR = 20 FT/MIN
600 '
      CALCULATIONS

      (WATER VAPOR PRESSURES FIRST)
610 T1=TWB(1)+273.16
620 CN=LOG(10)                 'CONVERTS LN TO LOG
630 LW=28.59051-8.2*LOG(T1)/CN+.00248*T1-3142.31/T1
640 LW=LW*CN                   'CONVERT LOG TO LN
650 PWB=EXP(LW)*1E3            'WET BULB H2O PRESS
660 T2=TDB(1)+273.16
670 LD=28.59051-8.2*LOG(T2)/CN+.00248*T2-3142.31/T2
680 LD=LD*CN
690 PDB=EXP(LD)*1E3            'DRY BULB H2O PRESS
700 PH2O=PWB-0.674825*(TDB(1)-TWB(1))
710 PV=.75*PH2O               'VAPOR PRESSURE, MM HG
720 RH=100*PH2O/PDB           'RELATIVE HUMIDITY
730 IF PV >= 42 THEN FL=1 ELSE FL=0
740 '
      (EREQ & EMAX & INTERMEDIATES)
750 MRT=TG(2)+(TG(2)-TDB(2))*0.13*VEL(2)[.5
760 RD(2)=15*(MRT-95):
    RD(1)=RD(2)/3.4144                'RADIANT LOAD
770 CV(2)=0.65*VEL(2)[.6*(TDB(2)-95):
    CV(1)=CV(2)/3.4144                'CONVECTIVE LOAD
780 EREQ(2)=M(2)+CV(2)+RD(2):
    EREQ(1)=EREQ(2)/3.4144            'TOTAL HEAT LOAD
790 EMAX(2)=2.4*VEL(2)[.6*(42-PV)
800 IF EMAX(2) > 2400 THEN EMAX(2)=2400  'MAX. POSSIBLE EVAP.
810 EMAX(1)=EMAX(2)/3.4144
820 HSI=100*EREQ(2)/EMAX(2)      'HEAT STRESS INDEX
830 IF HSI >= 100
    THEN XPT=250/(EREQ(2)-EMAX(2)) ELSE XPT= -1
840 IF XPT < 0 THEN 860
850 X1PT=INT(XPT):
    X2PT=INT((XPT-X1PT)*60)      'EXPOSURE TIME, HR, MIN
860 '
      (PARTITION HEAT LOAD)
870 PRD=100*RD(2)/EREQ(2)        '% RADIANT LOAD
880 PCV=100*CV(2)/EREQ(2)        '% CONVECTIVE LOAD
890 PM=100*M(2)/EREQ(2)          '% WORK (INTERNAL)
900 '
      TABULAR OUTPUT

910 CLS: PRINTTAB(23)"** CONDITIONS **"
920 PRINT"DB TEMP:";TAB(13);USING W1$;TDB(UF);TP$(UF);
930 PRINTTAB(35)"WB TEMP:";TAB(49);USING W1$;TWB(UF);TP$(UF)
940 PRINT"GLOBE TEMP:";TAB(13);USING W1$;TG(UF);TP$(UF);
950 PRINTTAB(35)"AIR VELOCITY:";TAB(49);USING W1$;VEL(UF);VL$(UF
)
960 PRINT"WORK RATE:";TAB(13);USING W1$;M(UF);WK$(UF)
970 PRINT
980 IF FL=0 THEN PRINT"HEAT STRESS INDEX (HSI) = ";USING W2$;HSI
990 IF FL=1 THEN PRINT"HEAT STRESS INDEX (HSI) CANNOT BE CALCULA
TED"
1000 PRINTTAB(3);:
   FOR I=1 TO 10: PRINT B$;: NEXT I: PRINT B1$
1010 FOR I=0 TO 10: PRINT@449+I*5,I*10;: NEXT I
1020 PRINT@515,CHR$(157);
1030 FOR I=1 TO 58
1040   IF I=5 OR I=15 OR I=30 OR I=50
     THEN PRINT@515+I,CHR$(156); ELSE PRINT@515+I,CHR$(140);
1050 NEXT I: PRINT CHR$(174)
1060 X9=INT(HSI/2+.5): IF X9 > 58 THEN X9=58
1070 IF FL=1 THEN PRINT@540,"(NOT SCALED)";:PRINT@640,"";:GOTO 1
160
1080 PRINT@515+X9,"I";: PRINT@640,"";
1090 PRINT"EXPOSURE: ";
1100 IF HSI < 10 THEN PRINT"MINIMAL":  GOTO 1150
1110 IF HSI < 30 THEN PRINT"MILD":     GOTO 1150
1120 IF HSI < 60 THEN PRINT"SEVERE":   GOTO 1150
1130 IF HSI < 100 THEN PRINT"VERY SEVERE": GOTO 1150
```

Listing continues

tive humidity is limited to 0–100, since it is expressed as a percentage.

Radiant temperature is checked to ensure that the upper temperature is higher than the lower one. If inappropriate values are chosen for radiant temperature, HSI calculations will be off scale, resulting in empty axes. When this happens, radiant temperature graphing is simply repeated with higher or lower limits.

At the end of optimization graphing, the program provides an option to recycle to the input phase to enter new data.

Program Notes

Variables that might be expressed as either English or metric units are subscripted. The dimension statement at line 170 declares these variables as two-element arrays (e.g., DIM TDB(2)). The program would function properly without the dimension statement, since Level II Basic allows subscripting by default for up to 10 elements for any variable, but explicit declaration of variables is a cleaner programming style.

Declaration of units at the start of the program sets a units flag (UF = 1 for metric, UF = 2 for English) that governs which subscript element will be used, including unit labels in the output. For example, unit labels for temperature are defined:

```
180 TP$(1)="DEG. C": TP$(2)="DEG. F"
```

and input of temperature data is then coded:

```
330 PRINT"ENTER DRY BULB TEMPERATURE (";TP$(UF);")";
340 INPUT TDB(UF)
350 PRINT"ENTER WET BULB TEMPERATURE (";TP$(UF);")";
360 INPUT TWB(UF)
370 PRINT"ENTER GLOBE TEMPERATURE (";TP$(UF);")";
380 INPUT TG(UF)
```

If the units flag is set for metric (UF = 1), then line 330 labels the request for dry-bulb temperature with TP$(1), or "DEG. C." In the following line, the units flag causes the data to be entered into TDB(1). The same strategy is used for all the input values.

Calculations for the HSI require a mixture of English and metric units (Table 1), so some unit conversions are necessary regardless of the input units. All the input variables are converted so that they are available in both English and metric units for the calculations and output. The units flag controls the direction of the conversions:

377

Listing continued

```
1140 PRINT"EXCEEDS MAXIMUM TOLERANCE"
1150 IF HSI >=100
     THEN PRINT"EXPOSURE TIME: ";X1PT;"HR";X2PT;"MIN"
     ELSE PRINT"EXPOSURE TIME:  UNDEFINED"
1160 PRINT: PRINT"DO YOU WANT INTERMEDIATE CALCULATIONS?"
1170 INPUT"(ENTER:  <Y>ES  OR  <N>O)";Y$
1180 IF LEFT$(Y$,1)="Y" THEN 1230
1190 PRINT"DO YOU WANT TO TRY ANOTHER COMBINATION OF CONDITIONS?
"
1200 INPUT"(ENTER:  <Y>ES OR <N>O)";Y2$
1210 IF LEFT$(Y2$,1)="Y" THEN CLS: GOTO 280  ELSE 3080
1220 '
        INTERMEDIATE CALCULATIONS OUTPUT

1230 CLS: PRINT,"INTERMEDIATE CALCULATIONS"
1240 PRINT"EVAPORATIVE HEAT LOSS":
     PRINTTAB(5)"REQUIRED FOR THERMAL BALANCE";
     TAB(45);USING W1$;EREQ(UF);WK$(UF)
1250 IF FL=1 THEN 1270
1260 PRINT"MAXIMUM EVAPORATIVE LOSS FOR CONDITIONS:";
     TAB(45);USING W1$;EMAX(UF);WK$(UF)
1270 PRINTTAB(5)"RADIANT HEAT ";:
     IF RD(UF) > 0 THEN PRINT"GAIN"; ELSE PRINT"LOSS";
1280 PRINTTAB(45);USING W1$;RD(UF);WK$(UF)
1290 PRINTTAB(5)"CONVECTIVE HEAT ";:
     IF CV(UF) > 0 THEN PRINT"GAIN"; ELSE PRINT"LOSS";
1300 PRINTTAB(45);USING W1$;CV(UF);WK$(UF)
1310 PRINTTAB(5)"INTERNAL HEAT";TAB(45);USING W1$;M(UF);WK$(UF)
1320 PRINT"RELATIVE HUMIDITY";TAB(40);USING W3$;RH
1330 PRINT"PARTITION OF HEAT LOAD:"
1340 PRINT,"DUE TO RADIANT EXCHANGE";TAB(45);USING W3$;PRD
1350 PRINT,"DUE TO CONVECTIVE EXCHANGE";TAB(45);USING W3$;PCV
1360 PRINT,"DUE TO WORK LOAD";TAB(45);USING W3$;PM
1370 PRINT:PRINT"(HIT SPACE BAR FOR DIAGNOSTICS)"
1380 Z1$=INKEY$: IF Z1$=" " THEN 1400 ELSE 1380
1390 '
        DIAGNOSTICS OUTPUT

1400 CLS: PRINT,"ANALYSIS AND DIAGNOSTICS"
1410 PRINT"RELATIVE HUMIDITY IS ";
1420 IF RH < 20 THEN PRINT"VERY LOW";:  GOTO 1480
1430 IF RH < 40 THEN PRINT"LOW";:       GOTO 1480
1440 IF RH < 60 THEN PRINT"NORMAL";:    GOTO 1480
1450 IF RH < 80 THEN PRINT"SOMEWHAT HIGH";: GOTO 1480
1460 IF RH < 90 THEN PRINT"VERY HIGH";: GOTO 1480
1470 PRINT"EXTREMELY HIGH";
1480 PRINT", AMBIENT TEMPERATURE MAY BE
CALLED ";
1490 IF TDB(2) < 40 THEN PRINT"COLD";: GOTO 1560
1500 IF TDB(2) < 60 THEN PRINT"CHILLY";: GOTO 1560
1510 IF TDB(2) < 70 THEN PRINT"COOL";:   GOTO 1560
1520 IF TDB(2) < 80 THEN PRINT"COMFORTABLE";: GOTO 1560
1530 IF TDB(2) < 90 THEN PRINT"WARM";:   GOTO 1560
1540 IF TDB(2) < 95 THEN PRINT"UNCOMFORTABLY HOT";: GOTO 1560
1550 PRINT "OPPRESSIVELY HOT";
1560 PRINT", WORK LEVEL IS ";
1570 IF M(2) < 400 THEN PRINT"MINIMAL";: GOTO 1620
1580 IF M(2) < 650 THEN PRINT"LIGHT";:   GOTO 1620
1590 IF M(2) < 1300 THEN PRINT"MODERATE";: GOTO 1620
1600 IF M(2) < 2000 THEN PRINT"HEAVY";:  GOTO 1620
1610 PRINT"VERY HEAVY";
1620 PRINT", AND AIR
FLOW IS ";
1630 IF VEL(2) < 20 THEN PRINT"MINIMAL.": GOTO 1680
1640 IF VEL(2) < 100 THEN PRINT"SLIGHT.": GOTO 1680
1650 IF VEL(2) < 400 THEN PRINT"MODERATE.": GOTO 1680
1660 IF VEL(2) < 700 THEN PRINT"BREEZY.":  GOTO 1680
1670 PRINT"STRONG."
1680 IF FL=1
     THEN PRINT"CONDITIONS ARE OUTSIDE THE CALCULABLE RANGE FOR
HSI.":
     GOTO 1780
1690 PRINT"THE RESULTING HSI (";INT(HSI*100)/100;") IS IN A";
1700 IF HSI < 10 THEN PRINT" MINIMAL RANGE.": GOTO 1750
1710 IF HSI < 30 THEN PRINT" MILD RANGE.": GOTO 1750
1720 IF HSI < 60 THEN PRINT" SEVERE RANGE.": GOTO 1750
1730 IF HSI < 100 THEN PRINT" VERY SEVERE RANGE.": GOTO 1750
1740 PRINT"N INTOLERABLE RANGE."
1750 IF HSI < 45 THEN 1760 ELSE 1770
1760 PRINT"THE HSI INDICATES TOLERABLE AND REASONABLE CONDITIONS
 THAT
MAY NOT BE COST EFFECTIVE TO REDUCE FURTHER."
1770 IF HSI >= 45 THEN 1780 ELSE 1840
1780 PRINT"CONDITIONS MAY BE IMPROVED BY:"
1790 IF RH > 70 THEN PRINTTAB(5)"REDUCING RELATIVE HUMIDITY"
```

Listing continues

Listing continued

```
1800 IF TDB(2) > 80 THEN PRINTTAB(5)"REDUCING AMBIENT TEMPERATUR
E"
1810 IF VEL(2) < 400 THEN PRINTTAB(5)"INCREASING AIR FLOW"
1820 IF TG(2) > 95 THEN PRINTTAB(5)"REDUCING RADIANT TEMPERATURE
"
1830 IF FL=1 THEN 1190
1840 PRINT: PRINT"OPTIONS FOR FURTHER ANALYSIS:
      (0)= END ANALYSIS
      (1)= SYSTEMATICALLY VARY ONE CONDITION
      (2)= CHANGE CONDITIONS AND TRY ANOTHER ANALYSIS
1850 INPUT"(ENTER: 0, 1, OR 2)";A9
1860 IF A9+1<1 OR A9+1>3 OR A9+1<>INT(A9+1) THEN 1850
1870 IF A9=0 THEN 3080
```

Listing continues

T' =	Wet-bulb Temperature, °K	
	$T' = T_{wb°C} + 273.16$	
P_{wb} =	Saturated Water-vapor Pressure at Wet-bulb Temp, mbar	
	$\log P_{wb} = 28.59051 - 8.2 \log T' + .00248\ T' - 3142.31/T'$	
	$P_{wb} = \text{antilog}(\log P_{wb})*1000$	
T'' =	Dry-bulb Temperature, °K	
	$T'' = T_{db°C} + 273.16$	
P_{db} =	Saturated Water-vapor Pressure at Dry-bulb Temp, mbar	
	$\log P_{db} = 28.59051 - 8.2 \log T'' + .00248\ T'' - 3142.31/T''$	
	$P_{db} = \text{antilog}(\log P_{db})*1000$	
P_{H_2O} or PV =	Prevailing Water-vapor Pressure, mbar or mm Hg	
	$P_{H_2O} = P_{wb} - .274825(T_{db°C} - T_{wb°C})$	(mbar)
	$PV = 0.75(P_{H_2O})$	(mm Hg)
MRT =	Mean Radiant Temperature, °F	
	$MRT = T_{g°F} + 0.13(\text{air vel})^{.5}(T_{g°F} - T_{db°F})$	
RD =	Radiant Heat Exchange, BTU/hr or watts	
	$RD = 15(MRT - 95)$	(BTU/hr)
	$RD' = RD/3.4144$	(watts)
CV =	Convective Heat Exchange, BTU/hr or watts	
	$CV = 0.65(\text{air vel})^{.6}(T_{db°F} - 95)$	(BTU/hr)
	$CV' = CV/3.4144$	(watts)
E_{req} =	Evaporative Heat Loss Required for Thermal Balance, BTU/hr or watts	
	$E_{req} = M \pm RD \pm CV$	(BTU/hr)
	$E_{req}' = E_{req}/3.4144$	(watts)
E_{max} =	Maximum Evaporative Heat Loss, BTU/hr or watts*	
	$E_{max} = 2.4(\text{air vel})^{.6}(42 - PV)$	(BTU/hr)
	$E_{max}' = E_{max}/3.4144$	(watts)
HSI =	Heat Stress Index, percent	
	$HSI = 100*\dfrac{E_{req}}{E_{max}}$	
t_{exp} =	Nominal Exposure Time, hrs (only if HSI>100)	
	$t_{exp} = \dfrac{250}{E_{req} - E_{max}}$	
RH =	Relative Humidity, percent	
	$RH = 100*\left(\dfrac{P_{H_2O}}{P_{db}}\right)$	

Partitioning Heat Load:

Percent Radiation, $\%RD = 100*(RD/E_{req})$
Percent Convection, $\%CV = 100*(CV/E_{req})$
Percent Work, $\%M = 100*(M/E_{req})$

*Maximum possible E_{max} is 2400 BTU/hr

Table 1. Variables and calculations for the Heat Stress Index. Units in the calculations: Dry-bulb temperature is in both Fahrenheit and Celsius ($T_{db°F}$ or $T_{db°C}$); wet-bulb temperature is in Celsius ($T_{wb°C}$); globe temperature is in Fahrenheit ($T_{g°F}$); air velocity is in ft./min.; water-vapor pressures are in either mbar or mm Hg; and heat is expressed as BTU/hr (English) or watts (metric).

```
470 IF UF=1 THEN 480 ELSE 540
480 TDB(2)=(9*TDB(1)/5)+32 'METRIC
490 TWB(2)=(9*TWB(1)/5)+32 'TO
500 TG(2)=(9*TG(1)/5)+32 'ENGLISH
510 VEL(2)=VEL(1)/.00508
520 M(2)=M(1)*3.4144
530 GOTO 590
540 TDB(1)=(TDB(2)-32)*5/9 'ENGLISH
550 TWB(1)-(TWB(2)-32)*5/9 'TO
560 TG(1)=(TG(2)-32)*5/9 'ENGLISH
570 VEL(1)=VEL(2)*.00508
580 M(1)=M(2)/3.4144
```

Table 1 summarizes the calculations required for the HSI. Most of the equations translate directly into Basic. One exception might be the calculations for saturated water-vapor pressures from wet and dry-bulb temperatures. The computer uses base-e logarithms (ln), while vapor pressure calculations are in base-10 logs. To take base-10 logs of dry-bulb and wet-bulb temperatures (°K), the program uses the base-conversion strategy:

$$\log_X Y = \frac{\log_e Y}{\log_e X} = \frac{\ln Y}{\ln X}.$$

To extract the antilog, the $\log_X Y$ value is converted back to base-e by multiplying back through by ln X. The antilog is then obtained with the EXP function for raising e to a power, since $e^{\ln X} = X$. This sequence for saturated water-vapor pressure at the wet-bulb temperature (P_{wb}—compare Table 1) looks like:

```
610 T1=TWB(1)+273.16              'T1=Twb°K
620 CN=LOG(10)                    'actually ln(10)
630 LW=28.59051-(8.2*LOG(T1)/CN)+
   (.00248*T1)-(3142.31/T1)       'LW=log(Pwb)
640 LW=LW*CN                      'now LW=ln(Pwb)
650 PWB=EXP(LW)*1E3               'antilog=Pwb
```

The procedure is the same for saturated water-vapor pressure at dry bulb temperature (P_{db}).

HSI calculations reveal some interesting properties of heat transfer. Although normal body temperature is between 98° and 99°F (the core temperature, measured with a rectal thermometer), the body surface is usually several degrees cooler. Most environmental heat exchange depends upon a temperature difference between the environment and the body surface, not the core. The equations for body heat exchange are based on a nominal body (skin) temperature of 95°F.

Mean radiant temperature (MRT) varies as a function of the square root of the air velocity and the difference between globe temperature and dry air temperature:

Listing continued

```
1880 IF A9=1 THEN 1910
1890 IF A9=2 THEN CLS: GOTO 280
1900 '
       OPTIMIZATION GRAPHING

1910 CLS: PRINT"HEAT STRESS INDEX (HSI) MAY BE EXAMINED AS A FUN
CTION
OF THE FOLLOWING:"
1920 PRINT"    (1) AIR FLOW
   (2) RELATIVE HUMIDITY
   (3) RADIANT TEMPERATURE"
1930 INPUT"(ENTER:  1, 2, 3, OR 0 TO END ANALYSIS)";A8
1940 IF A8+1 <1 OR A8+1 > 4 OR A8+1 <> INT(A8+1) THEN 1930
1950 IF A8=0 THEN 3080
1960 ON A8 GOSUB 2030 ,2220 ,2380
1970 PRINT@896,"";
1980 INPUT"(<1>= ANOTHER PLOT, <2>= END PLOT ANALYSIS)";A4
1990 IF A4<1 OR A4>2 OR A4<>INT(A4) THEN 1970
2000 IF A4=1 THEN 1910
2010 IF A4=2 THEN CLS: GOTO 1840
2020 '
       (AIR FLOW)
2030 VL(1)= 20*.00508:  VL(2)=20:
     VH(1)= 1000*.00508: VH(2)=1000
2040 CLS: PRINT"RECOMMENDED RANGE FOR AIR FLOW IS BETWEEN ";VL(U
F);"
 AND ";VH(UF);" ";VL$(UF)
2050 INPUT"ENTER LOWER LIMIT FOR AIR FLOW";V7(UF)
2060 IF UF=1 THEN V7(2) = V7(1)/.00508
             ELSE V7(1) = V7(2)*.00508
2070 IF V7(2) < 20 THEN PRINT"STILL AIR IS";VL(UF);" ";VL$(UF):
GOTO 2050
2080 INPUT "ENTER UPPER LIMIT FOR AIR FLOW";V8(UF)
2090 IF UF=1 THEN V8(2)=V8(1)/.00508
             ELSE V8(1)=V8(2)*.00508
2100 IF V8(UF) <= V7(UF) THEN PRINT"IT WON'T WORK...TRY AGAIN":
GOTO 2050
2110 RG=V8(2)-V7(2)    'RANGE FOR CALCULATIONS
2120 X7=V7(UF)         'MIN. FOR GRAPH LABEL
2130 X6=(V8(UF)-V7(UF))/5 'FOR GRAPH LABELS
2140 X8=V7(2)          'MIN. FOR CALCULATIONS
2150 GOSUB 2700         'DRAW AXES & LABEL
2160 PRINT @ 852,"AIR FLOW (";VL$(UF);")";
2170 X2 = V7(2)      'X2 & X3 ARE LOOP LIMITS
2180 X3 = V8(2)
2190 GOSUB 2550 'GENERAL LOOP
2200 RETURN
2210 '
       (RELATIVE HUMIDITY)
2220 CLS:PRINT"RECOMMENDED RANGE FOR RELATIVE HUMIDITY IS BETWEE
N 20
AND 100 PERCENT."
2230 INPUT"ENTER LOWER LIMIT FOR RELATIVE HUMIDITY";LR
2240 IF LR < 0 THEN PRINT"IMPOSSIBLE ... TRY AGAIN": GOTO 2230
2250 INPUT"ENTER UPPER LIMIT FOR RELATIVE HUMIDITY";UR
2260 IF UR > 100 THEN PRINT"IMPOSSIBLE ... TRY AGAIN": GOTO 2250
2270 IF UR <= LR THEN PRINT"IT WON'T WORK... TRY AGAIN": GOTO 22
30
2280 RG=UR-LR
```

Listing continues

$$MRT = T_{g°F} + 0.13\,(\text{air vel})^{.5}(T_{g°F} - T_{db°F})$$

The radiant heat exchange (RD) depends upon the difference between mean radiant temperature and skin temperature:

$$RD = 15(MRT - 95).$$

Convective heat exchange varies as a function of the 0.6 power of the air velocity and the difference between dry air temperature and skin temperature:

$$CV = 0.65(\text{air vel})^{.6}(T_{db°F} - 95).$$

The total heat load that has to be dissipated by evaporation (E_{req}) is the sum of the internal heat being produced by work (M) plus radiant and convective heat exchange:

$$E_{req} = M + RD + CV.$$

If either radiant or convective transfer is a heat loss, E_{req} is reduced.

The maximum possible evaporation (E_{max}) varies with the 0.6 power of air velocity and the water vapor pressure difference between the skin and the air:

$$E_{max} = 2.4(\text{air vel})^{.6}(42 - PV)$$

where PV = ambient vapor pressure and 42 is the saturated water-vapor pressure at 95 °F. The maximum possible E_{max} is 2400 BTU/hr.

Optimization graphing is handled as modular subroutines that are called from a menu (lines 1910–2010). Separate subroutines are used for air flow, relative humidity, and globe temperature to input minimum and maximum values for each. Two modules require unit conversions, since calculations for air flow and globe temperature are mostly in English units. If the program is being used in metric, input of graphing limits is taken in metric, and

GENERAL GRAPHING LOOP	AIR FLOW (VEL)	RELATIVE HUMIDITY (RH)	GLOBE TEMPERATURE (TG)
	(A8 = 1)	(A8 =)	(A8 = 3)
X9 = Variable Being Changed	X2 = Min. flow (ft/min)	X2 = Min. RH (%)	X2 = Min. $T_{g°F}$
	X3 = Max. flow (ft/min)	X3 = Max. RH (%)	X3 = Max. $T_{g°F}$
	RG = X3 − X2	RG = X3 − X2	RG = X3 − X2
FOR X9 = X2 TO X3 STEP RG/100			
The flag (A8) for choice of factors to be varied determines branching to the appropriate calculation for each intermediate variable.	M9 = TG(2) + .13*X9↑.5*(TG(2) − TDB(2)) R9 = 15*(M9 − 95) C9 = .65*X9↑.6*(TDB(2) − 95) E9 = M(2) + C9 + R9 P9 = PV E8 = 2.4*X9↑.6*(42 − P9) Y9 = 100*ABS(E9/E8)	M9 = MRT R9 = 15*(M9 − 95) C9 = .65*VEL(2)↑.6*(TDB(2) − 95) E9 = M(2) + C9 + R9 P9 = .75*(X9 * PDB/100) E8 = 2.4*VEL(2)↑.6*(42 − P9) Y9 = 100*ABS(E9/E8)	M9 = X9 + .13*VEL(2)↑.5*(X9 − TDB(2)) R9 = 15*(M9 − 95) C9 = .65*VEL(2)↑.6*(TDB(2) − 95) E9 = M(2) + C9 + R9 P9 = PV E8 = 2.4*VEL(2)↑.6*(42 − P9) Y9 = 100*ABS(E9/E8)
(GOSUB TO PLOT POINTS)			
NEXT X9			

Fig. 6. Partitioning of the general graphing loop (lines 2470–2610). In each case, X9, the loop counter, is substituted into the equations involving the factor being varied. Equivalence for the intermediate variables: M9 = Mean radiant temperature (°F), R9 = Radiant heat exchange, C9 = Convective heat exchange, E9 = Evaporation required to dispel the heat load, E8 = Maximum evaporation for the conditions, P9 = Prevailing vapor pressure (mm Hg), and Y9 = Heat Stress Index. The graphing subroutine plots Y9 as a function of X9.

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TRS-80* Model I EXPANSION

✓76

Our MDX-1 and MDX-2 Interface Expansion Boards are field tested/field proven and offer more options for the Model I than any on the market. Also compatible with the PMC-80 and LNW-80 Computers. **Custom Case Available for MDX-2.**

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• **MEMORY EXPANSION** to 48K	✓	✓
• **ON-BOARD SUPPLY**, fully protected	✓	✓
• **PHONE MODEM**, 0-600 baud, direct connect, "answer" and "originate" modes	✓	✓
• **REAL TIME CLOCK**, software programmable	✓	✓
• **PARALLEL PRINTER PORT**	✓	✓
• **SERIAL PORT**—RS232 and 20ma loop compatible	✓	✓
• **EPROM OPTION** for user firmware	✓	✓
• **DUAL CASSETTE LINE**	✓	✓
• **FLOPPY DISK CONTROLLER**: The MDX-2 has all the features of the MDX-1 *plus* Floppy Disk Controller. The Controller is compatible with any single or double-sided floppy disk drive that is configured for use with the TRS-80 computer.		✓

ALL MDX SERIES BOARDS ARE WARRANTED AND SERVICE IS AVAILABLE.

TRS-80* Model III EXPANSION

✓77

The **MDX-3** Interface Expansion Board is desinged to mount inside the Model III Computer. Connectors provide external access to the Floppy Disk Controller (for external drives) and RS232 port.

FEATURES:

- **DOUBLE-DENSITY FLOPPY DISK CONTROLLER**—1.8 times the normal single density storage; digital data separation; controls up to 4 drives.
- **SERIAL PORT**— RS232 and 20ma loop compatible, 110-19,200 baud
- **PHONE MODEM**—0-600 baud—direct connect—"answer" and "originate" modes.
- **FULLY COMPATIBLE** with all Model III software.

MDX-5: Also for the TRS-80* Model III

For the user who already has disk we offer the MDX-5. This board mounts next to the Floppy Disk Controller Board in the Model III.

FEATURES:

- **SERIAL PORT**—RS232 and 20ma loop compatible, 110-19,200 baud
- **PHONE MODEM**—0-600 baud—direct connect—"answer" and "originate" modes.
- **Fully compatible with all Model III Software**

PHONE MODEM

✓78

The **MDX-4** Phone Modem utilizes the same Direct Connect, 0-600 baud design as used in the other MDX series boards and: answer/originate modes; solder-masked & silkscreened; on-board power supply. Compatible with any RS232 port.

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Installation Kit for Model III Drive			$119.95		
Custom Case		$45.00			

Any manual ordered separately, $5.95 plus $3.00 postage & handling.
All board orders, add $5.00 for postage & handling. (Texas residents add 5% tax.)
*W-Case and power transformer-minor assembly required.

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Listing continued

```
2290 X7=LR
2300 X8=LR
2310 X6=(UR-LR)/5
2320 GOSUB 2700    'AXES AND LABELS
2330 PRINT @ 852,"RELATIVE HUMIDITY (%)";
2340 X2=LR:  X3=UR
2350 GOSUB 2550 'GENERAL LOOP
2360 RETURN
2370 '
      (RADIANT (GLOBE) TEMPERATURE)
2380 TL(1)= (65-32)*5/9:   TL(2)=65:
     TH(1)= (150-32)*5/9:  TH(2)=150
2390 CLS: PRINT"RECOMMENDED RANGE FOR GLOBE TEMPERATURE IS BETWE
EN";TL(UF);"
AND ";TH(UF);" ";TP$(UF)
2400 INPUT"ENTER LOWER LIMIT OF GLOBE TEMPERATURE";T7(UF)
2410 IF UF=1 THEN T7(2)=(9*T7(1)/5)+32
              ELSE T7(1)=(T7(2)-32)*5/9
2420 INPUT"ENTER UPPER LIMIT OF GLOBE TEMPERATURE";T8(UF)
2430 IF UF=1 THEN T8(2) = (9*T8(1)/5)+32
              ELSE T8(1) = (T8(2)-32)*5/9
2440 IF T8(UF) <= T7(UF) THEN PRINT"IMPOSSIBLE... TRY AGAIN":GOT
O 2400
2450 RG=T8(2)-T7(2)
2460 X7=T7(UF)
2470 X6=(T8(UF)-T7(UF))/5
2480 X8=T7(2)
2490 GOSUB 2700     'AXES AND LABELS
2500 PRINT @ 852,"GLOBE TEMPERATURE (";TP$(UF)")";
2510 X2=T7(2):  X3=T8(2)
2520 GOSUB 2550 'GENERAL LOOP
2530 RETURN
2540 '
      GENERAL GRAPHING LOOP
2550 FOR X9 = X2 TO X3 STEP RG/100
2560   IF A8=1 THEN M9=TG(2)+.13*X9[.5*(TG(2)-TDB(2))
2570   IF A8=2 THEN M9=MRT
2580   IF A8=3 THEN M9=X9+.13*VEL(2)[.5*(X9-TDB(2))
2590   R9=15*(M9-95)
2600  IF A8=1 THEN C9=.65*X9[.6*(TDB(2)-95)
                ELSE C9=.65*VEL(2)[.6*(TDB(2)-95)
2610   E9=M(2)+C9+R9
2620   IF A8=2 THEN P9=.75*(X9*PDB/100) ELSE P9=PV
2630   IF A8=1 THEN E8=2.4*X9[.6*(42-P9)
               ELSE E8=2.4*VEL(2)[.6*(42-P9)
2640   IF E8>2400 THEN E8=2400
2650   Y9=100*E9/E8
2660   GOSUB 2770  'PLOT POINTS
2670 NEXT X9
2680 RETURN
2690 '
      SUBROUTINE FOR GRAPH AXES
2700 CLS
2710 FOR I=1 TO 11:
     PRINTTAB(10)A1$;:
     FOR J=1 TO 10:  PRINT A2$;:  NEXT J:
     PRINT:
     NEXT I
2720 PRINTTAB(10)A3$;:
     FOR J=1 TO 10: PRINT A4$;: NEXT J:
     PRINT
2730 H9=200:
     FOR I=68 TO 646 STEP 64:
     PRINT @ I,H9;TAB(9)"-";: H9=H9-20:
     NEXT I:
     PRINT @ 256,"HSI";
2740 KJ=0:
     FOR J=776 TO 826 STEP 10:
     PRINT@J,INT((X7+KJ)*100)/100;:  KJ = KJ+X6:
     NEXT J
2750 PRINT@832,"";:  RETURN
2760 '
      PLOTTING SUBROUTINE -- X,Y ENTERED AS X9,Y9
2770 YP=34-(33*Y9/200)
2780 XP=20+(X9-X8)*100/RG
2790 IF XP < 0 OR XP > 120 OR YP < 0 OR YP > 34 THEN 2810
2800 SET(XP,YP)
2810 RETURN
2820 '
      SUBROUTINE FOR WORK ESTIMATE TABLE

2830 CLS: PRINTTAB(5)"BTU/HR";TAB(14)"WATTS";TAB(29)"** ACTIVITY
 **"
2840 PRINTTAB(5)2400;TAB(14)700;TAB(22)"* HARDEST SUSTAINED WORK
"
```

Listing continues

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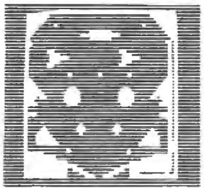
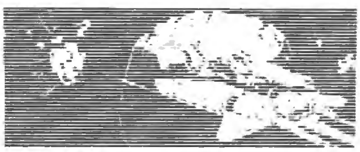
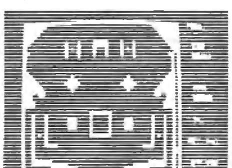
From Our Most-Requested List For TRS-80 I & III



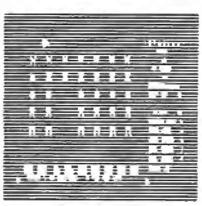
Astroball
By John Allen
More features, thrills and sound than even our famous Pinball! With a flying saucer, moving spaceships, meteors . . . even black holes that can swallow the ball. 5 skill levels.
16K Tape or Disk, $19.95*



Space Rocks
By Steven Kearns
Avoid and destroy gigantic space rocks. Fast game with sound.
16K Tape or Disk, $19.95*



Pinball
By John Allen
Lots of sound, machine language speed and flashing graphics make it *very* realistic! 5 speeds. The all-time favorite!
16K Tape, $14.95*   16K Disk, $20.95*



Invaders from Space
By Carl Miller
The classic, possibly addictive, space game. Aliens move, drop bombs and overrun your bases while you move and **simultaneously** fire at the invaders.
16K Tape, $14.95*   16K Disk, $20.95*

***plus $2.00 shipping and handling**

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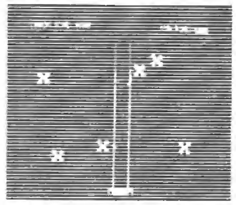
New!



Evade
By Tim Knight
You're in charge of the USS Krestan, a tri-ship on interstellar exploration. You must defend yourself against groups of enemy aliens, each requiring a different strategy. Then you can go for the big points by docking with another ship. Be careful, or your ship will be vaporized! **Now** you're ready for the evil Malicians . . . and the meteor showers. Not for the faint-hearted!
16K Tape or 32K Disk: TRS-80 I & III.
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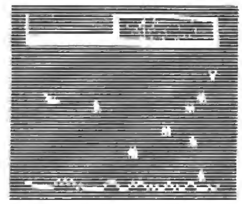
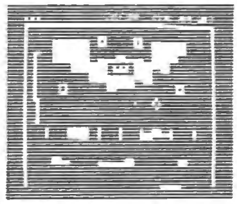
New!



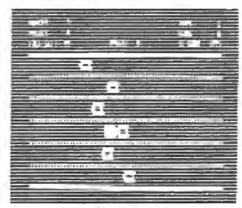
Demise
By P. Case
Shoot down the enemy ships which are coming—and firing—at you. After obliterating them all, you must carefully navigate a tunnel before you are in the clear. You can move your ship left, right, up, down and diagonally; your weapons include a laser cannon and "smart bombs" that render *all* ships on the screen impotent. You start with 5 ships and get another ship and "smart bomb" for each 10,000 points. 3 levels of play; great sound effects.
16K Tape or Disk: TRS-80 I & III.
$19.95 plus $2.00 shipping and handling

New!



King of the Jungle
By Patrik Vandewalle
An unusual combination of fast pinball action plus the challenges and dangers of an arcade game. Score points as you maneuver your ball from obstacle to obstacle, while moving through the jungle searching for the hidden crown. You start with 5 balls and get another for each 10,000 points. Choice of 3 screens; Joystick compatible.
16K Tape or Disk: TRS-80 I & III.
$19.95 plus $2.00 shipping and handling

New!



Enemy Evasion
By Raul Rivera
An original fast-paced arcade style game requiring quick mental and physical reflexes. You must control your Rover to avoid oncoming Rovelan Ramcraft. You gain points for each successful pass through the "death lanes", but the Ramcraft speed increases as you play. If you reach the double bonus mode, watch out for the land pellets they drop! Joystick compatible.
32K Disk: TRS-80 I & III.
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Listing continued

```
2850 PRINT: PRINTTAB(5)2000;TAB(14)600;TAB(22)"* INTERMITTENT HE
AVY WORK"
2860 PRINTTAB(24)"(LIFTING, SHOVING, PULLING)"
2870 PRINTTAB(5)1600;TAB(14)500
2880 PRINT: PRINTTAB(14)400;TAB(22)"* STANDING, MODERATE WORK"
2890 PRINTTAB(5)1200;TAB(24)"(MODERATE LIFTING, ETC.)"
2900 PRINTTAB(14)300;TAB(22)"* SITTING, HEAVY ARM & LEG MOVEMENT
"
2910 PRINTTAB(5)800;TAB(22)"* STANDING, LIGHT WORK"
2920 PRINTTAB(14)200;TAB(22)"* SITTING, LIGHT WORK (E.G., DRIVIN
G)"
2930 PRINTTAB(5)400;TAB(22)"* SITTING QUIETLY"
2940 PRINTTAB(14)100
2950 PRINTTAB(22)"* SLEEPING"
2960 PRINTTAB(5)200;
2970 FOR J = 3 TO 46: SET(23,J): NEXT J
2980 SET(22,3): SET(22,10): SET(22,17): SET(22,24):
     SET(22,31): SET(22,38): SET(22,45)
2990 SET(24,41): SET(24,34): SET(24,28): SET(24,21):
     SET(24,15): SET(24,9): SET(24,3)
3000 PRINT @ 936,"(PUSH SPACE BAR)";
3010 PRINT @ 1001,"( TO CONTINUE )";
3020 X1$ = INKEY$: IF X1$=" " THEN 3030 ELSE 3020
3030 CLS: PRINT "DRY BULB TEMPERATURE ";TDB(UF);" (";TP$(UF);")"
3040 PRINT "WET BULB TEMPERATURE ";TWB(UF);" (";TP$(UF);")"
3050 PRINT "GLOBE TEMPERATURE    ";TG(UF);" (";TP$(UF);")"
3060 PRINT "AIR VELOCITY         ";VEL(UF);" (";VL$(UF);")"
3070 RETURN
3080 END
```

```
OUTPUT WHEN CONDITIONS EXCEED CALCULABLE RANGE FOR HSI:

                         **CONDITIONS**
DB TEMP:            98.0 DEG. F     WB TEMP:          96.5 DEG. F
GLOBE TEMP:         94.0 DEG. F     AIR VELOCITY:    200.0 FT/MIN
WORK RATE:        200.0 BTU/HR

HEAT STRESS INDEX (HSI) CANNOT BE CALCULATED
|    |    |    |    |    |    |    |    |    |    ||
0   10   20   30   40   50   60   70   80   90   100
|----|---------|-----(NOT SCALED)------------------||

DO YOU WANT INTERMEDIATE CALCULATIONS?
(ENTER: <Y>ES OR <N>O)? Y

                  INTERMEDIATE CALCULATIONS
EVAPORATIVE HEAT LOSS
  REQUIRED FOR THERMAL BALANCE                  121.5 BTU/HR
  RADIANT HEAT LOSS                            -125.3 BTU/HR
  CONVECTIVE HEAT GAIN                           46.8 BTU/HR
  INTERNAL HEAT                                 200.0 BTU/HR
RELATIVE HUMIDITY                                 94.6%
PARTITION OF HEAT LOAD:
  DUE TO RADIANT EXCHANGE                        -103.1%
  DUE TO CONVECTIVE EXCHANGE                       38.5%
  DUE TO WORK LOAD                                164.6%

(HIT SPACE BAR FOR DIAGNOSTICS)

                  ANALYSIS AND DIAGNOSTICS
RELATIVE HUMIDITY IS EXTREMELY HIGH, AMBIENT TEMPERATURE MAY BE
CALLED OPPRESSIVELY HOT, WORK LEVEL IS MINIMAL, AND AIR FLOW IS
MODERATE.
CONDITIONS ARE OUTSIDE THE CALCULABLE RANGE FOR HSI.
CONDITIONS MAY BE IMPROVED BY:
  REDUCING RELATIVE HUMIDITY
  REDUCING AMBIENT TEMPERATURE
  INCREASING AIR FLOW
DO YOU WANT TO TRY ANOTHER COMBINATION OF CONDITIONS?
(ENTER: <Y>ES OR <N>O)? N
```

Fig. 7. Typical Output for High-Temperature, High-Humidity Environmental Conditions Exceeding Calculable Range for HSI

the graph is labeled in metric, but calculations are done in converted English units.

All the input modules call the same subroutines for constructing and labeling the graph axes (lines 2700–2750) and for calculations (the general graphing loop, lines 2550–2680). All three modules use X2 for the minimum, X3 for the maximum, and RG for the range going into the general graphing loop.

Figure 6 provides a breakdown of the branching in the general graphing loop to partition calculations according to which factor is being varied. The choice of factors from the menu sets a flag (A8) that determines the branching in the general graphing loop. The points are actually plotted in a separate subroutine (lines 2770–2810) that is called from within the general graphing loop.

Limitations of the Program

The HSI program was written on a Model I TRS-80, but it is compatible with a Model III, except that output is entirely uppercase. The program is large, over 13K, and is a tight fit on a 16K machine, causing a slight degradation in response time.

The program coding style is only moderately compact—a compromise between clean, readable style and effective use of memory. You can improve response time slightly by omitting some documentation, shortening all variable names to two characters, and using more multiple-statement lines.

The HSI has limitations when humidity is very high, because water cannot then evaporate. HSI calculations are not designed for such a condition and an appropriate flag (FL) is correspondingly set in our program. Some diagnostics are possible, but optimization graphing is not. Figure 7 shows output for these conditions.

Tolerance to heat stress varies widely among people depending on age, physical condition, and other personal characteristics. Also, if someone works in the heat for several weeks, his body adjusts to improve his heat tolerance. For these reasons, the HSI cannot be accurately or safely used to predict thermal tolerance for a specific person. The index is more useful as a guide in comparing the influence of different environmental factors and work rate on heat stress. ■

Donald Heckenlively (Hillsdale College, Hillsdale, MI 49242), a zoologist, enjoys railroad history and opera.

Make those Model I games more fun.

More Color Conversions

Jimmy L. Freeman
PSC Box 1025
APO New York, NY 09289

Being in the Air Force has some definite disadvantages. One was being sent to a country (Turkey) where my favorite hobby (amateur radio) is not permitted. And my daughters couldn't watch tv for amusement—they couldn't understand a word.

I finally invested in a Color Computer. I kept busy, converting Model I programs, and my daughters have new games to play.

First, Some Work

Converting Model I or III programs without graphics was simple. I just had to change the line length to fit the 32-character screen and add some "hit enter to continue" routines to make up for lost print space.

Programs with graphics presented another problem. First, I cut everything in half. Then I adapted for the joysticks and added a few simple sound routines. The programs came to life—in color!

Now, Some Play

Program Listing 1, Subdestroy, was written by John Cominio (*80 Micro*, June 1981). This program does not require joysticks and is basically the same as it appeared originally. I opted for contact depth charges instead of setting them for depth. I also moved the score and charges remaining information above the destroyer to prevent the data from being momentarily erased when a depth charge is dropped.

Program Listing 2, Lunar Lander, was written by John Beringer (*80 Micro*, June 1981). In the original program, the PEEK routine looked at the keyboard scanning matrix to get the burn rate for the rocket motors. I simply used the joysticks to determine the burn rate of the rocket motors.

Program Listing 4, Missiles from Mars, was written by Charles E. Gillen (*80 Micro*, January 1982). I deleted one of the cities due to space limitations on the Color Computer screen. You could put it back in, but virtually every missile that made it past your defenses would score. I also lowered the total number of hits required to finish the game because my daughters found it almost impossible to obtain 25 hits before losing both missile bases or the entire population. In the original program, John filled the screen with character strings so a trail would be left by the attacking missiles. I left this feature out but it could be easily added by changing line 330. Instead of resetting the graphics symbol that represents the missile, set it to a different color.

If you don't have joysticks and would still like to try Lunar Lander make the changes shown in Listing 3. This allows you to use keys 1-5 for your rocket motors and the <> keys for lateral movement. For Missiles from Mars delete line 340 and change lines 350-390 and 690 as shown in Listing 5.

To speed up the action, POKE 65495,0 before running these programs. The pitch of the sound routine increases but I have not experienced any difficulties with the action of the programs themselves. Remember, you must slow the clock down (by pushing reset) before saving a program on tape or loading a new one.

I hope these color conversions prompt more of them. It's not too hard after you get started—give it a try! ■

Jimmy Freeman enjoys his Color Computer as well as amateur radio.

The Key Box

Color Computer
Color Basic
16K RAM

Program Listing 1. Subdestroy

```
10 ' SUB DESTROY
20 ' ORIGINAL BY JOHN COMINIO
30 ' FOR TRS-80 MODEL I
40 ' PUBLISHED BY
50 ' 80 MICROCOMPUTING
60 ' JUNE 1981
70 ' TRS-80 COLOR COMPUTER
80 ' CONVERSION BY
90 ' JIM FREEMAN
100 CLEAR400
110 CLS
120 PRINT "--- S U B   D E S T R O Y ---":PRINT:PRINT:PRINT "DO
YOU WANT INSTRUCTION (Y/N)?"
130 R$=INKEY$:IFR$=""THEN130
140 IFR$="Y"THEN1160ELSEIFR$="N"THENCLS(0):GOTO150ELSE130
150 Q=33:J1=20
160 GOSUB170:GOTO300
170 E1$=CHR$(128)+CHR$(128)+CHR$(128)+CHR$(128)
180 E2$=CHR$(128)+CHR$(128)+CHR$(128)+CHR$(128)+CHR$(128)+CHR$(1
28)
190 A=RND(95):S=A+RND(150)
200 Z=RND(512):IFZ>480ORZ<192THEN190
210 IFZ+A>512ORZ+A<192THEN190
220 IFZ+A+S>512ORZ+A+S<192THEN190
230 X=480
240 L$=CHR$(62)
250 B2$=CHR$(243)+CHR$(247)+CHR$(255)+CHR$(251)+CHR$(243)
260 B$=CHR$(131)+CHR$(135)+CHR$(139)+CHR$(131)
270 B1$=CHR$(147)+CHR$(151)+CHR$(155)+CHR$(147)
```

Listing 1 continues

Listing 1 Continued

```
280 S$=CHR$(179)+CHR$(179)+CHR$(183)+CHR$(187)+CHR$(183)+CHR$(17
9)
290 RETURN
300 GOSUB310:GOTO330
310 FOR W=64 TO 95:PRINT@W,CHR$(172);:NEXT:RETURN
320 A$=INKEY$:IFA$=""THENGOSUB310
330 IFA$=CHR$(32)THENQ1=0:J1=J1-1:SOUND 200,2:GOSUB430
340 GOSUB380
350 GOSUB 320
360 END
370 RETURN
380 IFQ>58THENQ=33:PRINT@58,E2$+CHR$(128);
390 GOSUB720
400 GOSUB470
410 PRINT@Q-1,E1$;:PRINT@Q,S$;:Q=Q+1:RETURN
420 GOTO720
430 IF Q+Q1+32>480 THEN PRINT @Q+Q1,"****";:SOUND 1,10:PRINT @ Q
+Q1, E1$;:RETURN ELSE 440
440 GOSUB640:PRINT@Q+Q1+32,CHR$(177);
450 GOSUB470
460 PRINT@Q+Q1+32,CHR$(128);:Q1=Q1+33:GOTO430
470 PRINT@Z+4,B$;:Z=Z+1
480 PRINT@Z-1,E1$;
490 IFZ+A+S>500THEN550
500 PRINT@Z+S+A+4,B2$;:S=S+1
510 PRINT@Z+S+A-1,E1$;
520 PRINT@Z+A+4,B1$;:A=A+1
530 PRINT@Z+A-1,E1$;
540 RETURN
550 FOR W=480 TO 510:PRINT@W,CHR$(128);:NEXT
560 PRINT@Z+3,E1$;
570 PRINT@Z+A+2,E1$;
580 IF Q+Q1+32<480 THEN PRINT @ Q+Q1+32, CHR$(128);:ELSE GOTO590
590 GOSUB640
600 Z=0:A=0:S=0:Z=RND(504):IFZ>384ORZ<192THEN600
610 A=RND(95):S=RND(75)
620 IFZ+A>384ORZ+A<192THEN600
630 IFZ+A+S>504ORZ+A+S<192THEN610
```

Listing 1 Continues

Listing 1 continued

```
640 GOTO650
650 Z2=Z+A+S+4:Z1=Z+A+4:Z4=Z+4
660 Q3=Q+Q1+32:Q3=Q3+32
670 IFQ3>=XANDQ3<=X+32THEN680ELSERETURN
680 IFQ3>=Z4-1ANDQ3<=Z4+4THENJ=J+5:GOSUB890:GOTO710ELSE690
690 IFQ3>=Z1-1ANDQ3<=Z1+4THENJ=J+10:GOSUB980:GOTO710ELSE700
700 IFQ3>=Z2-1ANDQ3<=Z2+5THENJ=J+30:GOSUB1070:GOTO710ELSERETURN
710 Q1=0:Z2=0:Z1=0:Z4=0:A$="":GOSUB720:FORT=1TO1000:NEXTT:GOTO32
0
720 PRINT@0,"score";J;:PRINT@15,"charges";CHR$(128);"left";J1;:P
RINT@22,CHR$(128);
730 IFJ1=0THEN750ELSERETURN
740 Q1=0
750 GOTO770
760 GOTO760
770 CLS
780 IFJ<35THENPRINT@0,"THE GAME IS OVER, YOU HAD";J+JA;:PRINT "T
OTAL POINTS.";:GOTO1360ELSE790
790 IFJ>34ANDJ<=150THENJ1=2
800 IFJ>150ANDJ<200THENJ1=6
810 IFJ>=200ANDJ<=300THENJ1=9
820 IFJ>300ANDJ<=500THENJ1=14
830 IF J>500THENJ1=20
840 PRINT@0,"THE GAME IS OVER, BUT YOU ARE   LUCKY."
850 PRINT"YOUR SCORE WAS";J;"AND THAT":PRINT "ENTITLES YOU TO";J
1;"BONUS"
860 PRINT "DEPTH CHARGES."
870 PRINT "CREDIT GAME WILL RESUME WHEN THETIMER REACHES ZERO."
880 FORR=500TO1STEP-1:PRINT@270,R;:NEXTR:CLS(0):Q=33:JA=J:J=0:GO
TO170
890 SOUND 1,10:FORP=10TO110 STEP 10:PRINT@Z4-32,"glug";:SOUND P,
1
900 IFZ4>=503THENPRINT@Z4-32,E2$;:RETURN
910 PRINT@Z4,B$;
920 FORR=1TO100:NEXTR
930 PRINT@Z4-32,E1$;
940 PRINT@Z4-1,E1$+CHR$(128);
950 FORR=1TO100:NEXTR
960 Z4=Z4+32
970 NEXTP
980 SOUND 1,10:FORP=10TO110 STEP 10:PRINT@Z1-32,"glug";:SOUND P,
1
990 IFZ1>=503THENPRINT@Z1-32,E2$;:RETURN
1000 PRINT@Z1,B1$;
1010 FORR=1TO100:NEXTR
1020 PRINT@Z1-32,E1$;
1030 PRINT@Z1-1,E1$+CHR$(128);
1040 FORR=1TO100:NEXTR
1050 Z1=Z1+32
1060 NEXTP
1070 SOUND 1,10:FORP=10TO110 STEP 10:PRINT@Z2-32,"glug";:SOUND P
,1
1080 IFZ2>=503THENPRINT@Z2-32,E2$;:RETURN
1090 PRINT@Z2,B2$;
1100 FORR=1TO100:NEXTR
1110 PRINT@Z2-32,E1$;
1120 PRINT@Z2-2,E2$+CHR$(128)+CHR$(128);
1130 FORR=1TO100:NEXTR
1140 Z2=Z2+32
1150 NEXTP
1160 CLS:PRINT "**** S U B   D E S T R O Y ****"
1170 PRINT:PRINT "THE OBJECT OF THIS GAME IS TO   TRY AND SINK T
HE SUBMARINES"
1180 PRINT "TRAVELING BELOW YOU.  YOU CAN   ACCOMPLISH THIS BY D
ROPPING"
1190 PRINT "DEPTH CHARGES FROM YOUR DESTROY-ER SHIP CRUISING AT
THE SURFACE"
1200 PRINT "OF THE OCEAN."
1210 PRINT
1220 PRINT "TO DROP YOUR CHARGES JUST PRESS THE SPACE BAR."
1230 PRINT:PRINT "(HIT -ENTER- TO CONTINUE)";:INPUT R$
1240 CLS
1250 PRINT "     SCORING IS AS FOLLOWS:"
1260 PRINT
1270 PRINT "30 POINTS FOR THE ORANGE SUB"
1280 PRINT "10 POINTS FOR THE YELLOW SUB"
1290 PRINT "5 POINTS FOR THE GREEN SUB"
1300 PRINT
1310 PRINT "     IF YOU SCORE WELL ENOUGH   YOU WILL RECEIVE BON
US CHARGES.";
1320 PRINT
1330 PRINT "THE HIGHER YOU SCORE THE MORE   BONUS CHARGES YOU WI
LL RECEIVE.":PRINT "REMEMBER, YOU ONLY HAVE 20      CHARGES TO S
TART WITH.  PRESS   ENTER WHEN READY.";
1340 R$=INKEY$:IFR$=""THEN1340
1350 IFR$=CHR$(13)THENCLS(0):GOTO150:60ELSE1340
1360 PRINT:PRINT "HIT <ENTER> FOR NEW GAME";:INPUT R$:IFR$=""THE
N 110
```

Program Listing 2. Lunar Lander

```
10 'LUNAR LANDER
20 'ORIGINAL BY JOHN BERINGER
30 'FOR TRS-80 MODEL I
40 'PUBLISHED BY
50 '80 MICROCOMPUTING
60 'JUNE 1981
70 'TRS-80 COLOR COMPUTER
80 'CONVERSION BY
90 'JIM FREEMAN
100 GD=0:BD=0
110 CLS:PRINT@74, "REAL TIME":PRINT@137,"LUNAR LANDER":PRINT:PRI
NT"YOUR NAME, CAPTAIN";:INPUT NA$
120 IF Y<1 THEN Y=1
130 CLS
140 PRINT@8,"A L E R T !":PRINT:PRINT"EMERGENCY, CAPTAIN ";NA$:P
RINT:PRINT"NAVIGATIONAL COMPUTER FAILURE":PRINT:PRINT"YOU WILL H
AVE TO LAND BY THE   SEAT OF YOUR PANTS!"
150 PRINT"LAND AS NEAR THE BASE AS        POSSIBLE":PRINT:PRINT"
PRESS ANY KEY TO START"
160 FOR N=1TO50:NEXT N:PRINT@8,"            ";:FOR N=1TO50:NEXTN:
SOUND100,1:PRINT@8,"A L E R T !";:IF INKEY$="" GOTO 160
170 CLS(0)
180 PRINT@172,CHR$(247);:PRINT@173,CHR$(251);
190 PRINT@203,CHR$(247);:PRINT@204,CHR$(255);:PRINT@205,CHR$(255
);:PRINT@206,CHR$(251);:PRINT@212,CHR$(247);:PRINT@213,CHR$(251)
;
200 PRINT@234,CHR$(247);:FORX=235TO238:PRINT@X,CHR$(255);:NEXT:P
RINT@239,CHR$(251);:PRINT@242,CHR$(247);:FORX=243TO245:PRINT@X,C
HR$(255);:NEXT:PRINT@246,CHR$(251);
210 PRINT@263,CHR$(247);:FORX=264TO271:PRINT@X,CHR$(255);:NEXT:P
RINT@272,CHR$(251);:PRINT@273,CHR$(247);:FORX=274TO278:PRINT@X,C
HR$(255);:NEXT:PRINT@279,CHR$(251);
220 PRINT@294,CHR$(247);:FORX=295TO311:PRINT@X,CHR$(255);:NEXT:P
RINT@312,CHR$(251);
230 PRINT@324,CHR$(247);:FORX=325TO344:PRINT@X,CHR$(255);:NEXT:P
RINT@345,CHR$(251);
240 PRINT@353,CHR$(247);:FORX=354TO377:PRINT@X,CHR$(255);:NEXT:P
RINT@378,CHR$(251);:
250 PRINT@384,CHR$(247);:FORX=385TO410:PRINT@X,CHR$(255);:NEXT:P
RINT@411,CHR$(251);:FORX=412TO415:PRINT@X,CHR$(179);:NEXT
260 GRAV=6.4
270 VEL=RND(25)+10
280 TIME=.5:FUEL=600
290 IF GD>4 AND GD<10 THEN FUEL=550 ELSE IF GD>9 THEN FUEL =500
300 PIC=0
310 LY=2:LX=2:X=2:ALT=430
320 HI=0
330 PRINT@416,"FUEL:":PRINT@448,"VELOCITY:":PRINT@480,"ALTITUDE:
                    ";:PRINT@444,"BASE";
340 IF FUEL>0 THEN GOTO 350 ELSE BURN=0:GOTO 360
350 ZZ=JOYSTK(0):BURN=JOYSTK(1)/6
360 FUEL=INT(FUEL-BURN*TIME):IF FUEL<1 THEN FUEL =0
370 PRINT @423,FUEL;:VEL=INT(VEL-BURN*TIME+GRAV*TIME*TIME):PRINT
@459,VEL;:ALT=INT(ALT-VEL*TIME):IF ALT<1 THEN ALT=0
380 PRINT@491,ALT-10;:Y=43-INT(ALT/10)
390 IF ALT>0 GOTO 660
400 IF Y<1 THEN Y=1
410 IF VEL>15 GOTO 600 ELSE IF VEL>5 GOTO 500
420 IF VEL<=0 GOTO 670
430 IF Y=41 THEN Y=42
440 RESET(LX,LY):RESET(LX+1,LY-1):RESET(LX+2,LY):SET(X,Y,5):SET(
X+1,Y-1,5):SET(X+2,Y,5)
450 IFLX>55ANDLX<63THENGOSUB780:FORT=1TO1000:NEXTT:CLS:PRINT"NIC
E LANDING, SPORT":ELSEIFVEL>0THEN500ELSEGOTO410
460 G=RND(3):ON G GOSUB 470,480,490:GOTO800
470 PRINT"RIGHT ON THE MONEY!":RETURN
480 PRINT"PROMOTION ON THE WAY!":RETURN
490 PRINT"YOU'RE A NATURAL":PRINT"STAR PILOT":RETURN
500 IF Y=41 THEN Y=42
510 RESET(LX,LY):RESET(LX+1,LY-1):RESET(LX+2,LY):SET(X,Y+1,5):SE
T(X+1,Y,5):SET(X+1,Y+1,5):SET(X+2,Y+1,5)
520 IF X>0  THENSET(X-1,Y,5)
530 IF X<60 THEN SET(X+3,Y,5)
540 FORT=1TO3:FORI=150TO175:SOUNDI,1:NEXTI:NEXTT:FORT=1TO1000:NE
XTT:CLS:G=RND(4):ON G GOSUB 560,570,580,590:FORT=0TO1000:NEXT
550 IF LX>55ANDLX<62THENGOSUB780:PRINT@32,"AND YOU HIT THE BASE!
!";:GOTO 790 ELSE GOTO790
560 PRINT@64,"YOU SAVED THE CARGO";:PRINT@96,"BUT YOU SMASHED TH
E CREW!";:RETURN
570 PRINT@64,"YOU SAVED THE CREW";:PRINT@96,"BUT YOU SMASHED THE
 CARGO!!";:RETURN
580 PRINT@64,"UFF!";:PRINT@96,"SHE'LL NEVER FLY AGAIN!";:RETURN
590 PRINT@32,"NOT SO GOOD,";:PRINT@64,"L I E U T E N A N T !!";:
RETURN
```

Listing 2 Continues

Listing 2 Continued

```
600 RESET(LX,LY):RESET(LX+1,LY-1):RESET(LX+2,LY):RESET(X+1,Y):Y=
Y+1:SET(X,Y-1,5):SET(X+2,Y-1,5):RESET(X,Y):RESET(X+2,Y):RESET(X+
1,Y-1)
610 IF X>0 THEN SET(X-1,Y-2,5)
620 IF X<60 THENSET(X+3,Y-2,5)
630 IF POINT(X+1,Y)=0 THEN SET(X+1,Y,5)
640 SOUND1,22:FORT=1TO1000:NEXTT:CLS:IFX<55ANDX>0THENPRINT"COULD
N'T YOU SEE THAT":PRINT"MOUNTAIN, ";NA$;"?":GOTO790ELSEPRINT"YOU
 DESTROYED THE BASE!!":PRINT"NOTE THE NEW LUNAR FORMATION...":PR
INT"IT IS THE CRATER OF ";NA$
650 PRINT "WERE YOU TRYING TO DRILL A":PRINT "TUNNEL TO THE OTHE
R SIDE?":GOTO790
660 RESET(BX,BY):IF Y<0 GOTO 680 ELSE IF POINT(X,Y+2)<>0 OR POIN
T(X+2,Y+1)<>0 OR POINT(X+2,Y+2)<>0 GOTO 770
670 RESET(BX,BY)
680 IF Y<2 THEN RESET(LX,LY):RESET(LX+1,LY-1):RESET(LX+2,LY)
690 IF FUEL<5 GOTO 710 ELSE IF ZZ>50 THEN X=X+1:FUEL=FUEL-5 ELSE
 IF ZZ<15 THEN X=X-1:FUEL=FUEL-5
700 IF X>60 THEN X=1 ELSE IF X<0 THEN X=X+1
710 IF X=LX AND Y=LY GOTO 760 ELSE IF Y<1 GOTO 760
720 RESET(LX,LY):RESET(LX+1,LY-1):RESET(LX+2,LY)
730 IF PIC<>0 THEN SET(LX+1,LY+1,5)
740 SET(X,Y,5):SET(X+1,Y-1,5):SET(X+2,Y,5):LX=X:LY=Y:BX=X+1:BY=Y
+1
750 PIC=POINT(BX,BY):IF BURN>1 THEN SET(BX,BY,5)
760 GOTO 340
770 IF ALT<440 GOTO 400 ELSE GOTO 680
780 FORX=1TO20:SOUND200,1:SOUND100,1:NEXT:RETURN
790 BD=BD+1:GOTO 810
800 GD=GD+1
810 IF FUEL=0THENPRINT:PRINT"NEXT TIME, CAPTAIN ";NA$;",":PRINT"
WATCH YOUR FUEL MORE CLOSELY!!!"
820 PRINT:PRINT:PRINT "GOOD LANDINGS SO FAR - ";GD:PRINT:PRINT"B
AD LANDINGS SO FAR - ";BD:PRINT:PRINT"TRY YOUR LUCK AGAIN? (Y/N)
?"
830 R$=INKEY$
840 IF R$="Y" THEN 170 ELSE IF R$="N" THEN 850 ELSE GOTO 830
850 PRINT:PRINT "HOW ABOUT ANOTHER CAPTAIN? (Y/N)";
860 R$=INKEY$
870 IF R$="Y" THEN RUN ELSE IF R$="N" THEN END ELSE GOTO 860
880 END
```

```
350 IF PEEK(339)=239THENBURN=1:GOTO360
351 IF PEEK(340)=239THENBURN=2:GOTO360
352 IF PEEK(341)=239THENBURN=4:GOTO360
353 IF PEEK(342)=239THENBURN=8:GOTO360
354 IF PEEK(343)=239THENBURN=12:GOTO360
355 BURN=0
690 IF FUEL<5 GOTO 710 ELSE IF PEEK(344)=247 THEN X=X+1:FUEL=FUE
L-5 ELSE IF PEEK(343)=247 THEN X=X-1:FUEL=FUEL-5
```

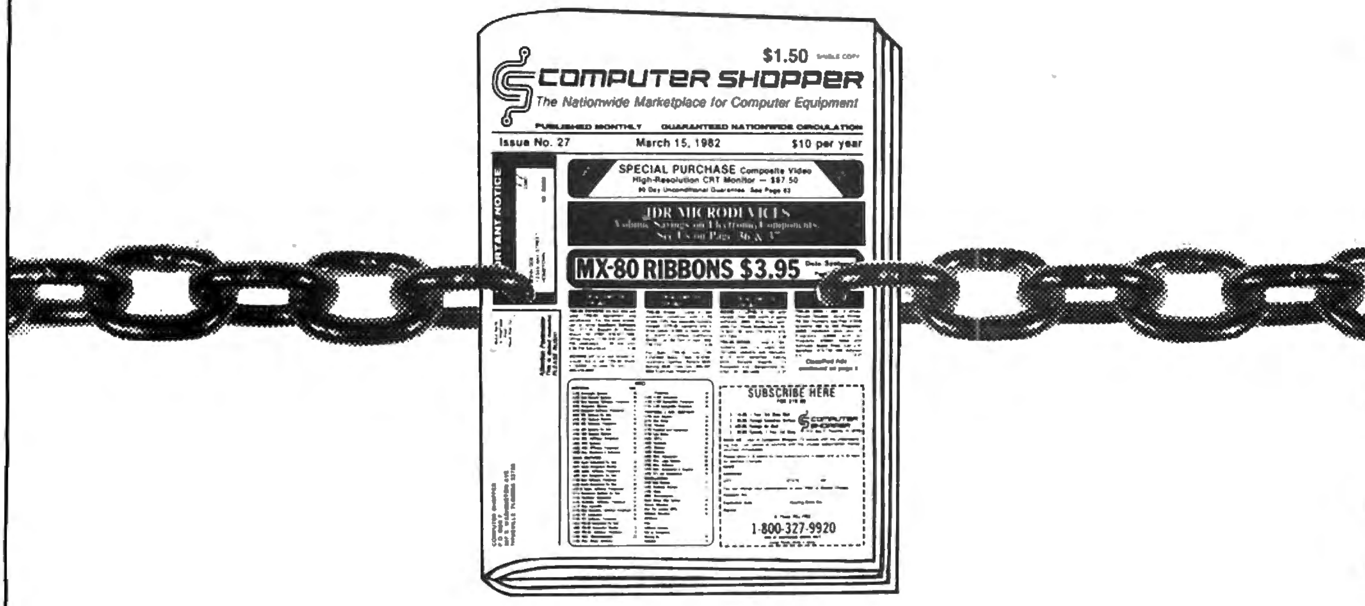
Program Listing 3. Lunar Lander

Program Listing 4. Missiles from Mars

```
10 'MISSILES FROM MARS
20 'ORIGINAL BY CHARLES GILLEN
30 'FOR TRS-80 MODEL I
40 'PUBLISHED BY
50 '80 MICROCOMPUTING
60 'JANUARY 1982
70 'TRS-80 COLOR COMPUTER
80 'CONVERSION BY
90 'JIM FREEMAN - APRIL 1982
100 CLS:GOSUB660
120 CLEAR200:LN=100:MW=LN:LN$="LONDON":MW$="MOSCOW":CO$="CAIRO":
DI$="DELHI":BL$=CHR$(191)+CHR$(191)+CHR$(191)+CHR$(191)+CHR$(191
)+CHR$(191):E$=CHR$(128)+CHR$(128):B$="      "
130 S$=CHR$(94):SB$="<>":K$=CHR$(236)+CHR$(236)
135 E1$=CHR$(128)+CHR$(128)+CHR$(128)+CHR$(128)+CHR$(128)
140 CLS0
150 PRINT@384,CHR$(165);:PRINT@386,CHR$(162);:PRINT@388,CHR$(161
);:PRINT@410,CHR$(162);CHR$(170);CHR$(161);CHR$(170);
160 PRINT@416,CHR$(167);CHR$(175);CHR$(171);CHR$(167);CHR$(175);
CHR$(175);CHR$(163);CHR$(163);CHR$(163);CHR$(163);CHR$(163);S$;C
HR$(163);CHR$(163);CHR$(163);CHR$(163);CHR$(163);CHR$(163);CHR$(
163);S$;
165 PRINT CHR$(163);CHR$(163);CHR$(163);CHR$(163);CHR$(163);CHR$
(163);
170 PRINT@442,CHR$(175);CHR$(175);CHR$(167);CHR$(171);CHR$(167);
```

Listing 4 Continues

YOU'VE JUST FOUND
THE MISSING LINK!



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Listing 4 continued

```
CHR$(175);
180 PRINT@448,LN$;TAB(9);CO$;TAB(17);DI$;TAB(25);MW$;" ";
200 PRINT@0," MISSILES FROM MARS ";MK;" HITS ";
210 IF LN<0THENLN=0
220 IF MW<0THENMW=0
230 IF LN>0THENPRINT@480,LN;ELSEPRINT@480,E1$;
240 IF MW>0THENPRINT@506,MW;ELSEPRINT@506,E1$;
250 FORTD=0TO950:NEXT:FORI=1TO3:FORTDF=15TO20:NEXT:NEXT
260 RV=0:FORTD=1TORND(500):NEXT:X=1+RND(45)
270 IFX<30THENZ=1ELSEIFX>40THENZ=-1
280 R=200:FORY=4TO26:R=R+1
290 IFY<18THEN330
300 IFRND(10)>3THENRV=1
310 IFRV=0ANDZ=-1THENZ=1:RV=1:GOTO330
320 IF RV=0ANDZ=1THENZ=-1:RV=1
330 SET(X,Y,4):SOUNDR,1:RESET(X,Y):X=X+Z
340 P=JOYSTK(0)
350 IFS=0THENPS=JOYSTK(1):IFPS<20THENSA$=SB$:PP=320+RND(30):PRIN
T@PP,SA$;:S=1
360 IFS=1THENP=JOYSTK(0)
370 IFP<10THENPRINT@PP,E$;:PP=PP-2:IFPP<320THENPP=320:GOTO390
380 IFP>53THENPRINT@PP,E$;:PP=PP+2:IFPP>350THENPP=350
390 PS=JOYSTK(1):IFPS>43THENSA$=K$:K=1
400 IFS=1THENPRINT@PP,SA$;
410 IFPOINT(X,Y+1)=7THENGOTO430
420 NEXTY:GOTO440
430 MK=MK+1:SOUND1,10:PRINT@PP,E$;:S=0:IFMK=>21THEN610ELSE180
440 IFX=6ORX=7THENLN$="":LN=0:GOTO510
450 IFX=57ORX=58THENMW$="":MW=0:GOTO490
460 IFX>20ANDX<25THENCO$="":GOSUB560:PRINT@427,CHR$(179);:SO=1:P
RINT@457,B$;
470 IFX>36ANDX<41THENDI$="":GOSUB560:PRINT@435,CHR$(179);:SL=1:P
RINT@465,B$;
480 IFSO=1ANDSL=1THEN570
490 IFX>52THENMW=MW-(10+RND(10)):GOSUB560
500 IFMW<1THENMW$="":PRINT@441,BL$;:PRINT@473,B$;
510 IFX<12THENLN=LN-(10+RND(10)):GOSUB560
520 IFLN<1THENLN$="":PRINT@416,BL$;:PRINT@448,B$;
530 IFLN=0ANDMW=0THEN600
540 SOUND100,10
550 IFS=1THENPRINT@PP,E$;:S=0:SA$="":GOTO180ELSE180
560 FORTT=1TO7:SOUND25,2:SOUND20,2:NEXT:RETURN
570 FORT=1TO15:SOUND150,1:SOUND200,1:NEXT:PRINT@96,"BOTH OF YOUR
 KILLER-SATELLITE   BASES WERE DESTROYED BY THE      MARTIAN MISS
ILES."
580 PC=INT(((LN+MW)/200)*100):PRINT"HOWEVER";PC;"PERCENT OF EART
H'S":PRINT"POPULATION SURVIVED TO REBUILD  AND FIGHT ON."
590 GOTO640
600 FORX=1TO15:SOUND100,1:SOUND150,1:NEXT:PRINT@96,"ALL OUR CITI
ES WERE DESTROYED BYTHE MISSILE MEN FROM THE RED     PLANET.  YOU
 CONTINUD FIGHTING  TO THE LAST, BUT THE MARTIANS   FINALLY CONQ
UERED THE EARTH.":GOTO640
610 FORX=1TO15:SOUND100,1:SOUND200,1:NEXT:PRINT@96,"YOUR ANTI-MI
SSILES BLASTED 21 OFTHE DREADED MARTIAN INVADERS OUTOF EARTH'S S
KIES.  CONSIDERING  THE DAMAGE SUFFERED BY OUR      CITIES, YOU'
RE FINAL RATING     IS:  ";
620 FR=MK*1000+((LN+MW)*1000):IFSO=1ORSL=1THENFR=INT(FR/2)
630 PRINTFR
640 PRINT:PRINT"HIT <ENTER> FOR NEW WAVE"
650 IF INKEY$<>CHR$(13)THEN650ELSERUN
660 PRINT"      MISSILES FROM MARS"
670 PRINT:PRINT"  A FLEET OF INVADING MISSILES    FROM THE RED P
LANET IS         APPROACHING EARTH AT HIGH        SPEED."
680 PRINT"  THE CONTROLS OF YOUR KILLER-     SATELLITE BASES ARE:
"
690 PRINT:PRINT"  PUSH UP TO LAUNCH KILLER          PUSH DOWN TO A
RM KILLER         PUSH LEFT/RIGHT TO MOVE"
700 PRINT:PRINT"INTERCEPT THE MARTIANS AND SAVE EARTH.  PLEASE!!
!";
710 IF INKEY$=""THEN710ELSERETURN
```

```
350 IFS=0THENP$=INKEY$:IFP$=S$THENSA$=SB$:PP=320+RND(30):PRINT@P
P,SA$;:S=1
360 IFS=1THENP=PEEK(343):IFP=247THENPRINT@PP,E$;:PP=PP-2:IFPP<32
0THENPP=320:GOTO390
370 IFS=1THENP=PEEK(344):IFP=247THENPRINT@PP,E$;:PP=PP+2:IFPP>35
0THENPP=350
380 IFP$=CHR$(9)THENPRINT@PP,E$;:PP=PP+2:IFPP>350THENPP=350
390 P=PEEK(342):IFP=247THENSA$=K$:K=1
690 PRINT:PRINT"  UP ARROW        LAUNCH KILLER       DOWN ARROW
ARM KILLER        LEFT ARROW      MOVE LEFT           RIGHT ARROW
MOVE RIGHT"
```

Program Listing 5. Missiles from Mars

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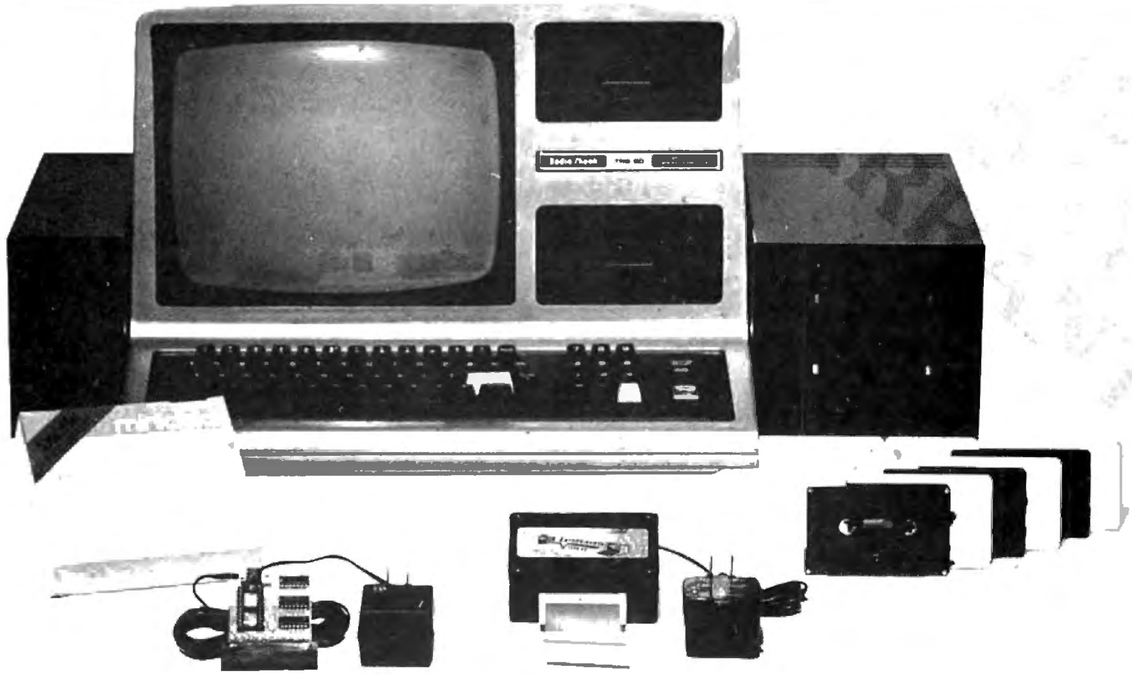

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Micros in the Lab

by Tom Hager

Microcomputers are not yet used extensively in scientific exploration, but some pioneering scientists are leading a micro revolution.

Dr. Howard Whitlock is a respected research chemist, a member of the faculty at the University of Wisconsin, Madison, and a self-described "underground computer guerrilla." He, and a new breed of scientists like him, are pioneering the use of microcomputers in the laboratory. They are finding new ways to tie Apples to astronomy and PETs to paleontology. They are testing the power of computers against the secrets of nature.

And it looks like the micros are winning.

"It's had an incredible effect on our productivity," says Whitlock, describing a microcomputer system he and his students pieced together to improve the efficiency of a common laboratory instrument.

Not long ago, graduate students working in his lab would sit interminably in front of a spectrophotometer, an instrument used to measure the light passing through a solution. First they would analyze a test sample; then, on the same machine, they would manipulate their newly-obtained data. One researcher doing one experiment could tie up the spectrophotometer for hours. Work began to bottleneck. Short of buying more of the costly instruments, Whitlock's junior researchers had no choice but to line up and wait.

Not any more. Whitlock now uses an Apple to separate data acquisition, still done on the spectrophotometer, from data manipulation, now done on the microcomputer. While one investigator is conducting an experiment, another is analyzing data and putting it into readable form on the Apple.

"Relaying data from measuring instruments to higher machines has tripled our efficiency," says Whitlock. "This sort of thing is duck soup with micros."

And it's a major reason more and more scientists are buying them. Tedious, repetitive testing composes much of research science. Whitlock and a number of other ground-breaking scientists around the country are freeing lab personnel from this monotony by hooking laboratory equipment into microcomputers. The micros not only work long hours without complaining, they also record the data accurately and play it back to the investigator in whatever form is desired. A British personal computer company labels its product "The ideal lab assistant," and, to hear some scientists talking, that's an understatement.

But, there are problems. Connecting a microcomputer to a spectrophotometer may be duck soup for a computer fan like Whitlock, but other scientists, not so well versed in computer lore, have been slow to take advantage of this new technology. In fact, scientific use of microcomputers is still in its infancy.

This is not what you'd expect. Theoretically, scientists, constantly concerned with staying on the cutting edge of knowledge, should be the first to put micros to work. But, in fact, people doing active scientific research spend most of their waking hours reading about developments in their field, devising experiments, and writing grant proposals. This doesn't leave much time for taking an introductory microcomputer class or perusing *80 Micro*.

Steeped in narrow disciplines, trained on equipment common twenty years ago, and hampered by a lack of computer systems and software designed to fit their needs, most scientists have ignored this potentially valuable tool. It is ironic that the premier technological advance of the last decade has found wider use in the entertainment, business, and military fields than in the sciences; it is sobering that certain kinds of advanced microprocessor technology are more common in video game arcades than in the laboratory.

> *"A few ingenious scientists are interfacing off-the-shelf micros with their research equipment."*

But this is beginning to change. A few ingenious scientists are interfacing off-the-shelf micros with their research equipment. Some are taking advantage of a rapidly growing number of laboratory instruments with built-in microprocessors called "smart machines." Still others are buying entire micro-based systems, complete with software, designed specifically for scientific applications.

Last year the prestigious science journal *Nature* introduced a special issue devoted to computers by telling its readers that "computers can wring more out of an experiment, or a series of observations, than is possible with more traditional techniques of data handling." About microcomputers, the journal said, "the benefits are certainty, speed, and the saving of a research assistant's time. The cost is often small." And, it should have added that microcomputers can also improve a scientist's teaching effectiveness as well as speed up his ability to communicate with other researchers.

The micro revolution in the sciences is just beginning. A look at some of the first "computer guerrillas" in the field may show where it is taking us.

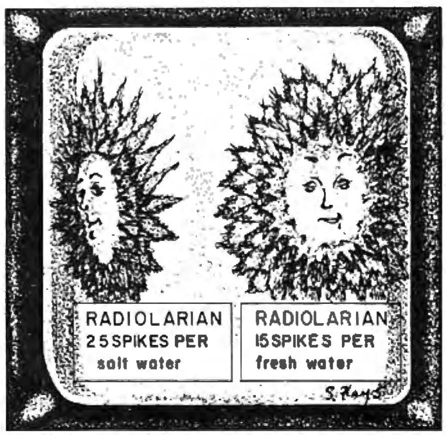
Some Examples

Dr. William Riedel, Chairman of the Geological Research Committee at the University of California, San Diego, is trying to put together a family tree. Unfortunately for Dr. Riedel, the family he's interested in has hundreds of members. Some have been extinct for millions of years. None can be easily seen without a microscope.

They are radiolarians, tiny, one-celled organisms that float in fresh and salt waters around the world. Some of them build incredibly intricate exoskeletons out of silica. These exoskeletons sink when they die, gradually building up a radiolarian ooze that, over millions of years, is compressed into stone.

Scientists need to know one radiolarian from another because the fossilized remains are used in geological dating. But only a handful of the hundreds of living and extinct species have been well studied. Dr. Riedel is trying to change that—with the help of a microcomputer. He and his co-workers are digitizing tv images of magnified radiolarians and feeding the digitized pictures into a microcomputer. A string of descriptive terms for the organisms is fed in at the same time. Now, when a scientist wants to know which radiolarians have, for example, x number of spikes on the y portion of their exoskeleton, the computer can tell him.

The microcomputer is making it possible for Riedel and his lab workers to look at radiolarians in terms of common characteristics rather than depend on outdated, sketchy taxonomic listings. Fossil radiolarians can be compared to living radiolarians, and fresh water organisms can be compared with those that live in the ocean. Microcomputers are changing the way scientists look at the radiolarian family tree.



Riedel's technique, though effective, is fairly simple. Feeding in masses of data and then searching for common items is old hat for computers. To find a more ingenious method of using micros, you have to travel 1,000 miles up the coast, to Eugene, OR.

Dr. Michael Posner, a nationally renowned research psychologist, wants to know how thought processes occur at a very basic level, and microcomputers are his primary research tools. He has programmed his machines to run simple psychological tests that help him build a picture of how the brain works. His laboratory at the University of Oregon is dominated by a closet-sized black plastic cubicle that, on any work day, contains a tv screen on a table, a chair, and an experimental subject. The subject sits on the chair, head immobilized and pressed against a viewer, electrodes attached near the eyes, fingers on a response button. Posner's microcomputer flashes patterns on the tv screen. The subject's eyes dance in response. The electrodes pick up the movement and feed the data to the microcomputer. The computer gives a different cue, and the subject's finger punches the response key.

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The computer stores the new data.

Posner is using this system to answer some simple questions. For instance: When you try to recall the letter A, does your mind "see" A first, or does it "say" A? To answer this, Posner programmed his microcomputer to flash pairs of letters on the tv screen. Some of the pairs were identical visual matches (AA), others were identical verbal matches, but differed visually (Aa), Subjects watching the screen were instructed to press the response key as quickly as possible when either match came up.

Posner found that subjects responded to the visually identical pair 80 to 100 milliseconds faster than they did to the pair that was the same in name only. It appears from such experiments that visual cues are more accessible in the brain than verbal cues. You have to rummage deeper in your mind for the names of things than you do for their shapes.

"Microcomputers are helping Posner look into the human mind."

This kind of split-second work—which helped Posner win the 1981 Distinguished Scientific Contribution Award from the American Psychological Association—would be nearly impossible without microcomputers.

While microcomputers are helping Posner look into the human mind, another scientist is using them to track pollution in wilderness lakes. Dr. Stanley Burden and his students at Taylor University in Upland, IN, are examining the effects of a recent oil discovery, and the subsequent population growth, on some pristine lakes in northern Michigan. Burden's group collects water samples from the lakes and tests them with electrodes that can detect very small quantities of pollution-related ions. These finicky electrodes once had to be hand-calibrated before each experiment. Now, the microcomputer does that automatically, besides performing a complex analysis of pollutants in the water.

Not only does his Apple-based sys-

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tem make gathering data easier, Burden says, but the color graphics capability makes it possible for him to display his results more effectively. "This setup represents a huge saving in terms of operator time," he says, "and it improves the quality of time for upper-class students by freeing them from the simple logging of data."

The era of pale laboratory assistants keeping night-long vigils over laboratory instruments may soon be over. But it's not going to happen right away. Unfortunately, many scientists still see this kind of work as too specialized for micros, which are viewed in some labs as toys, or, at best, as fancified calculators.

Not John Zimmerman. This Wabash University (Crawforsdsville, IN) chemist has just finished a study on the usefulness of commercially available microcomputers in laboratory work. He cites the limited 8-bit resolution of most micros as the main reason they haven't found more niches in research.

"Apart from teaching, 8 bits just doesn't do it for a chemist," he says.

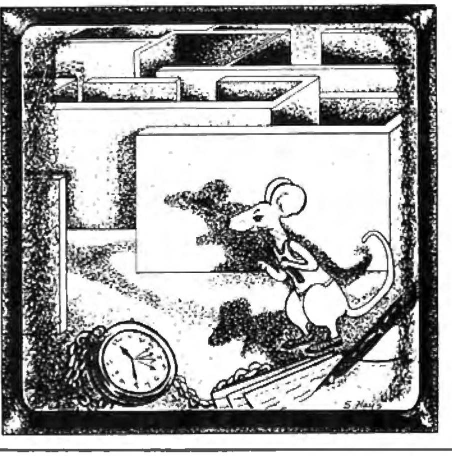
But he's quick to add that newer microcomputers with greater resolution have all the power needed for scientific applications.

"We're getting to the point where serious work can be done with off-the-shelf items, which you couldn't do a few years ago," he says.

Amateur astronomer David Skillman has been running an Apple-controlled observatory in his back yard for the last two years. Skillman programmed his microcomputer to keep track of specific stars as they wheel overhead at night. The computer orders Skillman's homemade telescope to turn an appropriate number of degrees, keeping the star in its sights for hours. So far, the system has worked well.

Even with amateurs showing the way, many scientists have neither the skill nor the inclination to concoct their own laboratory microcomputer systems. But they're still interested in the benefits micros can offer. To tap this market, microcomputer entrepreneurs are offering science packages, complete with hardware and software, for specific research applications.

Two years ago a group of former Massachusetts Institute of Technology (MIT) men started Laboratory Computer Systems in Boston. They've designed a microcomputer package that measures the volume of small biological structures by "reading" pictures from a microscope and then computing three-dimensional volume from the two-dimensional data. Biovolume is an important measurement in many studies, but until now its estimation has been too time-consuming to be practical.



Another company is selling a complete microcomputer system that monitors a classic behavioral psychology experiment: The running of rats through a maze. Columbus Instruments Inc. has hooked an Apple II to infrared sensors that tell the computer the time a rat spends travelling, resting, even turning in circles while negotiating a maze. The company's software converts the data to a printout that once took a researcher hours to prepare. The company has also developed a Skinner Box package in which the microcomputer delivers electric shocks or rewards to an animal, and then analyzes their response data.

Microcomputers that can do it all—conduct an experiment, gather the data, and then analyze it—may be the coming thing. As John Zimmerman says, "We're gradually moving toward a system where the whole lab is under a sort of computer control."

But that's still in the future. Right now, microprocessor technology is making its biggest scientific impact on a much smaller scale. The new laboratory fad this season is the microcomputer's little brother—the smart machine.

This new type of equipment is simply a standard laboratory instrument—a spectrophotometer, a column chromatograph, or a scintillation counter—souped up with a built-in microprocessor. All this requires is removing the CPU heart of a microcomputer and transplanting it into another machine. The result: A relatively inexpensive instrument that can be programmed for desired activity sequences and is much easier to run than a full microcomputer.

There are disadvantages. Smart machines are inherently limited in function and scope, and the machine's abilities cannot be expanded. But scientists with no programming or hardware skills can at least have the luxury of some computer power, so the smart machines' popularity is understandable. As Zimmerman says, "You don't buy an instrument any more without a micro inside."

In science, the most precious commodity is new knowledge. Next to making a discovery (and getting grant money), the most important task for a scientist is to keep current with other research in the field. This is done primarily through scholarly scientific journals, refereed by panels of experts who decide which findings are worthy of printing. Getting published in a journal can be a lengthy process. More than a year can pass between the time of a discovery and its publication.

Enter Comtex, a small two-year-old company that is planning this fall to offer the first electronic journal for scientists. Comtex president Frederick Plotkin plans to have submissions judged and on line in the breathtakingly short span of six to eight weeks. The research papers will be stored in a central computer with reports available, for a fee, to any scientist in North America equipped with a phone line and a microcomputer.

Feelings about the planned system are mixed. One editor of an established biology journal has already called Comtex "an electronic garbage heap." But others are more enthusiastic. The prospect of getting new information within weeks of discovery rather than months means that research as a whole can move ahead faster.

Despite these positive trends, almost everyone involved in the scientific use of microcomputers points to one central problem that blocks their full incorporation: inadequate education. Older investigators need to be introduced to the technology. Younger researchers must be taught the easiest, most productive ways to integrate micros into their labs. And science students from grade school through college should be taught about the uses of microcomputers in all fields.

Steps are being taken in this direction. In the last few years the National Science Foundation, the nation's largest source of money for scientific re-

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search, has funded dozens of programs using microcomputers in science educations.

One of these, at the University of Mississippi, is designed to teach primary and secondary school science teachers how to use microcomputers in the classroom. Jean Shaw, organizer of the program, grew enthusiastic about microcomputing after joining a TRS-80 club. Shaw believes that more and more children will have access to personal computers in the home, and she wants to make sure that science teachers keep up with the youngsters.

"The teachers coming through the program will at least be familiar with what they'll be surrounded with when they're out teaching," she says.

David Moursund, editor of *The Computing Teacher*, agrees that micros will have an important effect on science education, although he sees teachers, not students, as the moving force.

"Our educational system is completely dependent on how teachers view the world," he says. "If teachers can't adjust to using computers, to this change in the world, then it's going to be very, very hard for the kids to adjust to it."

Whether it's led by students or teachers, the move to bring micros into science education is growing. Chemistry teachers are using microcomputer graphics to show moving three-dimensional chemical diagrams (in color) to their students. Psychology teachers program microcomputers to give their students the same kind of psychological tests given to their patients. The students not only learn about psychology, they learn about themselves, and have fun doing it. Physics professors teach complex numerical analysis to college students with a microcomputer program that simulates the decreasing orbit of a spaceship near a black hole.

> *"Our educational system is completely dependent on how teachers view the world."*

Biology professors have developed programs in which students try to save herds of bison or pods of whales from extinction in the face of environmental changes. Other biology programs simulate the effects of various pollutants on water ecosystems.

Computer-assisted instruction of this sort is exciting for the students, but it doesn't teach them how to use microcomputers in the lab. To do that, you need a class like the one developed by Bruce Rafert and R.C. Nicklin at Appalachian State University in Boone, NC. These two physics professors teach their students how to interface a KIM-1 microcomputer board to common laboratory equipment. They avoid programming language and diagramming details as much as possible, concentrating instead on hands-on wiring and getting systems to work. Their conclusion after successfully running the class: ". . . micros should be as common as voltmeters and scopes at *all* levels."

Why Not More?

Microcomputers. Their potential seems unlimited, they're cheap, and they're available. So why doesn't every science laboratory have one?

The most obvious reason is inertia. Contrary to popular conception, scientists fear new and complex technologies almost as much as anyone else. Scientific research moves ahead at a dizzying pace already, and microcomputers threaten to speed the process even more. Some scientists fear that the little machines will make them outmoded. They're scared.

Those who decide to take the plunge and buy a micro for the lab face another problem. Retail computer dealers are notoriously ignorant of scientific needs. They may be able to talk for hours about the latest video game, but they're woefully ignorant of ways to hook their machines into lab sensors. Support for scientists is therefore poor, and well-documented interfacing material is rare. None of that would matter much if adequate scientific software existed, but it doesn't. While microcomputer hardware is, or soon will be, adequate for most laboratory applications, good software is lagging far behind—a problem not limited solely to science.

But all these problems are slowly being solved. There's a feeling across the field that we're on the edge of a microcomputer explosion in the sciences. More science students are becoming computer literate. More micros are being built with the power needed for research. More firms are designing microcomputer systems for the sciences. Software is gradually being developed by scientists who can't wait for computer companies to catch up. As more important data is collected through the use of micros, resistance should gradually die down.

Soon every science department in every school may resemble the Chemistry Department at the University of Wisconsin, Madison, where 35 Apples and PETs are scattered among the faculty. Pockets of activity like this will grow, says computer guerrilla Howard Whitlock, even though there may be resistance at the highest levels.

"The most interesting part of microcomputers in the University is that the school administration is scared to death of them," he says. "Most people in the University don't know anything about computers. They hear the drums beating in the bush, and they see a few guerrilla raids here and there, but they don't know there's a revolution—yet." ■

Tom Hager can be reached at 868 W. 10th Ave., Eugene, OR 97402.

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Control your Model II's cursor.

Curse You, Cursor!

Joseph L. Frese
The Software Service Company
37W829 Pine Needles Court
Batavia, IL 60510

Ron Balewski's article "Block That Cursor" in the April 1981 issue of *80 Microcomputing* scored a real hit with me. I, too, find a non-blinking block cursor more comfortable than the standard TRS-80 cursor.

Ron's Model I solution couldn't be applied directly to my Model II system. Fortunately, an entirely different solution proved easy to implement on the Model II. This method has some other interesting applications as well, and now I wouldn't be without it in my collection of systems subroutines.

Why Control Your Cursor?

The cursor is an important part of the interface between the computer and its user. A blinking cursor calls attention to its position on the screen, while a non-blinking cursor seems less insistent. A fast-blinking cursor demands attention, appropriate when special attention is required for an unusual situation (an error condition, for example). When you write information on a partial screen rather than a line at a time, the cursor should be turned off so it doesn't flicker annoyingly while moving about the screen.

Different cursor sizes are appropriate for different situations. For example, when filling in a large number of blank spaces indicated by underscore characters, a non-blinking underscore cursor is not a preferred shape. Or, when entering data into a reverse video field (black characters on a white background), a block cursor creates the illusion of two reverse video fields separated by a space or white on black character. This probably is not the effect you intended. It is often helpful to adapt the cursor format to the situation.

Model II Basic and TRSDOS give cursor control limited to having the cursor blink, not blink, or not show. That's helpful, but really not enough. And then the system is always trying to change back to the standard format when you least want it.

Bit 7 (Most Significant)	—Not Used				
Bits 6–5	—Cursor Display Mode				
	Bits Binary	Byte Hex	Byte Decimal	Meaning:	
	00	00	00	Non-blinking cursor	
	01	20	32	No cursor displayed	
	10	40	64	Blink double speed	
	11	60	96	Blink normal speed	
Bits 4–0	—Cursor Start Line (within the 7 by 10 dot matrix of a character) The value is from 0–9: 0 gives a full block cursor. 9 gives an underline cursor.				

Note: TRSDOS normal value for this byte is decimal 101 or hex 65.

Table 1. Register 10 layout

The subroutine below gives nearly total cursor control, can be loaded anywhere without modifying the code, uses only 16 bytes of memory, and it's free. Such a deal!

Method of Operation

The Model II uses a Motorola MC6845 CRT Controller to operate the display. This controller contains 19 registers or high speed memory locations, accessible via the system bus, which tailor the controller chip for a given application.

The ability to set register number 10 provides all capabilities discussed above. Table 1 shows the layout of the bits in register 10. Control the cursor by choosing a particular combination of bits and putting them into that register.

However, TRSDOS 2.0 and other programs have the nasty habit of putting their own bits into the register every so often. (They are just making sure that the cursor is turned "on.") Therefore, to do the job right, you must also modify the byte which TRSDOS and these other programs will put into register 10. This magic byte is stored in memory location 06B1H (in TRSDOS 2.0). It is sent to the CRT controller just before every TRSDOS Ready command prompt, and also when you call the Cursor (SVC 26) operating system call with a non-zero argument.

Set It and Forget It

To change the cursor permanently for a given application, just PATCH location 06B1H on

The Key Box

Model II
32K RAM
TRSDOS 2.0

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```
                  00110 ;  THIS SUBROUTINE ALLOWS USERS OF BASIC ON THE TRS-80 MODEL II TO TAKE
                  00120 ;  FULL CONTROL OF THEIR CURSOR.
                  00130 ;  WRITTEN BY J. L. FRESE, (312) 879-9335, ON MAY 24, 1981.
                  00140 ;
                  00150 ;  THE ROUTINE IS SELF-RELOCATING - THAT IS TO SAY IT MAY BE LOADED AT
                  00160 ;  ANY DESIRED MEMORY LOCATION WITHOUT MODIFYING THE MACHINE CODE.
                  00170 ;
                  00180 ;  WHEN CALLED FROM BASIC, THE SINGLE PARAMETER IS AN INTEGER (16-BITS)
                  00190 ;  THE LEAST SIGNIFICANT BYTE OF THIS INTEGER IS THEN OUTPUT TO THE CRT
                  00200 ;  CONTROLLER REGISTER 10, WHERE THE FOLLOWING BIT FIELDS CONTROL THE
                  00210 ;  CONTROLLER ACTIONS DESCRIBED BELOW:
                  00220 ;              BIT 7 (MOST SIGNIFICANT)  -- NOT USED
                  00230 ;              BITS 6-5                  -- CURSOR DISPLAY MODE
                  00240 ;                                            00 = NON-BLINK
                  00250 ;                                            01 = NON-DISPLAY
                  00260 ;                                            10 = BLINK, 2X SPEED
                  00270 ;                                            11 = BLINK, NORMAL SPEED
                  00280 ;              BITS 4-0                  -- CURSOR START LINE (0 TO 9)
                  00290 ;                                           0 MEANS BLOCK CURSOR, 9
                  00300 ;                                           MEANS UNDERLINE AS CURSOR
                  00310 ;
                  00320 ;  AT ENTRY FROM BASIC:
                  00330 ;       REGISTER A -- TYPE CODE OF PASSED PARAMETER (2 FOR INTEGER)
                  00340 ;       REGISTERS HL -- ADDRESS OF INTEGER IN THE ARGUMENT STORAGE AREA
                  00350 ;                       INTEGER IS STORED IN NORMAL Z-80 ORDER, LEAST
                  00360 ;                       SIGNIFICANT BYTE FIRST.
                  00370 ;
                  00380 ;  UPON RETURN TO BASIC:
                  00390 ;       REGISTERS AND THE ARG STORAGE AREA ARE NOT MODIFIED.
                  00400 ;       THE VALUE RETURNED IS THE CALLER'S ARGUMENT.
                  00410 ;
                  00420 ;  OPERATING SYSTEM DEPENDENCIES:
                  00430 ;       THE ORG IN LINE 470 AND THE LOAD TO MEMORY LOCATION 06B1H IN
                  00440 ;       LINE 580 DEPEND UPON THE USE OF TRSDOS 2.0.
                  00450 ;
                  00460 ;
F000              00470         ORG     0F000H  ;ORIGIN OK FOR TRSDOS 2.0 IF YOU ARE NOT USING
                  00480                         ;ANY HIGH MEMORY COMMUNICATIONS ROUTINE.
                  00490                         ;TRSDOS 2.0 PROTECTS MEMORY DOWN TO 0F000H FROM
                  00500                         ;THE BASIC INTERPRETER.
F000 FE02         00510 SETCSR  CP      2       ;TEST FOR INTEGER ARGUMENT
F002 C0           00520         RET     NZ      ;IF INVALID, RETURN WITHOUT ACTION
F003 F5           00530         PUSH    AF      ;SAVE AF
F004 3E0A         00540         LD      A,10    ;ADDRESS CRT CONTROLLER REG 10
F006 D3FC         00550         OUT     (0FCH),A        ;INFORM CRT CONTROLLER
F008 7E           00560         LD      A,(HL)  ;GET CONTROL BITS FROM USER PROGRAM
F009 D3FD         00570         OUT     (0FDH),A        ;MOVE TO CRT CONTROLLER REG 10
F00B 32B106       00580         LD      (06B1H),A       ;ALSO MODIFY MEMORY WHICH TRSDOS 2.0
                  00590                                 ;AND OTHERS USE TO RESET CURSOR "ON".
                  00600 ;NOTE:  THE PREVIOUS INSTRUCTION MAY BE OMITTED.  THIS WILL CAUSE
                  00610 ;       YOUR CURSOR MODIFICATION TO BE ONLY TEMPORARY.  TRSDOS
                  00620 ;       AND SOME OTHER PROGRAMS WILL UNDO YOUR CHANGE BY WRITING THE
                  00630 ;       CONTENTS OF LOCATION 06B1H TO THE CRT CONTROLLER WHEN THEY GET
                  00640 ;       AN OPPORTUNITY TO DO SO.  (I.E. THEY WILL EXECUTE THE "CURSOR"
                  00650 ;       SVC WITH AN "ON" ARGUMENT.)
F00E F1           00660         POP     AF      ;RESTORE AF
F00F C9           00670         RET             ;FINISHED SO RETURN
0000              00680         END
00000 TOTAL ERRORS
```

Program Listing 1. SETCSR

the System disk used to load TRSDOS 2.0 for that application. The change will take effect the next time you reload the system (at power up, or at reset time) using the patched System disk. Figure 1 shows how to make the patch setting a non-blinking full block cursor. Obtain other cursor formats with different values (as shown in Table 1) for the C parameter on the PATCH command. As in Fig. 1, I always build a DO file containing each patch applied to TRSDOS. This documents exactly what was changed, and simplifies later removal, if that becomes desirable. Removal is especially easy if you have a program like UNPATCH/BAS by Ken Snapp, Jr. (April 1981, *TRS-80 Microcomputer News*). His program reverses the F and C values on the PATCH commands in a DO file to undo a patch.

Change It at Will

Perhaps you need a more dynamic method for controlling your cursor. In that case, use the SETCSR subroutine in Program Listing 1 to adjust your cursor from a Basic program or from Basic command level. Notice that any integer passed to the subroutine will be sent out to the CRT controller. You can't do any real harm with some strange value, although you may have an unusual cursor for a while. SETCSR is also self-relocating; load its 16 bytes at any available address without modifying the SETCSR code.

Also notice that the memory address given above applies to TRSDOS 2.0 only. It is quite

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```
At TRSDOS Ready type the following lines:

BUILD BLKCURSR<Enter>
PAUSE THIS PATCH MODIFIES TRSDOS 2.0 TO USE A BLOCK CURSOR. <Enter>
<Enter>
PAUSE PRESS "BREAK" TO ABORT, OR "ENTER" TO PATCH. <Enter>
<Enter>
PATCH SYSRES/SYS (A=06B1,F=65,C=00) <Enter>
<Enter>
<Enter>
DO BLKCURSR<Enter>
```

Fig. 1. Block cursor installation

```
At TRSDOS Ready type the following lines:

DEBUG ON<Enter>
DEBUG<Enter>
MF000<F1>
FE 02 C0 F5 3E 0A D3 FC 7E D3 FD 32 B1 06 F1 C9<F2>
O
DUMP SETCSR (START=F000,END=F00F,RORT=R)<Enter>
```

Fig. 2. SETCSR installation

```
10 REM  SAMPLE PROGRAM TO DEMONSTRATE USE OF THE SETCSR SUBROUTINE
20 REM
30 REM  INSERT CLEAR COMMAND HERE IF NEEDED FOR YOUR LOAD ADDRESS.
40 SYSTEM "LOAD SETCSR"
50 DEFUSR0=&HF000:   'TELL BASIC WHERE SETCSR IS TO BE ENTERED
60 X% = USR0(96)     'SET BLINKING BLOCK CURSOR
70 GOSUB 190
80 X% = USR0(0)      'SET NONBLINKING BLOCK CURSOR
90 GOSUB 190
100 X% = USR0(96+9)  'SET BLINKING UNDERLINE AS CURSOR
110 GOSUB 190
120 X% = USR0(64+5)  'SET TRSDOS CURSOR WITH FAST BLINK
130 GOSUB 190
140 X% = USR0(32)    'TURN CURSOR OFF
150 GOSUB 190
160 X% = USR0(96+5)  'RESTORE NORMAL TRSDOS CURSOR BEFORE STOPPING
170 GOSUB 190
180 STOP
190 Y%=0:FOR X%=1 TO 5000:Y%=Y%+1:NEXT X%:RETURN 'DELAY AWHILE
```

Program Listing 2. Sample program

possible that it will change in other versions.

Installing and Testing SETCSR

Installing a small machine-language subroutine without using an assembler program involves just two steps on the Model II. The first step gets the correct numbers into memory; the second writes the numbers to disk in a format which TRSDOS can load as a program later.

One way to do step one uses the Debug program to enter numbers into memory. Then the Dump command performs step two. Figure 2 shows both steps for SETCSR. TRSDOS and Debug prompts and responses are *not* shown in the figure for simplicity. <F1> and <F2> denote the function keys F1 and F2.

The short Basic program in Listing 2 demonstrates different cursor formats. It also verifies that SETCSR is on disk and can be accessed by Basic. The colon in line 50 is intentional; otherwise, Basic gets a syntax error.

Happy Controlling

I hope you enjoy complete control of your cursor. If you, as I, would like to see more utility and systems-oriented articles for the Model II, let this discussion stimulate you to share your ideas. ■

Joe Frese has been programming one computer or another since 1967. The interface between people and computers especially interests him.

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Nike Sport Research Lab

by J. L. Larsen

When Alberto Salazar ran the New York Marathon in 1981, he had one thing on his mind: time. In particular he wanted to save time—enough time over the 26.2 mile course to establish a new world record.

Speed is important to the scientific process, too. Sometimes it is necessary to collect and analyze data at almost the same instant an event transpires. Left to pencil and paper calculations, important data can be lost. Even if all the important data is recorded, analyzing it may take too long. Some computers provide a tool to increase the speed of data collection and reduce the time of subsequent analysis.

An experiment conducted recently at the Nike Sport Research Lab dealt with in-shoe temperature as a factor in the formation of blisters. By examining how a microcomputer was used in this experiment, we can demonstrate that it can serve as a catalyst in the scientific process.

Scientific research benefits from using microcomputers for data collection and analysis.

Observation

Salazar no doubt developed a blister or two on his run for the record.

Blistering is a cause of concern to shoe makers as well as athletes, since the blame is placed on the shoe. A survey conducted at the 1982 Boston Marathon showed that 36 percent of the runners surveyed had developed blisters. Many people mentioned either abrasion or heat build-up as a contributing factor.

Hypothesis

As there was little quantitative data regarding temperature and how it effects the blistering process, we decided to investigate the temperature at various locations in the shoe while a subject ran at a set pace on a treadmill. Our working hypothesis was that there is a temperature threshold at which blistering is a natural consequence.

Experiment

Our hardware consists of a copper-constantine thermocouple connected to an Omni I thermocouple amplifier (both from Omega Engineering, Inc.). The Omni amplifier is then connected to an amplifier/filter with variable gain and offset. The output from this amplifier is then passed to an analog-to-digital (A/D) converter and into the microcomputer.

The most important piece of hardware is an analog-to-digital converter. This A/D converter does exactly what the name implies. It takes an analog signal, the output by the thermocouple, and converts it to a representative digital value that the computer can use. Our system uses an Interactive Structures AI-02, an A/D converter that outputs an 8-bit number between 0 and 256.

The A/D converter interfaces any instrument that outputs a voltage signal. Most laboratory instruments come equipped with this output capability or can be adapted to output such a signal. For example, at the Nike Sport Research Lab, an oxygen analyzer, a carbon dioxide analyzer, and a Parkinson-Cowen flowmeter, all of which are used in exercise physiology studies, output a 0–5-volt signal that can be converted and sampled by the above-mentioned setup.

The converted digital value is often read by PEEKing variable storage memory, if the event being monitored is slow enough. When speed is a factor, we use a machine-language subroutine instead. Example routines demonstrating both instances are described later.

Another important piece of hardware is the amplifier/filter. This amplifier conditions signals to read a range of values within a desired resolution. In the case of the thermocouples, the Omni I amplifier is adjusted to output a signal between 0 and 90 millivolts (mV) corresponding to a temperature range of 20–40 degrees Celsius. The 8-bit A/D converter requires a voltage of 20 mV to register a change of one on its scale of 0–256 (total voltage range 0–5 volts). We expected in-shoe temperatures to range between 20° and 70°C. To attain an accuracy of .2°C, the signal from the Omni I must be amplified by a factor of 50. A low-pass filter is built into the amplifier to remove noise that might result from amplification of the signal or from sources outside the immediate system.

By substituting various sized resistors, this basic amplifier circuit can be used to condition signals from other laboratory instruments as well. For example, our carbon dioxide and oxygen analyzers, from Applied Electrochemistry, output a 0–5-volt signal. These signals are amplified by a factor of 2 and 5 over a concentration range of 0–6 percent and 15–21 percent, respectively.

The offset in the circuit is used in conjunction with the gain to define a range of values between 0 and 5 volts (lower and upper end) to aid in achieving maximum resolution.

Hardware is useless without software to direct it. We use two subroutines, one in Basic, the other in machine language, depending on the particular study. Our pilot studies have shown that, for our needs, a sample every five seconds is sufficient to monitor any temperature change that takes place. Typically we sample every five seconds, plot a point on the monitor, and print out the reading. A subject runs for 30–60 minutes at a varied pace (five, six, and seven minutes per mile). As the experiment progresses, we track the average and maximum temperature for every minute. Any blistering that occurs ends the session. The time and temperature at which blistering occurs is then the last time and temperature recorded. Maximum temperature, minute averages, and time to blister, if any occurred, were stored in a disk file for later statistical analysis.

Further studies will include varied shoe conditions in order to obtain an expanded picture of the blistering problem, as there are many other factors influencing in-shoe temperature and blistering, including the materials that the shoe is made of, total time of run, and even foot type.

As mentioned earlier, if sampling speed is important, a machine-language sampling routine is necessary. The fastest rate at which we have sampled one channel of converted data (our A/D converter has 16 possible channels), is 10,000 per second. The temperature study did not require such speed but studies using the air/gas analyzer and flowmeter mentioned earlier can only be undertaken with machine-language drivers. The program requires a timer or clock capable of interrupts. This routine samples two channels every second and stores the values in memory locations accessible by other routines. From this skeleton, a control program can be fleshed out to handle and monitor a multitude of analog signal events.

Conclusion

Although speed is not important in all phases of the scientific process, it is essential in some.

A slower pace is helpful, for example, when allowing an idea to build and when forming a hypothesis. But once data collection starts, speed is a primary concern, and microcomputers can provide an important service. In our temperature study, for instance, a microcomputer allowed us to collect the data and analyze it much faster than alternate methods. ■

J. L. Larsen (156 Front St., Exeter, NH 03833) enjoys studying birds, rocks, and apples.

Trick Your ROM

by Bob Boothe

Are you frustrated with your printer driver? These programs let you use CHR$(0) for simple and speedy bit-graphics on your printer.

The original designers of ROM must have thought anybody sending a CHR$(0) to the printer was in error.

Program listings don't use it. Word processors don't use it. Screen dumps don't use it. But those of us who have modern printers with fancy options need zero all the time.

I made a three-dimensional paraboloid with 288,960 points combined into 41,280 bytes. Of those 41,280 bytes, 16,830 are zeros.

I knew I would run into problems using the LPRINT statement, so instead I used a very slow process of PEEKing the printer address. When it was clear I POKEd my values into it one at a time.

Zero is not the only problem with the ROM printer driver. The designers must have thought anyone sending a CHR$(10) to the printer meant to send a CHR$(13), and so the helpful ROM changes any 10 to a 13.

I have another design, the Mirror, which uses a 10 twice on every line. More about this design later.

If you are desperate for a 10, send an 11 or 12. ROM intercepts your 11 or 12 and gives you 66 tens instead, a good trade if you're changing money, but a disaster when doing bit graphics.

Solutions

Naturally, there are plenty of ways to trick the ROM. First, let's take a look at the printer driver.

The keyboard, video display, and printer all have device control blocks in RAM. The printer device control block starts at 16421. I use decimal instead of hexadecimal here, so we can do a little PEEKing and POKEing.

Address 16421 contains a six as the DCB type. I don't think the six matters, but to play it safe leave it alone. The next address, 16422, contains a 141; POKE 140 into it. This disables the printer by exchanging the printer

> *The Key Box*
> **Basic Level II**
> **Model I**
> **Printer**

058D	79	LD	A,C
058E	B7	OR	A
058F	2840	JR	Z,05D1H
0591	FE0B	CP	0BH
0593	280A	JR	Z,059FH
0595	FE0C	CP	0CH
0597	201B	JR	NZ,05B4H
0599	AF	XOR	A
059A	DDB603	OR	(IX+03H)
059D	2815	JR	Z,05B4H
059F	DD7E03	LD	A,(IX+03H)
05A2	DD9604	SUB	(IX+04H)
05A5	47	LD	B,A
05A6	CDD105	CALL	05D1H
05A9	20FB	JR	NZ,05A6H
05AB	3E0A	LD	A,0AH
05AD	32E837	LD	(37E8H),A
05B0	10F4	DJNZ	05A6H
05B2	1818	JR	05CCH
05B4	F5	PUSH	AF
05B5	CDD105	CALL	05D1H
05B8	20FB	JR	NZ,05B5H
05BA	F1	POP	AF
05BB	32E837	LD	(37E8H),A
05BE	FE0D	CP	0DH
05C0	C0	RET	NZ
05C1	DD3404	INC	(IX+04H)
05C4	DD7E04	LD	A,(IX+04H)
05C7	DDBE03	CP	(IX+03H)
05CA	79	LD	A,C
05CB	C0	RET	NZ
05CC	DD360400	LD	(IX+04H),00H
05D0	C9	RET	
05D1	3AE837	LD	A,(37E8H)
05D4	E6F0	AND	0F0H
05D6	FE30	CP	30H
05D8	C9	RET	

Table 1. Disassembled ROM Printer Driver

driver with a return statement.

Address 16423 contains a five; the five and the 141 point to the ROM printer driver at address 1421. Table 1 shows a disassembled listing of the offending code. The 76-byte routine includes lines for almost everything from ignoring zeros to making form feeds from elevens and twelves.

In this routine, lines using the number 37E8H either check the status or output the byte to the printer.

Now is the time to replace the ROM routine. Unfortunately we cannot change the ROM, but the device control block does allow us to put our own routine in RAM. Normally, small machine-language routines are put in high memory, protected when the computer asks for memory size. That's annoying when you want more than one program in the same place. To circumvent this standard procedure, I wrote a short program to tally the different numbers in the reserved RAM area (16405–17128). Since 249 never occurred, I filled the entire section with 249s from a machine-language routine. Then I booted the system and exercised commands forcing the computer to use its reserved memory. I PEEKed through this memory section and wrote down all continuous sections still containing 249s (see Table 2).

These are *apparently* unused addresses. There's a good chance some odd command will use them, but I use the open section 16571–16594 without any problem. If you decide not to fix the printer driver, you still might relocate the keyboard debounce routine into one of these low sections. If you don't want to risk having the new printer driver destroyed in low memory, move it to high memory. The code is relocatable.

16554–16577
16571–16594
16610–16613
16668–16672
16678–16687
16697–16721

Table 2. Unused Reserved RAM

The Programs

Printer driver 1 (Program Listing 1) takes only nine bytes of memory. With this in memory send a CHR$(0) to the printer and get a CHR$(0) printed. Send an 11 and you get an 11; a 12 prints a 12. Try sending a 10 —you'll get a 13.

Your 10 becomes a 13 long before the printer driver; the ROM changes it to a 13.

Enter printer driver 2 (Program Listing 2). Somewhat larger than Program 1, this program takes up 15 bytes of memory. The extra six bytes allow the program to constantly scan the break key. With this feature you can stop the printer quickly.

Next comes printer driver 3 (Program Listing 3). This one is for the conservationists: It uses a miniscule four bytes of memory. It moves the print character from C to A and then jumps to the end of the ROM printer driver. This printer driver also can't tell a 13 that looks like a 13 from a 10 that looks like a 13.

Basic Tricks

Many printers use seven bits and ignore the last one. A common trick to get numbers past the ROM on seven-bit machines is to add 128 to all the numbers. The ROM then passes the numbers through to the printer.

```
{|xy}                   00100 ;PROGRAM 1   STANDARD PRINTER DRIVER
4026           00110           ORG      16422           ;DRIVER ADDR
ESS
4026 BB40      00120           DEFW     START           ;LATCH IN NE
W DRIVER
40BB           00130           ORG      16571           ;NICE BIG PL
ACE TO PUT IT
40BB 21E837    00140 START     LD       HL,37E8H        ;LINE PRINTE
R ADDRESS
40BE CB7E      00150 LOOP      BIT      7,(HL)          ;CHECK STATU
S
40C0 20FC      00160           JR       NZ,LOOP         ;LOOP UNTIL
READY
40C2 71        00170           LD       (HL),C          ;OUTPUT BYTE

40C3 C9        00180           RET
0000           00190           END
00000 TOTAL ERRORS
```

Program Listing 1

I use an Epson MX-80 with the Graftrax-80 graphics ROM update. It's an eight-bit machine and requires some tricks to pass zeros. The easiest but slowest way is to just POKE numbers to the printer address.

Printer driver 4 makes an eight-bit printer function like a seven-bit printer (Program Listing 4). It takes the numbers passing through and erases bit 7 (bits are numbered 0–7), if there is one. In other words, if you

```
                00100 ;PROGRAM 2    PRINTER DRIVER THAT CHECKS BREA
K KEY
4026            00110           ORG     16422           ;DRIVER ADDR
ESS
4026 BB40       00120           DEFW    START           ;LATCH IN NE
W DRIVER
40BB            00130           ORG     16571           ;NICE BIG PL
ACE TO PUT IT
40BB 21403B     00140 START     LD      HL,3B40H        ;BREAK KEY A
DDRESS
40BE CB56       00150           BIT     2,(HL)          ;TEST KEY
40C0 C0         00160           RET     NZ              ;IF BREAK RE
TURN
40C1 21E837     00170           LD      HL,37E8H        ;LINE PRINTE
R ADDRESS
40C4 CB7E       00180           BIT     7,(HL)          ;CHECK STATU
S
40C6 20F3       00190           JR      NZ,START        ;LOOP UNTIL
READY
40C8 71         00200           LD      (HL),C          ;OUTPUT BYTE

40C9 C9         00210           RET
0000            00220           END
```

Program Listing 2

```
                00100 ;PROGRAM 3    PRINTER DRIVER THAT USES PART O
F ROM (BOO)
4026            00110           ORG     16422           ;DRIVER ADDR
ESS
4026 BB40       00120           DEFW    START           ;LATCH IN NE
W DRIVER
40BB            00130           ORG     16571           ;NICE BIG PL
ACE TO PUT IT
40BB 79         00140 START     LD      A,C             ;THIS IS THE
 SHORTEST FIX
40BC C3B405     00150           JP      05B4H           ;LAST HALF O
F ROM ROUTINE
0000            00160           END
00000 TOTAL ERRORS
```

Program Listing 3

```
                00100 ;PROGRAM 4    PRINTER DRIVER TO MASK OUT BIT
SEVEN
4026            00110           ORG     16422           ;DRIVER ADDR
ESS
4026 BB40       00120           DEFW    START           ;LATCH IN NE
W DRIVER
40BB            00130           ORG     16571           ;NICE BIG PL
ACE TO PUT IT
40BB 21E837     00140 START     LD      HL,37E8H        ;LINE PRINTE
R ADDRESS
40BE CB7E       00150 LOOP      BIT     7,(HL)          ;CHECK STATU
S
40C0 20FC       00160           JR      NZ,LOOP         ;LOOP UNTIL
READY
40C2 3E7F       00170           LD      A,7FH           ;MASK 0111 1
111
40C4 A1         00180           AND     C               ;COMBINE BYT
E
40C5 77         00190           LD      (HL),A          ;OUTPUT BYTE

40C6 C9         00200           RET
0000            00210           END
00000 TOTAL ERRORS
```

Program Listing 4

send a 138 the printer gets a 10. If you send a 49 the printer gets a 49. Of course a 10 still comes out as a 13. We finally have a way to get a ten to the printer. The big disadvantage is losing many eight-bit capabilities. This driver is useful for using seven-bit programs on an eight-bit machine. An excellent article, "A Turn of the Screw," (*80 Micro*, April 1981) includes bit graphics for seven-bit machines.

The only problem left is getting the 10 to the printer as a 10. Since it is changed deep in the catacombs beyond trackable distance, it took a long time. I checked all the registers. I disassembled code, searched memory, and considered pouring dye on the CPU to trace its path. Finally, I found it 17 bytes up on the stack. I immediately pulled out the editor/assembler and wrote printer driver 5 (Listing 5). It uses 16 bytes of memory.

Listing 5 is different from other printer drivers that print the value from the C register. This program ignores its input, looking 17 bytes up from the start of the stack. It sends whatever it finds to the printer. For Basic programs this approach has never failed. A problem arises when using machine-language programs such as EDTASM. EDTASM doesn't leave the output bytes 17 bytes up the stack. This is no big problem for graphics, because EDTASM doesn't use bit graphics on its printouts. Remember to reset the computer when switching from printer driver 5 to EDTASM. The JKL function of NEWDOS also doesn't work with driver 5.

All the drivers work when LLISTing programs although they're not needed for this.

The advantages of my printer drivers for graphics are speed and simplicity. For example, in executing a Basic program called The Mirror, the old POKE routine took nine minutes to print its design. Converted to use printer driver 5, the program is half the length and prints the design in 2 minutes and 15 seconds—a 75 percent time reduction.

Last Program

Program Listing 6 is a Basic loader for any printer driver. I set it to load printer driver 5 into memory. To change it, put all data in hexadecimal form on line 120. I use hexadecimal because the assembler uses it. The remainder of the program converts the data and POKEs it into memory starting at 16571. Lines 210 and 220 change the device control block to link into the new printer driver. To change the location, change lines 135, 210 and 220. ■

Bob Boothe is majoring in Computer Science at the University of California at San Diego. He can be reached at 4651 Browndeer Lane, Rolling Hills Estates, CA 90274.

```
                00100 ;PROGRAM 5  PRINTER DRIVER THAT GETS CHARACT
ER FROM STACK
                00110 ;        ***** THIS IS THE BEST ONE *****
                00120 ;DOES NOT WORK OUTSIDE OF BASIC (EDTASM, JKL
)
4026            00130           ORG     16422           ;DRIVER ADDR
ESS
4026 BB40       00140           DEFW    START           ;LATCH IN NE
W DRIVER
40BB            00150           ORG     16571           ;NICE BIG PL
ACE TO PUT IT
40BB 21E837     00160 START     LD      HL,37E8H        ;LINE PRINTE
R ADDRESS
40BE CB7E       00170 LOOP      BIT     7,(HL)          ;CHECK STATU
S
40C0 20FC       00180           JR      NZ,LOOP         ;LOOP UNTIL
READY
40C2 211100     00190           LD      HL,17           ;ADD 17 TO S
TACK POINTER
40C5 39         00200           ADD     HL,SP           ;RESULT IN H
L
40C6 7E         00210           LD      A,(HL)          ;GET ORIGIAN
AL BYTE
40C7 32E837     00220           LD      (37E8H),A       ;SEND IT TO
THE PRINTER
40CA C9         00230           RET
0000            00240           END
00000 TOTAL ERRORS
```

Program Listing 5

```
100 REM     LOADER PROGRAM FOR ANY PRINTER DRIVER
110 REM     PUT DATA IN HEXIDECIMAL FORM IN LINE 120
120 DATA 21E837CB7E20FC211100397E32E837C9
125 REM     EXAMPLE IS PRINTER DRIVER 5
130 READ B$
135 A=16571
140 FOR P = 1 TO LEN(B$) STEP 2
150    B=ASC(MID$(B$,P,1))-48
160    IF B>9 THEN B=B-7
170    T=ASC(MID$(B$,P+1,1))-48
180    IF T>9 THEN T=T-7
190    POKE A,B*16+T
195    A=A+1
200 NEXT P
210 POKE 16422,187
220 POKE 16423,64
230 END
```

Program Listing 6

TRS-80 Laboratory

by Wynne Keller

If you are thinking about purchasing a computer for your laboratory, this article describes the options you may want to consider.

In 1979, buying a TRS-80 Model I was an unorthodox approach to clinical laboratory management. Since then, it has become more widely accepted that both private and hospital labs can benefit from a microcomputer. Laboratory application software is becoming available, and many standardized programs can also be used in a lab. A TRS-80 in the lab is a cost-efficient management tool. The experiences of a small lab that has had a TRS-80 for several years may help other laboratories considering this purchase to appreciate the problems and benefits that can result.

The Purchase

When the laboratory manager of a 92-bed hospital in Skowhegan, ME, approached the administration about buying a TRS-80, he already had first-hand knowledge of the machines through the purchase of one for his home. He argued that he could program the machine himself and use it for a number of time-consuming lab tasks, some of which were being done by outside firms for a fee. He also pointed out uses in other areas of the hospital, and persuaded the administration to try a minimal system.

The initial equipment consisted of a Model I with 32K, one drive, and a printer. The system cost about $2,700, which in today's market would buy considerably more computer power.

The equipment as purchased soon proved to be inadequate. They eventually added 16K more memory, another disk drive, a lowercase mod, and double density.

It is impractical to use a one-drive system in a laboratory, not only because the capacity is small, but also because such daily routines as making backups are extremely time consuming with only one drive. Any lab considering a TRS-80 should purchase at least two drives, 48K, and preferably double density.

Of course, what I have just described is the standard Model III computer, and it can be obtained, with a dot-matrix printer, for approximately the same money as the Skowhegan lab spent on their early, limited-capacity Model I.

Use in Other Departments

A number of other departments in the hospital became interested in computerizing various projects.

One department that made successful use of the computer was the business office. Their problem required a custom program, but the program was often used. An early version of the program written for them, "Procedures Pricing," was published in *80 Micro* in December, 1981. A version of this program is still being used today. It automates price changes, so that when the cost of any item in a hospital procedure changes, all procedures using that item are updated.

Data Base Managers

A data base program is very useful in a laboratory. This type of program stores information of many different kinds in a flexible manner, so any data may be changed, added, deleted, sorted, or printed. All data base programs use the words field, record, and file.

A field is a category of information such as the name, the cost, the quantity. A record contains all the field information for one item. For example, one record in an inventory might contain this: rubber bands (name field), $1 (cost field), 200 (quantity field). Finally, a file is the largest unit. All the records on a subject are stored in a single file on the disk.

There are two common types of data base managers. One is the in-memory type, which requires that all records fit in the memory of the computer at one time. As might be expected, this type of data base has a small capacity. The other type, random access, uses the disk to file each record as a separate, retrievable unit. This type is not dependent on computer memory, and is the most useful type for a laboratory.

One obvious use of a data base is for inventory control, but many more fields are needed than were given in the example above. Such fields as manufacturer name, product number, reorder date, reorder quantity, quantity on hand, and price discount might all be included.

This program application has saved the lab between $300 and $1,000 per month. Keeping track of discount information is the key to these savings. The laboratory receives many of its reagents at discount. These discounts are often not reflected in the invoices for any particular batch of reagents. By checking all invoices with the price information in the computer, errors are quickly noticed.

The data base manager is used for many other projects, such as mailing and slide labels. A data base is even used in microbiology to accumulate data on changes in the sensitivity of microrganisms to antibiotics.

Another planned use of the data base manager is a classification scheme for autopsies. By entering autopsy results in the data base, the pathologist hopes to spot statistical trends in the frequency of occurrence of disease types. All these uses are for a single program. Data base programs, because of their flexibility, are one of the most important software purchases for a laboratory.

Word Processors

Apart from the obvious uses in such areas as correspondence, autopsy reports, and personnel job descriptions, a word processor may also be used to create a manual of test procedures. All labs maintain such manuals, which are difficult to update. With a word processor, all test procedures may be typed into the computer, saved on disk as one or more files, and easily corrected and reprinted whenever necessary.

A spelling checker is a useful program to run in conjunction with a word processor. Choose one capable of learning the specialized vocabulary that laboratory work requires. One final note on word processors: If the medical records department ever discovers you have one, you may never see your computer again.

VisiCalc

The third general-purpose program is VisiCalc. When discussing data bases and word processors, I did not mention the names of any particular product because there are many good ones and it would be unfair to single out one or two. There is, however, only one VisiCalc. It is a unique financial management tool. The Skowhegan lab currently uses it at the end of the year to evaluate the workload data.

The program allows a lab manager to take a hard look at personnel productivity in the current year as opposed to prior years. At budget preparation time, VisiCalc helps the manager predict future needs based on current growth rates. The comptroller for the hospital used VisiCalc constantly for a month to prepare the budget.

As consultants for laboratories, we have sometimes been asked to write custom programs for various applications. Some of these problems don't need a specialized program; they can be solved with VisiCalc. The program has tremendous potential, but requires a lot of creative thought to be used effectively.

Specialized Programs

Specialized programs have been

slow coming on the market for laboratories. Three new laboratory programs will be released this fall by Downeast Digital as part of their new LabManager series. The three will be Workload/Finance, Quality Control, and Test Pricing. Two others, a program on Blood Gas Analysis and an Inventory Control program, are planned for next year.

LabManager Workload/Finance is a new, more sophisticated version of a program that has been on the market two years. It stores year-to-date and current workload values and quantities for inpatient, outpatient, quality control, and non-chargeables, and prints a complete workload report organized by department, with a one-page summary. Up to 50 departments are now allowed, which means larger hospitals can separate data by shifts, with a subtotal for each shift. The program includes a financial report of revenues charged for impatient and outpatient tests.

The LabManager Quality Control stores QC data for current month, previous month, and year to date. It provides continuous display and update of the mean, coefficient of variation, number of assays, and upper and lower limits. It graphs the data using a Levy-Jennings plot. It performs precision, shift, and trend analysis, and allows multiple control levels per test. Reports are compatible with the requirements of laboratory computer data centers. Many labs currently spend much money to have quality control done by outside firms. This new program could help justify the purchase of a computer for your lab.

Test Pricing allows the lab manager to rapidly and accurately determine the cost of each test. With this information, he can set test prices at realistic levels, and keep prices correct when costs change. A calculator mode is included so that various purchasing decisions can be compared for their effect on prices.

What of the software that is needed but not on the market? Serious thought should be given to having at least one employee trained in Basic programming. Many small but very useful programs can be written in house. Having a programmer on the staff is definitely helpful.

Problems

Some of the problems encountered by the Skowhegan lab have already been briefly mentioned. The three biggest have been access to the computer, program turnover, and reliability. Other problems, such as lack of computer experience, are rapidly overcome as one gains familiarity with the machine.

Access to the computer has been a continuous problem, and has increased as other departments have also wanted to use the machine. In order to facilitate access within the lab, a wheeled table was recently purchased. Unfortunately, the table also made it easier for the comptroller to borrow the computer at budget time.

The ultimate solution is to persuade other departments to buy their own computer. Since the first TRS-80 arrived in 1979, three additional microcomputers have been purchased for this hospital: an Apple, a Model III, and a Hewlett-Packard. (The latter was for the comptroller, and is used almost exclusively to run VisiCalc. The Hewlett-Packard has an advantage over the TRS-80 for this application because of its greater memory size.) Another TRS-80 will also be purchased for the lab so that one machine may be interfaced with lab equipment without jeopardizing computer access for employees.

Program turnover has been an occasional problem, from the point of view of the employees who had to learn a new program method. Data base programs have been particularly susceptible to turnover: Three have been purchased in a two-year period. Because there is a programmer in the lab, it has not been necessary to re-enter all the data each time a change was made, but the programs all use different screen and key controls, and employees, especially those who don't use the program often, may be unable to remember how to make a program work.

In a lab without a programmer, software changes should be approached with great caution. Even if the new program is better, if it is necessary to retype all the data that the old program stored, the change may not be worth the effort. To a novice it may be hard to imagine why anyone would want a new program to do the same thing the old one did. However, programs today are far more sophisticated than yesterday's, and such factors as speed, printout sophistication, and ease of operation may make a new program a worthwhile investment.

The greatest problem is reliability. TRS-80 Model Is are notorious for rebooting or freezing up at the worst possible moments. Recently a product called a Gold Plug has been introduced by E.A.P. Company. This simple device is soldered to the edge connectors on the Model I and prevents the corrosion that causes freeze-up. We have applied Gold Plugs to every Model I we own and recommend it to anyone who suffers from this problem. It has (finally) made the Model I a reliable machine.

Any computer may need occasional repairs and down time is a serious problem. Ultimately the solution is more than one computer. Until that is possible, a reasonable intermediate step is to have one extra drive, because that is the most likely unit to need repair. Also, if other departments in the hospital buy the same brand of computer, they can serve as back-ups to each other. Such internal consistency should be strongly encouraged, not just for the equipment, but also because employees can share knowledge they have gained by experience.

Expansion

What place will the TRS-80 have in the lab's future plans? The next goal is to interface a TRS-80 with the Centrifichem. An interface is being made by Baker Instruments.

Many laboratory instruments are now being built with an RS-232 port, and any such instrument can be easily connected to the TRS-80. The manufacturer can often construct an interface if the RS-232 does not exist. Some companies are providing microcomputers with their equipment. If the micro comes with a major instrument purchase, it can be used for other purposes when the instrument is not in use. Be certain before making such a purchase, however, that the computer is a brand you want. Very little laboratory software exists, and what there is usually runs on the TRS-80 or Apple microcomputers.

Computerizing the Skowhegan lab has not always been easy, but it has resulted in substantial savings and more efficient use of employee time. Both the hospital administration and the laboratory are pleased with the results and plan to increase the number of computers and the breadth of applications. ■

Wynne Keller, RD 1 Box 4130, Solon, ME 04979, enjoys computing and mineral collecting.

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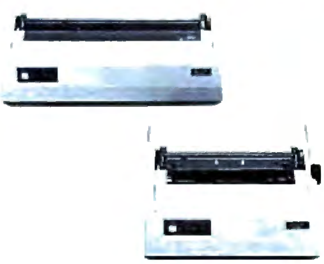

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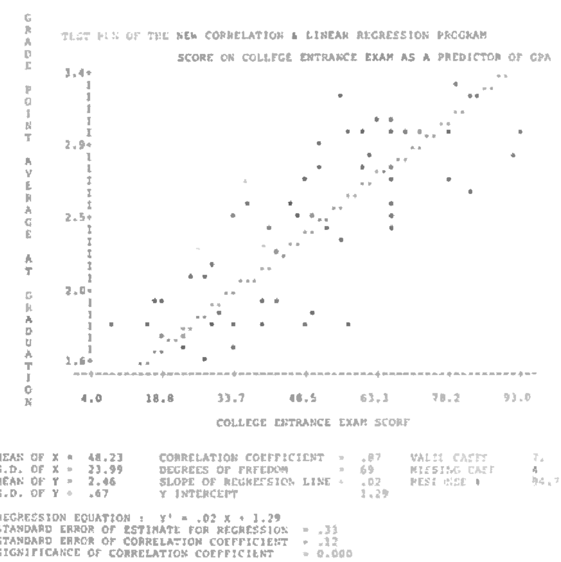

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Astrodynamics for Beginners

by John D. Fowler, Jr.

Has gravity got you down? Here's a program that lets you use your 80 to explore Sir Isaac Newton's basic laws of gravitation.

Want to create your own star system? How about three suns orbiting a solitary planet? Or twin planets orbiting each other while moving around a single sun? Or...

Your computer can calculate orbits like the big machines at NASA. And you can actually try out the systems mentioned above, or any others you might think of.

Astrodynamics is the study of how objects move under the influence of gravity. This includes planets, comets, asteroids, space probes, moons, galaxies, and the apple that fell on Sir Isaac Newton's head.

Orbital mechanics has allowed NASA scientists to predict the motions of space probes with great accuracy. To land a spacecraft on Mars, for instance, you must know not only where Mars will be at the right time, but also how the path of the probe itself will be affected as it nears the target. The regularity of planetary motions, along with centuries of celestial observation, have led to precise predictions of their positions in the sky. Detailed orbits of multibody systems, however, require numerical calculations.

The problem of the motion of two bodies under the force of mutual gravitational attraction can be solved exactly. The path of one relative to the other is an ellipse, a parabola, or a hyperbola. The size and type are determined by the starting positions and relative velocities of the two objects. Bodies that are in closed orbits travel in ellipses. An object that has just achieved escape velocity takes a parabolic path, and faster objects travel on hyperbolas.

The three-or-more-body problem has no exact solution. There is no equation that can be written to describe the motion of three or more bodies under gravitational attraction, except for a few special cases. The *only* way to get a solution for more than two objects is by number-crunching numerical calculations. Enter the computer.

We need a law—the law that governs the motions of objects under mutual gravitational attraction. Notice that I said "mutual gravitational *attraction.*" Why not repulsion? Anything with mass possesses an attraction for everything else with mass. Usually the force of attraction is so small as to be unnoticed. The exceptions are large objects, such as planets or stars.

The law that describes this basic, universal interaction between matter was discovered by Sir Isaac Newton. The law says that the force between two bodies due to gravity is attractive, and is proportional to the product of their masses and the inverse of the square of the distance separating them. The formula is Equation 1:

$$F=Gm_1m_2/r^2$$

The symbol G is the constant of proportionality. It is called the universal gravitational constant because it is believed to have the same value everywhere in the universe. The numerical value of G depends on which system of units you use. Several systems, with corresponding values of G, are shown in Table 1. Notice that G is quite small. This is why gravitational forces are apparent only between objects where at least one has an extremely large mass.

The force F can also be made large by making the distance of separation, r, very small.

The Universal Law of Gravitation is formulated in terms of interactions between *pairs* of objects only. So what do we do if we have three or more objects? If we have, say, a sun, a planet, and a comet (call them S, P, and C), you can apply the law to the system one pair at a time and then add the resulting forces on each object. In our example, we have the interactions: sun and planet (SP), sun and comet (SC), planet and comet (PC), planet and sun (PS), comet and

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sun (CS), and comet and planet (CP). The sum of forces on the comet, for instance, is CP+CS. The sum of forces on the sum is SP+SC, and the sum on the planet is PS+PC. In general, for a system of N objects there will be N−1 pairs of forces for each object, for a total of N*(N−1) pairs of forces representing the sum of all forces between all pairs of objects in the system.

Only half these pairs have to be calculated, however, due to another handy law from Sir Isaac. But first, you have to learn how to go from the Law of Gravitation to the actual description of the orbits or trajectories of the objects in the system. For this you must use the formidable-sounding process of numerical integration of the equations of motion.

Let's go back and sample a few more of Newton's Laws. The first law says that an object will move in a straight line at constant speed until acted on by an outside force—an object won't change its direction or speed unless it is pushed or pulled on. The second law, which deals with the pushing and pulling, says that the acceleration of an object is proportional to its force: F=ma (Equation 2), where m is the mass of the object. (No one has ever proved that this mass, which is called the inertial mass, is the same as the mass used in Equation 1, which is the gravitational mass, but they are believed to be the same.)

So, if we know the force on an object (Equation 1), we can use Equation 2 to find the acceleration by dividing both sides by the object's mass. Combining Equation 2 and Equation 1, the acceleration due to gravity on object 1 due to object 2 is:

$$a=F_{12}/m_1=Gm_2/r^2$$

F_{12} is the force on object 1 due to object 2. Newton's third law states that for every action there is an equal and opposite reaction. From this law, you can infer something about the force on object 2 due to object 1, namely that:

$$F_{21}=-F_{12}$$

Thus, when you calculate the force on object 1 due to object 2, you also automatically know the force on object 2 due to object 1: It is equal but with the opposite sign. You can use this information to reduce the calculational burden on the program. When half the forces have been calculated, the other half are known.

Once you know the acceleration, the next step is to find the object's velocity. If the acceleration is constant over the time interval t, the object's velocity at the end of that interval is Equation 3:

$$v=v_0+at$$

where v_0 is the velocity at the start of the interval. Another way to put it is that the change in velocity ($v-v_0$) equals the product of acceleration and the time interval.

Remember, though, that for this formula to be valid, the acceleration *must not change* over the time interval. This seems to be a problem because looking at Equation 1, as the separation r changes, the force changes, and from Equation 2, as the force changes, the acceleration changes. Therefore, we can't use Equation 3 to find the velocity, right?

Well, suppose that we made the time interval small enough that the acceleration didn't change much over that interval. Then the conditions would be approximately right. The symbol for this small time increment is dt. Correspondingly, the velocity increment symbol associated with the interval dt is dv. Thus, Equation 3 becomes dv=a*dt (Equation 4).

All that remains is to get the positions from the velocities. For this we use Equation 5:

$$s=s_0+v_{av}*dt$$

This is just the formula: distance=rate*time, with s the position at the end of the time interval dt, s_o the beginning position, and v_{av} the average velocity (rate) during the interval. To find the position, you must know the average velocity during the interval. This is given by half the sum of the velocities at the start of the interval and at the end (Equation 6):

$$v_{av}=(v+v_0)/2=v_0+dv/2.$$

So the average velocity is just the starting velocity plus half the velocity increment during the interval. Combining equations 5, 6, 4, 2, and 1, you finally get the equation for the position in terms of starting separation, position, velocity, and mass (Equation 7):

$$s=s_0+v_0+½a*dt^2$$

Remember that the acceleration a is found by adding all the individual accelerations due to all the other objects in the system. For object number 1:

$$a_1=F_{12}/m_1+F_{13}/m_1+F_{14}/m_1+\ldots, \text{ or}$$
$$a_1=G(m_2/r^2_{12}+m_3/r^2_{13}+m_4/r^2_{14}+\ldots)$$

The symbol r_{ij} denotes the distance between object i and object j.

We have established a chain leading from the law of motion, Equation 1, down to the positions, in Equation 5 or 7. The only assumption was that the time interval dt must be small enough that the acceleration is approximately constant during that interval.

To calculate over long time intervals,

Set of Units	Mass Unit	Length Unit	Velocity Unit	Time Unit	Gravitational Constant, G (Unit)
mks	1 kilogram (kg)	1 meter (m)	1 meter/ second (m/s)	1 second (s)	6.67E-11 (m^3/s^2-kg)
fps	1 pound (lb)	1 foot (ft)	1 foot/ second (ft/s)	1 second (s)	1.07E-9 (ft^3/s^2-lb)
AU-EM-Te	1 Earth Mass (EM) 5.98E24kg	1 Astronomical Unit (AU) 1.496Ell m	1 AU Temp 29,770 m/s	1 Temp (Te) 5.025E6 s	3.01E-6 (AU^3/Te^2-EM)

Table 1. Units for input data and gravitational constant. A consistent set of length-mass-time units must be chosen to use the formulas developed in this article. Several sets are presented above, with corresponding values of the gravitational constant G. (You should place the appropriate value for G in line 40 of the program.) The first set is based on the widely used meter-kilogram-second system used by most scientists. The second set uses the foot-pound-second system. The third set uses the Astronomical Unit-Earth Mass-Temp system. I made up the Temp, which is determined so that the Earth's velocity around the sun is 1 A.U. per Temp. The advantage of this last system is that it allows the use of smaller numbers for input. But remember that the variable TIME (line 320) will be in Temps. So pick a line (mks, fps, or AU-EM-Te) and stick with it for a given run.

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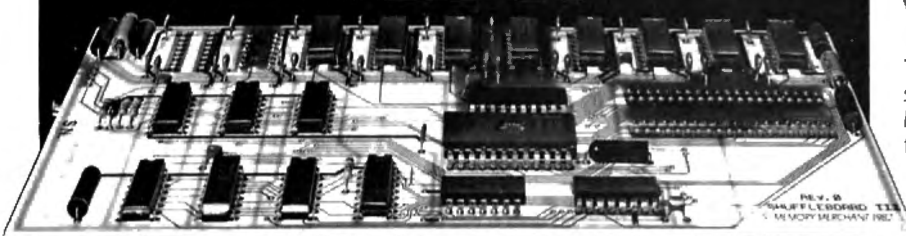

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you only have to calculate over a lot of small time intervals. The trick is to use the newly found velocities and positions from the most recent time interval to update the starting separations for the current time interval. You must update the values of r in Equation 1 from the new positions s, and calculate a new cycle. You can continue this procedure over as many cycles as desired. They can add to as long a time interval as you wish.

Before discussing the program, let's look at how the separations are updated from the new positions that are calculated each time cycle.

Everything so far has been presented in one dimension. Real space has three dimensions, usually referred to as x, y, and z. The orbits of the two-body problem discussed earlier must exist in the two dimensions needed to draw an ellipse, parabola, or hyperbola. In what follows, consider only two dimensions, x and y, because your screen is best at displaying two-dimensional images. You can generalize the results to three dimensions yourself without much trouble.

Every point on a two-dimensional surface has two components. You can keep track of the positions of the objects in our program by calculating the x component of position and the y component. Those two components specify a point, which is the position of the object. To get the separation between two objects in terms of their four-position components, you get an x separation and a y separation, and apply Pythagoras' theorem.

The x and y separations are just the differences between the corresponding components of the two objects. If x_{12} is the x separation between objects 1 and 2, and y_{12} the y separation, then:

$$x_{12} = x_2 - x_1 \text{ and } y_{12} = y_2 - y_1$$

where x_1 and y_1 are the coordinates of object 1, and x_2 and y_2 are the coordinates of object 2. The separation is then the hypotenuse of the right triangle formed by x_{12} and y_{12} (see Fig. 1). Pythagoras' theorem in geometry says that the separation, r, is given by the square root of the sums of the squares of the sides, or:

$$r_{12} = \text{SQR}\ (x^2_{12} + y^2_{12}), \text{ or}$$
$$r_{12} = \text{SQR}\ ((x_1 - x_2)^2 + (y_1 - y_2)^2).$$

So the separations between pairs of objects are found from the coordinates for the positions using the above formula.

The components of acceleration are found by scaling as follows:

$$a_{x12} = \frac{a^*(x_2 - x_1)}{r} \text{ and}$$

$$a_{y12} = \frac{a^*(y_2 - y_1)}{r}$$

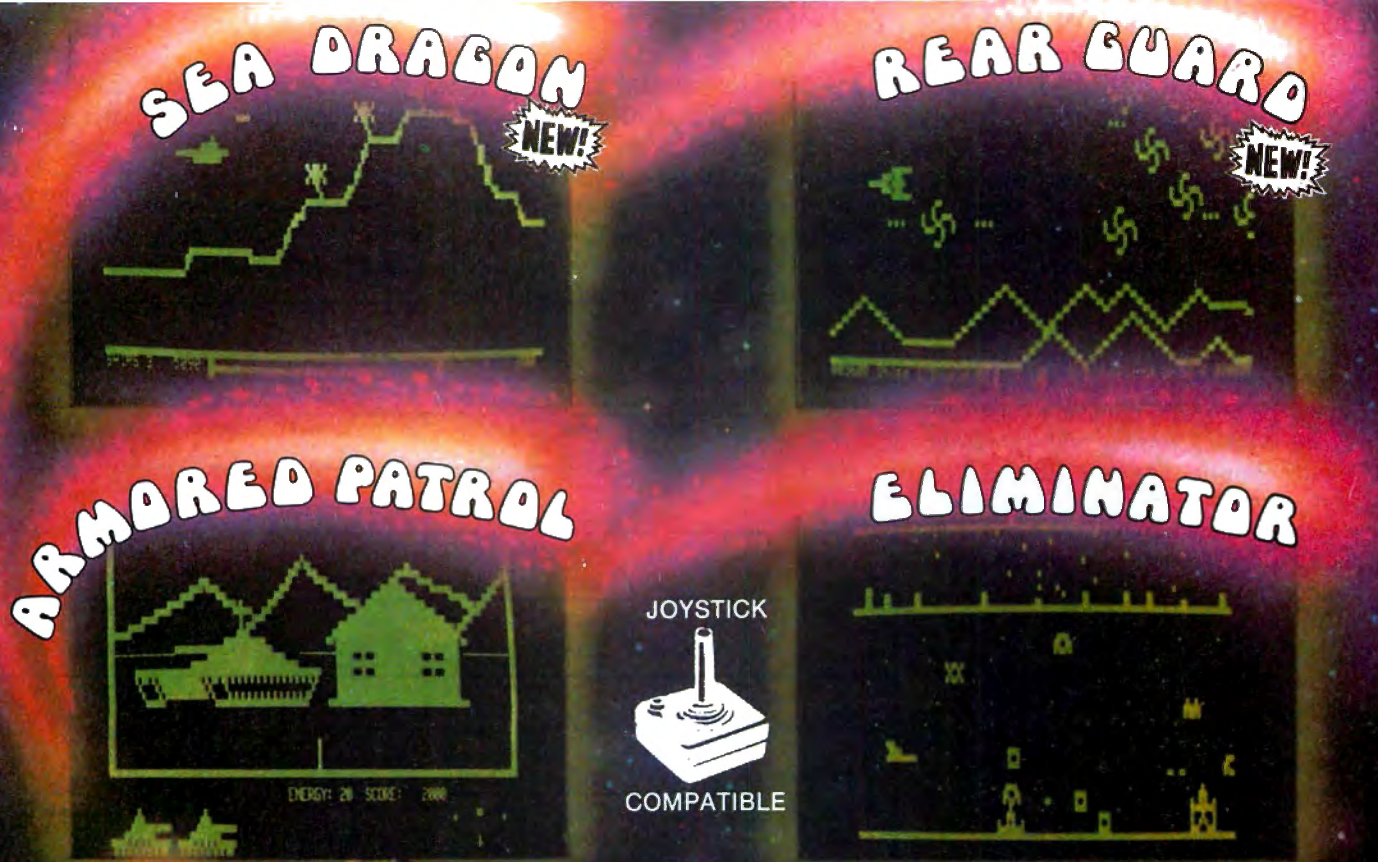
where the first equation is the x component of acceleration due to the force between objects 1 and 2, and the second equation is the y component.

Program Listing 1 was written for the Color Computer, but with the exception of the plotting subroutine (lines 520–610), it should run on other machines as well. The doubly subscripted variables A, S, and V are the accelerations, positions, and velocities, respectively. The second subscript specifies the component (1 for x, 2 for y). The program asks you to input the number of objects and starting positions and velocities for each. Remember to use consistent units, as shown in Table 1. If you don't use meters, kilograms, and seconds, you should change the value of G in line 40.

The program then asks you for a horizontal scale factor. This is used in the plotting subroutine to scale the graph-

```
10 INPUT "HOW MANY OBJECTS";N
20 DIM M(N),A(N,2),S(N,2),V(N,2),LP(N),LQ(N)
30 TIME=0
40 G=6.67E-11
50 FOR I=1 TO N
60 PRINT "MASS OF NUMBER"I"?"
70 INPUT M(I)
80 PRINT "X AND Y OF NUMBER"I"?"
90 INPUT S(I,1),S(I,2)
100 PRINT "VX AND VY OF NUMBER"I"?"
110 INPUT V(I,1),V(I,2)
120 NEXT I
130 INPUT "SCALE FACTOR FOR X";SX
140 SY=.85*SX
150 INPUT "TIME STEP";DT
160 PMODE 4,1:PCLS:SCREEN 1,0
170 GOSUB 360
180 FOR I=1 TO N
190 V(I,1)=V(I,1)-.5*A(I,1)*DT
200 V(I,2)=V(I,2)-.5*A(I,2)*DT
210 NEXT I
220 FOR I=1 TO N
230 CX=.5*A(I,1)*DT
240 CY=.5*A(I,2)*DT
250 VX=V(I,1)+CX
260 VY=V(I,2)+CY
270 S(I,1)=(CX+VX)*DT+S(I,1)
280 S(I,2)=(CY+VY)*DT+S(I,2)
290 V(I,1)=VX+CX
300 V(I,2)=VY+CY
310 NEXT I
320 TIME=TIME+DT
330 GOSUB 520
340 GOSUB 360
350 GOTO 220
360 FOR I=1 TO N
370 A(I,1)=0
380 A(I,2)=0
390 NEXT I
400 FOR I=1 TO N-1
410 FOR J=I+1 TO N
420 RD=((S(I,1)-S(J,1))^2+(S(I,2)-S(J,2))^2)^1.5
430 A1=G*M(J)*(S(J,1)-S(I,1))/RD
440 A2=G*M(J)*(S(J,2)-S(I,2))/RD
450 A(I,1)=A(I,1)+A1
460 A(I,2)=A(I,2)+A2
470 A(J,1)=A(J,1)-A1*M(I)/M(J)
480 A(J,2)=A(J,2)-A2*M(I)/M(J)
490 NEXT J
500 NEXT I
510 RETURN
520 FOR I=1 TO N
530 IF ABS(S(I,1))>SX THEN 600
540 IF ABS(S(I,2))>SY THEN 600
550 P=127+127*S(I,1)/SX
560 Q=96+96*S(I,2)/SY
570 PSET (P,Q,2)
580 PSET (LP(I),LQ(I),1)
590 LP(I)=P:LQ(I)=Q
600 NEXT I
610 RETURN
```

Program Listing



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The reviews are saying what the fans have known all along: "The Eliminator" and "Armored Patrol" are nothing short of fantastic. Read for yourself.

Byte Magazine (on Armored Patrol): "A real super job with the graphics."

Byte Magazine (on The Eliminator): "The best thing to happen to the TRS-80 in a long time."

80 Microcomputing (on both): "This is state-of-the-art stuff."

80 U.S. (on The Eliminator): "The graphics are vastly superior to that of any game currently available . . . it is slick, professional, and, without qualification, a blast."

And now, **two** new releases — and both are incredible arcade-style games. The TRS-80 is almost transformed into an arcade machine, performing Arcade Action Graphics(tm) like never before. Rear Guard and Sea Dragon are great fun and will provide you with hours of enjoyment. Both programs are available now, and all four are compatible with the Alpha Joystick!

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Armored Patrol Features: Simulated 3-D perspective, multiple player option, real time, sound and Arcade Action Graphics(tm) second to none.

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Sea Dragon Features: Arcade Action Graphics(tm) and sound, 29 (!!!) screens of horizontally scrolling seascape, advancing skill levels and two player option. Early reviews are outstanding!

REAR GUARD: Waves of Cyborg ships are attempting to attack your fleet's crew pods. If they penetrate your defenses, they'll kamikaze your fleet. The enemy is relentless, your crew pods weaponless, your firepower endless. Are you made of the right stuff to successfully defend your fleet?! FIND OUT NOW!
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ics. Use a number a little larger than the biggest position coordinate input. When objects go off the screen, they are still calculated. The vertical axis is scaled to 85 percent of horizontal in line 140. This makes circles look round on my display. You may need to use a different scaling factor on yours.

The last thing you must input is the time step. Remember, it has to be small enough that not much motion occurs in a single time step. If you make it too small, the program appears to run very slowly. Make it too big and the results are not realistic. The best thing to do is to try a time step and then run it again with a new time step half the old one. If the two runs generate nearly identical trajectories, then the time step is okay. If the two runs look different, then try a still smaller time step.

The subroutine at line 360 calculates the accelerations. The variable RD, which is the cube of the separation r, can generate overflow errors for sufficiently large separations.

The For...Next loop at lines 180–210 is executed only once and generates velocities half a time step back from the input data.

Lines 220–310 do the updating of velocites and positions. The elapsed time is also updated, but in this program, it is never used. It is there (line 320) if you want it.

In the plotting subroutine, the current position (P,Q) is plotted to the background color, so the current position can be seen in a closed orbit. Then, the last point (LP, LQ) is replotted in the foreground color.

Let's run some orbits. All the examples here use mks unis, so line 40 should have G = 6.67E-11.

The first example is three suns orbiting a planet in the center with another planet outside. The input data is shown in Table 3. The planet in the center is an example of unstable equilibrium. The sum of forces on the center planet adds to zero as long as it remains exactly in the center. But let it get even slightly off center and it is pulled farther outward.

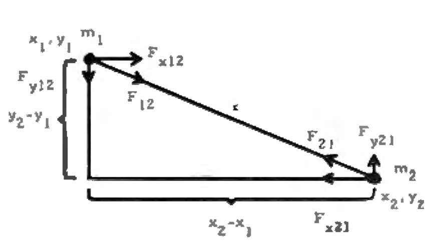

Fig. 1. Components of Separation and Force for Two Objects Under Mutual Gravitational Attraction

This happens when planet 2 wanders in and perturbs its position.

For example 2, assume that two planets orbit each other while going around their sun. The planets execute two or three orbits about each other per year.

The last example is the Venus fly-by. This is an example of an Earth-launched probe making a near encounter with the planet Venus about four months later.

Try some examples of your own. Let your imagination take rein. Remember, the sky's the limit. ■

John Fowler is proprietor of JDF Software. He can be reached at 946 Capulin, Los Alamos, NM 87544.

Object	Mass		Distance from Sun		Average Orbital Velocity	
	Kilograms	Earth Mass	Meters	Astronomical Units	Meters/ Seconds	AU/Temp
Sun	1.97 E30	329390				
Mercury	3.29 E23	.055	5.8E10	.387	47,870	1.608
Venus	4.83 E24	.807	1.08E11	.723	35,020	1.176
Earth	5.98 E24	1.00	1.496E1	1.00	29,770	1
Mars	6.40 E23	.107	2.28E11	1.524	24,130	.8105
Jupiter	1.88 E27	314	7.78E11	5.203	13,060	.4387
Saturn	5.63 E26	94.1	1.43E12	9.539	9,650	.3242
Uranus	8.61 E25	14.4	2.87E12	19.182	6,800	.2284
Neptune	9.99 E25	16.7	4.50E12	30.058	5,430	.1824
Pluto	6 E23	.1	5.9E12	39.5	4,800	.1612
Moon	7.36 E22	.0123	3.84E8*	2.57 E-3*	1,023	.03436

*From Earth

Table 2. Data for our Solar System in mks and AU-EM-Te Units

Example 1	Example 2	Example 3
Objects = 5	Objects = 3	Objects = 4
M1 = 2E30	M1 = 2E30	M1 = 2E30
X1, Y1 = 2E11, 0	X1, Y1 = 0, 0	X1, Y1 = 0, 0
VX1, VY1 = 0, 20000	VX1, VY1 = 0, 0	VX1, VY1 = 0, 0
M2 = 2E30	M2 = 2E27	M2 = 4.83E24
X2, Y2 = −1E11, 1.732E11	X2, Y2 = 1.5E11, 0	X2, Y2 = 9.553E10, −5.08E10
VX2, VY1 = −17320, −10000	VX2, VY2 = 0, 27500	VX2, VY2 = 16440, 30920
M3 = 2E30	M3 = 2E27	M3 = 5.98E24
X3, Y3 = −1E11, −1.732E11	X3, Y3 = 1.6E11, 0	X3, Y3 = 1.496E11, 0
VX3, VY3 = 17320, −10000	VX3, VY3 = 0, 32500	VX3, VY3 = 0, 29770
M4 = 1E27	Scale Factor = 2.2E11	M4 = 1000
X4, Y4 = 0, 0	Time Step = 1E5	X4, Y4 = 1.49E11, 1E10
VX4, VY4 = 0, 0		VX4, VY4 = −5000, 27200
M5 = 1E27		Scale Factor = 2.2E11
X5, Y5 = 0, 5E11		Time Step = 2E5
VX5, VY5 = 15000, 0		
Scale Factor = 7E11		
Time Step = 2E6		

Table 3. Input Data for Three Examples (See Text)

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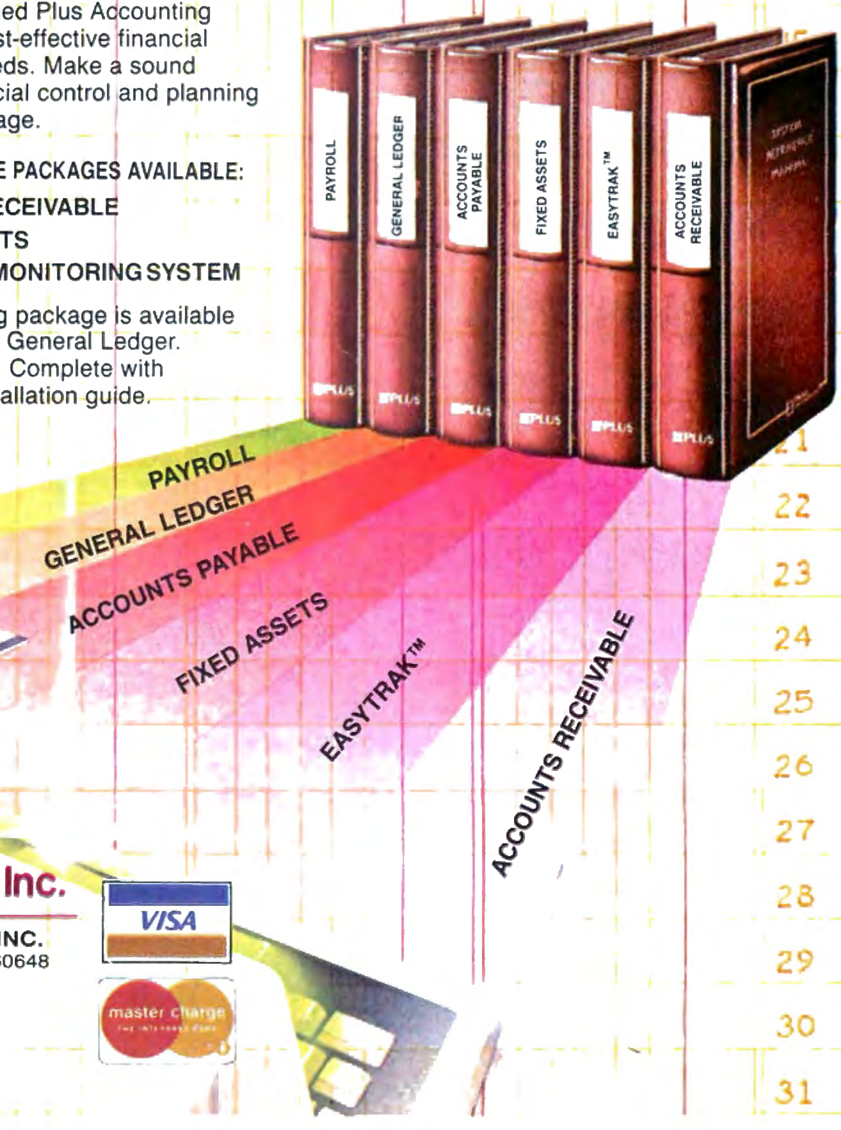

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Microsoft Basic is a versatile and powerful language, but it executes s-l-o-w-l-y. When you want speed, there is no substitute for Assembly language.

Since I wanted to program my computer at the Assembly language level, I wrote a Basic 6809 assembler. I added an editing program, refined the assembler, and began writing test programs. Program Listing 1 shows my editor/assembler program for the Color Computer.

Using the Editor

To enter the editor, type GOTO. The message Cold/Warm Start? will be displayed. To begin with the text buffer empty and all pointers reset, type C; to reenter with text and pointers as you left them when you last exited, type W. Either command puts you in the command mode, signified by the period prompt.

Editor commands include:

- Rdn file name—Reads lines of text from a device (dn) and appends them onto the program in memory. Dn may be zero (keyboard) or minus one (cassette). With cassette, you may specify a file name after the device number (leave a space between them).
- Ldn file name—Lists the program in memory to device dn with an optional file name. Device numbers zero and minus one are the same as in the R command, and minus two will list to a printer.
- N—Clears text buffer.
- P—Lists the program to the screen with reference line numbers. These line numbers are not used as labels by the assembler.
- C—Enters the change mode. Respond to the prompts with the reference number of the line you wish to change, or press enter to return to the command mode. The program will display the line and allow you to enter a new one.
- I—Asks for the number of lines to be inserted and the position to insert them, then allows you to type the lines.
- D—Asks for number of lines to be deleted and the position to begin deleting, then deletes these lines.
- Exit—Returns to Basic command mode. Reenter the editor with GOTO.

Use these commands to enter Program Listing 2. When you are sure there are no errors, type TA. This is the trial assembly command, and it assembles the program without putting the code into memory. Respond to the Device? prompt with zero for screen or minus two for printer. Sit back: The assembly will take several minutes.

First you will see the symbol table and then the object code. Note that each source-code line is listed next to the object code it produces. Check the object code against Program Listing 3—it should be the same. If not, recheck your work.

When the assembler works properly, enter Program Listing 4. This time you want the object code placed in memory, so type A* to assemble the program. When assembly is complete, type Go. The computer will ask for an address at which to begin execution. You may use a hexadecimal address prefixed by a $, a decimal address, or any label from the most recent assembly. In this case, type 1536, $600 or Start. The screen should fill with dollar signs. For comparison, Program Listing 5 will do the same thing in Basic, but much more slowly.

Limitations

My assembler is not perfect. First, it assembles very slowly; a commercial assembler could probably assemble all of Program Listing 4 in the time it takes mine to assemble one line.

Although the assembler supports the entire 6809 instruction set and all addressing modes, the indexed modes requiring a constant offset are identical in syntax regardless of the size of the offset; therefore, my assem-

The Key Box

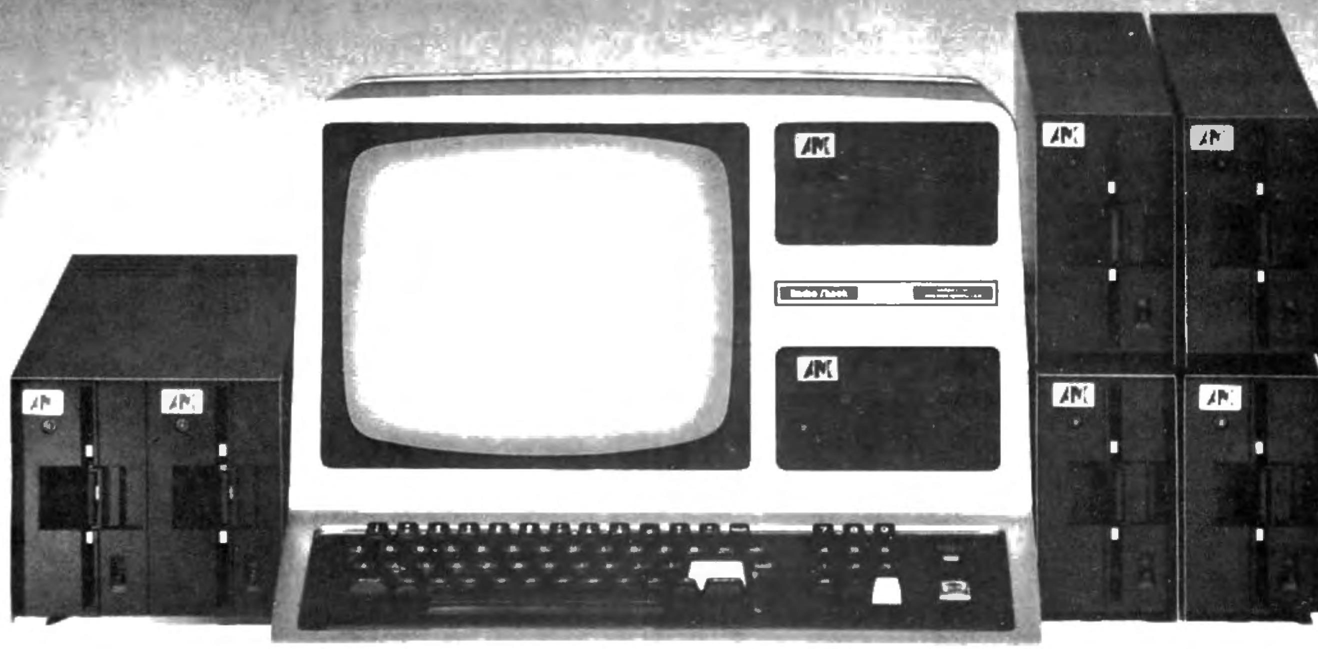
Color Computer
16K RAM
Extended Color Basic
Printer Optional

Program Listing 1

```
0 PRINT"Cold/Warm START?"
10 IW$=INKEY$:IFIW$=""THEN10ELSEIFIW$="C"THEN RUN20ELSEIFIW$="W"
THEN50ELSE0
20 CLS:CLEAR10000:DIML$(1000):DEFFNH(X)=INT(X/256):DEFFNL(X)=X-F
NH(X)*256
30 PRINT"TEXT EDITOR","VERSION 2"
40 R$(0)="CC":R$(1)="A":R$(2)="B":R$(3)="DP":R$(4)="X":R$(5)="Y"
:R$(7)="PC":RN$="XYUS"
50 LINEINPUT".";C$:IFC$=""THEN50
60 C1$=LEFT$(C$,1):IFC1$="R"THEN90 ELSEIFC1$="L"THEN130 ELSEIFC1
$="N"THENP9=0:L$(0)="":GOTO50 ELSEIFC1$="P"THEN140 ELSEIFC1$="C"
THEN 150 ELSEIFC1$="I"THEN160 ELSEIFC1$="D"THEN190 ELSEIFC$="A*"
THENTA=0:GOTO220 ELSEIFC$="TA"THENTA=1:GOTO220
70 IFC$="GO"THENINPUT"ADDR.";L4$:L4$=L4$+",":GOSUB1000:EXECT:GOT
O50 ELSEIFC$="EXIT"THENEND
80 PRINT"?"C$"?":GOTO50
90 DV=VAL(MID$(C$,2)):OPEN"I",DV,MID$(C$,5):ON ABS(DV)+1 GOTO100
,110
100 LINEINPUT">";L$(P9):IFL$(P9)<>"_"THENP9=P9+1:GOTO100ELSEL$(P
9)="":GOTO50
110 LINEINPUT#-1,L$(P9):P9=P9+1:L$(P9)="":IFNOT EOF(-1)THENGOTO1
10
120 CLOSE:GOTO50
130 DV=VAL(MID$(C$,2)):OPEN"O",DV,MID$(C$,5):FORX=0TOP9-1:PRINT#
DV,L$(X):NEXTX:CLOSE:GOTO50
140 FORX=0TOP9-1:PRINTUSING"#### ";X;:PRINTL$(X):NEXTX:GOTO50
150 INPUT"LINE #";CL$:IFCL$=""THEN50ELSEPRINT" "L$(VAL(CL$)):LIN
EINPUT">";L$(VAL(CL$)):GOTO150
160 INPUT"POSITION,NO. OF LINES";IP,IN
170 FORX=P9+IN TOIP+IN STEP-1:L$(X)=L$(X-IN):NEXTX:FORX=IP TOIP+
IN-1:LINEINPUT">";L$(X):NEXTX:P9=P9+IN
180 GOTO50
190 INPUT"POSITION,NO. OF LINES";DP,DN
200 FORX=DP TOP9-DN:L$(X)=L$(X+DN):NEXTX:P9=P9-DN
210 GOTO50
220 INPUT"DEVICE";DV:LN=0
230 PRINT#DV,"ASSEMBLER/6809","VERSION 1"
240 PC=0:PS=1:PRINT#DV,"SYMBOL TABLE":FORLP=0TOP9-1:L$=L$(LP):GO
SUB260:NEXTLP
250 PRINT#DV,CHR$(13)"OBJECT CODE":PC=0:PS=2:FORLP=0TOP9-1:LZ$="
":PRINT#DV,HEX$(PC)":";:L$=L$(LP):GOSUB260:PRINT#DV,LZ$,L$:NEXTL
P:PRINT#DV,CHR$(13):GOTO50
260 'ASSEMBLE L$
270 IFLEFT$(L$,1)="*"THENRETURN
280 LF=0:F4=0
290 L1$=LEFT$(L$,7)+" ":L2$=MID$(L$,8,5)+" ":L3$=MID$(L$,13,1):L
4$=MID$(L$,13)+" "
300 L1$=LEFT$(L1$,INSTR(L1$," ")-1):L2$=LEFT$(L2$,INSTR(L2$," ")
-1):L4$=LEFT$(L4$,INSTR(L4$," ")-1)
310 IFPS=1THENIFL1$<>""THENLB$(LN)=L1$:LB(LN)=PC:PRINT#DV,L1$"="
HEX$(PC):LN=LN+1
320 RESTORE
330 READMN$,M$(1),O1,M$(2),M$(3),M$(4):IFMN$="\"THENL4$=L4$+",":
GOTO640
340 IFMN$<>L2$THEN330
350 AM=0:BT=0:F8=0:F4=0:LF=0
360 IFL3$="#"THENAM=1ELSEIFL3$="<"THENAM=2ELSEIFL3$="("AND(INSTR
(L4$,",")=0)THENAM=5:L4$=LEFT$(L4$,LEN(L4$)-1):M$(5)=M$(3)
370 IFAM THENL4$=MID$(L4$,2)ELSEIFINSTR(L4$,",")THENAM=3 ELSEAM=
4
380 IFM$(AM)=""THENER=1:GOTO1150 ELSEWD=VAL("&H"+M$(AM)):GOSUB11
40
390 L4$=L4$+",":IFAM=3THEN460
400 GOSUB1010:BT=T:WD=T:ON AM GOTO430,1070,1150,1100,440
410 ER=2:GOTO1150
420 'IMMEDIATE MODE
430 IFO1=1THEN1070ELSEIFO1=2THEN1100ELSEER=0:GOTO1150
440 BT=&H9F:GOSUB1060:GOTO1100
450 'INDEXED MODE
460 IFL3$="("THENL4$=MID$(L4$,2,LEN(L4$)-3)+",":F4=16
470 GOSUB980:IFT$<>""THEN540
480 GOSUB980:T1$=LEFT$(T$,1):IFLEN(T$)<>1THEN510
490 'NO OFFSET
500 BT=&H84:GOTO590
510 IFLEFT$(T$,2)="--"THENBT=&H83:T1$=MID$(T$,3):GOTO590 ELSEIFT
1$="-"THENBT=&H82:T1$=MID$(T$,2):GOTO590
520 T2$=MID$(T$,2):IFT2$="+"THENBT=&H80:GOTO590 ELSEIFT2$="++"TH
ENBT=&H81:GOTO590
530 'A/B/D OFFSET
540 IFT$="A"THENBT=&H86:GOTO550 ELSEIFT$="B"THENBT=&H85:GOTO550
ELSEIFT$="D"THENBT=&H8B:GOTO550 ELSE560
550 GOSUB980:T1$=T$:GOTO590
560 T4$=T$:GOSUB980:IFT$="PCR"THENBT=&H8D OR F4:GOSUB1060:F8=1:G
OTO600
570 BT=&H89:F8=1:T1$=T$
580 'SET UP POSTBYTE
590 GOSUB620:BT=(BT OR T1*32)ORF4:GOSUB1070
```

Listing 1 Continues

BORN TO RUN



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Listing 1 continued

```
600 IFF8 THENT$=T4$:GOSUB1020:WD=T:GOTO1100 ELSERETURN
610 'GET REGISTER CODE
620 T1=INSTR(RN$,T1$):IFT1=0THENER=4:GOTO1150ELSET1=T1-1:RETURN
630 'INHERENT MODE
640 READMN$,M$:IFMN$="\"THEN670ELSEIFMN$=L2$THEN650ELSE640
650 WD=VAL("&H"+M$):GOTO1140
660 'RELATIVE BRANCHES
670 READMN$,M$:IFMN$="\"THEN780ELSEIFMN$=L2$ORMN$=MID$(L2$,2)THE
N680ELSE670
680 IFL2$="LBRA"THENM$="16":LF=1:GOTO700 ELSEIFL2$="LBSR"THENM$=
"17":LF=1:GOTO700
690 IFLEFT$(L2$,1)="L"THENL2$=MID$(L2$,2):LF=1:BT=&H10:GOSUB1060
700 BT=VAL("&H"+M$):GOSUB1070
710 GOSUB1010
720 BT=T-(PC+1+LF):IFLF=0THEN750
730 IFBT<0THENWD=65536+BT ELSEWD=BT
740 GOSUB1090:RETURN
750 IFBT<0THENBT=BT+256
760 GOSUB1070:RETURN
770 'SPECIAL INSTRUCTIONS
780 READMN$,M$:IFMN$="\"THEN910ELSEIFMN$=L2$THEN790ELSE780
790 BT=VAL("&H"+M$):GOSUB1060
800 IFL2$<>"EXG"ANDMN$<>"TFR"THEN850
810 BT=0:GOSUB820:BT=R*16:GOSUB820:BT=BT OR R:GOTO1060
820 GOSUB970
830 IFT$="D"THENR=0 ELSEIFT$="X"THENR=1 ELSEIFT$="Y"THENR=2 ELSE
IFT$="U"THENR=3 ELSEIFT$="S"THENR=4 ELSEIFT$="PC"THENR=5 ELSEIFT
$="A"THENR=8 ELSEIFT$="B"THENR=9 ELSEIFT$="CC"THENR=10 ELSEIFT$=
"DP"THENR=11
840 RETURN
850 BT=0:IFMID$(L2$,4,1)="U"THENR$(6)="S"ELSER$(6)="U"
860 GOSUB970:IFT$=""THEN900
870 FORX=0TO7:IFT$=R$(X)THENBT=BT OR 2^X
880 NEXTX
890 GOTO860
900 GOSUB1060:RETURN
910 DR=0'DIRECTIVES
920 READMN$:DR=DR+1:IFMN$="\"THENER=3:GOTO1150ELSEIFMN$=L2$THEN9
30ELSE920
930 GOSUB1010:ON DR GOTO 940,950,960
940 PC=T:RETURN
950 BT=T:GOSUB1060:GOSUB980:IFT$=""THENRETURN ELSEGOSUB1020:GOTO
950
960 PC=PC+T:RETURN
970 'GET T$
980 T$=""
990 I9=INSTR(L4$,","):IFI9=0THENRETURN ELSET$=LEFT$(L4$,I9-1):L4
$=MID$(L4$,I9+1):RETURN
1000 'GET OPERAND VALUE
1010 GOSUB980
1020 II$=LEFT$(T$,1):IFII$="$"THENT$="&H"+MID$(T$,2):GOTO1040
1030 IFII$<"/"ORII$>":"THEN1050
1040 T=VAL(T$):RETURN
1050 FORX=0TOLN:IFT$=LB$(X)THENT=LB(X):RETURN ELSENEXTX:ER=2:GOT
O1150
1060 'SEND BYTE
1070 IFPS=1THEN1080 ELSELZ$=LZ$+STRING$(2-LEN(HEX$(BT)),"0")+HEX
$(BT):IFTA=0THENPOKEPC,BT
1080 PC=PC+1:RETURN
1090 'SEND WORD
1100 BT=FNH(WD):GOSUB1070
1110 BT=FNL(WD):GOSUB1070
1120 RETURN
1130 'SEND WORD OR BYTE
1140 IFWD<256THENBT=WD:GOTO1070 ELSE1100
1150 IFPS=1THENRETURN ELSEPRINT:ON ER GOTO1170,1180,1190
1160 PRINT"UNDEFINED ERROR";:GOTO1210
1170 PRINT"BAD ADDR. MODE";:GOTO1210
1180 PRINT"UNDEFINED LABEL";:GOTO1210
1190 PRINT"BAD MNEMONIC";:GOTO1210
1200 PRINT"BAD REGISTER";:GOTO1210
1210 PRINT" IN LINE"LP:RETURN
1220 DATA ADCA,89,1,99,A9,B9,ADCB,C9,1,D9,E9,F9
1230 DATAADDA,8B,1.9B,AB,BB,ADDB,CB,1,DB,EB,FB,ADDD,C3,2,D3,E3,F
3
1240 DATA ANDA,84,1,94,A4,B4,ANDB,C4,1,D4,E4,F4,ANDC,1C,1,,,""
1250 DATA ASL,,,08,68,78,ASR,,,07,67,77
1260 DATA BITA.85,1,95,A5,B5,BITB,C5,1,D5,E5,F5
1270 DATA CLR,,,0F,6F,7F
1280 DATACMPA,81,1,91,A1,B1,CMPB,C1,1,D1,E1,F1,CMPD,1083,2,1093,
10A3,10B3,CMPS,118C,2,119C,11AC,11BC,CMPU,1183,2,1193,11A3,11B3,
CMPX,8C,2,9C,AC,BC,CMPY,108C,2,109C,10AC,10BC
1290 DATA COM,,,03.63,73,DEC,,,0A,6A,7A,INC,,,0C,6C,7C,JMP,,,0E,
6E,7E,JSR,,,9D,AD,BD
1300 DATA LDA,86,1,96,A6,B6,LDB,C6,1,D6,E6,F6,LDD,CC,2,DC,EC,FC,
LDS.10CE,2,10DE,10EE,10FE,LDS,10CE,2,10DE,10EE,10FE,LDU,CE,2,DE,
EE,FE,LDX,8E,2,9E,AE,BE,LDY,108E,2,109E,10AE,10BE
1310 DATA LEAS,,,,32,,LE@U,,,,33,,LEAX,,,,30,,LEAY,,,,31,""
1320 DATA LSL,,,08,68,78,LSR,,,04,64,74,NEG,,,00,60,70,ORA,8A,1,
9A,AA,BA,ORB,CA,1,DA,EA,FE,ORCC,1A,1,,,,ROL,,,09,69,79,ROR,,,06,
66,76
1330 DATA STA,,,97,A7,B7,STB,,,D7,E7,F7,STD,,,DD,ED,FD,STS,,,10D
F,10EF,10FF,STU,,,DF,EF,FF,STX,,,9F,AF,BF,STY,,,109F,10AF,10BF
1340 DATA SUBA,80,1.90,A0,B0,SUBB,C0,1,D0,E0,F0,SUBD,83,2,93,A3,
B3,TST,,,0D,6D,7D
1350 DATA\,,,,,""
1360 DATAASLA,48,ASLB,58,ASRA,47,ASRB,57,CLRA,4F,CLRB,5F,COMA,43
,COMB,53,DAA,19,DECA,4A,DECB,5A,INCA,4C,INCB,5C,LSLA,48,LSLB,58,
LSRA,44,LSRB,54,MUL,3D,NEGA,40.NEGB,50,NOP,12,ROLA,49,ROLB,59,RO
RA,46,RORB,56,RTI,3B,RTS,39,SEX,1D,SWI,3F,SWI2,103F,SWI3,113F
1370 DATA SYNC,13,TSTA,4D,TSTB,5D,"\",""
1380 DATA BCC,24,BCS,25,BEQ,27,BGE,2C,BGT,2E,BHI,22,BHS,24,BLE,2
F,BLO,25,BLS.23,BLT,2D,BMI,2B,BNE,26,BPL,2A,BRA,20,BRN,21,BSR,8D
,BVC,28,BVS,29
1390 DATA\,""
1400 DATA EXG,1E,TFR,1F,PSHS,34,PSHU,36,PULS,35,PULU,37
1410 DATA \,""
1420 DATAORG,FCB,RMB
1430 DATA"\"
```

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> *"A commercial assembler could probably assemble all of Program Listing 4 in the time it takes mine to assemble one line."*

```
* TEST IMM. ADDR.
        LDA   #$02
* TEST EXT. ADDR.
        LDB   $5768
        LDD   <$29
* TEST INDXD. ADDR.
        LDD   ,X
        LDA   $500,Y
        LDB   A,Y
        LDY   ,X+
        STD   ,--Y
        STA   $300,PCR
        STB   (,X++)
* TEST EXT. INDIR ADDR.
        JSR   ($A002)
* TEST REG. ADDR.
        TFR   X,Y
        PSHS  A,B,PC
* LABEL
L1      JMP   L1
        BEQ   L1
        LBEQ  L1
```

Program Listing 2

bler always uses a 16-bit offset. The code it produces may be slightly different from that produced by other assemblers, but it will still function properly.

In the constant-offset-from-PC mode, you will have to calculate the offset. Relative branch offsets are calculated by the assembler.

There are only three directives: ORG, FCB and RMB. You may define as many bytes as you wish with one FCB as long as you separate them with commas. There is no EQU, but it can be easily simulated with an ORG and an RMB.

You can see the advantages of a commercial assembler. If you do a lot of Assembly-language programming, you will probably need one. There are ways to get around problems, however, especially when you are typing in a program from a magazine. If the code produced by my assembler does not

```
ASSEMBLER/6809  VERSION 1
SYMBOL TABLE
ASSEMBLER/6809  VERSION 1
SYMBOL TABLE
L1=22

OBJECT CODE
0:                * TEST IMM. ADDR.
0:8602                    LDA   #$02
2:                * TEST EXT. ADDR.
2:F65768                  LDB   $5768
5:DC29                    LDD   <$29
7:                * TEST INDXD. ADDR.
7:EC84                    LDD   ,X
9:A6A90500                LDA   $500,Y
D:E6A6                    LDB   A,Y
F:10AE80                  LDY   ,X+
12:EDA3                   STD   ,--Y
14:A78D0300               STA   $300,PCR
18:E791                   STB   (,X++)
1A:               * TEST EXT. INDIR ADDR.
1A:AD9FA002               JSR   ($A002)
1E:               * TEST REG. ADDR.
1E:1F12                   TFR   X,Y
20:3486                   PSHS  A,B,PC
22:               * LABEL
22:7E0022         L1      JMP   L1
25:27FB                   BEQ   L1
27:1027FFF7               LBEQ  L1
```

Program Listing 3

```
ASSEMBLER/6809  VERSION 1
SYMBOL TABLE
L1=22
START=600
LOOP=605

OBJECT CODE
0:              * TEST IMM. ADDR.
0:8602            LDA   #$02
2:              * TEST EXT. ADDR.
2:F65768          LDB   $5768
5:DC29            LDD   <$29
7:              * TEST INDXD. ADDR.
7:EC84            LDD   ,X
9:A6A90500        LDA   $500,Y
D:E6A6            LDB   A,Y
F:10AE80          LDY   ,X+
12:EDA3           STD   ,--Y
14:A78D0300       STA   $300,PCR
18:E791           STB   (,X++)
1A:             * TEST EXT. INDIR ADDR.
1A:AD9FA002       JSR   ($A002)
1E:             * TEST REG. ADDR.
1E:1F12           TFR   X,Y
20:3486           PSHS  A,B,PC
22:             * LABEL
22:7E0022       L1     JMP   L1
25:27FB                BEQ   L1
27:1027FFF7            LBEQ  L1
2B:             * FILL SCRN. WITH "$"
2B:                    ORG   $600
600:8E0400      START  LDX   #$400
603:8664               LDA   #100
605:A780        LOOP   STA   ,X+
607:8C0600             CMPX  #$600
60A:26F9               BNE   LOOP
60C:39                 RTS
```

Program Listing 4

"According to Motorola, there are 1,464 instruction/addressing mode combinations for the 6809 microprocessor."

match that printed in the article (Assembly-language programs are almost always printed as the object code), just change the line to an FCB and specify the exact bytes. Most fancy directives can be simulated using the ones I have supplied.

This program was developed on a 32K computer. If you have 16K, change the Clear and Dimension statements in line 10 to fit your system.

If you have a disk, you should be able to save and load source code from it using R and L with device one (leave two spaces between the one and the file name).

To save object code in memory to cassette or disk, exit the assembler and use CSAVEM or SAVEM. Alternatively, you may convert the code into data statements as described in my article Datagen (*80 Micro*, June/July 1982).

One word of caution: According to Motorola, there are 1,464 instruction/addressing mode combinations for the 6809 microprocessor. I haven't tested all 1,464 combinations! If you run into difficulty, please contact me.■

John Heusinkveld is a high school sophomore.

```
10 FORX=1024TO1535
20 POKEX,100
30 NEXTX
```

Program Listing 5

LOAD 80

Relativity and the TRS-80

by Sidney Levin

Albert Einstein's hundredth birthday in 1979 was duly celebrated by many events, including excellent television presentations and a fascinating exhibit at the Smithsonian Museum in Washington.

To appreciate this unique and venerated giant you need some understanding of the Special Theory of Relativity, the cardinal production of the Miracle Year (1905). This brilliant intuitive explosion began a new conceptualization of nature, particularly with respect to light, time, and space. Moreover, as our instrumental technology evolves into the nuclear and space age, scientists continue to validate relativity concepts with each new experiment.

The germinal ideas of relativity seem so contrary to common sense that one can waste time trying to retrace Einstein's thought experiments in an effort to grasp such astonishing features as the unchanging constancy of the velocity of light, and the amazing time-dilation, mass-increase, and length-contraction transformations that occur in a frame of reference moving at velocities approaching the speed of light.

Let your micro strip the veils from relativity theory and ignite your own intuitive fires.

The Program Listing can stimulate thinking about these concepts. The animated graphics utilize a stationary and moving photon clock in which a to-and-fro movement of the photon (tick-tock) is a unit of time measurement (a design of physicist R.P. Feynman).

Using simple geometry with the Pythagorean Theorem, the relativistic constant, $A = SQR(1 - V^2/C^2)$, is derived. The computer then calculates changing mass, length, and time for

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Level II

Program Listing

```
1 CLS:PRINT:PRINT:PRINT"     ** ALBERT EINSTEIN---SPECIAL THEORY
 OF RELATIVITY **"
2 PRINT"            PROGRAM BY SIDNEY LEVIN,DEC.1979":PRINT
3 PRINT"    THE FIRST PART OF THIS PROGRAM DERIVES THE RELATIVIS
TIC
EQUATION MUCH AS EINSTEIN DID IN 1905,BUT EMPLOYS AS A MODEL THE
CONCEPT OF A MOVING CLOCK WHICH EMITS LIGHT PARTICLES(PHOTONS)
AT REGULAR INTERVALS."
4 PRINT"   (THIS IDEA IS BY THE U.S.PHYSICIST R.P.FEYNMAN)"
5 PRINT:PRINT
6 PRINT"   THE SECOND PART OF THE PROGRAM ILLUSTRATES (CALCULATE
S)
TRANSFORMATIONS OF TIME,MASS AND LENGTH WITH INCREASING VEL-
OCITIES(EINSTEIN-LORENTZ TRANSFORMATIONS)."
7 PRINT
8 INPUT"    PRESS <ENTER> TO CONTINUE:";
9 CLS:PRINT@194,"Y"
10 PRINT@201,"Y'"
11 PRINT@214,"<-------'FEYNMAN' CLOCK"
12 FOR X=0 TO 100:SET(X,20):NEXT
14 FOR Y=0 TO 20:SET(0,Y):NEXT
20 FOR X=15 TO 39
30 SET(X,5)
40 NEXT
50 FOR X=15 TO 39:SET(X,15):NEXT
60 FOR Y=14 TO 6 STEP-1
70 SET(27,Y)
75 FOR N=1 TO 50:NEXT
80 RESET(27,Y)
85 NEXT
87 PRINT@500,"'TICK'"
90 FOR Y=6 TO 14
```

Listing continues

any initial values entered. Animation repeats at appropriate stages of the unfolding program.

Line 770 sets the final velocity of the scrolling display at 185,500 miles per second and increments the initial velocity in 500-miles-per-second steps. To change these, alter the program lines. Light velocity (C) and your velocity (V) must be expressed in the same units.

The program requires about 8K of memory.

I was recently demonstrating the powers of the TRS-80 to a visiting computer science student from MIT and we ran through this program. His father informs me that when he returned to Cambridge, he buried himself in a week of reading Einstein and relativity! If you get similarly turned on, the literature is enormous, but I recommend *Einstein for Beginners* by Joseph Schwartz and Michael McGuiness, (Pantheon, New York). It inspired me to write this program!

Happy Birthday, Albert! ■

Sidney Levin, a physician, enjoys astronomy and music. He can be reached at 700 25th Avenue, San Francisco, CA 94121.

Listing continued

```
92 SET(27,Y)
94 FOR N= 1 TO 50:NEXT
96 RESET(27,Y)
98 NEXT
100 PRINT@500,"'TOCK'
116 PRINT"   THE FRAME OF REFERENCE OF THE CLOCK (Y') IS NOT MOV
ING
IN RELATION TO THE LARGE FRAME (Y).
117 PRINT"  TO OBSERVERS IN EITHER FRAME OF REFERENCE THE MOVING

PHOTON TRAVERSES THE SAME DISTANCE (Y'+Y') DURING A SINGLE
CLOCK CYCLE('TICK'-'TOCK')."
118 PRINT:INPUT"    TYPE R TO REVIEW CLOCK SEQUENCE,TYPE C TO CO
NTINUE";CH$
119 IF CH$="R" THEN GOTO60
120 CLS
122 PRINT:PRINT:PRINT"*   THE MOVING PHOTON HAS A CONSTANT VELOC
ITY,C----
(THE SPEED OF LIGHT) FOR ALL OBSERVERS AND REGARDLESS OF THE
RELATIVE VELOCITIES OF THEIR FRAMES OF REFERENCE !    *"
124 PRINT"       THIS DIFFICULT CONCEPT,WHICH EINSTEIN DERIVED F
ROM
MAXWELL'S ELECTROMAGNETIC EQUATIONS (AND WHICH IS SUGGESTED BY
THE MICHELSON-MORLEY EXPERIMENT) LIES AT THE HEART OF THE THEORY
OF SPECIAL RELATIVITY."
126 PRINT
128 PRINT"  FROM 'DISTANCE'='VELOCITY' X 'TIME' :
130 PRINT"          2Y'=(C) X (TIME INTERVAL OF CLOCK CYCLE)
132 PRINT"           2Y'=C X T
134 PRINT"             T=2Y'/C
136 PRINT
138 INPUT"    PRESS <ENTER> TO CONTINUE";
140 CLS
142 PRINT@448+14,"<---------------D--------------->"
143 PRINT@192+41,"<---L"
144 FOR Y=0 TO 20:SET(0,Y):NEXT
145 FOR X=0 TO 100:SET(X,20):NEXT
147 FOR X=15 TO 39:SET(X,5):SET(X,15):NEXT
149 SET(27,14)
```

Listing continues

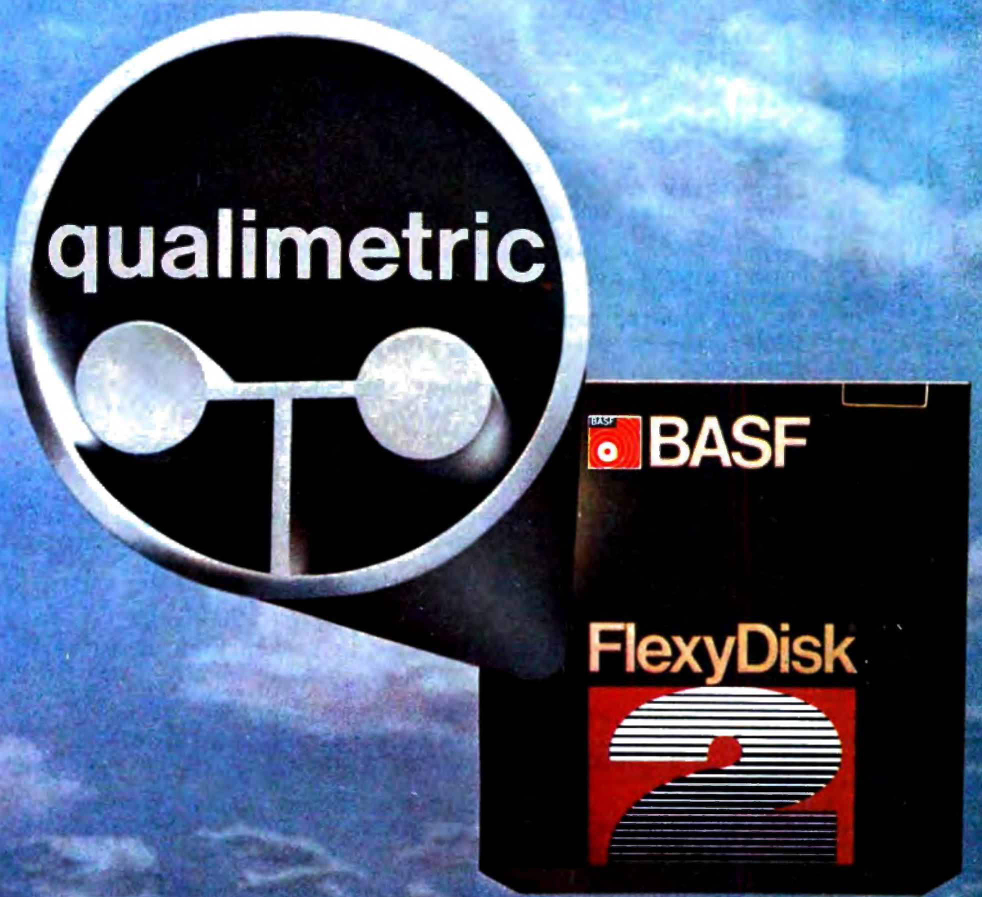
Listing continued

```
151 FORN=1 TO 50:NEXT
153 FOR X=15 TO 39:RESET(X,5):RESET(X,15):NEXT
155 FOR X=19 TO 43:SET(X,5):SET(X,15):NEXT
157 SET(31,13)
159 FORN=1 TO 50:NEXT
160 FOR X=19 TO 43:RESET(X,5):RESET(X,15):NEXT
161 FOR X=23 TO 47:SET(X,5):SET(X,15):NEXT
163 SET(35,12)
165 FORN=1 TO 50:NEXT
167 FOR X=23 TO 47:RESET(X,5):RESET(X,15):NEXT
169 FOR X=27 TO 51:SET(X,5):SET(X,15):NEXT
171 SET(39,11)
173 FORN=1 TO 50:NEXT
175 FOR X=27 TO 51:RESET(X,5):RESET(X,15):NEXT
177 FOR X=31 TO 55:SET(X,5):SET(X,15):NEXT
179 SET(43,10)
181 FOR N=1 TO 50:NEXT
183 FOR X=31 TO 55:RESET(X,5):RESET(X,15):NEXT
185 FOR X=35 TO 59:SET(X,5):SET(X,15):NEXT
187 SET(47,9)
189 FOR N=1 TO 50:NEXT
191 FOR X=35 TO 59:RESET(X,5):RESET(X,15):NEXT
193 FOR X=39 TO 63:SET(X,5):SET(X,15):NEXT
195 SET(51,8)
197 FORN=1 TO 50:NEXT
199 FOR X=39 TO 63:RESET(X,5):RESET(X,15):NEXT
201 FOR X=43 TO 67:SET(X,5):SET(X,15):NEXT
203 SET(55,7)
205 FORN=1 TO 50:NEXT
207 FOR X=43 TO 67:RESET(X,5):RESET(X,15):NEXT
209 FOR X=47 TO 71:SET(X,5):SET(X,15):NEXT
211 SET(59,6)
213 FORN=1 TO 50:NEXT
215 FOR X=47 TO 71:RESET(X,5):RESET(X,15):NEXT
217 FORX=51 TO 75:SET(X,5):SET(X,15):NEXT
219 SET(63,7)
221 FORN=1 TO 50:NEXT
223 FOR X=51 TO 75:RESET(X,5):RESET(X,15):NEXT
225 FOR X=55TO 79:SET(X,5):SET(X,15):NEXT
227 SET(67,8)
229 FORN=1 TO 50:NEXT
231 FOR X=55 TO 79:RESET(X,5):RESET(X,15):NEXT
233 FOR X=59 TO 83:SET(X,5):SET(X,15):NEXT
235 SET(71,9)
237 FORN=1 TO 50:NEXT
239 FOR X=59 TO 83:RESET(X,5):RESET(X,15):NEXT
241 FOR X=63 TO 87:SET(X,5):SET(X,15):NEXT
243 SET(75,10)
245 FORN=1 TO 50:NEXT
247 FOR X=63 TO 87:RESET(X,5):RESET(X,15):NEXT
249 FOR X=67 TO 91:SET(X,5):SET(X,15):NEXT
251 SET(79,11)
253 FORN=1TO50:NEXT
255 FOR X=67 TO 91:RESET(X,5):RESET(X,15):NEXT
257 FOR X=71 TO 95:SET(X,5):SET(X,15):NEXT
259 SET(83,12)
261 FORN=1TO50:NEXT
263 FOR X=71 TO 95:RESET(X,5):RESET(X,15):NEXT
265 FOR X=75 TO 99:SET(X,5):SET(X,15):NEXT
267 SET(87,13)
269 FORN=1TO50:NEXT
271 FORX=75 TO 99:RESET(X,5):RESET(X,15):NEXT
273 FOR X=79 TO 103:SET(X,5):SET(X,15):NEXT
275 SET(91,14)
277 FORN=1 TO 50:NEXT
281 PRINT@512,"

   TO THE OBSERVER IN THE MOVING(CLOCK)FRAME OF REFERENCE THE
PHOTON DISTANCE REMAINS Y' AS BEFORE.(HE HAS NO WAY TO DETERMINE
 WHETHER HE IS STANDING STILL OR MOVING WITH UNIFORM VELOCITY).
283 PRINT"    TO THE OBSERVER IN THE LARGE(Y)FRAME,THE PHOTON DI
S-
TANCE IS TWICE THE DIAGONAL L(=2L) DURING THE SINGLE CLOCK
CYCLE!!"
285 INPUT"   TYPE R TO REVIEW,C TO CONTINUE";CH$
287 IF CH$="R" THEN GOTO 140
289 CLS
291 PRINT:PRINT:PRINT"   THUS,FOR THE STATIONARY OBSERVER,THE TI
ME INTERVAL
OF THE MOVING CLOCK MAY BE WRITTEN:"
293 PRINT"        T(2)=2L/C
294 PRINT:PRINT"DURING THIS TIME T(2),THE MOVING FRAME HAS TRAVE
LED A
DISTANCE:"
```

Listing continues

BASF QUALIMETRIC™
A TOTALLY NEW DIMENSION OF QUALITY.



From BASF comes a totally new level of excellence in magnetic media – the Qualimetric standard, a standard so advanced that BASF FlexyDisks® are confidently backed by the industry's only lifetime warranty. The Qualimetric standard is maintained without compromise through every step of BASF design, production, inspection, and testing...reflecting an unwavering BASF commitment to media fidelity and durability.

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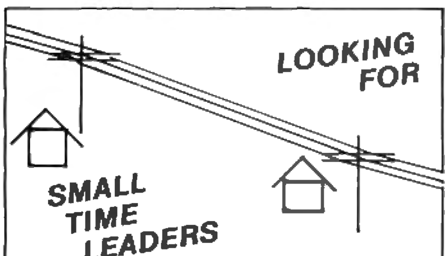
**Contact BASF for warranty details.*

334

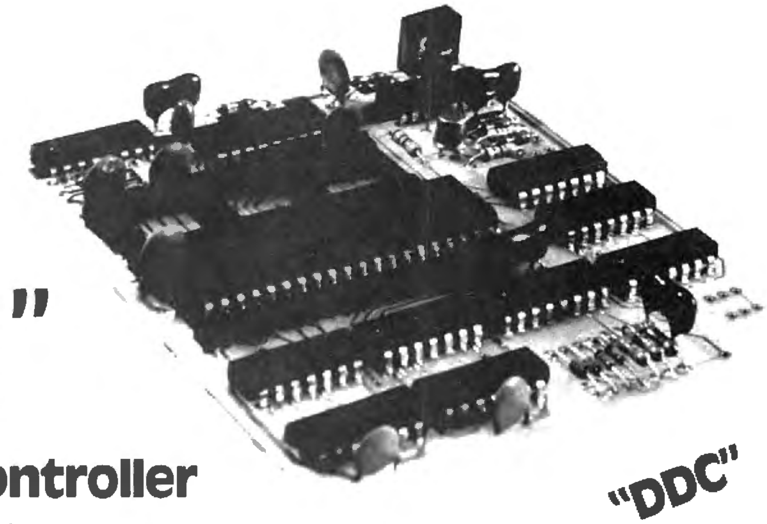


Listing continued

```
295 PRINT"              D=V X T(2)
297 PRINT"  (WHERE V=THE VELOCITY OF THE MOVING FRAME WITH RESPE
CT TO THE STATIONARY FRAME)."
299 PRINT" WE NOW HAVE THE ELEMENTS TO DERIVE THE RELATIVISTIC
EQUATION( OR CONSTANT)!!!!"
300 PRINT:PRINT:INPUT"    PRESS<ENTER>TO CONTINUE:";
310 CLS
312 PRINT" FROM THE PYTHAGOREAN THEOREM:"
314 PRINT"(1)      L[2=(D/2)[2+Y'[2"
315 PRINT" PREVIOUSLY DERIVED EXPRESSIONS:"
316 PRINT"(2)      T(2)=2L/C              OR    L=C X T(2)/2"
318 PRINT"(3)      D=V X T(2)             OR    D/2=VT(2)/2
320 PRINT"(4)      T=2Y'/C                OR     Y'=CT/2"
322 PRINT"   SUBSTITUTING INTO EXPRESSION (1):
324 PRINT"         (CT(2)/2)[2=(VT(2)/2)[2+(CT/2)[2
325 PRINT:PRINT
326 PRINT"   SOLVING FOR T(2) WE GET:
328 PRINT"       ** T(2)=T/SQR(1-(V[2/C[2)) **
329 PRINT:PRINT
330 INPUT"   PRESS <ENTER> TO CONTINUE";
332 CLS
334 PRINT"            ** T(2)=T/SQR(1-(V[2/C[2)) **
336 PRINT:PRINT "      THIS EQUATION EXPRESSES QUANTITATIVELY TH
E 'DILATION
OF TIME' OR SLOWING DOWN OF THE MOVING CLOCK AS ITS VELOCITY
APPROACHES THAT OF THE SPEED OF LIGHT----AS SEEN BY THE STATION-
ARY OBSERVER."
338 PRINT"     (THERE IS NO CHANGE FOR THE OBSERVER IN THE MOVIN
G
FRAME OF REFERENCE)."
340 PRINT
342 PRINT" IN PONDERING THIS TYPE OF 'THOUGHT EXPERIMENT',EINST
EIN
MADE THE GREAT LEAP IN CONCEPT BY REALIZING THAT ** TIME ** WAS
SUSPECT-----DIFFERENT FOR THE TWO OBSERVERS !!!!!"
344 PRINT
346 INPUT" TYPE R TO REVIEW THIS PROGRAM,C TO CONTINUE";CH$
347 IF CH$="R" THEN GOTO9
400 CLS
410 PRINT"THE LORENTZ TRANSFORMATIONS IN EINSTEINIAN RELATIVITY"

420 PRINT:PRINT
430 PRINT"THE RELATIVISTIC FACTOR,A,=SQR(1-(V[2/C[2))"
440 PRINT" FOR MASS TRANSFORMATION,M2=M1*1/A,FOR LENGTH"
450 PRINT"L2=L1*A,FOR TIME T2 =T1*1/A"
460 PRINT
470 PRINT"   VELOCITIES IN MILES PER SECONDS.VALUES FOR MASS,"
480 PRINT"LENGTH,AND TIME MAY BE STATED IN ANY UNITS.":PRINT:PRI
NT
490 C=186000
500 INPUT"DO YOU WISH MASS TRANSFORMATIONS?(YES/NO)";Y$
510 IF Y$="YES" THEN GOSUB 600
520 INPUT"DO YOU WISH LENGTH TRANSFORMATIONS?";Y$
530 IF Y$="YES" THEN GOSUB680
540 INPUT"DO YOU WISH TIME TRANSFORMATIONS?";Y$
550 IF Y$="YES" THEN GOSUB 760
560 CLS
570 PRINT:PRINT:PRINT:PRINT
580 PRINTCHR$(23)"HAPPY BIRTHDAY ALBERT!!!---"
590 GOTO 590
600 INPUT"ENTER INITIAL MASS";M1
610 FOR V=1 TO 185900 STEP 500
620 M2=M1*(1/SQR(1-(V[2/C[2)))
630 PRINT"M2=";M2, ,"V=";V
640 NEXT
650 FOR N=1 TO 2000:NEXT
660 CLS
670 RETURN
680 INPUT"ENTER INITIAL LENGTH";L1
690 FOR V=1 TO 185500 STEP 500
700 L2=L1*SQR(1-(V[2/C[2))
710 PRINT"LENGTH =";L2 ,"VELOCITY=";V
720 NEXT
730 FOR N= 1 TO 2000:NEXT
740 CLS
750 RETURN
760 INPUT"ENTER INITIAL TIME INTERVAL";T1
770 FOR V=1 TO 185500 STEP500
780 T2=T1*1/(SQR(1-(V[2/C[2)))
790 PRINT"TIME INTERVAL=";T2,"VELOCITY=";V
800 NEXT
810 FOR N=1 TO 2000:NEXT
820 CLS
830 RETURN
```

Aerocomp's Proven Best-By Test! The "DDC"



Double Density Controller

★ Technical Superiority

At last! A double density controller for Model I with HIGHER PROB... ...ITY OF DATA RECOVERY THAN WITH ANY OTHER DOUBLE DENSITY CONTROLLER ON THE MARKET TODAY! The "DDC" f... ...erocomp. No need to worry about the problems that keep cropping up on existing products. AEROCOMP'S ne... ...design phase lock loop data separator has a wider capture window than the digital types currently ... ...allows high resolution data centering. The finest resolution available with digital circuitry is 1... ..."DDC" analog circuit allows infinately variable tuning. Attack and settling times are opt... The units presently on the market use a write precompe... ...Board to board tolerance is extremely wide - in the order of ± 100 ns. T... ...s. The bottom line is state of the art reliability!

> **Satisfied customer writes**
>
> A. Brandwein, D.D.S.
> New York, New York
>
> 11/07/81
>
> I received your (DDC) on the first attempt ... to my astonishment disk was successful to copy my system ... prior to purchasing your double density board I had tried LNW's and Percom's boards without success. My drives are the oldest RS ones that came out. The serial numbers are below 33000. Percom says you should have ... numbers above 70000 for double density to work ...
>
> Yours truly,
> A. Brandwein

★ Test Proven

Tests were conducted on AEROCOMP'S "DDC", Percom... ...d LNW's "LNDoubler"** using a Radio Shack TRS80*** Model I, Level 2, 48 K with T... ...om TFD100* disk drive (Siemens Model 82). Diskette was Memorex 3401. T... ...sed piece of media to determine performance under adverse conditions. The... ...ere installed sequentially in the expansion interface.
The test consisted of formatting 40 tracks on th... ...pattern on all tracks. The 6DB6 pattern was chosen because it is recommended as... ...turers of drives and diskettes. An attempt was then made to read each sector on the dis... ...ng system was Newdos/80, Version 1.0, with Double Zap, Version 2.0. Unreadable sectors were ... The test was run ten times with each double density controller and the data averaged. Test res... ...the table.

★ Features

TRS80 Model I owners who are ready for reliable double density operation will get (1) 80% more storage per diskette, (2) single and double density data separation with far fewer disk I/O errors, (3) single density compatibility and (4) simple plug-in installation. Compatible with all existing double density software.

★ TEST RESULTS ★

MFR & PRODUCT	SECTORS LOCKED OUT (AVG)
AEROCOMP "DDC"	0
PERCOM "DOUBLER II"	18
PERCOM "DOUBLER A"	250
LNW "LNDOUBLER"	202

Note: test results available upon written request. All tests conducted prior to 8-25-81

★ Value

$139.95 for the BEST double density controller on the market.

$179.95 for "DDC" complete with DOSPLUS 3.3D
$229.95 for "DDC" complete with LDOS

Aerocomp's 14 day money back guarantee applies to hardware only.
Specials will be prorated. Shipping $2.00 in Cont. US. See opposite page for details.

Data Separators

The advances that make the "DDC" great are incorporated in the new AEROCOMP Single Den... and Double Density Data Separator ("DDS").

★ Has your original manufacturer left you holding the bag?

If you already own a Percom "Doubler A", "Doubler II" or LNW "LNDoubler", the AEROCOMP "DDS" will make it right. Look at the test results:

MFR. & PRODUCT	SECTORS LOCKED OUT	
	WITHOUT "DDS"	WITH "DDS"
PERCOM "DOUBLER II"	18	1
PERCOM "DOUBLER A"	250	0
LNW "LNDOUBLER"	202	0

Note: Same test procedures as "DDC".
* Trademark of Percom Data Co.
** Trademark of LNW
*** Trademark of Tandy Corporation

★ **"DDS"..... $49.95** (Use 1791 chip from your DD Controller)

★ **"DDS"** with disk controller chip included....... **$79.95**

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(Shipping $2.00 Cont. US - see opposite page for details)

Plugs directly into your existing Double Density Controller.

> **Happy DDS customer writes . . .**
>
> I don't often write letters such as this, but I feel I should in this case . . . I am suprised and pleased with your DDS. It is not often a product is better than one expects . . . This (these) test (s) used a Percom Doubler "A". (Test without DDS installed showed many errors). (With DDS) not one error!!! After ten (10) tests of formatting and verifing and zeroing NOT ONE FAILURE OR LOCK OUT. Great!!!
>
> Phil Gnadt
> Kansas City, Kansas

See opposite page▸▸▸▸▸▸

✓ See List of Advertisers on Page 455

Epson Airfoils

by Bob Boothe

Are you tired of laboriously plotting airfoils by hand? Use this program with your 80 and an Epson printer to make it fast and easy.

Besides being interested in computers, I am also a weekend flyer—of radio-controlled model aircraft. The computer offered an ideal tool to use in the experimentation with various wing shapes. Airfoil data is widely available in tabular form (see Tables 1–5), but the conversion of this data into a usable pattern is a time-consuming job involving the accurate plotting of perhaps 50 points to an exact scale for a single wing rib. Also, if the aircraft is to have anything other than a perfectly straight wing, as many as 10 or more different sizes of ribs might be needed. The design job, done manually, could quickly get out of hand.

STATION	VALUE	UPPER SURFACE	LOWER SURFACE
1	0.00	0.000	0.000
2	1.25	0.950	−0.950
3	2.50	1.310	−1.310
4	5.00	1.780	−1.780
5	7.50	2.100	−2.100
6	10.00	2.340	−2.340
7	15.00	2.670	−2.670
8	20.00	2.870	−2.870
9	25.00	2.970	−2.970
10	30.00	3.000	−3.000
11	40.00	2.900	−2.900
12	50.00	2.650	−2.650
13	60.00	2.280	−2.280
14	70.00	1.830	−1.830
15	80.00	1.310	−1.310
16	90.00	0.720	−0.720
17	95.00	0.400	−0.400
18	99.00	0.060	−0.060
19	100.00	0.000	0.000
20	100.00	2.000	−2.000

Table 1. NACA 0006 Airfoil

Getting Started

To do the job on the computer, the first thing we must decide is what size to make the field for plotting the airfoils. For most model aircraft a chord of about 10 inches is adequate, and fits nicely on a sheet of 8.5-by-11-inch paper. The printer used for this work is an Epson MX-80 with the Graftrax option. This machine has a nine-wire head, which is rather handy because we can address eight wires with one data byte in the graphics mode. In the vertical direction the Epson prints at 72 dots per inch. If we use 95 rows of dots at eight per row, the vertical size of our field is 10.55 inches ((8 × 95)/72 = 10.55).

The program runs on a 48K disk machine and after allowing room for Disk Basic, the machine-language line-plotting program, and a medium-sized Basic program to process the tables of data, about 32K of RAM is left over that can be used as a storage buffer for the field. Horizontally, if we use 340 columns of dots the field takes 32,300 bytes. (That's 258,400 individual points at eight per byte.) Horizontal spacing is at 60 dots per inch, so our field turns out to be 10.55 inches high by 5.66 inches wide—a rather generous area.

The Program That Does the Work

Now that we have established a field size, the next step is to set up the ma-

The Key Box

Model I
48K RAM
Disk Basic
2 Disk Drives
Epson MX-80 with Graftrax

chine-language program. As mentioned earlier, the basis of this work is a line-plotting program. You can find it starting on page 139 of the May, 1981 *80 Micro*. For the present version see Program Listing 1. Even though the program is intended to run in Disk Basic, three of the disk commands have been redefined to be used for entry to the machine-language routines. I prefer this method of entry over USR calls since it seems to be more reliable and allows more flexibility in programming. (See the April, 1981 issue of *80 Micro*, page 116.) Program conversion to Level II Basic, which only has a single USR call, is also much easier this way.

The first three ORG statements in lines 200, 220, and 240 of the new program enable the three disk commands while the rest of the program is loading. Our 32,300-byte field buffer resides from 64635 down to 33235, which means that the machine-language program should end at 33234 (81D2H). The ORG in line 260 takes care of this.

The original program was written for the $Base_2$ printer which has only seven wires, numbered top to bottom, as compared to the Epson which has eight addressable wires, numbered from the bottom up. Lines 1410–1480 set things up for the Epson.

This can be compared to lines 1330–1390 of the May, 1981 program. The routine PRTOUT starting at line 1570 will not work on a Model III. The Model III still uses 37E8H for printer status but to output a byte you must change line 1650 to an OUT statement to the printer port, or Call 03BH.

Finally, there are a few bits of code worth looking at in lines 1780–1840. Line 1780 sends the escape character (27) to the printer, which in essence means "Interpret the following byte(s) as control codes." The 75 in line 1800 sets the printer into the bit-image graphics mode, and the following two bytes define the number of dots to be printed per line. The 1 in line 1840 is the code for 256 dots, and the 84 in line 1820 is added to this to produce the desired 340 dots per line (256 + 84 = 340).

If any other details of this new program need explanation, look up the May, 1981 article. All we have done is adjusted the original to work on a new field size with a different printer. Perhaps you have noticed that two of the original disk commands (Open and Close) have been changed. The original program was written for a 32K Level II machine without disk drives. The present program is intended to run in Disk Basic and these two commands are needed for handling of data files. I have substituted Field and RSET since these are not needed for any other purpose in this application.

Getting Down To Basic

From here on we will use only Basic, primarily because of the ease of editing and changing as our needs might dictate. The program AIRFOIL/BAS (see listing 2) handles all our file-management problems and does all the necessary math to calculate the precise position on the field of each point that we want to plot.

The program is written in compacted style, using the smallest line numbers possible, multi-statement lines, and eliminating spaces except where absolutely necessary. The sole reason for going to this extra trouble is conservation of memory space.

Only one frivolous excess can be found: the use of the down arrow to improve the readability of the listing in this compact format. Look at line 13, for example. You should type the down arrow after the colon following the 2 then type three spaces to get out of the line-number column and continue on. A second down arrow comes after the colon following Next, and so on.

STATION	VALUE	UPPER SURFACE	LOWER SURFACE
1	0.00	0.000	0.000
2	1.25	3.070	−1.790
3	2.50	4.170	−2.480
4	5.00	5.740	−3.270
5	7.50	6.910	−3.710
6	10.00	7.840	−3.980
7	15.00	9.270	−4.180
8	20.00	10.250	−4.150
9	25.00	10.920	−3.980
10	30.00	11.250	−3.750
11	40.00	11.250	−3.250
12	50.00	10.530	−2.720
13	60.00	9.300	−2.140
14	70.00	7.630	−1.550
15	80.00	5.550	−1.030
16	90.00	3.080	−0.570
17	95.00	1.670	−0.360
18	99.00	0.160	−0.160
19	100.00	0.000	0.000
20	100.00	2.000	−2.000

Table 2. NACA 4415 Airfoil

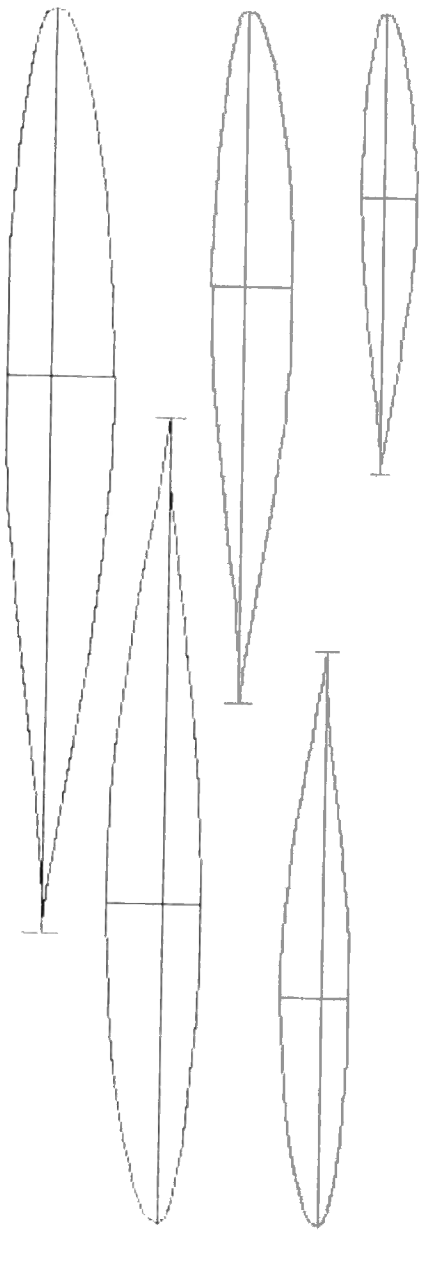

Fig. 1. Airfoils Plotted from NACA 651-212 Data

STATION	VALUE	UPPER SURFACE	LOWER SURFACE
1	0.00	3.040	3.040
2	1.25	5.400	1.860
3	2.50	6.400	1.420
4	5.00	7.800	0.910
5	7.50	8.800	0.590
6	10.00	9.600	0.390
7	15.00	10.600	0.120
8	20.00	11.300	0.010
9	30.00	11.700	0.000
10	40.00	11.400	0.000
11	50.00	10.500	0.000
12	60.00	9.130	0.000
13	70.00	7.300	0.000
14	80.00	5.200	0.000
15	90.00	2.800	0.000
16	95.00	1.500	0.000
17	100.00	0.000	0.000
18	100.00	2.000	−2.000

Table 3. Clark-Y Airfoil

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- Extender Cable..................$14.95

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- TA400B Flippy...................$269
- TA800B Flippy...................$359

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- MX80 F/T........................$579.00
- MX100...........................$769.00
- Parallel Cables.................$9.95‡
- MX 70-80 Ribbons................$9.95

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- LDOS............................$119.95
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- Disk Drive Power Supply, Single.$37
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- Diskettes (box of 10)...........$25

90 day warranty on **DRIVES.** Add $5.00 freight per drive in Cont. U.S. UPS COD charge $1.50. There is also a 15 day FREE TRIAL on TA drives. If not completely satisfied I'll refund your money (less shipping). I'll take exception to improper use or mishandling.

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- 26-1062 MIII, LII, 16K..........$835
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- 26-1066 MIII, 48K-2 Dr-RS232....$2099
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In case you are wondering about the slight jaggedness of some areas on the plots, remember that we are plotting on a dot-matrix printer and the finest detail we can obtain is the size of one dot. At 60 per inch horizontally, dot-to-dot spacing is 1/60 inch, or .0167 inch. Vertically, the spacing is 1/72 inch or .0139 inch. We would say that we have a resolution of .0167 by .0139. In trying to plot a curve, the dots print in a given row or column until the calculated position changes by one full increment. When you stop and think about it, the computer plots every single point that lies exactly on the calculated line. It is a simple matter to make a template from the plotted data by trimming so that the outline just touches the high points.

STATION	VALUE	UPPER SURFACE	LOWER SURFACE
1	0.00	0.000	0.000
2	1.25	1.058	−1.058
3	2.50	1.421	−1.421
4	5.00	1.961	−1.961
5	7.50	2.383	−2.383
6	10.00	2.736	−2.736
7	15.00	3.299	−3.299
8	20.00	3.727	−3.727
9	30.00	4.282	−4.282
10	40.00	4.496	−4.496
11	50.00	4.336	−4.336
12	60.00	3.743	−3.743
13	70.00	2.856	−2.856
14	80.00	1.805	−1.805
15	90.00	0.738	−0.738
16	95.00	0.280	−0.280
17	100.00	0.000	0.000
18	100.00	2.000	−2.000

Table 4. NAC09 Tip Airfoil

STATION	VALUE	UPPER SURFACE	LOWER SURFACE
1	0.00	0.000	0.000
2	0.42	0.970	−0.870
3	0.66	1.176	−1.020
4	1.15	1.491	−1.290
5	2.39	2.058	−1.700
6	4.88	2.919	−2.270
7	7.37	3.593	−2.700
8	9.87	4.162	−3.120
9	14.90	5.073	−3.720
10	19.89	5.770	−4.170
11	24.91	6.300	−4.500
12	29.92	6.687	−4.740
13	34.94	6.942	−4.870
14	39.96	7.068	−4.910
15	44.98	7.044	−4.840
16	50.00	6.860	−4.654
17	55.02	6.507	−4.320
18	60.03	6.014	−3.860
19	65.04	5.411	−3.355
20	70.05	4.715	−2.770
21	75.05	3.954	−2.160
22	80.05	3.140	−1.544
23	85.05	2.302	−0.950
24	90.03	1.463	−0.426
25	95.02	0.672	−0.040
26	100.00	0.000	0.000
27	100.00	2.000	−2.000

Table 5. NACA 651-212 Airfoil

How It All Works

The first six POKEs in line 2 initialize the three disk commands, Line, Field, and RSET. The other two set memory size so the Basic program won't wipe out any of the machine language and other information stored in higher memory. Line 3 is a simple check to make sure that the machine-language program is loaded before we go any further.

After some housekeeping, the file DATALIST/TXT is input from disk. Next, a list of all data files on the disk is printed at the top of the screen for reference (line 13). This is a nice feature to have in a program like this. How often have you wanted to input a file but couldn't remember exactly what you had called it? The file DATALIST/TXT is updated automatically as new files are added from the keyboard. The title for a file is input in line 19, as N$(D). When it comes time to update DATALIST/TXT, a subroutine in line 55 converts N$(D) to a suitable filespec that keeps the machine happy, but retains your title for use in update of DATALIST/TXT in Line 23.

On With The Plot

Tables of data for various airfoil sections are available from a variety of sources. Tables 1, 2, 4, and 5 are based on NACA data frequently quoted in engineering handbooks (Marks), books on airplane design (*R/C Modeler's Handbook of Gliders and Sailplanes*, by George Siposs), and various monthly publications aimed at the model builder (*R/C Sportsman*, *R/C Modeler*, and so on).

Table 3 was copied from some data scribbled on the back of an envelope (source unknown). The tables are presented here only for the purpose of demonstrating the plotting functions and no claims are made for their accuracy or recommendations made for their use. All values in the tables are given in percent of chord length. Station 0 is the leading edge, the station 100 is the trailing edge. In the case of a more or less symmetrical airfoil, the upper surface ordinates have positive

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values and the lower surface ordinates are negative. For the flat-bottomed Clark-Y, all values are positive.

Lines 100–106 of Listing 2 were used to print Tables 1–5. If you want to print a similar table, press break and enter GOTO100. If you want to use this feature frequently, add the following to line 14: (5) Print a data table. Then add ,100 to the end of line 17.

Once we have input a data table and a few parameters such as number of ribs to be plotted, lengths, and so on, the program must calculate the room needed to plot each rib. In line 26 the maximum upper ordinate and the maximum lower ordinate are found (MU = Max. Upper, ML = Max. Lower). In line 29, the total number of dots in the horizontal direction needed to plot the rib is calculated (E). Line 30 takes care of inverting the plot for every other rib.

We then calculate the horizontal coordinates of the first two points on the upper surface (X1, X2), and then in line 37 the vertical coordinates (Y1, Y2). A GOSUB 46 gets a line between the two points just defined stored in the field buffer. Note at the start of line 54 is the simple command, Line. As the Basic program reads this command, a jump is made to memory location 808AH (36874), the start of the Line subroutine. (See Program Listing 1, lines 390–1400.) This is a good illustration of the simplicity of this method for access to machine-language routines.

While all this is going on, a little bookkeeping is done on the screen. A pair of < > characters are printed each time a line increment is drawn to the field buffer. If you place an AM radio close to the keyboard you will hear a wondrous array of sounds.

When all the points are calculated or when there is no more room in the field buffer, the program branches to line 45 where the RSET command causes a jump to memory location 8192H, the start of the routine to output the contents of the field buffer to the printer in bit-image format.

The process seems slow compared to normal printing speeds. In the graphics mode the printer always prints in one direction only, to help ensure the best possible column alignment. Also, because the buffer in the printer simply cannot hold enough data for a full line of dot graphics, the head must make a second pass on each line. The net result is a speed roughly one-fourth that of normal.

Paper positioning is critical with this program since the field takes up virtually the complete page. With the power switch on the side of the printer turned off, move the paper so the top of a page is just even with the top of the ribbon. This gives a margin of about 1/4 inch top and bottom. If you are plotting more than one page, the paper must be adjusted this way for each new page. With vertical printing set at 72 dots per inch the printer cannot keep track of the top of the form.

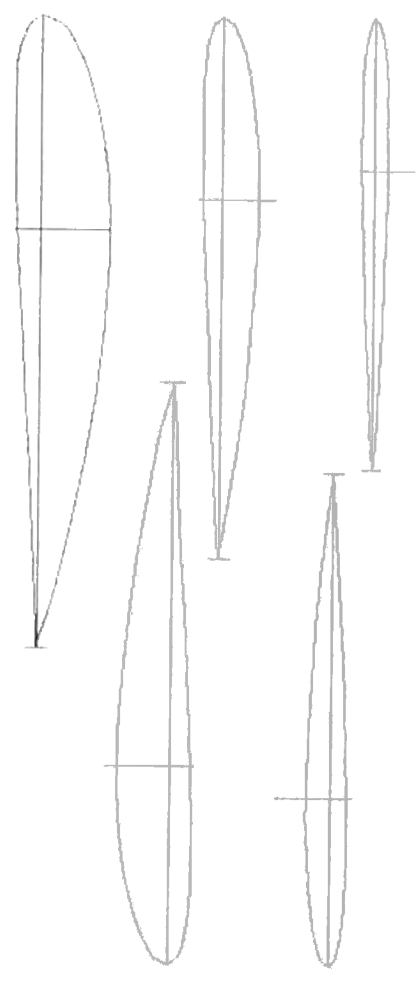

Fig. 2. Progressive Airfoils—Root Section: NACA 4415; Tip Section: NACA 0006

Progressive Airfoils

The program allows you to load a pair of data files—one for the root section, and one for the tip. Figure 2 shows a set of ribs with a rather thick semi-symmetrical airfoil at the root and a thin fully symmetrical shape at the tip. This is more or less the plan for the old C-47 of World War II.

As each rib is plotted, points are calculated for both root and tip sections and, from these, points for the rib are calculated by interpolating values related to the position of the rib on the wing. The result is a wing with a constantly changing airfoil shape from root to tip.

Some interesting intermediate airfoil sections result from using two sections with very different shapes—like the flat-bottomed Clark-Y at the root and the symmetrical NACA 65 009 for the tip (Fig. 2). One word of caution: The data tables for both sections should have the same number of stations, and the same station values. Table 4 is an edited version of the NACA 65 009 data set up to match the Clark-Y. Table 5 is more typical of the type of data that you will find for some of the newer sections.

There are several closely spaced stations in the critical leading-edge area. This leads to a better definition of the nose part of the section. Figure 1 was plotted from this data. Each data table has two stations with a value of 100. This is a feature that I always add to a table, and the purpose is to draw the little hash mark at the trailing edge of each rib to define this point exactly when cutting out.

I usually use these plotted sections in one of two ways: First, for balsa wood ribs, I make copies and then transfer the pattern to the wood using an electric iron. The first cut I make is at the hash mark. Second, the plot can be glued to a piece of thin metal or formica, trimmed to shape, and used as a master template in hot-wire cutting of foam wing cores.

Other Applications

Not everyone is going to get excited about plotting airfoils, but fortunately the Basic program can be easily changed and adapted to do all sorts of plotting. As used with the machine-language program FOILEXEC/OBJ, the system runs rather tight on memory. You will find that you can manage six or eight data tables before running into memory constraints. This is no problem when using the system as written to plot airfoil sections. If you want to store more than this, switch to another data disk. The first time you run the program you will create a new DATALIST/TXT file.

If you decide to adapt this program to another use that will require more space for the Basic program, you can get this space by changing the field size. For instance, a six-inch-square field (432 vertical by 360 horizontal) takes about 20K bytes of memory. The key lines of Listing 1 that will need revision are 260, 1260, 1270, 1500, 1510, 1520, 1760, 1820, 1860, and 1990.

As for the Basic program, all you have to do is calculate the X and Y coordinates for a pair of points (X1, X2, Y1, Y2) and then execute the command Line. When ready to print, execute RSET and to clear the field for a new plot, execute Field. ■

Bob Boothe (4651 Browndeer Lane, Rolling Hills Estates, CA 90274) is studying computer engineering at the Univ. of CA, San Diego.

Program Listing 1

```
               00100            ;...."FOILEXEC"....
               00110            ;
               00120            ;LINE DRAWING ROUTINE FOR "EPSON"
               00130            ;MX-80 PRINTER WITH "GRAFTRAX" ROM
               00140            ;AND TRS-80 MOD I ... 48K DISK BASIC
               00150            ;
               00160            ;THIS VERSION DEFINES A RECTANGULAR FIELD
               00170            ;760 DOTS HIGH BY 340 DOTS WIDE. (10.55" X 5.66")
               00180            ;
               00190            ;BOB BOOTHE 12/20/81   REVISED 01/25/82
41A3           00200            ORG     16804-1            ;LINE LOCATION
41A3 C38A80    00210            JP      LINE               ; AUTOMATIC ENABLE
4179           00220            ORG     16762-1
4179 C37181    00230            JP      FIELD
4185           00240            ORG     16774-1
4185 C39281    00250            JP      RSET
8072           00260            ORG     32882   ;SO END IS BELOW 33235
8072 0000      00270 STARTX     DEFW    0                  ;RESERVE 4 BYTES
8074 0000      00280            DEFW    0                  ;FOR EA. VARIABLE
8076 0000      00290 STARTY     DEFW    0
8078 0000      00300            DEFW    0
807A 0000      00310 ENDX       DEFW    0
807C 0000      00320            DEFW    0
807E 0000      00330 ENDY       DEFW    0
8080 0000      00340            DEFW    0
8082 0000      00350 DIRX       DEFW    0                  ;LEAST SIGNIFICANT
8084 0000      00360            DEFW    0                  ;MOST SIGNIFICANT
8086 0000      00370 DIRY       DEFW    0
8088 0000      00380            DEFW    0
808A D9        00390 LINE       EXX                        ; SAVE REGISTERS
808B 2A7C80    00400            LD      HL,(ENDX+2)        ; GET END OF X POINT
808E ED5B7480  00410            LD      DE,(STARTX+2)      ; START OF X
8092 B7        00420            OR      A                  ; RESET CARRY FLAG
8093 ED52      00430            SBC     HL,DE              ; FIND DIFFERENCE
8095 228280    00440            LD      (DIRX),HL
```

Listing 1 Continues

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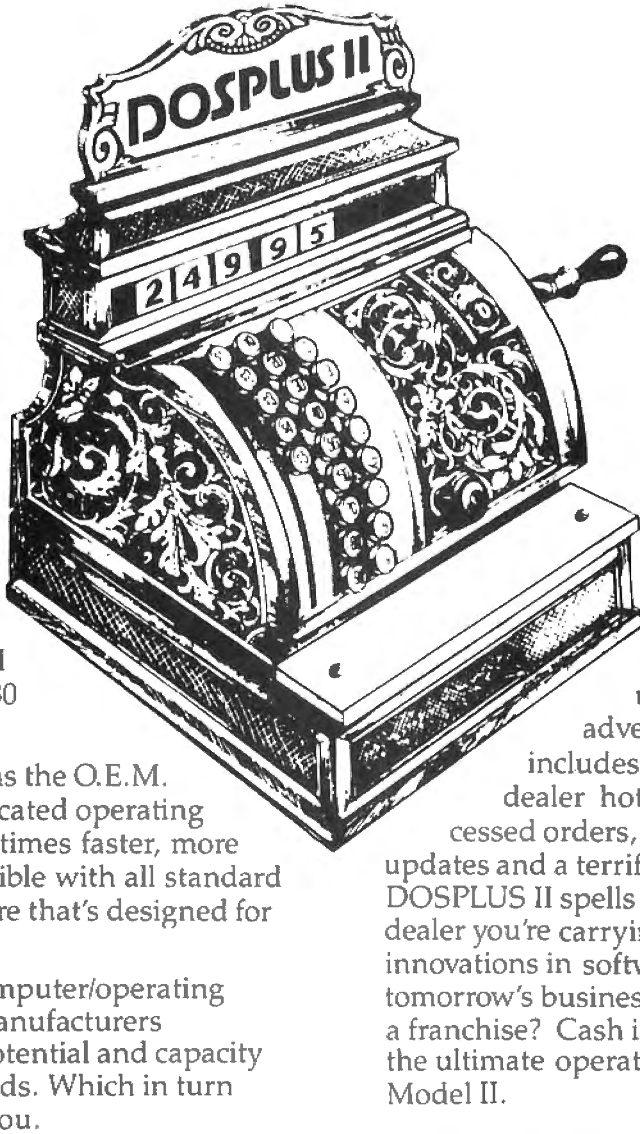
Listing 1 Continued

```
8098 CB7C                BIT   7,H             ; IS RESULT NEGATIVE
809A 2805                JR    Z,DX0
809C 21FFFF              LD    HL,-1           ; YES, MAKE MSW NEG
809F 1803                JR    PDX
80A1 210000      DX0     LD    HL,0            ; NO, MAKE MSW 0
80A4 228480      PDX     LD    (DIRX+2),HL
80A7 2A8080              LD    HL,(ENDY+2)     ; REPEAT ABOVE FOR Y
80AA ED5B7880            LD    DE,(STARTY+2)
80AE B7                  OR    A
80AF ED52                SBC   HL,DE
80B1 228680              LD    (DIRY),HL
80B4 CB7C                BIT   7,H
80B6 2805                JR    Z,DY0
80B8 21FFFF              LD    HL,-1
80BB 1803                JR    PDY
80BD 210000      DY0     LD    HL,0
80C0 228880      PDY     LD    (DIRY+2),HL
80C3 2A8280              LD    HL,(DIRX)
80C6 ED5B8680            LD    DE,(DIRY)
80CA 7C                  LD    A,H
80CB E680                AND   80H             ; PUT BIT 7 OF H IN B
80CD 47                  LD    B,A
80CE 7A                  LD    A,D
80CF E680                AND   80H             ; PUT BIT 7 OF D IN C
80D1 4F                  LD    C,A
80D2 CB25        SHIFT   SLA   L               ; EXPAND DIRECTION UNTIL
80D4 CB14                RL    H               ; BIT 7 CHANGES
80D6 CB23                SLA   E               ; THIS GIVES MAX. SPEED
80D8 CB12                RL    D
80DA 7C                  LD    A,H
80DB E680                AND   80H
80DD B8                  CP    B
80DE 2008                JR    NZ,DSHIFT
80E0 7A                  LD    A,D
80E1 E680                AND   80H
80E3 B9                  CP    C
80E4 2002                JR    NZ,DSHIFT
80E6 18EA                JR    SHIFT
80E8 228280      DSHIFT  LD    (DIRX),HL       ; DONE SHIFTING SO STORE
80EB ED538680            LD    (DIRY),DE
80EF CD3C81      NXTBLO  CALL  SET             ; SET 1ST POINT
80F2 AF                  XOR   A               ; RESET CARRY FLAG
80F3 2A7C80              LD    HL,(ENDX+2)
80F6 ED5B7480            LD    DE,(STARTX+2)
80FA ED52                SBC   HL,DE           ; DOES START = END YET
80FC 2830                JR    Z,MAYBE
80FE 2A7280      NOTYET  LD    HL,(STARTX)     ; ADD DIRECTION TO START
8101 ED5B8280            LD    DE,(DIRX)
8105 19                  ADD   HL,DE           ; ADD LSW'S FIRST
8106 227280              LD    (STARTX),HL
8109 2A7480              LD    HL,(STARTX+2)
810C ED5B8480            LD    DE,(DIRX+2)     ; (DIRX+2) SHOULD BE 0
8110 ED5A                ADC   HL,DE           ; ADD CARRY FROM LSW'S
8112 227480              LD    (STARTX+2),HL   ; REPEAT FOR Y'S
8115 2A7680              LD    HL,(STARTY)
8118 ED5B8680            LD    DE,(DIRY)
811C 19                  ADD   HL,DE
811D 227680              LD    (STARTY),HL
8120 2A7880              LD    HL,(STARTY+2)
8123 ED5B8880            LD    DE,(DIRY+2)
8127 ED5A                ADC   HL,DE
8129 227880              LD    (STARTY+2),HL
812C 18C1                JR    NXTBLO
812E B7          MAYBE   OR    A               ; ARE Y'S ALSO EQUAL
812F 2A8080              LD    HL,(ENDY+2)
8132 ED5B7880            LD    DE,(STARTY+2)
8136 ED52                SBC   HL,DE
8138 20C4                JR    NZ,NOTYET       ; NO, GO BACK AND FINISH
813A D9                  EXX                   ; GET BACK OLD REGISTERS
813B C9                  RET                   ; RETURN TO PROGRAM
813C 0600        SET     LD    B,0             ; ROUTINE TO SET A POINT
813E 2A7880              LD    HL,(STARTY+2)
8141 110800              LD    DE,8            ; GOING TO DIVIDE BY 8
8144 B7                  OR    A               ; RESET CARRY FLAG
8145 ED52        DIV7    SBC   HL,DE           ; DIVIDE BY SUBTRACTION
8147 3803                JR    C,DONDIV
8149 04                  INC   B               ; COUNT THE 7'S
814A 18F9                JR    DIV7
814C 19          DONDIV  ADD   HL,DE           ; PUT BACK LAST 7
814D 4D                  LD    C,L             ; PUT REMAINDER IN C
814E 04                  INC   B               ; SO B ISN'T 0
814F 115401              LD    DE,340          ; 340 BYTES PER LINE
8152 217F80              LD    HL,33235-340    ; COMPENSATE FOR (INC B)
8155 19          MULT    ADD   HL,DE           ; ADD 340 FOR EACH LINE
8156 10FD                DJNZ  MULT
8158 ED5B7480            LD    DE,(STARTX+2)   ; GET X COLUMN
815C 19                  ADD   HL,DE           ; MAKE ADDRESS
815D 41                  LD    B,C
815E 04                  INC   B               ; SO B DOESN'T EQUAL 0
815F 116881              LD    DE,TABLE-1      ; COMPENSATE FOR (INC B)
8162 13          FINDT   INC   DE
8163 10FD                DJNZ  FINDT           ; FIND LOCATION IN TABLE
8165 1A                  LD    A,(DE)
8166 B6                  OR    (HL)            ; SET THAT BIT
8167 77                  LD    (HL),A          ; STORE
8168 C9                  RET                   ; FINALLY DONE
8169 80          TABLE   DEFB  80H             ; BIT 0
816A 40                  DEFB  40H             ; BIT 1
816B 20                  DEFB  20H             ; SO ON
```

Listing 1 Continues

YOU DON'T NEED A RADIO SHACK FRANCHISE TO CASH IN ON MODEL II SALES.



It's true, all you have to do is carry the DOSPLUS II operating system for TRS-80 Model II users.

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Listing 1 Continued

```
816C 10         01440          DEFB    10H
816D 08         01450          DEFB    08H
816E 04         01460          DEFB    04H
816F 02         01470          DEFB    02H
8170 01         01480          DEFB    01H
8171 D9         01490 FIELD    EXX                     ; SAVE REGISTERS
8172 21D381     01500          LD      HL,33235        ; START PICTURE
8175 11D481     01510          LD      DE,33236        ; START +1
8178 012C7E     01520          LD      BC,32300        ; (760*340)/8 = 32300
817B 3600       01530          LD      (HL),0          ; CLEAR
817D EDB0       01540          LDIR                    ; COPY ALL THE WAY
817F D9         01550          EXX                     ; GIVE 'EM OLD REGISTERS
8180 C9         01560          RET                     ; GET BACK TO FUN STUFF
8181 E5         01570 PRTOUT   PUSH    HL              ; SAVE HL
8182 C5         01580          PUSH    BC
8183 0600       01590          LD      B,0             ;256 STEP DELAY LOOP
8185 10FE       01600 DELAY    DJNZ    DELAY
8187 C1         01610          POP     BC
8188 21E837     01620          LD      HL,37E8H        ; LP POINTER - MOD I
818B CB7E       01630 PRTLP8   BIT     7,(HL)          ; BIT 7 ON MEANS BUSY
818D 20FC       01640          JR      NZ,PRTLP8
818F 77         01650          LD      (HL),A          ; LP READY, SO OUTPUT
8190 E1         01660          POP     HL              ; GET BACK HL
8191 C9         01670          RET                     ; BACK TO WORK
8192 D9         01680 RSET     EXX                     ; YOU KNOW WHAT THIS DOES
8193 3E1B       01690          LD      A,27            ; ESCAPE
8195 CD8181     01700          CALL    PRTOUT
8198 3E33       01710          LD      A,51            ; ASCII - 3
819A CD8181     01720          CALL    PRTOUT
819D 3E18       01730          LD      A,24            ; 8 DOT SPACING
819F CD8181     01740          CALL    PRTOUT
81A2 065F       01750          LD      B,95            ; NUMBER OF LINES
81A4 21D381     01760          LD      HL,33235        ; FIRST BYTE LOCATION
81A7 C5         01770 LOOP     PUSH    BC              ; SAVE LINE COUNTER
81A8 3E1B       01780          LD      A,27            ; ESCAPE
81AA CD8181     01790          CALL    PRTOUT
81AD 3E4B       01800          LD      A,75            ; TRANSMIT GRAPHICAL DATA
81AF CD8181     01810          CALL    PRTOUT
81B2 3E54       01820          LD      A,84            ;ADD TO 256 = 340
81B4 CD8181     01830          CALL    PRTOUT
81B7 3E01       01840          LD      A,1             ;256 BYTES
81B9 CD8181     01850          CALL    PRTOUT
81BC 015401     01860          LD      BC,340          ; NO. CHARS FROM MEMORY
81BF 7E         01870 CHAR     LD      A,(HL)
81C0 CD8181     01880          CALL    PRTOUT
81C3 23         01890          INC     HL              ; INC ADDRESS AFTER EACH
81C4 0B         01900          DEC     BC              ; DEC COUNTER AND CHECK
81C5 79         01910          LD      A,C
81C6 B0         01920          OR      B
81C7 20F6       01930          JR      NZ,CHAR
81C9 3E0D       01940          LD      A,13            ; CAUSES LINE FEED
81CB CD8181     01950          CALL    PRTOUT
81CE C1         01960          POP     BC              ; GET LINE COUNTER
81CF 10D6       01970          DJNZ    LOOP
81D1 D9         01980          EXX             ; GET BACK OLD REGISTERS
81D2 C9         01990          RET     ;ADDRESS SHOULD BE 81D2H WHEN ASSEMBLING
1A19            02000          END     1A19H           ;ENTRY TO LEVEL II BASIC
00000 TOTAL ERRORS
```

Program Listing 2

```
1 ' AIRFOIL/BAS -- BOB BOOTHE -- 12/28/81
2 POKE16804,138:POKE16805,128:POKE16765,113:POKE16766,129:
   POKE16795,146:POKE16796,129:POKE16561,113:POKE16562,128:
   CLEAR150
3 IFPEEK(&H41A3)<>195THENCLS:
   PRINT"YOU MUST LOAD (FOILEXEC/OBJ) BEFORE YOU CAN RUN.":
   INPUT"PRESS <ENTER> TO RETURN TO DOS";Q$:CMD"S"
4 F$="## =###.##  ##.###  ##.###"
5 FIELD:DEFINT A,D,N,Q,W,Z:
   DIMP(30,3):DIMTR(30,3):GOTO8
6 IF ERR<>106 THENPRINT"ERROR":END
7 CLOSE1:D=0:CLS:PRINT"NO DATAFILE LIST ON THIS DISK 1":
   PRINT:RESUME14
8 ON ERROR GOTO 6
9 OPEN"I",1,"DATALIST/TXT:1"
10 IF EOF(1)THEN12
11 D=D+1:INPUT#1,N$(D):GOTO10
12 CLOSE1:ONERRORGOTO0
13 CLS:FORQ=1TODSTEP2:
    PRINTQ;" - ";N$(Q);TAB(24)Q+1;" - ";N$(Q+1):NEXT:
    PRINT:PRINTSTRING$(64,"=")
14 PRINT@640,"       (1) LOAD A DATA FILE FROM DISK
      (2) LOAD A PAIR OF DATA FILES -- FOR PROGRESSIVE AIRFOILS.
      (3) INPUT A DATA TABLE FROM KEYBOARD
      (4) REVISE A DATA TABLE
15 INPUT"CHOOSE A FUNCTION BY NUMBER";DT
16 PRINT@640,CHR$(31);
17 ONDTGOTO57,62,19,57
```

Listing 2 Continues

Listing 2 Continued

```
18 GOTO15
19 ONERRORGOTO0:D=D+1:
    INPUT"TITLE FOR THIS DATA ....
    (FIRST EIGHT CHARACTERS MUST BE UNIQUE) ";N$(D)
20 INPUT"HOW MANY STATIONS PER RIB (30 MAX) ";NS
21 FORW=1TONS:
    INPUT"STATION VALUE, UPPER, LOWER ";P(W,1),P(W,2),P(W,3):
    NEXT
22 INPUT"SAVE DATA TO DISK (Y/N) ";Q$:IFQ$<>"Y"THENCLS:GOTO25
23 OPEN"O",1,"DATALIST/TXT:1":FORQ=1TOD:PRINT#1,N$(Q):NEXT:
    CLOSE1:DF=D:GOSUB55
24 OPEN"O",1,FS$:PRINT#1,NS:FORW=1TONS:
    PRINT#1,P(W,1);P(W,2);P(W,3);:NEXT:CLOSE1:CLS:IFDT=4THENRUN
25 INPUT"HOW MANY RIBS (10 MAX)";NR:
    INPUT"SPAR CENTERLINE AT WHAT STATION";SC:FORW=1TONR:
    INPUT"LENGTH IN INCHES";L(W):NEXT:C=0
26 MU=P(1,2):ML=P(1,3):FOR E=1TONS:IFP(E,2)>MUTHENMU=P(E,2)
27 IFP(E,3)<MLTHENML=P(E,3)
28 NEXTE
29 FOR W=1TONR:PRINT:PRINTW;:E=(MU-ML)/100*L(W)*60:
    IFC+E>339THENGOSUB45
30 XC=C-ML/100*L(W)*60:YC=0:F=1:
    IF(W/2)=INT(W/2)THENYC=759:F=-1
31 IFF=-1THENXC=C+C+E-XC
32 FORA=1TONS-1
33 X1=F*P(A,2)/100*L(W)*60+XC:X2=F*P(A+1,2)/100*L(W)*60+XC
34 IFDT<>2THEN37
35 T1=F*TR(A,2)/100*L(W)*60+XC:T2=F*TR(A+1,2)/100*L(W)*60+XC
36 X1=(X1*(NR-W)+T1*(W-1))/(NR-1):
    X2=(X2*(NR-W)+T2*(W-1))/(NR-1)
37 Y1=F*P(A,1)/100*L(W)*72+YC:Y2=F*P(A+1,1)/100*L(W)*72+YC
38 GOSUB46
39 X1=F*P(A,3)/100*L(W)*60+XC:X2=F*P(A+1,3)/100*L(W)*60+XC
40 IFDT<>2THENGOSUB46:NEXT:GOTO44
41 T1=F*TR(A,3)/100*L(W)*60+XC:T2=F*TR(A+1,3)/100*L(W)*60+XC
42 X1=(X1*(NR-W)+T1*(W-1))/(NR-1):
    X2=(X2*(NR-W)+T2*(W-1))/(NR-1)
43 GOSUB46:NEXT
44 X1=XC:X2=XC:Y1=YC:GOSUB46:
    X1=C:X2=C+E:Y1=YC+F*SC/100*L(W)*72:Y2=Y1:GOSUB46:
    C=C+E:NEXT:GOSUB45:END
45 C=0:RSET:FIELD:RETURN
46 PRINT"<";:REM LINE ROUTINE
47 IF X1 < 0 OR X1 > 339 THEN PRINT"X1 ILLEGAL":END
48 IF X2 < 0 OR X2 > 339 THEN PRINT"X2 ILLEGAL":END
49 IF Y1 < 0 OR Y1 > 759 THEN PRINT"Y1 ILLEGAL":END
50 IF Y2 < 0 OR Y2 > 759 THEN PRINT"Y2 ILLEGAL":END
51 IF INT(X1)=INT(X2) AND INT(Y1)=INT(Y2)THEN
    PRINT"VALUE TOO CLOSE":RETURN
52 X3=INT(X1/256):X4=INT(X2/256):Y3=INT(Y1/256):Y4=INT(Y2/256)
53 POKE&H8074,X1-X3*256:POKE&H8075,X3:
    POKE&H8078,Y1-Y3*256:POKE&H8079,Y3:
    POKE&H807C,X2-X4*256:POKE&H807D,X4:
    POKE&H8080,Y2-Y4*256:POKE&H8081,Y4
54 LINE:PRINT">";:RETURN
55 FS$=LEFT$(N$(DF)+"        ",8):FORQ=1TO8:
    FT=ASC(MID$(FS$,Q,1)):
    IFFT>31ANDFT<48ORFT>57ANDFT<65THENMID$(FS$,Q,1)="0"
56 NEXT:FS$=FS$+"/DAT:1":RETURN
57 INPUT"WHICH DATA FILE ";DF:GOSUB55
58 OPEN"I",1,FS$:INPUT#1,NS:FORW=1TONS:
    INPUT#1,P(W,1),P(W,2),P(W,3):NEXT:CLOSE1:IFDT=2THEN63
59 Z=NS/2:IF2*Z<>NSTHENZ=Z+1
60 CLS:FORW=1TOZ:PRINTUSINGF$;
    W,P(W,1),P(W,2),P(W,3);:PRINT"    *    ";:PRINTUSINGF$;
    W+Z,P(W+Z,1),P(W+Z,2),P(W+Z,3):NEXT
61 IFDT=1THEN25ELSEIFDT=4THEN65ELSE63
62 INPUT"WHICH FILE FOR THE ROOT RIB ";DF:GOSUB55:GOTO58
63 INPUT"WHICH FILE FOR THE TIP RIB ";DF:GOSUB55:
    OPEN"I",1,FS$:INPUT#1,NS:FORW=1TONS:
    INPUT#1,TR(W,1),TR(W,2),TR(W,3):NEXT:CLOSE1
64 GOTO25
65 INPUT"CHANGE WHICH LINE  (0, IF THROUGH)";CL:IFCL=0THEN24
66 CLS:PRINT"CHANGE EACH ITEM AS IT APPEARS":PRINT
67 PRINT"STATION VALUE ";P(CL,1);:INPUTP(CL,1)
68 PRINT"UPPER SURFACE ";P(CL,2);:INPUTP(CL,2)
69 PRINT"LOWER SURFACE ";P(CL,3);:INPUTP(CL,3)
70 GOTO59
100 INPUT"TABLE NO. ";TN
101 LPRINT,"  DATA TABLE FOR ";N$(DF);" AIRFOIL":LPRINT:
102 LPRINT,"  STATION"," UPPER"," LOWER"
103 LPRINT,"   VALUE","SURFACE","SURFACE":LPRINT
104 DT$="##  ###.##       ##.###          ##.###"
105 FORQ=1TONS:LPRINT,USINGDT$;Q,P(Q,1),P(Q,2),P(Q,3):NEXT
106 LPRINT:LPRINT:LPRINT,"                    TABLE -";TN
```


See List of Advertisers on Page 455

This system uses only one key.

Plant a Binary Tree

Ken Knecht
1340 West Third St. #130
Yuma, AZ 85364

You might wish to plant the binary tree in your random disk files. Easy to utilize, it requires only two bytes in each record. It allows for fast sorted printouts, in key data order, and very quick searches for a record using key data.

Key data is the record data most often used for sorts and when searching for a record. For example, in an inventory file it could be a part number.

The system described here only permits one key. The disadvantage of this is that you cannot use the binary tree's help in searching for an address in a mailing list if names are used as your key data. A sequential search is needed in this case. Also, you cannot move records around in a file or easily replace deleted records when using the binary tree.

The system works most efficiently with blocked files (random length records), like those found in LDOS and Model III TRSDOS. Note: You can't use several subrecords in each 256-byte record without modifying the system.

In the following example I've used records consisting of three fields: a part number; a part description; and the quantity. (In actual use as many fields as needed could be used.) The part number is the key data field. The file layout is as follows:

Part Number Field	10 Characters
Description Field	20 Characters
Quantity Field	Integer Number (2 Bytes)

The field statement resulting from the above file layout is:

```
1000 FIELD 1, 10 AS A$, 20 AS B$, 2 AS
C$, 1 AS D$, 1 AS E$: RETURN
```

The D$ and E$ field variables store the binary tree pointers.

Before we go any further, let me explain how a binary tree is formed (see Fig. 1). The LP (for the left pointer) stores the offset to the next record number whose key field is lower (in this case lower in alphabetical order) than the present record. The RP (for right pointer) stores the offset to the next record number whose key field is higher than the present record. RN stands for the present record number. Figure 2 shows ten records, stored by key field in the following order: P50, P40, P10, P30, P60, P80, P100, P70, P20 and P90. Remember, LP and RP are offsets from the present record number to the next record number.

To search for the key field P70 start at Record 1 (always begin at Record 1) and note if the key field is higher or lower. Record 1 contains P50; P70 is higher. Next, look at the right pointer. This pointer is a four so one (we are at Record 1) is added to four with a result of Record 5. Compare P70 to the P60 contained in Record 5; P70 is higher. Again, add the right pointer (one) to the record number (five) and go to the sum, or Record 6. Compare the P80 found in Record 6 with P70. This time the contents of the present record are higher so look at the left pointer. It is two, so add two to the record number (six) and move to Record 8 (the total). We compare again and

Figure 1

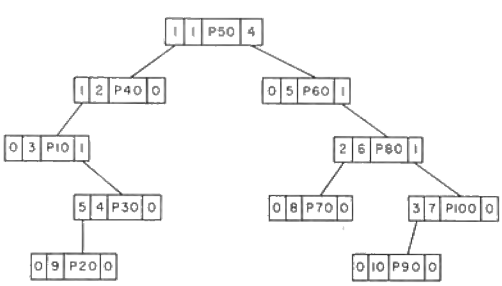

Figure 2

The Key Box

Basic Level II
Model III
16K RAM
LDOS or TRSDOS

Disk Drives and Cases

The B.T. Enterprises Mini-Floppy 5-1/4 inch Disk Drive Case is unique in that it is constructed of clear plexiglass. This innovative design is the first on the market which enables the user to actually see the Disk Drives working while using the computer. The case is constructed of a 1/4 inch durable plexiglass base with a 1/16 inch clear plexiglass cover. The case and power supply are available for single or dual drives. One advantage of the dual design is that both floppy drives are built into one case for saving space and easier handling.

The unit is equipped with a linear filtered power supply that is regulated to match the power consumption of the mini drives. The power is AC fuse protected with a chasis mounting fuse on the back of the case for easy maintenance. An on/off switch is provided on the bacck of the case. The AC line cord is a standard 3 prong plug designed to meet UL listing.

FLOPPY DISK DRIVES

201100*	5-1/4 Disk Drive Case & Power Supply (Sgl)	$ 79.95
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201103*	Tandon 80tk SH w/case & Supply	$ 399.95
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201203*	Dual Tandon 80tk SH w/case & Supply	$ 779.95
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*Complete with extender cable

Bare Drives

200101	Tandon 40tk SH Bare	$ 259.95
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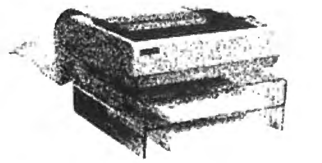
200103	Tandon 80tk SH Bare	$ 359.95
200104	Tandon 80tk DH Bare	$ 459.95

Helpful Products for Your Computer

Printer Stands



End the paper mess on your computer desk. Our printer stand allows your paper to be fed from under the printer, making room for the used paper to stack behind the print out of the way. Available with an optional removable shelf (Shown) for easy computer forms change. Available in Large size also, for MX-100 and other large printer users also. Also available with center slot for bottom feed printers. (Large only).

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Elephant Memories Systems Diskettes at a special LOW price!!!

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Clean all old data off of your diskettes before reusing them! This is a MUST for your computer room. Easy to use, non-electric, portable!!!

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Reload your old ribbon cartridge for much less than replacing the cartridge! Quick and easy to do, takes only about 2 minutes each to reload. Includes complete instructions. Available in Black and 4 popular colors!

Black Reload	(500000)	$3.95 ea.	(500001)	$39.95 dz.
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Green Reload	(500030)	$4.95 ea.	(500031)	$49.50 dz.
Brown Reload	(500040)	$4.95 ea.	(500041)	$49.50 dz.

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Blue Cartridge	(500070)	$11.95 ea.	(500071)	$31.95/3
Green Cartridge	(500080)	$11.95 ea.	(500081)	$31.95/3
Brown Cartridge	(500090)	$11.95 ea.	(500091)	$31.95/3

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```
12000 Y%=1: X%=LOF(1)+1: RP=0: LP=0: IF LEN(PN$)<10 THEN
      PN$ = PN$+STRING$(10-LEN(PN$),32)
12010 GOSUB 1000: GET 1,Y%
12020 IF LEFT$(A$,1)=CHR$(0) THEN X%=1: GOTO 12100
12030 IF PN$>A$ THEN A%=ASC(E$): GOTO 12070
12040 A%=ASC(D$)
12050 IF A%=0 THEN LSET D$=CHR$(X%-Y%): PUT 1,Y%: GOTO 12100
12060 Y%=Y%+A%: GOTO 12090
12070 IF A%=0 THEN LSET E$=CHR$(X%-Y%): PUT 1,Y%: GOTO 12100
12080 Y%=Y%+A%
12090 GET 1,Y%: GOTO 12030
12100 LSET A$=PN$: LSET B$=DE$: LSET C$=MKI$(QU%):
      LSET D$=CHR$(LP): LSET E$=CHR$(RP): PUT 1,X%: RETURN
```

Subroutine 1

```
14000 X%=1: GOSUB 1000: GET 1,X%: ER=0: IF LEN(PN$)<10 THEN
      PN$=PN$+STRING$(10-LEN(PN$),32)
14010 IF LEFT$(A$,1)=CHR$(0) THEN 14050
14020 IF PN$<A$ THEN Y%=ASC(D$): X%=X%+Y%: IF Y%=0 THEN 14050
      ELSE GET 1,X%: GOTO 14020
14030 IF PN$=A$ THEN RETURN
14040 Y%=ASC(E$): X%=X%+Y%: IF Y%=0 THEN 14050 ELSE GET 1,X%:
      GOTO 14020
14050 ER=1: RETURN
```

Subroutine 2

```
15000 X%=1: GOSUB 1000: GET 1,X%: ER=0: Z%=0: LN%(0)=0: Y%=1
15010 IF LEFT$(A$,1)=CHR$(0) THEN ER=1: RETURN ELSE 15030
15020 IF Y%>0 THEN GET 1,X%: GOTO 15030 ELSE 15040
15030 Z%=Z%+1: LN%(Z%)=X%: Y%=ASC(D$): X%=X%+Y%: GOTO 15020
15040 X%=LN%(Z%): Z%=Z%-1: IF X%=0 THEN ER=1: RETURN
15050 GET 1,X%: IF LEFT$(B$,1)=CHR$(0) THEN 15070
15060 RETURN
15070 Y%=ASC(E$): X%=X%+Y%: GOTO 15020 'REENTER HERE
```

Subroutine 3

find the key field, P70.

This search took four file accesses to find the record. If we had been looking for P10 it would have taken three. As more records are added to the file the advantages of the binary tree become greater. A balanced tree requires a maximum of nine accesses for a file containing 256 records. If searched sequentially this file would take an average of 128 accesses. The larger the file the more impressive the binary tree's results.

One peculiarity of the binary tree is that key fields must be entered in random order. If they were entered in alphabetical order the resulting tree would be the same as a sequential file. Try it and see!

Note also that the pointers are set to zero if they do not point to another record, signifying the end of a branch.

The Program

Subroutine 1 stores the first record and any thereafter. Use whatever code you wish to get the new part number in PN$, the description in DE$ and the quantity in QU%. Now call Subroutine 1 to store the binary tree pointers and the new record.

Assume our new key field is P45. Let's follow the subroutine through and store the new record in the tree. Figure 2 is the file before P45 is added.

In line 12000 Y% is set to one. The variable Y% contains the number of the record being examined for a space for P45. X% is set to LOF(1) plus one. This is the first empty record in the file, where the new record will be stored. However, the pointers must be set correctly first so we can find the record in the future. The pointer of the record designating the new record (from zero to the correct offset) must be changed.

In the same line (12000), spaces must be added to PN$ so it will be in the same format as the part numbers already in the file.

In line 12010 the program executes a GOSUB 1000 (the Field statement) and retrieves record Y%. If line 12020 finds Record 1 (Y%) to be empty (CHR$(0) as the first byte in the part number field) then the file is also empty, so line 12100 stores the record in record 1. Zeroes are stored in the LP and RP fields (preset in line 12000) as there are no other records to point to.

If a part number (the P50) is in Record 1, it is compared to the new part number, P45. Since the new part number is smaller the program skips to line 12040 and gets the LP in variable A% in line 12040 (A% equals one).

Line 12050 is skipped because A% does not equal zero. In line 12060 the program adds A% to Y% (1 + 1). Then in line 12090 the program retrieves the record Y% and goes back to 12030 to begin again.

Next P40 is found in record Y% (2); this time line 12030 is true. The RP in A% (A% equals zero) is retrieved and we jump to 12070. This time A equals zero so 12070 follows and the RP is LSET in record Y% to point to record X%. The record Y% is stored next and the program jumps to line 12100, stores record X%, and finally returns to the calling program.

Deleting Records

To delete a record change the first byte in the B$ field to a CHR$(0). (Do not change the A$ field or the searches and sorts won't work any more.) In the future test this byte to see if the record is deleted. Note, we leave the A$ field and the pointers in the D$ and E$ field intact in this record; you cannot use it again.

It is possible to write a routine to reset the previous pointers to skip this record so its space could be reused. However, I haven't found it necessary in my programs. This routine would also have to keep track of all the deleted record numbers so they could be reused. The present subroutine does not.

Part Number Searches

To search for a specific part number use Subroutine 2. The proper record number is returned in X%, and the proper data in the fielded variables (A$, B$ and C$ in this example). The variable ER is returned as zero if the record number in X% and the data are valid. If ER equals one, the record was not found.

Note how I use CHR$ and ASC for the pointers. I find this a convenient way to store positive integers from zero to 255 in a single byte in a random record. It only works for positive numbers, so don't use this method when writing a routine to reuse deleted records as mentioned earlier. You would have to use MKI$ and CVI for the pointers, two bytes for each—another reason I don't reuse deleted records.

You can use the binary tree pointers to give you a sorted printout. Subroutine 3 does the job. When you first use the subroutine begin with GOSUB 15000. This gets you the record lowest in alphabetical order. For the rest of the records in sorted order use GOSUB 15070. (See the example program.)

As long as ER equals zero your record data is the Fielded variables (in the example A$, B$ and C$) each time you return from the subroutine. If ER equals one you have completed the file. Deleted records are skipped in line 15050. You must DIM LN%(50) at the beginning of the program.

The sort algorithm is difficult to explain. Try walking through the subroutine using the file in Fig. 2 as an example. Don't forget to reenter the routine at 15070 for all records after the first one. If you keep using GOSUB 15000 you'll keep getting the first record.

The Program Listing demonstrates the use of the three subroutines. Enter it, line 1000 (the field statement), and the three subroutines and try out binary trees. Note the 34 at the end of the Open statement (line 10). If you don't have blocked files (variable length random records) leave this off.

Model III TRSDOS is supposed to support variable length records but as of this writing Version 1.2 does not do so properly. The program works perfectly using variable length records under LDOS.

Data can be changed in a record; however, don't change the key data field. If you must change the key data delete the record and generate a new one.

I think you will find the binary tree useful for files that only have one key field, and need fast searches and frequently sorted printouts. Remember to use blocked files (variable length records) and that the routines are not set up to use subrecords in a 256 byte record.

One last reminder: Enter key data in random order for a balanced, efficient tree. ■

The author is a free-lance writer, programmer and broadcast engineer. He has been associated with computers since the original MITS Altair.

```
10 CLEAR 1000: DIM LN%(50): OPEN"R",1,"TEST",34
20 PRINT"MENU
1: ADD RECORD
2: SEARCH FOR RECORD
3: PRINT SORTED FILE
4: FINISHED"
30 INPUT"CHOICE";CH:IF CH<1 OR CH>4 THEN 30
40 ON CH GOTO 50, 90, 150, 220
50 LINEINPUT "PART NUMBER? ";PN$: IF LEN(PN$)>10 THEN 50
60 LINEINPUT "DESCRIPTION? ";DE$: IF LEN(DE$)>20 THEN 60
70 INPUT"QUANTITY";QU%
80 GOSUB 12000: GOTO 20
90 LINEINPUT "PART NUMBER? ";PN$
100 GOSUB 14000
110 IF ER=1 THEN PRINT "PART NUMBER NOT FOUND": GOTO 20
120 PRINT "PART N0.","DESCRIPTION",,"QUANTITY"
130 PRINT A$, B$, CVI(C$)
140 GOTO 20
150 GOSUB 200: GOSUB 15000
160 IF ER=1 THEN 20 ELSE GOSUB 210
170 GOSUB 15070
180 IF ER=1 THEN 20 ELSE GOSUB 210
190 GOTO 170
200 LPRINT "PART N0.","DESCRIPTION",,"QUANTITY": RETURN
210 LPRINT A$, B$, CVI(C$): RETURN
220 CLOSE: END
1000 FIELD 1, 10 AS A$, 20 AS B$, 2 AS C$, 1 AS D$, 1 AS E$:
     RETURN
```

Program Listing

Does your 80 have a better poker face than you?

Casino Draw Poker

Ron Balewski
412 East Ridge St.
Nanticoke, PA 18634

Atlantic City casinos feature rows upon rows of electronic video draw poker games. More than conventional arcade games, these video games can get mighty expensive. Rather than depositing a quarter for a few minutes of play, these cost a dollar for about 15 seconds of play. Sure you can win some back, but as casinos are not charity institutions, you will probably not come out ahead. I enjoy the play, but not the losses. So I wrote my own poker software. Listing 1 is the result of this brainstorm.

Most of the program is written in Basic. I used machine language to draw the cards on the screen. Using a short machine-language routine helped keep the Basic program simpler.

The payoff table used by this program is identical to that in the casino machines. I do not recommend your changing it, but will tell you how just in case you can't resist. The graphics also closely duplicate the casino machines. The graphics are not quite as pretty, but they get the job done and in no way detract from the fun.

The Key Box

Model I or III
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Level II Basic

The Basic Program

Housekeeping is taken care of by lines 10–150. A routine POKEs in the machine-language routine and sets up constants such as the payoff table (line 130) and the win type strings (line 90).

Line 160 draws five random cards on the screen and lines 180–200 print the necessary text.

Elements of array DK(4,13) are set to zero at line 210. This array represents the deck of cards (four suits by 13 values per suit). Each time a card is dealt, its corresponding element in this array is set to one. By checking the array after randomly generating a card, the program can tell if it generated a duplicate and, if so, tries again.

Line 220 decodes the input commands and lines 230-300 perform the deposit coin function.

The subroutine starting at line 1000 POKEs the card value string in variable A$ into the card top and bottom images defined in the Assembly listing of the subroutine (Program Listing 2). The four locations used here correspond to assembly labels N1, N2, N3, and N4.

Subroutine 2000 prints a card of suit SU on the screen. The card's upper left corner is printed at position PL. Sound is also generated in this routine.

Section 3000 lets you add money to your pot. Section 4000 prints a payoff chart on the video screen. Section 5000 prints an analysis of your losses (or winnings) at the end of play. Section 6000 deals the first five cards.

Section 7000 lets you draw new cards. Lines 7010–7080 accept the input of cards to be redrawn, while lines 7100–7200 deal the new cards.

Your cards are checked for a win at section 8000. All five of your cards are stored in array CS(5,2) where CS(n,1) is the value of the nth card and CS(n,2) is the suit of the nth card.

Section 9000 pays your winnings. Everything up to line 9040 deals with a standard win. The rest is for a royal flush win. Holding the top hand treats you to some special effects.

Subroutine 11000 POKEs the machine-language program into reserved memory. I used Datagen by Dan and Cass Lewart (see *80 Micro*, August 1981) to generate the data statements.

The Assembly Listing

The first 10 bits of the argument contain the print position on the screen. With 10 bits you can get up to 1024 print positions, exactly how many there are on the screen. The 11th and 12th bits are set or reset depending on the suit of the card to be printed, as indicated on the top of the listing. Bits 11 and 12 of a binary number have decimal values of 1024 and 2048. By adding this amount to another decimal number, the corresponding bit in the binary representation will be set to one (provided it was zero to start with).

Basic line 120 sets up an array of values to be added to the print location for each suit. As an example, notice that SV(3) is set to 3072. This is the sum of 1024 and 2048. When this amount is added to a print location, both bits 11 and 12 will be set. This combination will print a spade (comment line 250). Basic line 2020 uses the array SV in calculating the argument for the USR call.

Assembly line 290 gets the argument from Basic. The argument is then duplicated in registers DE (lines 3100–3110). Bits two and three of the H register are reset (lines 320–330) to mask out the suit bits, leaving only the print location in HL. (An AND 03H operation could have been used here just as effectively as the two RES instructions.) Next D is shifted right twice (lines 340–350) and incremented (line 360) to give D a value between one and four, depending on the suit selected. The suit value is stored in C temporarily (line 370). 3C00H is now added to HL (lines 380–390) to give the actual location in memory of where to draw the cards. The top two lines of a card are written to it (lines 410–420) by calling subroutine MOVE2L. Then DE is set to point to the proper suit picture in memory (lines 440–510) and move the three lines with the suit symbol to the screen using subroutine MOVE3L (line 520). The value for DE is calculated by first setting DE to 36 below the start of the suit images. Then 36 is added to DE from one to four times, depending on the suit value saved earlier in register C. (Each suit image is three lines long by 12 bytes per line, or 36 bytes total.) Last, the bottom two lines of the card are printed (lines 540-560).

The Subroutines

MOVE2L just calls subroutine MOVE1L twice while routine MOVE3L calls MOVE1L three times. This could have been eliminated by putting multiple CALL MOVE1Ls in the main program. But, I think this method looks a little nicer.

Subroutine MOVE1L is where the action really takes place. Here 12 bytes are moved from the image line pointed to by registers DE and stored in video memory starting at the location stored in HL. The DJNZ loop takes care of this (lines 900-950). Next, 52 is added to the video pointer register HL. This sets the pointer to exactly one screen line below where this line started, in preparation for printing the next line of the card.

TOPHAF and BOTHAF contain graphics for the top and bottom two lines of the cards. They are the same no matter what suit is being printed.

Sound is a modified version of the Supersound routine (see *80 Micro*, May 1980).

The rest of this listing contains all the DEFBs needed to define the graphic characters in the card suits.

How to Play

Set your memory size to 32255 to reserve space for the machine-language routine. Then CLOAD and Run. After it sets up the machine-language subroutine five cards will be dealt out complete with the "plop... plop" of cards hitting a table. Since these cards are just for show, I did not put values on them.

Your pot starts at 50 coins as displayed. To insert coins into the machine, just press the down arrow key. Just like the casino machines, you can insert up to five coins for each play. Each time you feed the machine you will hear the "ker-plunk" of dropping money and the coin accepted light will flash.

Press the space bar to tell the computer to deal your hand. Each card is numbered and has the word Keep printed below it. If you want to draw a new card in place of one, tap its corresponding number key. You will get a strange noise (maybe the dealer ruffling the deck) and the word under the card will change to Draw. If you make a mistake or change your mind, press the left arrow key. All cards will return to the Keep state. When you are satisfied with your draw choices, hit the space bar again to get your new cards. If you win, the type of win will be printed above the cards and coins will tinkle into your pot.

How many coins? All machines have payoff charts stuck on them somewhere. Press the P key for your payoff chart. The win combinations are on the left and the number of coins played is along the top. These payoffs are completely authentic, having come from a machine in Altantic City.

Since these are casino odds, you will probably lose your 50 coins fast. To keep playing hit the M key for more money and enter how many coins you want added to the pot.

To quit type Q. You will be told how many coins you had, how many you have left and how many you lost or won.

Changing the Payoff

Basic line 130 defines the payoff table in array PT. PT(1,n) contains the payoff for a pair of jacks or better with n coins played. The payoffs then proceed upwards in order of value until PT(9,n) contains the payoff for a royal flush with n coins played. All payoffs are direct multiples except for the royal flush at five coins. This is a super big pot. The casinos use the chance to win this grand amount of money as an incentive for people to deposit five coins per play instead of less.

I have not hit the royal flush yet and would love to hear from anyone who does. One word of warning: When you lose money to your TRS-80 and try to pay up by forcing money into the machine through the ventilation slots, be sure to use paper money—coins may short something out! ■

Ron Balewski, a self-employed free-lance programmer, enjoys ham radio, model railroading, community theater and electronics.

Program Listing 1. Basic

```
1 REM ***** C A S I N O   D R A W   P O K E R *****
2 REM                    by Ron Balewski
3 REM
4 REM                    November 3, 1981
5 REM
6 REM
1Ø CLEAR5ØØ:DEFINTA-Z
2Ø DIMDK(4,13),CS(5,2),SV(3),IM$(13),PT(9,5),WN$(9)
3Ø CLS:PRINTTAB(16)"* * * D R A W   P O K E R * * *":PRINT:PRINT
TAB(2Ø)"JUST A MINUTE, PLEASE."
4Ø GOSUB11ØØØ
9Ø WN$(1)="PAIR":WN$(2)="2 PAIR":WN$(3)="3 OF A KIND":WN$(4)="ST
RAIGHT":WN$(5)="FLUSH":WN$(6)="FULL HOUSE":WN$(7)="4 OF A KIND":
WN$(8)="STRAIGHT FLUSH":WN$(9)="ROYAL FLUSH"
1ØØ POKE16526,13Ø:POKE16527,126
11Ø PO=5Ø:MA=5Ø
12Ø SV(Ø)=Ø:SV(1)=1Ø24:SV(2)=2Ø48:SV(3)=3Ø72
13Ø PT(1,1)=1:PT(2,1)=2:PT(3,1)=3:PT(4,1)=4:PT(5,1)=6:PT(6,1)=9:
PT(7,1)=25:PT(8,1)=5Ø:PT(9,1)=25Ø:FORK1=1TO9:FORK2=2TO5:PT(K1,K2
)=PT(K1,1)*K2:NEXTK2:NEXTK1:PT(9,5)=4ØØØ
14Ø N1=32352:N2=32358:N3=32364:N4=3237Ø
15Ø IM$(1)="A ":IM$(2)="2 ":IM$(3)="3 ":IM$(4)="4 ":IM$(5)="5 ":
IM$(6)="6 ":IM$(7)="7 ":IM$(8)="8 ":IM$(9)="9 ":IM$(1Ø)="1Ø":IM$
(11)="J ":IM$(12)="Q ":IM$(13)="K "
16Ø CLS:A$="    ":GOSUB1ØØØ:FORK=1TO5:SU=RND(4):PL=32Ø+(K-1)*13:G
OSUB2ØØØ:NEXTK
18Ø PRINT@768,CHR$(31);:PRINT@2Ø,"FIVE CARD DRAW POKER";:PRINT@8
4,STRING$(2Ø,"=");:PRINT@768,"O P T I O N S :";:PRINT@835,"DEPOS
IT COIN":PRINT@854,"COINS PLAYED";:PRINT@1Ø1Ø,PO;:PRINT@942,"**
YOUR POT **";
19Ø NC=Ø
2ØØ PRINT@922,NC;
21Ø FORK1=1TO4:FORK2=1TO13:DK(K1,K2)=Ø:NEXTK2:NEXTK1
22Ø A$=INKEY$:IFA$=" "ANDNC>ØTHEN6ØØØELSEIFA$=""THEN22ØELSEIFA$=
"P"THENGOTO4ØØØELSEIFA$="Q"THENGOTO5ØØØELSEIFA$="M"THENGOTO3ØØØE
LSEIFA$<>CHR$(1Ø)THEN22Ø
23Ø IFPO=ØTHEN22Ø
24Ø IFNC<5THENNC=NC+1:PO=PO-1:PRINT@922,NC;:PRINT@1Ø1Ø,PO;:PRINT
@982,"COIN ACCEPTED";:X=USR(296):X=USR(266):FORK1=1TO3Ø:NEXTK1:P
RINT@982,"             ";ELSEGOTO22Ø
26Ø PRINT@899,"DEAL";
```

Listing 1 Continues

Listing 1 Continued

```
280 IFNC=5PRINT@835,"              ";
300 GOTO220
1000 ' LOAD A$ INTO THE CARDS
1010 AL=ASC(LEFT$(A$,1)):AR=ASC(RIGHT$(A$,1))
1020 POKEN1,AL:POKEN1+1,AR:POKEN2,AL:POKEN2+1,AR
1030 POKEN3,AL:POKEN3+1,AR:POKEN4,AL:POKEN4+1,AR
1040 RETURN
2000 ' PUT CARD SUIT SU, VALUE CV AT LOCATION PL
2010 POKE16526,0
2020 X=USR(SV(SU-1)+PL)
2030 POKE16526,130
2035 FORKA=290TO400STEP15:X=USR(KA):NEXT
2040 RETURN
3000 ' ADD MONEY TO YOUR POT
3010 CLS
3020 PRINT@260,"HOW MANY COINS WOULD YOU LIKE TO ADD TO YOUR POT
";
3030 INPUTAM:PO=PO+AM:MA=MA+AM
3040 PRINT@772,"SO FAR YOU ADDED";MA;" COINS TO YOUR POT."
3050 FORK1=1TO1000:NEXTK1
3060 GOTO160
4000 ' PRINT PAYOFF TABLE
4010 CLS:PRINT@20,"P O K E R   P A Y O F F   T A B L E"
4020 PRINT:PRINT"  # COINS PLAYED ===> 1        2        3
  4        5":PRINTSTRING$(64,"=");
4030 PRINT"ROYAL FLUSH":PRINT"STRAIGHT FLUSH":PRINT"4 OF A KIND"
:PRINT"FULL HOUSE":PRINT"FLUSH":PRINT"STRAIGHT":PRINT"3 OF A KIN
D":PRINT"2 PAIR":PRINT"PAIR JK OR BETTER"
4040 FORK1=1TO9:FORK2=1TO5
4050 PRINT@(203+(K1*64)+(9*K2)),PT(10-K1,K2);
4060 NEXTK2:NEXTK1
4070 PRINT@980,"PRESS ANY KEY TO RETURN TO GAME.";:KY$=INKEY$
4080 KY$=INKEY$:IFKY$=""THEN4080ELSEGOTO160
5000 ' END OF GAME ANALYSIS
5010 CLS:PRINT:PRINTTAB(10)"A N A L Y S I S :"
5020 PRINT:PRINT"PERSONAL MONEY USED";TAB(20);"==>";MA;"COINS":P
RINT"MONEY LEFT IN POT";TAB(20);"==>";PO;"COINS"
5030 PRINTTAB(20)"==========":PRINT"NET GAIN/LOSS";TAB(20);ABS(P
O-MA);"COINS ";
5040 IFPO>MAPRINT"GAINED"ELSEIFPO=MATHENPRINT" *** EVEN ***"ELSE
PRINT"LOST"
5050 PRINT:PRINT:PRINT:STOP:END
6000 ' DEAL INITIAL 5 CARDS
6010 CLS
6030 FORK=1TO5
6050 SU=RND(4):CV=RND(13):IFDK(SU,CV)=1GOTO6050
6070 DK(SU,CV)=1
6090 A$=IM$(CV):GOSUB1000:
6110 CS(K,1)=CV:CS(K,2)=SU:PL=320+(K-1)*13:GOSUB2000
6150 NEXTK
7000 '  PROCESS DRAWS
7010 FORK=1TO5:PRINT@899+13*(K-1),"CARD";:PRINT@964+13*(K-1),K;:
PRINT@771+13*(K-1),"KEEP";:KT(K)=0:NEXTK
7030 A$=INKEY$:IFA$=""THEN7030ELSEIFA$=" "THEN7100ELSEIFA$=CHR$(
8)THENFORK=1TO5:KT(K)=0:PRINT@771+13*(K-1),"KEEP";:NEXTK:GOTO703
0
7050 A=VAL(A$):IFA<1ORA>5THEN7030
7060 IFKT(A)=0THENFORKA=1TO5:X=USR(512):NEXTKA
7070 KT(A)=1:PRINT@771+13*(A-1),"DRAW";
7080 GOTO7030
7100 FORK=1TO5
7120 IFKT(K)=0GOTO7200
7140 SU=RND(4):CV=RND(13):IFDK(SU,CV)=1GOTO7140
7160 DK(SU,CV)=1:A$=IM$(CV):GOSUB1000
7180 CS(K,1)=CV:CS(K,2)=SU:PL=320+(K-1)*13:GOSUB2000
7200 NEXTK
8000 ' DETERMINE WINS AND PAYOFFS
8020 WV=0
8040 FORK=1TO4:FORL=4TO1STEP-1:IFCS(L,1)>CS(L+1,1)THENTP=CS(L,1)
:CS(L,1)=CS(L+1,1):CS(L+1,1)=TP:TP=CS(L,2):CS(L,2)=CS(L+1,2):CS(
L+1,2)=TP
8060 NEXTL:NEXTK
8100 ' ROYAL FLUSH
```

Listing 1 Continues

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Speed Improvement (Ratio)				Operation	Space Degradation (Bytes)			
INT	SNG	DBL	STR		INT	SNG	DBL	STR
178	28	20	7.3	Assignment (LET)	−4	0	0	0
3.5	3.6	3.6	3.5	Array Reference (1-dim)	13	13	13	13
3.0	3.0	3.0	3.0	Array Reference (2-dim)	12	12	12	12
35	1.8	1.6		AND, OR	4	7	7	
23	2.0	1.6	6.6	Compare (=, >, <, etc.)	3	10	10	3
57	1.8	1.4	3.6	Add, Concatenate (+)	1	6	6	2
48	1.8	1.3		Subtract (−)	4	6	6	
1.5	1.5	1.1		Multiply (*)	6	6	6	
1.08	1.17	1.02		Divide (/)	6	6	6	
77	70	84	9.3	Constant Reference	0	6	4	4
7.1	1.9			FOR—NEXT	6	23		
111	6.8	4.8		POKE	−1	5	5	
10	4.5	3.6		SET, RESET	−1	5	5	
47	4.6	3.0	8.1	IF THEN ELSE	3	9	9	3
33	4.3	3.5		ON expression GOTO	−2	0	0	
50	6.8	5.1		ON expression GOSUB	0	3	3	
1.2	1.01	1.03	1.2	PRINT simple-variable	−1	−1	−1	−1
61	5.0	3.7		OUT	5	11	11	
				Flow of Control				
	216			GOTO		−7		
	74			GOSUB/RETURN		−10		
				Functions				
inf	inf	inf	inf	VARPTR	−3	−3	−3	−3
5.2	1.9	1.7		POINT	3	9	9	
38	2.3	1.7		INP	5	8	8	
149	2.3	2.0		PEEK	0	3	3	
				String Functions				
			53	ASC				5
			258	LEN				0
			4.8	LEFT$				1
			4.7	RIGHT$				1
			6.4	MID$				2
			25	CHR$				0
			36	CVI				0
			16	MKI$				0
			7.1	CVS				0
			25	MKS$				0
			5.4	CVD				0
			16	MKD$				0

(4) Correct BASIC programs (no dynamic renaming, no out-of-range arguments) compile without modification.

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EDIT **EDIT is to your line-editor as disk is to tape, lets you work and play in one more dimension.** **$40**

```
8110 FF=1:FORK=2TO5:IFCS(1,2)<>CS(K,2)THENFF=0:NEXTKELSENEXTK
8120 IF(FF=1)AND(CS(1,1)=13)AND(CS(2,1)=12)AND(CS(3,1)=11)AND(CS
(4,1)=10)AND(CS(5,1)=1)THENWT=9:GOTO9000
8140 IF(CS(1,1)=CS(2,1))AND(CS(1,1)=CS(3,1))AND(CS(1,1)=CS(4,1))
THENWT=7:GOTO9000
8150 IF(CS(2,1)=CS(3,1))AND(CS(2,1)=CS(4,1))AND(CS(2,1)=CS(5,1))
THENWT=7:GOTO9000
8160 ' STRAIGHT FLUSH
8170 SF=1:FORK=1TO4:IF((CS(K,1))<>(CS(K+1,1)-1))THENSF=0:NEXTKEL
SENEXTK
8175 IFCS(1,1)=1ANDCS(2,1)=10ANDCS(3,1)=11ANDCS(4,1)=12ANDCS(5,1
)=13THENSF=1
8180 IFSF=1ANDFF=1THENWV=8:GOTO9000
8190 ' STRAIGHT
8200 IFSF=1THENWV=4:GOTO9000
8210 ' FLUSH
8220 IFFF=1THENWV=5:GOTO9000
8230 ' FULL HOUSE
8240 IF(CS(1,1)=CS(2,1))AND(CS(1,1)=CS(3,1))AND(CS(4,1)=CS(5,1))
THENWV=6:GOTO9000
8250 IF(CS(1,1)=CS(2,1))AND(CS(3,1)=CS(4,1))AND(CS(3,1)=CS(5,1))
THENWV=6:GOTO9000
8260 ' 3 OF A KIND
8270 KR=1:KM=0:FORK=2TO5
8280 IFCS(K,1)=CS(K-1,1)THENKR=KR+1ELSEIFKM<KRTHENKM=KR:PV=CS(K-
1,1):KR=1ELSEKR=1
8290 NEXTK:IFKR>KMTHENKM=KR:PV=CS(5,1)
8300 IFKM=3THENWV=3:GOTO9000
8310 ' 2 PAIR
8320 IF(CS(1,1)=CS(2,1))AND(CS(3,1)=CS(4,1))THENWV=2:GOTO9000
8330 IF(CS(1,1)=CS(2,1))AND(CS(4,1)=CS(5,1))THENWV=2:GOTO9000
8340 IF(CS(2,1)=CS(3,1))AND(CS(4,1)=CS(5,1))THENWV=2:GOTO9000
8350 ' 1 PAIR, JACKS OR BETTER
8360 IFKM=2AND(PV>10ORPV=1)THENWV=1:GOTO9000
9000 ' GIVE WINNINGS
9010 IFWV=0THENGOTO180
9015 PRINT@768,CHR$(31);:PRINT@287-(LEN(WN$(WV))/2),WN$(WV);:PRI
NT@942,"** YOUR POT **";:IFWV=9GOTO9100
9020 FORK=1TOPT(WV,NC):PO=PO+1:PRINT@1010,PO;:X=USR(261+RND(15))
:FORK1=1TO30:NEXTK1:NEXTK
9030 WV=0
9040 GOTO180
9100 ' JACKPOT -- ROYAL FLUSH
9110 PO=PO+PT(WV,NC):PRINT@1010,PO;
9120 FORK=1TO6:FORL=300TO257STEP-1:X=USR(L):NEXTL:NEXTK
9130 FORK=1TO100:NEXTK
9200 STOP
11000 ' SET MACHINE LANGUAGE PROGRAM
11010 K=32256:FORL=1TO300
11020 READM:POKEK,M
11030 K=K+1:NEXTL:RETURN
11040 DATA 205,127, 10,229,209,203,148,203,156,203
11050 DATA  58,203, 58, 20, 74, 17,  0, 60, 25, 17
11060 DATA  82,126,205, 48,126,229, 17, 36,  0, 33
11070 DATA 118,126, 65, 25, 16,253,235,225,205, 55
11080 DATA 126, 17,106,126,205, 48,126,201,205, 65
11090 DATA 126,205, 65,126,201,205, 65,126,205, 65
11100 DATA 126,205, 65,126,201,197,  6, 12, 26,119
11110 DATA  19, 35, 16,250,213, 17, 52,  0, 25,209
11120 DATA 193,201,188,140,140,140,140,140,140,140
11130 DATA 140,140,140,188,191,128, 32, 32,128,128
11140 DATA 128,128, 32, 32,128,191,191,128, 32, 32
11150 DATA 128,128,128,128, 32, 32,128,191,131,131
11160 DATA 131,131,131,131,131,131,131,131,131,131
11170 DATA 205,127, 10, 62,  1, 14,  0, 69, 47,230
11180 DATA   3,211,255, 13, 40,  4, 16,247, 24,243
11190 DATA  37, 32,242,201,191,160,188,191,189,180
11200 DATA 160,190,191,188,144,191,191,130,143,191
11210 DATA 191,191,191,191,191,143,129,191,191,128
11220 DATA 128,128,131,139,135,131,128,128,128,191
11230 DATA 191,128,128,128,128,190,189,128,128,128
11240 DATA 128,191,191,136,174,191,140,174,157,140
11250 DATA 191,157,132,191,191,128,128,128,140,143
```

Listing 1 Continues

Listing 1 Continued

```
11260 DATA 143,140,128,128,128,191,191,128,128,160
11270 DATA 184,190,189,180,144,128,128,191,191,128
11280 DATA 130,139,175,191,191,159,135,129,128,191
11290 DATA 191,128,128,128,128,130,129,128,128,128
11300 DATA 128,191,191,128,128,176,188,190,189,188
11310 DATA 176,128,128,191,191,128,130,175,159,175
11320 DATA 159,175,159,129,128,191,191,128,128,128
11330 DATA 140.143,143,140,128,128,128,191,253,  4
```

Program Listing 2. Assembly Language

```
                 ;                 ******************************
                 ;                 *   CARD PLACER SUBROUTINE   *
                 ;                 ******************************
                 ;                              BY
                 ;                         RON BALEWSKI
                 ;
                 ;                     SEPTEMBER 28,  1981
                 ;
                 ;
                 ;  MAIN PROGRAM
                 ;  ARGUMENT --    1ST 10 BITS     -PRINT POSITION
                 ;                 BITS 11 & 12    -CARD AS FOLLOWS
                 ;                                         00 - HEARTS
                 ;                                         01 - CLUBS
                 ;                                         10 - DIAMONDS
                 ;                                         11 - SPADES
                 ;
                 ;
7E00                           ORG      7E00H
7E00 CD7F0A      CARD          CALL     0A7FH
7E03 E5                        PUSH     HL
7E04 D1                        POP      DE
7E05 CB94                      RES      2,H
7E07 CB9C                      RES      3,H
7E09 CB3A                      SRL      D
7E0B CB3A                      SRL      D
7E0D 14                        INC      D
7E0E 4A                        LD       C,D
7E0F 11003C                    LD       DE,3C00H
7E12 19                        ADD      HL,DE
                 ;  DISPLAY TOP 2 LINES OF CARD
7E13 11527E                    LD       DE,TOPHAF
7E16 CD307E                    CALL     MOVE2L
                 ; DETERMINE WHERE THE PROPER SUIT IS AND DISPLAY IT
7E19 E5                        PUSH     HL
7E1A 112400                    LD       DE,36
7E1D 21767E                    LD       HL,CARDIM-36
7E20 41                        LD       B,C
7E21 19          NXTADD        ADD      HL,DE
7E22 10FD                      DJNZ     NXTADD
7E24 EB                        EX       DE,HL
7E25 E1                        POP      HL
7E26 CD377E                    CALL     MOVE3L
                 ;  DISPLAY BOTTOM 2 LINES OF CARD
7E29 116A7E                    LD       DE,BOTHAF
7E2C CD307E                    CALL     MOVE2L
7E2F C9                        RET
                 ;
                 ;
                 ;                 **********
                 ;                 * MOVE2L *
                 ;                 **********
                 ;
                 ;         MOVE 2 12-BYTE LINES TO THE VIDEO SCREEN.  DE
                 ; IS THE SOURCE, HL IS THE DESTINATION.
7E30 CD417E      MOVE2L        CALL     MOVE1L
7E33 CD417E                    CALL     MOVE1L
7E36 C9                        RET
                 ;
                 ;
                 ;                 *********
                 ;                 * MOVE3L *
                 ;                 **********
                 ;
                 ;         MOVE 3 12-BYTE LINES TO THE VIDEO SCREEN.  DE IS
                 ;  THE SOURCE ADDRESS,  HL IS THE DESTINATION ADDRESS.
7E37 CD417E      MOVE3L        CALL     MOVE1L
7E3A CD417E                    CALL     MOVE1L
7E3D CD417E                    CALL     MOVE1L
7E40 C9                        RET
```

Listing 2 Continues

✓See List of Advertisers on Page 455

Listing 2 Continued

```
                00800 ;
                00810 ;
                00820 ;                   ***********
                00830 ;                   * MOVE1L *
                00840 ;                   ***********
                00850 ;
                00860 ;          MOVE 1 12-BYTE LINE FROM (DE) TO (HL) AND ADD 52
                00870 ;  TO HL TO RE-CYCLE TO TO THE NEXT LINE ON THE VIDEO
                00880 ;  DISPLAY.
7E41 C5         00890 MOVE1L  PUSH    BC
7E42 060C       00900         LD      B,12
7E44 1A         00910 NXTBYT  LD      A,(DE)
7E45 77         00920         LD      (HL),A
7E46 13         00930         INC     DE
7E47 23         00940         INC     HL
7E48 10FA       00950         DJNZ    NXTBYT
7E4A D5         00960         PUSH    DE
7E4B 113400     00970         LD      DE,52
7E4E 19         00980         ADD     HL,DE
7E4F D1         00990         POP     DE
7E50 C1         01000         POP     BC
7E51 C9         01010         RET
                01020 ;
                01030 ;
7E52 BC         01040 TOPHAF  DEFB    188
7E53 8C         01050         DEFB    140
7E54 8C         01060         DEFB    140
7E55 8C         01070         DEFB    140
7E56 8C         01080         DEFB    140
7E57 8C         01090         DEFB    140
7E58 8C         01100         DEFB    140
7E59 8C         01110         DEFB    140
7E5A 8C         01120         DEFB    140
7E5B 8C         01130         DEFB    140
7E5C 8C         01140         DEFB    140
7E5D BC         01150         DEFB    188
                01160 ; 2ND LINE
7E5E BF         01170         DEFB    191
7E5F 80         01180         DEFB    128
7E60 80         01190 N1      DEFB    128
7E61 80         01200         DEFB    128
7E62 80         01210         DEFB    128
7E63 80         01220         DEFB    128
7E64 80         01230         DEFB    128
7E65 80         01240         DEFB    128
7E66 80         01250 N2      DEFB    128
7E67 80         01260         DEFB    128
7E68 80         01270         DEFB    128
7E69 BF         01280         DEFB    191
                01290 ;
                01300 ;
7E6A BF         01310 BOTHAF  DEFB    191
7E6B 80         01320         DEFB    128
7E6C 80         01330 N3      DEFB    128
7E6D 80         01340         DEFB    128
7E6E 80         01350         DEFB    128
7E6F 80         01360         DEFB    128
7E70 80         01370         DEFB    128
7E71 80         01380         DEFB    128
7E72 80         01390 N4      DEFB    128
7E73 80         01400         DEFB    128
7E74 80         01410         DEFB    128
7E75 BF         01420         DEFB    191
                01430 ; 2ND LINE
7E76 83         01440         DEFB    131
7E77 83         01450         DEFB    131
7E78 83         01460         DEFB    131
7E79 83         01470         DEFB    131
7E7A 83         01480         DEFB    131
7E7B 83         01490         DEFB    131
7E7C 83         01500         DEFB    131
7E7D 83         01510         DEFB    131
7E7E 83         01520         DEFB    131
7E7F 83         01530         DEFB    131
7E80 83         01540         DEFB    131
7E81 83         01550         DEFB    131
                01560 ;
                01570 ;
                01580 ;
                01590 ;          *********
                01600 ;          * SOUND *
                01610 ;          *********
                01620 ;
                01630 ;          SOUND ROUTINE CALLED BY BASIC TO GENERATE SOUND
                01640 ;  EFFECTS.   NOT CALLED BY ABOVE MACHINE LANGUAGE PGM.
7E82 CD7F0A     01650 SOUND   CALL    0A7FH
```

Listing 2 Continues

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The Word Processor that re-wrote the book on Word Processing

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COMPARISON CHART	SUPER COLOR WRITER			THE COMPETITION		
System Size	4K	16K	32K	4K	16K	32K
TAPE Text space	N/A	8K	24K	N/A	2K	18K
ROMPAK Text space	2.5K	15K	31K	N/A	N/A	N/A
DISK Text space	N/A	6.5K	22.5K	N/A	0.5K	16.5K
Right Justify		YES			NO	
Video Window		YES			NO	
Edit any ASCII File		YES			NO	

The figures speak for themselves and with professional features like PROGRAMMABLE function string commands to perform up to 28 commands automatically, PROGRAMMABLE text file chaining, PROGRAMMABLE column insert & delete, and right hand JUSTIFICATION with punctuation precedence, the choice is clear but there's still more!

The **Super "Color" Writer** takes full advantage of the new breed of "smart printers" with Control codes 1-31, 20 Programmable control codes 0-255 for special needs and built in Epson MX-80, Centronics 737, 739 and R.S. Line Printer IV, VII, VIII drivers.

CHECK THESE FEATURES!!

HIGH SPEED & normal operations • 32K Compatible • Window • Key beep • HELP table • 128 character ASCII & graphics • Memory left • Lower case • Full cursor control • Quick paging • Scrolling • Word wrap around • Tabs • Repeat all functions • Repeat last command • Insert character & line • Delete character, delete to end of line, line to cursor, line & block • Block move, copy & delete • Global Search, Exchange & Delete • Merge or Append files • Imbed Control Codes in text • Underline • Superscripts • Subscripts • Headers, Footers & 2 Auxiliary footnotes on odd, even or all pages definable position • Flush right • Non-breakable space • 4 centering modes: 5, 8.3, 10 & 16.7 (CPI) • Full page & print formatting in text • Single sheet pause • Set Page length • Line length, Line spacing, Margins, page numbers • Title pages • Printer baud: 110, 300, 600, 1200, 2400 • Linefeeds after CR • Soft & hard formfeed • Works with 8 bit printer fix • and more!

SUPER "COLOR" WRITER DISK

The Disk version of the **Super "Color" Writer** works with the TRS-80C Disk System and has all the features listed above plus many more! Use with up to four Disk Drives. Includes an extended HELP table you can access at any time. Call a directory, print FREE space, Kill disk files and SAVE and LOAD text files you've created all from the **Super "Color" Writer.** Print, merge or append any **Super "Color" Terminal** file, ASCII file, BASIC program or Editor/Assembler source listing stored on the Disk or tape. The **Super "Color" Writer Disk** version has additional formatting and print features for more control over your printer and PROGRAMMABLE chaining of disk files for "hands off" operation. Print an entire BOOK without ever touching a thing!

Includes comprehensive operators manual.

TAPE $49.95 ROM PAK $74.95 DISK $99.95

Manual only, $7.00 Refundable with purchase.

COMMUNICATIONS

THE SUPER "COLOR" TERMINAL

Time Share, Smart Terminal, High-speed Data X'fer & Videotex

The **Super "Color" Terminal** turns the Color Computer into a Super-smart terminal with all the features of VIDEOTEX(TM) plus much more. COMMUNICATE with Dow Jones & Compuserve and with computers like the TRS-80(TM) MODEL I, II, III, APPLE etc., via moden or RS-232 direct! Save the data to tape or print it! Reduces ON—LINE cost to a minimum!

FEATURES

10 buffer size settings from 2-30K • Buffer full indicator • Lprints buffer contents • Full 128 ASCII keyboard • Compatible with **Super "Color" Writer** files • UPLOAD & DOWNLOAD ASCII files, Machine Language & Basic programs • Set RS-232 parameters • Duplex: Half/Full • Baud Rate: 110, 300, 600, 1200, 2400, 4800 • Word Lengths: 5, 6, 7 or 8 • Parity: Odd, Even or None • Stop Bits: 1-9 • Local linefeeds to screen • Tape save & load for ASCII files, Machine code & Basic programs • Unique clone feature for copying any tape.

Super "Color" Terminal Disk

The Disk version offers all the features listed above plus Host ability in full duplex • Lower case masking • 10 Keystroke Multiplier (MACRO) buffers on disk to perform repetitive log-on tasks and send short messages (up to 255 bytes) • Programmable prompts for send next line • Selectable character trapping • Set printer line length • Pagination • Linefeed with CR option • Printer Baud: 110, 300, 600, 1200 & 2400 • Documentation.

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Put your programs in a ROMPAK or execute tape based programs in a RAMPAK at $C000. Kit includes 1 socketed P.C. board that holds up to 4, 2716 EPROMs or 4, 2K Static Ram Chips for a total of 8K and a plastic housing to fit the rom port. $24.95

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Listing 2 Continued

```
7E85 3E01     01660          LD      A,1
7E87 0E00     01670          LD      C,0
7E89 45       01680 SOUND2   LD      B,L
7E8A 2F       01690          CPL
7E8B E603     01700 SOUND3   AND     3
7E8D D3FF     01710          OUT     (255),A
7E8F 0D       01720          DEC     C
7E90 2804     01730          JR      Z,SOUNDD
7E92 10F7     01740          DJNZ    SOUND3
7E94 18F3     01750          JR      SOUND2
7E96 25       01760 SOUNDD   DEC     H
7E97 20F2     01770          JR      NZ,SOUND3
7E99 C9       01780          RET
              01790 ;
              01800 ;
              01810 ;  HEART FIRST LINE
7E9A BF       01820 CARDIM   DEFB    191
7E9B A0       01830          DEFB    160
7E9C BC       01840          DEFB    188
7E9D BF       01850          DEFB    191
7E9E BD       01860          DEFB    189
7E9F B4       01870          DEFB    180
7EA0 A0       01880          DEFB    160
7EA1 BE       01890          DEFB    190
7EA2 BF       01900          DEFB    191
7EA3 BC       01910          DEFB    188
7EA4 90       01920          DEFB    144
7EA5 BF       01930          DEFB    191
              01940 ; HEART LINE 2
7EA6 BF       01950          DEFB    191
7EA7 82       01960          DEFB    130
7EA8 8F       01970          DEFB    143
7EA9 BF       01980          DEFB    191
7EAA BF       01990          DEFB    191
7EAB BF       02000          DEFB    191
7EAC BF       02010          DEFB    191
7EAD BF       02020          DEFB    191
7EAE BF       02030          DEFB    191
7EAF 8F       02040          DEFB    143
7EB0 81       02050          DEFB    129
7EB1 BF       02060          DEFB    191
              02070 ; HEART LINE 3
7EB2 BF       02080          DEFB    191
7EB3 80       02090          DEFB    128
7EB4 80       02100          DEFB    128
7EB5 80       02110          DEFB    128
7EB6 83       02120          DEFB    131
7EB7 8B       02130          DEFB    139
7EB8 87       02140          DEFB    135
7EB9 83       02150          DEFB    131
7EBA 80       02160          DEFB    128
7EBB 80       02170          DEFB    128
7EBC 80       02180          DEFB    128
7EBD BF       02190          DEFB    191
              02200 ; CLUB LINE 1
7EBE BF       02210          DEFB    191
7EBF 80       02220          DEFB    128
7EC0 80       02230          DEFB    128
7EC1 80       02240          DEFB    128
7EC2 80       02250          DEFB    128
7EC3 BE       02260          DEFB    190
7EC4 BD       02270          DEFB    189
7EC5 80       02280          DEFB    128
7EC6 80       02290          DEFB    128
7EC7 80       02300          DEFB    128
7EC8 80       02310          DEFB    128
7EC9 BF       02320          DEFB    191
              02330 ; CLUB LINE 2
7ECA BF       02340          DEFB    191
7ECB 88       02350          DEFB    136
7ECC AE       02360          DEFB    174
7ECD BF       02370          DEFB    191
7ECE 8C       02380          DEFB    140
7ECF AE       02390          DEFB    174
7ED0 9D       02400          DEFB    157
7ED1 8C       02410          DEFB    140
7ED2 BF       02420          DEFB    191
7ED3 9D       02430          DEFB    157
7ED4 84       02440          DEFB    132
7ED5 BF       02450          DEFB    191
              02460 ; CLUB LINE 3
7ED6 BF       02470          DEFB    191
7ED7 80       02480          DEFB    128
7ED8 80       02490          DEFB    128
7ED9 80       02500          DEFB    128
7EDA 8C       02510          DEFB    140
```

Listing 2 Continues

Listing 2 Continued

```
7EDB 8F        02520           DEFB    143
7EDC 8F        02530           DEFB    143
7EDD 8C        02540           DEFB    140
7EDE 80        02550           DEFB    128
7EDF 80        02560           DEFB    128
7EE0 80        02570           DEFB    128
7EE1 BF        02580           DEFB    191
               02590 ; DIAMOND LINE 1
7EE2 BF        02600           DEFB    191
7EE3 80        02610           DEFB    128
7EE4 80        02620           DEFB    128
7EE5 A0        02630           DEFB    160
7EE6 B8        02640           DEFB    184
7EE7 BE        02650           DEFB    190
7EE8 BD        02660           DEFB    189
7EE9 B4        02670           DEFB    180
7EEA 90        02680           DEFB    144
7EEB 80        02690           DEFB    128
7EEC 80        02700           DEFB    128
7EED BF        02710           DEFB    191
               02720 ; DIAMOND LINE 2
7EEE BF        02730           DEFB    191
7EEF 80        02740           DEFB    128
7EF0 82        02750           DEFB    130
7EF1 8B        02760           DEFB    139
7EF2 AF        02770           DEFB    175
7EF3 BF        02780           DEFB    191
7EF4 BF        02790           DEFB    191
7EF5 9F        02800           DEFB    159
7EF6 87        02810           DEFB    135
7EF7 81        02820           DEFB    129
7EF8 80        02830           DEFB    128
7EF9 BF        02840           DEFB    191
               02850 ; DIAMOND LINE 3
7EFA BF        02860           DEFB    191
7EFB 80        02870           DEFB    128
7EFC 80        02880           DEFB    128
7EFD 80        02890           DEFB    128
7EFE 80        02900           DEFB    128
7EFF 82        02910           DEFB    130
7F00 81        02920           DEFB    129
7F01 80        02930           DEFB    128
7F02 80        02940           DEFB    128
7F03 80        02950           DEFB    128
7F04 80        02960           DEFB    128
7F05 BF        02970           DEFB    191
               02980 ; SPADE LINE 1
7F06 BF        02990           DEFB    191
7F07 80        03000           DEFB    128
7F08 80        03010           DEFB    128
7F09 B0        03020           DEFB    176
7F0A BC        03030           DEFB    188
7F0B BE        03040           DEFB    190
7F0C BD        03050           DEFB    189
7F0D BC        03060           DEFB    188
7F0E B0        03070           DEFB    176
7F0F 80        03080           DEFB    128
7F10 80        03090           DEFB    128
7F11 BF        03100           DEFB    191
               03110 ; SPADE LINE 2
7F12 BF        03120           DEFB    191
7F13 80        03130           DEFB    128
7F14 82        03140           DEFB    130
7F15 AF        03150           DEFB    175
7F16 9F        03160           DEFB    159
7F17 AF        03170           DEFB    175
7F18 9F        03180           DEFB    159
7F19 AF        03190           DEFB    175
7F1A 9F        03200           DEFB    159
7F1B 81        03210           DEFB    129
7F1C 80        03220           DEFB    128
7F1D BF        03230           DEFB    191
               03240 ; SPADE LINE 2
7F1E BF        03250           DEFB    191
7F1F 80        03260           DEFB    128
7F20 80        03270           DEFB    128
7F21 80        03280           DEFB    128
7F22 8C        03290           DEFB    140
7F23 8F        03300           DEFB    143
7F24 8F        03310           DEFB    143
7F25 8C        03320           DEFB    140
7F26 80        03330           DEFB    128
7F27 80        03340           DEFB    128
7F28 80        03350           DEFB    128
7F29 BF        03360           DEFB    191
7E00           03370           END     CARD
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```

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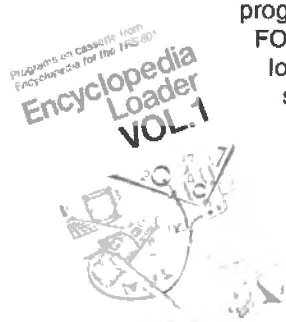

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EN11

After all, you print all the news that fits.

Make Those Headlines Fit

Richard Ramella
1493 Mountain View Avenue
Chico, CA 95926

Who needs a program that measures headline type?

- Student journalists who need electronic experience before they jump from typewriters to video display terminals.
- People who produce typeset newsletters, flyers and posters.
- Anyone who occasionally prepares material for publication.

TRS-80 ownership gives you powerful capabilities when preparing the printed word. Word processing systems such as the Electric Pencil and Scripsit offer writing and editing ease. Printing firms offer phone-to-phone typesetting originating from a TRS-80. The product is paper type, high resolution photos of material set to user specifications. After pasteup in the form desired, the material goes to a printer for production.

In short, the TRS-80 owner approaches the same production capability as newspapers which use sophisticated electronic word processing and typesetting computer systems.

Measuring headline type is a partial but integral part of this publication process.

The accompanying program is written in Level II Basic and is about 3000 bytes long. A line printer is helpful but is not necessary. If you do not have one, I will include a program modification.

Some Basics

Why must you count headline type? Body type, such as the type in which this article is set, is small enough that it can be justified to even lines throughout. But headline type is larger and must be counted with three aims: that it is neither too short nor too long for the space it will occupy, and that succeeding lines in the headline are about even in length.

Type comes in various sizes and is measured in points. The measurement "point" refers to height (see Fig. 1).

The same type style may come in condensed, medium and extended forms. This refers to the way the type is "squeezed,"

18 POINT
24 POINT
30 POINT
36 POINT
48 POINT
60 POINT
72 POINT

Fig. 1. Point sizes

The Key Box

Basic Level II
Model I
4K RAM
Line printer optional

"stretched" or left in regular dimensions. This sideways measurement is not absolute.

And last, the widths of different letters are different. For example, the letters l, m, R and W all have different count values. This program totals each line's count value and tells you how well it fits in the space you have allowed.

The only other esoteric information I must pass on has to do with column size. Your daily newspaper is divided into columns. Chances are, those columns are either 10 picas or 14 picas wide. Forget about picas except to note that a 10-pica column is about 1 5/8 inches wide, and a 14-pica column is about 2 5/16 inches wide. You need to know this if you decide to work with column widths other than the 10-pica standard this program uses.

How the Program Works

The program instructs you to make two punctuation substitutions: < for a comma (,) and an asterisk (*) for a colon (:). If you place a comma or a colon in an input response, the program ignores all following material. Remember to make these substitutions and be assured the final version will be translated into the correct punctuation marks.

Then make the four Input choices:

- Number of (10-pica) columns the headline will occupy.
- Type size (18–60 point).
- Condensed, medium or extended type.
- Number of lines in the headline.

The program flashes a reminder of the kind of headline you are going to write and then prompts you to enter the succeeding lines. The prompt also includes a field of dashes roughly defining the limit of the line.

Note for Model I Owners

If you own a Model I and have a line printer that can print lowercase characters you may have noticed something curious. If you want to LPRINT in lowercase, hold down the shift key; for uppercase, leave it up. In either case the screen prints only capital letters.

To relieve some of this Model I confusion, I have included a subroutine (lines 1160–1290) which exchanges the ASCII numbers of upper and lowercase letters. It affects only letters. So type as you would on a typewriter and it will print correctly.

Owners with built-in lowercase will want to delete the subroutine and the two GOSUB 1160 references at lines 560 and 840.

After your first try at writing the headline, it takes several seconds for the program to gauge each character's assigned width. It then reprints each line you have written with one of three messages to the right: 0 Perfect means the line fills all column space. N Short or N Long gives the number of counts the headline is over or under the column space allowed.

You can then rewrite any line; the program remeasures and gives you the result. This process of fits and starts comes to an end when your headline satisfies you and you enter 0 rather than the number of the line.

At this point the program prints the headline and adds the information the printer (not the line printer but the man with ink on his hands) needs to set it according to your specifications (for example, 2 column 24 point medium).

If you do not have a line printer, you will have to copy the headline by hand. In this case, delete lines 900–960, add 965 INPUT X so you can hold the result on the screen before the program reverts to its start for more headlines. Change LPRINT statements to PRINT statements in lines 870–880.

This program is nearly as good as those I used while working on computerized daily newspapers. The major difference is that this program requires you to rewrite a line in its entirety, whereas newspaper systems have a moveable cursor for deletions and additions.

A Disclaimer

The values I have used for the 10-pica columns adhere to standards that served me well in 20 years of writing newspaper

Program Listing

```
100 REM *FITS AND STARTS: A HEADLINE COUNTING PROGRAM* BY RICHARD RAMELLA
110 CLS
120 PRINT "WHEN WRITING HEADLINES, SUBSTITUTE"
130 PRINT "< FOR , AND * FOR :"
140 PRINT "LRPINT WILL TRANSLATE CORRECTLY."
150 INPUT "HIT ENTER TO CONTINUE";X
160 CLS
170 P = 0
180 CLEAR 400
190 INPUT "NUMBER OF COLUMNS"; K
200 INPUT "TYPE SIZE: 18 24 30 36 42 48 60"; S
210 PRINT "TYPE STYLE:"
220 INPUT "(CONDENSED - 1) (MEDIUM - 2) (EXTENDED - 3)"; T
230 INPUT "NUMBER OF LINES"; D
240 IF S = 18 THEN C = 16
250 IF S = 24 THEN C = 10
260 IF S = 30 THEN C = 8
270 IF S = 36 THEN C = 6.5
280 IF S = 42 THEN C = 6
290 IF S = 48 THEN C = 3.5
300 IF S = 60 THEN C = 2.5
310 IF T = 1 THEN C = C * 1.25
320 IF T = 3 THEN C = C * .75
330 H = K * C
340 A = H
350 E = INT(H)
360 B = A - E
370 IF B < .25 THEN H = INT(H): GOTO 400
380 IF B < .60 THEN H = INT(H) + .5: GOTO 400
390 H = INT(H) + 1
400 CLS
410 PRINT "NOW WRITING";K;"COLUMN";S;"POINT";
420 IF T = 1 PRINT " CONDENSED";
430 IF T = 2 PRINT " MEDIUM";
440 IF T = 3 PRINT " EXTENDED";
450 PRINT D;"LINE HEADLINE."
460 PRINT
470 PRINT "APPROXIMATE WIDTH"
480 PRINT
490 PRINT STRING$(9," ") + STRING$(INT(H),"-");
500 PRINT " COUNT";INT(H)
510 FOR F = 1 TO D
520 PRINT "LINE";F;
530 INPUT A$(F)
540 NEXT F
550 FOR F = 1 TO D
560 GOSUB 1160
570 NEXT F
580 FOR F = 1 TO D
590 G = LEN(A$(F))
600 FOR U = 1 TO G
610 B$ = MID$(A$(F),U,1)
620 J = ASC(B$)
630 IF J < 65 AND J > 31 GOSUB 990
640 IF J > 95 GOSUB 1080
650 IF J > 64 AND J < 96 GOSUB 1120
660 NEXT U
670 P(F) = P
680 P = 0
690 NEXT F
700 CLS
710 FOR F = 1 TO D
720 Q = H - P(F)
730 PRINT A$(F);" ";
740 IF Q = 0 PRINT Q "PERFECT"
750 IF Q < 0 PRINT Q - (Q + Q) "LONG"
760 IF Q > 0 PRINT Q "SHORT"
770 P(F) = 0
780 NEXT F
```

Listing continues

headlines. But if you show these counts to another crusty old editor, he will say, "Yeah, that's *about* how it would count out. Close enough."

Type styles vary in widths of characters. It will be a rare occasion that this program plays you false because I have set limits which are comfortably within usual types used.

If you are a serious headline writer, talk to your printer and get his counts for type in the column width you plan to use. Armed with that information, refer to program lines 240–300. In these lines C equals the 10-pica column count of the type size represented by S.

If you are interested in the count of each character on your keyboard, you can figure it out by looking up the ASCII values of J in the subroutines starting at lines 990, 1080, and 1120. ■

Richard Ramella is a writer whose favorite computer use is writing programs for his two children, ages 6 and 9.

Listing continued

```
790 PRINT
800 PRINT "ENTER 0 TO PRINT COMPLETED HEADLINE."
810 PRINT "ENTER LINE NUMBER ( 1, 2, 3 ETC.) TO REWRITE LINE."
820 INPUT F
830 IF F = 0 THEN 860 ELSE INPUT A$(F)
840 GOSUB 1160
850 GOTO 580
860 FOR F = 1 TO D
870 LPRINT A$(F)
880 LPRINT
890 NEXT F
900 LPRINT STRING$(10," ");K;"COLUMN";S;"POINT";
910 IF T = 1 LPRINT " CONDENSED"
920 IF T = 2 LPRINT " MEDIUM"
930 IF T = 3 LPRINT " EXTENDED"
940 LPRINT STRING$(50,"-")
950 LPRINT
960 LPRINT
970 RESTORE
980 GOTO 160
990 IF J = 32 THEN P = P + 1: RETURN
1000 IF J > 34 AND J < 39 THEN P = P + 1.5: RETURN
1010 IF J = 48 THEN P = P + 1.5: RETURN
1020 IF J > 49 AND J < 58 THEN P = P + 1.5: RETURN
1030 IF J > 38 AND J < 43 THEN P = P + .5: RETURN
1040 IF J > 44 AND J < 47 THEN P = P + .5: RETURN
1050 IF J = 49 OR J = 58 OR J = 59 THEN P = P + .5: RETURN
1060 P = P + 1
1070 RETURN
1080 IF J = 102 OR J = 105 OR J = 106 OR J = 108 OR J = 116 THEN P = P + .5
: RETURN
1090 IF J = 109 OR J = 119 THEN P = P + 1.5: RETURN
1100 P = P + 1
1110 RETURN
1120 IF J = 73 OR J = 74 THEN P = P + 1: RETURN
1130 IF J = 77 OR J = 87 THEN P = P + 2: RETURN
1140 P = P + 1.5
1150 RETURN
1160 G = LEN(A$(F))
1170 FOR U = 1 TO G
1180 B$ = MID$(A$(F),U,1)
1190 J = ASC(B$)
1200 IF J = 42 THEN J = 58
1210 IF J = 60 THEN J = 44
1220 IF J > 96 THEN J = J - 32: GOTO 1240
1230 IF J < 91 AND J > 64 THEN J = J + 32
1240 B$ = CHR$(J)
1250 C$ = C$ + B$
1260 NEXT U
1270 A$(F) = C$
1280 C$ = ""
1290 RETURN
```

What makes a robot tick?

Cybernetics—Part II

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Canada, M5N 2Z6

All robot systems are composed of three parts: sensors, a decision-base and actuators.

A sensor is a device that relays information about the environment. Humans have sensors to detect tactile, visual, audible and other stimuli, both internal and external to their bodies. These sensors allow us to create a workable, though imperfect, internal representation of the world. All of our decisions are ultimately based on this internal conception.

Human sensors are electrochemical; most man-made sensors are either mechanical or solid state. The selection of mechanical sensors is quite large. An example of a mechanical sensor is the switch: There are 67 switches on the current edition of the TRS-80 Model 1.

All switches connect two wires which allow a current to flow and a circuit to be complete. A complete or closed circuit may perform a function; an open or interrupted circuit cannot. A switch is generally a digital device that exists in only two states—opened or closed.

There are a variety of switches that come in different sizes, power handling capability and mechanical action. These include mercury wetted contacts, momentary push buttons, lever-action microswitches and membrane keypads, to name a few.

Problems Interfacing to a Micro

There are three problems with interfacing switches to the TRS-80 (or any other micro).

- First, most switches create RF noise by arcing as the switch is almost closed and the electrons collected on the negative side of the switch leap across a very small air gap to the positive side of the switch. Because microcomputers are sensitive to RF noise, minimize the interference by enclosing all switches in an aluminum box and grounding the box, or purchasing higher quality switches. The effect of the RF noise will be minimal if low voltages and currents are used.
- The second problem is switch bounce. The double characters that plagued early machines were a direct result of one complication—the rate at which the computer scanned the keyboard was too fast, often resulting in a key being read twice. There are two solutions for this. One is a bounceless switch (Fig. 1). The other, a software fix, slows the rate of scan by adding delay loops.
- Thirdly, ringing is a phenomenon affecting the voltage/current relationship. If you design a very sophisticated system, you will have to study ringing in more depth.

The solid state sensor may be either a digital or an analog device. Almost all solid state sensors are based on the physics and chemistry of the PN junction.

The PN Junction

The PN junction is the fundamental technology behind the electronics, computer and robot industry. Pure silicon monocrystals, formed in a gradually cooling crucible of molten silicon, are processed (or doped) by adding impurities in one of

The Key Box
Basic Level II
Model I
16K RAM

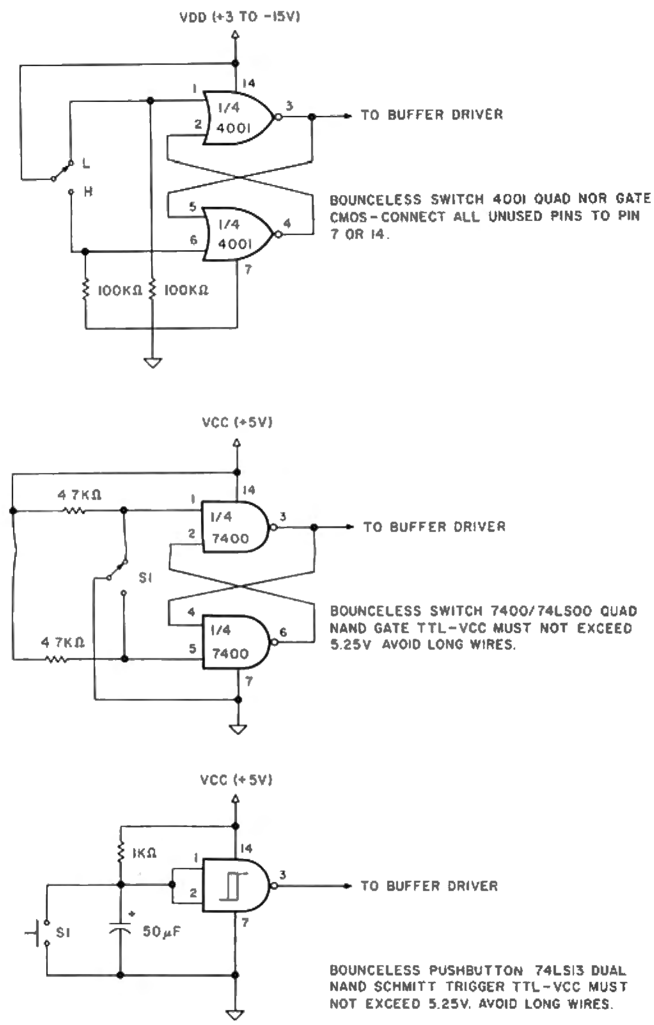
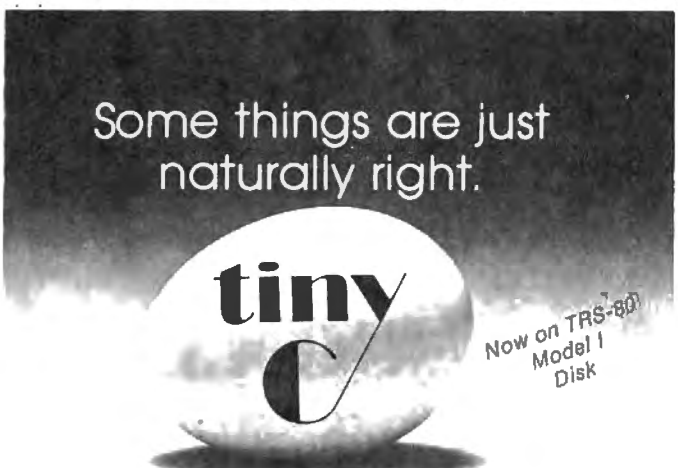


Fig. 1. Examples of Bounceless switches for use as input sensors



three processes.

The type of impurity added to the silicon determines its electrical character. Pure silicon does not conduct electricity. Silicon with boron added becomes a P-type material. Other impurities produce N-type materials. N and P-type materials are semiconductors, meaning they conduct electricity but not very well. External factors affect their ability to conduct. When N and P-type materials are physically joined, a PN junction is produced. Electricity may flow from the N to the P-type material when a voltage is applied across the junction, but may not easily flow in the opposite direction.

Light, heat and pressure all increase the junction's conductivity. That is why normal transistors are sealed in hard, opaque and sometimes aluminum packages. The package retains uniform performance over a wide range of environmental changes.

A diode, photodiode, or LED has only a single PN junction while phototransistors have two (see Fig. 2). The normal direction of current flow is from N-type material to P-type material across the PN junction. A leakage current is a current that flows in the opposite direction, from P to N. Light shining on these junctions greatly increases the leakage current forcing the device to conduct in the opposite direction.

As sensors for the TRS-80, light sensitive devices are excellent. They can detect a light of particular frequency (such as infrared). Used with a source of such light these sensors detect the presence of a reflective object or locate the source and notify the TRS-80 of its discovery. Obstacles to the robot's movement are sensed before actual contact.

In much the same fashion, heat and pressure-sensitive solid state devices vary their resistance according to the quantity of strain or heat applied. Although these devices are analog and have a wide operating or functional range, the experimenter can use them as part of a threshold detecting device. This device uses the analog sensor in an all-or-none circuit where the output of the circuit is a binary low (less than 1.4 volts dc) until the sensor detects a predetermined weight or temperature. At this threshold the circuit produces a binary high (over 4.2 volts dc).

Programming the TRS-80 for digital input is much simpler than for analog; the related hardware is also less expensive.

The Hardware

A simple way to interface sensors to the TRS-80 is to have the software handle the analog to digital conversion (ADC) process. The following is a straightforward approach to building an interface which plugs directly into the TRS-80 expansion port. Software is written for Level II Basic.

The interface circuit (see Fig. 3) is designed to handle six sensors, although a single sensor could be used. The 74367 integrated circuit is a bus driver chip and the 555s are common timers used here as monostable pulse generators. (Do not worry about unfamiliar terminology. The proper names are included merely to label—not to confuse).

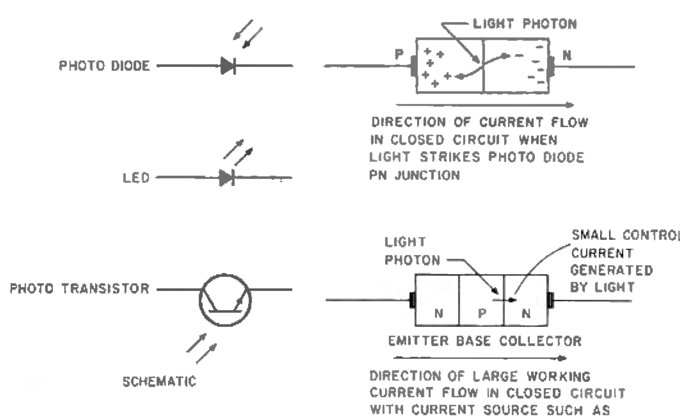


Fig. 2.

Looking at Fig. 3, when the 555 timers are triggered by a negative $\overline{OUT}$ pulse from the TRS-80, a positive output may be seen on pin 3. The voltage applied to pins 6 and 7 by the sensor determines the duration of this output pulse, usually between 10 and 30,000 microseconds.

Before $\overline{OUT}$ goes negative, enabling the 555, pin 7 is close to ground. Output 3 of the 555 will go high when $\overline{OUT}$ goes negative until the current from the sensor charges the sensor capacitor and the voltage at pins 6 and 7 of the 555 match the voltage at pin 5 (usually 3.33 volts dc). I recommend a simple IC or one transistor amplifier as an intermediate stage between the sensor and the 555 for any sen-

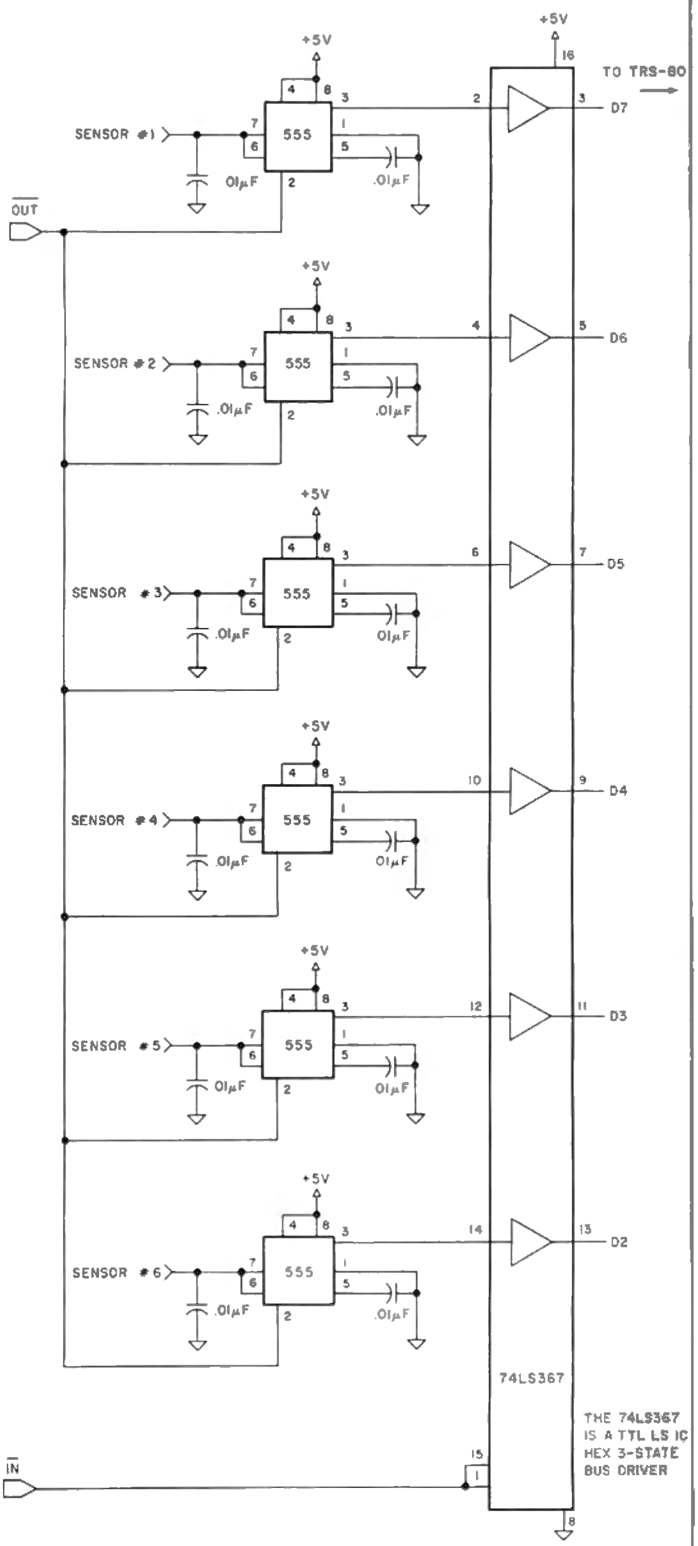


Fig. 3. The TRS-80 Model 1 sensor interface

See List of Advertisers on Page 455

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sor with a very low output.

The 74367 is a tri-state bus driver. Upon receiving a negative $\overline{IN}$ pulse from the TRS-80 the bus driver presents the sensor outputs 0 or 1 onto the TRS-80 data bus. A switch may be interfaced to the input of the 74367 directly and read only once by the IN(0) command from Level II Basic.

The machine language code (Program Listing 1) may be POKEd into the string definitions in Program Listing 2 or entered permanently using T-Bug. If the latter approach is used, the resultant Basic program can be stored on cassette, as is, for later use.

The use of sensors to monitor its environment is only the first step towards creation of the TRS-80 based robot I affectionately call "Trashie." Next month you can expect a discussion of actuators and output devices. If there is sufficient response I will release the complete schematics for Trashie in the final installment. Let us hear from you if you're interested. ■

Stephen Davids has designed and developed some of the world's most fascinating robot systems, including talking vending machines, robot waiters and K-9 the robot dog.

D3 10	A$	OUT(10H) A	; trigger A to D converter
CD 7F 0A		CALL 0A 7FH	; initialize converter
44		LD B H	; with most significant byte
4D		LD C L	; least significant byte
03	LOOP 1	INC BC	; increment counter
CB 58		BIT 3 B	; limit max converter value
C0		RET NZ	; return if value exceeded
DB 10		IN A (10H)	; input sensor data D_7
CB 7F		BIT 7 A	; check if $D_7 = 1$ (see note 1)
ED 43 01 70		LD(7001H) BC	; store count in 7001H (see note 2)
20 F2		JR NZ LOOP1	; keep counting if $D_7 = 1$
C9		RET	; stop count when $D_7 = 0$
			; and return to Basic

Note 1: Op-codes for BIT n, A with n = 0, 1, 2 ... 7 are:

n = 7:CB 7F	n = 4:CB 67	n = 1:CB 4F
n = 6:CB 77	n = 3:CB 5F	n = 0:CB 47
n = 5:CB 6F	n = 2:CB 57	

Note 2: To deposit the results at different addresses change the last two bytes of the LD instruction to the desired address low-order byte first so that "ED 43 03 70" will store the result at 7003-4, etc.

Program Listing 1

```
10 A$=" SENSOR #1 A/D CONVERSION"
20 B$=" SENSOR #2 A/D CONVERSION"
30 C$=" SENSOR #3 A/D CONVERSION"
40 D$=" SENSOR #4 A/D CONVERSION"
50 E$=" SENSOR #5 A/D CONVERSION"
60 F$=" SENSOR #6 A/D CONVERSION"
70 X=VARPTR(A$)
80 POKE16526, PEEK(X+1):POKE16527,PEEK(X+2)
90 L=USR(0)
100 X=VARPTR(B$)
110 POKE16526,PEEK(X+1):POKE16527,PEEK(X+2)
120 L=USR(0)
130 X=VARPTR(C$)
140 POKE16526,PEEK(X+1):POKE 16527,PEEK(X+2)
150 L=USR(0)
160 X=VARPTR(D$)
170 POKE16526,PEEK(X+1):POKE16527,PEEK(X+2)
180 L=USR(0)
190 X=VARPTR(E$)
200 POKE16526,PEEK(X+1):POKE16527,PEEK(X+2)
210 L=USR(0)
220 X=VARPTR(F$)
230 POKE16526,PEEK(X+1):POKE16527,PEEK(X+2)
240 L=USR(0)
250 S1=PEEK(28673)+256*PEEK(28674)
260 S2=PEEK(28675)+256*PEEK(28676)
270 S3=PEEK(28677)+256*PEEK(28678)
280 S4=PEEK(28679)+256*PEEK(28680)
290 S5=PEEK(28681)+256*PEEK(28682)
300 S6=PEEK(28683)+256*PEEK(28684)
310 PRINTS1,S2,S3,S4,S5,S6
320 GOTO70
330 END
```

Program Listing 2. Basic Program for Analog Digital Conversion and Display

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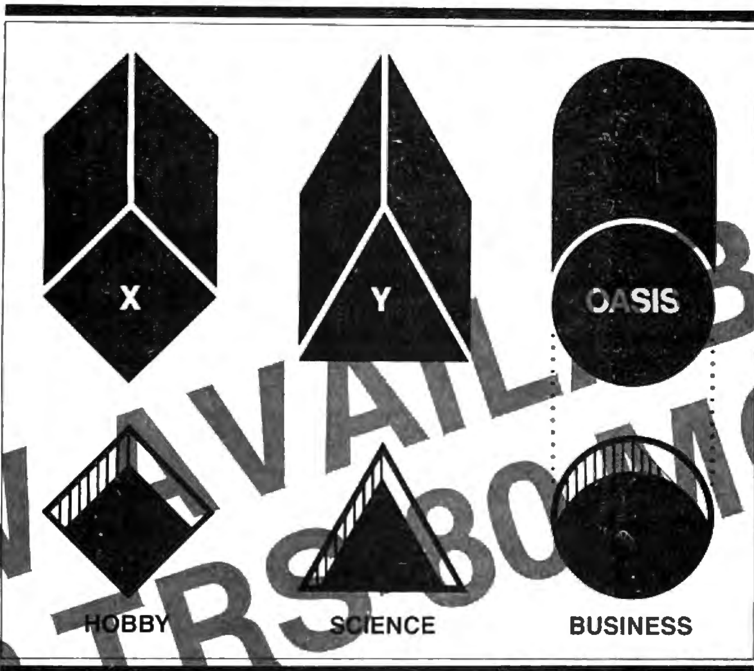

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24 Fall Features For

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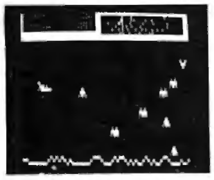

By Case from Acorn
A fast-action space game that's *very* challenging! You must destroy the aliens with lasers and "smart bombs." Then, make your way carefully through a meteor storm and a rocky tunnel. Great sound effects; keyboard control.
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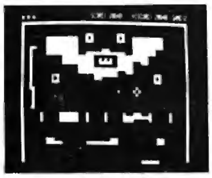

By Vandewalle from Acorn
An unusual combination of fast pinball action plus the challenges and dangers of an arcade game. Keep the ball in play, scoring points as it caroms from obstacle to obstacle, while wandering through the jungle searching for the hidden crown. And try to avoid the deadly Cobra. Lots of action, sound and fun! Choice of 3 screens. Can be used with Trisstick joystick.
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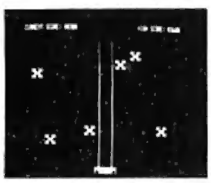

By Knight from Acorn
You're in charge of the USS Krestan, an interstellar tri-ship. If you defeat the enemy aliens you encounter, you get a chance to earn extra points by successfully docking with a larger ship. *Then* come the evil Malicians and dangerous meteor showers. Never a dull moment with this one!
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MYSTERIOUS ADVENTURE
ARROW OF DEATH, PART 1

By Brian Howarth from Acorn
Proper English only! This British import is Acorn Software's first adventure and it meets their reputation for high quality. The vocabulary you use in this adventure must conform to proper English standards—not the barbaric tongue spoken here in the colonies! You and Sorcerer Zardra must restore the kingdom from the engulfing sense of bitterness and ill feeling that forced the ruler to flee the palace.
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By Demas from Fantastic
An arcade style game of a fascinating future world with high-res graphics and **voice**. Filled with action and excitement; in machine language.
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ARMORED PATROL

By Westmoreland & Gilman from Adventure
As commander of a lumbering T-36 tank you have the firepower to destroy the enemy—if you can find them. They may be hiding behind the houses scattered about, the bleak terrain and your only view is thru the drivers port (your screen). Impressive animation in this arcade game.
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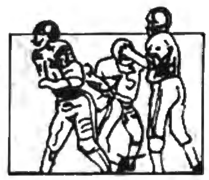

From Avalon Hill
Exciting computer version of the famous board game. You'll have to think fast as you plan the offensive and defensive formations for your team. Play against the computer or a friend.
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From Med Systems **
You are sitting alone at 2 AM. Your eyes are bloodshot as you peer into your computer's screen and cry, "I must be CRAZY!" If this has never happened to you, you've never tried ASYLUM. It's Med Systems most ambitious 3-D graphics adventure yet!
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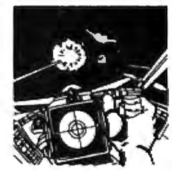

By Philip Mitchell from Beam
Armed with missiles and bombs, you must fly your fighter to the enemy's cache of neutron bombs and destroy them. Your mission is in four stages, involving rugged terrain, caverns and manmade obstacles—not to mention enemy radar, missiles and paratroopers. This new departure in arcade gaming allows you to set up your own terrain and enemy emplacements, then save them for future use. Make your mission as hard or easy as you like. Joystick compatible
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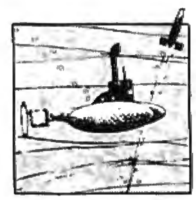

By Westmoreland & Gilman from Adventure
Underwater adventure is yours as you command a nuclear sub armed with deadly missiles and torpedoes. Guide it carefully through sea mines and underwater mountains; watch out for depth charges being fired by overhead ships. . . and don't run out of air! Scrolling sea bottom for added excitement.
16K Tape, $19.95
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REAR GUARD

By Neil Larimer from Adventure Int.
A space battle between your cruiser and wave-after-wave of enemy ships. You can destroy them with your energy darts or you can ram them—as long as your shields are intact. The action takes place on a continuous horizontal landscape. You control the altitude and speed of your craft as you pursue the enemy. Skill level 1 is exciting, and there are four more levels available.
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Put numbers on your CC screen while in the graphics mode.

Show the Score

Frederick F. Battista
9 Belle Court
Budd Lake, NJ 07828

The fast moving full graphic Color Computer games are challenging and quite exciting. The excitement is diminished somewhat by the computer's inability to display numeric characters such as scoring and timing while in the full graphic mode. I wrote a machine language program and a demonstration program to add this missing pizzazz to your game displays.

The program can be called from Basic, displays numerics 0–999, operates in PMODE 1, 2, and 3 and allows positioning the screen display.

Operation

Program Listing 1 is a Basic program that loads the machine language routine. The machine language code, Program Listing 2, resides in 230 bytes of memory and starts at address 16054 decimal. The machine language routine starts at memory address 16235, while data starts at 16054. The screen display position is POKEd into memory addresses 16286 and 16287. The value of the numeric display is transferred from the Basic calling program to the machine language routine through the Basic USR(N) function.

The character set in the machine language routine is generated through a bit-mapping technique. The characters are mapped in a 16 bit wide by 9 bit high display (Fig. 1a–d). Each character requires 18 bytes for definition. For the character set 0–9, 180 bytes of memory are re-

Byte															
1								2							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
0	1	0	1	1	0	1	0	1	0	1	0	0	1	0	1
0	1	1	0	0	1	0	1	0	1	0	1	1	0	0	1
0	1	1	0	0	1	0	1	0	1	0	1	1	0	0	1
0	1	1	0	0	1	0	1	0	1	0	1	1	0	0	1
0	1	0	1	1	0	1	0	1	0	1	0	0	1	0	1
0	1	1	0	0	1	0	1	0	1	0	1	1	0	0	1
0	1	1	0	0	1	0	1	0	1	0	1	1	0	0	1
0	1	1	0	0	1	0	1	0	1	0	1	1	0	0	1
0	1	0	1	1	0	1	0	1	0	1	0	0	1	0	1

Fig. 1a.

Program Listing 1

```
5 REM INITIALIZE
10 REM**************************************************
20 REM*        ADD NUMERICS TO TRS80                    *
25 REM DRAW SHIP
30 REM*        COLOR GRAPHICS                           *
40 REM*                                                 *
50 REM*             F.F. BATTISTA                       *
60 REM*             BUDD LAKE, N.J.                     *
70 REM*             APRIL 25,1981                       *
75 REM DRAW SUB 1
80 REM**************************************************
90 REM  PROTECT MEMORY ABOVE 16054
100 REM
105 REM DRAW SUB 2
110 CLEAR 62,16054
120 REM
130 REM  POKE MACHINE LANGUAGE ROUTINE INTO MEMORY
135 REM SOUND EFFECTS
140 REM
150 FOR I=16235 TO 16371
155 REM DRAW TITLE
160 READ CD
170 POKE I,CD
180 NEXTI
185 REM LASER DISPLAY ROUTINE
190 REM
200 REM  POKE BIT MAP DATA INTO MEMORY
205 REM MOVE SHIP DISPLAY
210 REM
220 FOR I=16054 TO 16233
230 READ A
240 POKE I,A
250 NEXT I
260 REM
270 REM  DEFINE MACHINE CODE STARTING ADDRESS
280 REM
290 DEFUSR=16235
300 DATA 189,179,237,206,63,255,54,15,134,63,30,139,15,180,15,181,15,1
82,55,7,16,131,0,100,45,7,131,0,100,12,180,32,243,16,131,0,10,45,7,131
,0,10,12,181,32,243,215,182,150,180,142,6,3,189,63,184,150,181,48,002,
189,63,184,150,182,48,002,189,
310 DATA 55,8,57,0,0,0,0,15,244,15,245,15,246,15,247,15,248,54,16,198,
18,61,215,246,134,9,151,244,16,142,62,182,16,159,247,220,245,16,158,24
7,166,171,167,132,12,248,220,245,16,158,247,166,171,167,1,198,32,58,12
,248,10,244,38,227,55,16,57
320 DATA 90,165,101,89,101,89,101,89,101,89,101,89,101,89,101,89,90,16
5
330 DATA 86,85,86,85,86,85,86,85,86,85,86,85,86,85,86,85,86,85
340 DATA 90,165,101,89,85,89,85,101,85,149,86,85,89,85,101,85,10
8,169
340 DATA 90,165,101,89,85,89,85,101,85,149,86,85,89,85,101,85,108,169
345 REM PUT SHIP AT NEW POSITION
350 DATA 90,165,101,89,85,101,85,149,86,165,85,89,101,89,101,101,90,14
9
355 REM READ AND UPDATE SHIP POSITION
360 DATA 101,89,101,89,101,89,101,89,101,89,106,165,85,89,85,89,85,89
370 DATA 108,165,101,85,101,85,106,165,85,89,85,89,101,89,101,101,90,1
49
380 DATA 90,165,101,89,101,85,101,85,102,165,105,89,101,89,101,89,90,1
65
390 DATA 100,169,85,89,85,101,85,149,86,85,89,85,101,85,101,85,101,85
400 DATA 90,165,101,89,101,89,101,89,90,165,101,89,101,89,101,89,90,16
5
410 DATA 90,165,101,89,101,89,101,89,90,165,85,89,85,89,101,89,90,165
```

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Program Listing 2

```
*******************************************************
*                                                     *
*      3 DIGIT BIT MAPPED DISPLAY ROUTINE FOR         *
*      THE TRS80 COLOR COMPUTER. CALLED FROM BASIC    *
*                                                     *
*      WRITTEN BY FRED BATTISTA   APRIL 5,1981        *
*                    BUDD LAKE, N.J.                  *
*                                                     *
*******************************************************
3F6B    BD    JSR B3ED       'GET USR(N) ARGUMENT AND PUT IN D REG.
3F6C    B3
3F6D    ED
3F6E    CE    LDU #3FFF      'SET STACK POINTER
3F6F    3F
3F70    FF
3F71    36    PSHU #CC,A,B,DP 'SAVE IN STACK
3F72    0F
3F73    86    LDA #3F        'SET DIRECT PAGE REGISTER
3F74    3F
3F75    1E    EXC A,DP
3F76    8B
3F77    0F    CLR B4         'INITIALIZE DIGITS TO ZERO
3F78    B4
3F79    0F    CLR B5
3F7A    B5
3F7B    0F    CLR B6
3F7C    B6
3F7D    37    PULU #CC,A,B 'RESTORE USR(N) ARGUMENT
3F7E    07
3F7F    10    CMPD #64       'IF D<100 THEN BRANCH TO 3F8C
3F80    83
3F81    00
3F82    64
3F83    2D    BLT 07
3F84    07
3F85    83    SUBD #64       'SUBTRACT 100 FROM D
3F86    00
3F87    64
3F88    0C    INC B4         'INCREMENT MOST SIGNIFICANT DIGIT
3F89    B4
3F8A    20    BRA F3        'GOTO 3F7F
3F8B    F3
3F8C    10    CMPD #A        '
3F8D    83
3F8E    00
3F8F    0A
3F90    2D    BLT 07         'IF D<10 THEN BRANCH TO 3F99
3F91    07
3F92    83    SUBD #A        'SUBTRACT 10 FROM D
3F93    00
3F94    0A
3F95    0C    INC B5         'INCREMENT SECOND DIGIT
3F96    B5
3F97    20    BRA F3        'GOTO 3F8C
3F98    F3
3F99    D7    STB B6         'STORE LEAST SIGNIFICANT DIGIT
3F9A    B6
3F9B    96    LDA B4         'LOAD MSD
3F9C    B4
3F9D    8E    LDX #0603      'LOAD SCREEN DISPLAY SCREEN ADDRESS
3F9E    06
3F9F    03
3FA0    BD    JSR 3FB8       'JUMP TO DISPLAY ROUTINE
3FA1    3F
3FA2    B8
3FA3    96    LDA B5         'LOAD 2ND DIGIT
3FA4    B5
3FA5    30    LEAX 2,X       'INCREMENT SCREEN DISPLAY ADDRESS
3FA6    02
3FA7    BD    JSR 3FB8       'JUMP TO DISPLAY ROUTINE
3FA8    3F
3FA9    B8
3FAA    96    LDA B6         'LOAD LEAST SIGNIFICANT DIGIT
3FAB    B6
3FAC    30    LEAX 2,X       'INCREMENT SCREEN DISPLAY ADDRESS
3FAD    02
3FAE    BD    JSR 3FB8       'JUMP TO DISPLAY ROUTINE
3FAF    3F
3FB0    B8
3FB1    37    PULU #DP       'RESTORE DIRECT PAGE REGISTER
3FB2    08
3FB3    39    RTN            'RETURN TO MAIN PROGRAM
3FB4    00                    MOST SIGNIFICANT DIGIT
3FB5    00                   '2ND DIGIT
3FB6    00                   'LEAST SIGNIFICANT DIGIT

*********************************************************
*                                                       *
*       DISPLAY ROUTINE FOR TRS80 COLOR COMPUTER        *
*                                                       *
*********************************************************

3FB8    0F    CLR F4         "INITIALIZE SCRATCH PAD TO ZERO
3FB9    F4
3FBA    0F    CLR F5
3FBB    F5
3FBC    0F    CLR F6
3FBD    F6
3FBE    0F    CLR F7
3FBF    F7
3FC0    0F    CLR F8
3FC1    F8
3FC2    36    PSHU #X       'SAVE SCREEN DISPLAY LOCATION
3FC3    10
3FC4    C6    LDB #12       'CALCULATE CHARACTER TABLE OFFSET
3FC5    12
3FC6    3D    MUL
3FC7    D7    STB F6        'STORE TABLE OFFSET
3FC8    F6
3FC9    86    LDA #9        'LOAD LINES PER DISPLAY
3FCA    09
3FCB    97    STA F4        'STORE LINES PER DISPLAY
3FCC    F4
3FCD    10    LDY #3EBB     'LOAD START OF CHARACTER TABLE
3FCE    8E
3FCF    3E
3FD0    BB
3FD1    10    STY F7        'STORE START ADDRESS
3FD2    9F
3FD3    F7
3FD4    DC    LDD F5        'LOAD TABLE OFFSET
3FD5    F5
3FD6    10    LDY F7        'LOAD START ADDRESS
3FD7    9E
3FD8    F7
```

Listing 2 Continues

quired for data.

Integer values are passed to the machine language routine through the USR(N) argument. Basic jumps to the machine language code starting at the memory address established by the statement DEFUSR = address.

The high order address byte for the screen display location is POKEd into 16286. The low order address byte is POKEd into 16287. The value POKEd must be the decimal equivalent of the high and low address byte. Address 0AF1 would have the decimal values of 10 for the high byte and 241 for low.

The display start position is

Decimal Byte 1	Value Byte 2
90	165
101	89
101	89
101	89
90	165
101	89
101	89
101	89
90	165

Fig. 1b.

C1	C2	C1	C2	C1	C2	C1	C2

Byte Format

Fig. 1c.

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Listing 2 Continued

```
3FD9    A6    LDA D,Y      'LOAD ACCA WITH VALUE IN (Y+D)
3FDA    AB
3FDB    A7    STA 0,X      'STORE TO SCREEN DISPLAY
3FDC    84
3FDD    0C    INC F8       'INCREMENT CHARACTER TABLE
3FDE    F8
3FDF    DC    LDD F5       'LOAD TABLE OFFSET
3FE0    F5
3FE1    10    LDY F7       'LOAD NEXT CHAR. BYTE ADDRESS
3FE2    9E
3FE3    F7
3FE4    A6    LDA D,Y      'LOAD ACCA WITH (Y+D)
3FE5    AB
3FE6    A7    STA 1,X      'STORE TO SCREEN DISPLAY+1
3FE7    01
3FE8    C6    LDB #20      ' LOAD B WITH NEXT LINE INCREMENT
3FE9    20
3FEA    3A    ABX          'X+B=NEXT SREEN DISPLAY LOCATION
3FEB    0C    INC F8        INCREMENT CHARACTER TABLE
3FEC    F8
3FED    0A    DEC F4       'DECREMENT LINES/DISPLAY COUNTER
3FEE    F4
3FEF    26    BNE E3       'IF COUNTER<>0 GOTO 3FD4
3FF0    E3
3FF1    37    PULU #X      'RESTORE ORIGINAL SCREEN DISPLAY
3FF2    10                 'LOCATION
3FF3    39    RTN           RETURN TO CALLING PROGRAM
3FF4    00                 'LINES/DISPLAY COUNT
3FF5    00                  TABLE OFFSET HI BYTE
3FF6    00                  TABLE OFFSET LO BYTE
3FF7    00                  CHAR. TABLE ADDRESS HI BYTE
3FF8    00                 'CHAR. TABLE ADDRESS LO BYTE

BIT MAPPING DATA FOR CHARACTER SET 0-9

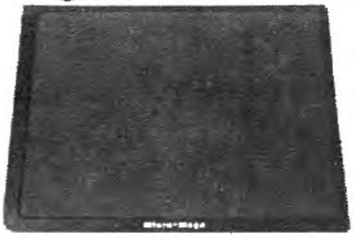
HEX ADDR.     DATA          DEC. ADDR     DATA

3EB6          5A            16054         90
3EB7          A5            16055         165
3EB8          65            16056         101
3EB9          59            16057         89
3EBA          65            16058         101
3EBB          59            16059         89
3EBC          65            16060         101
3EBD          59            16061         89
3EBE          65            16062         101
3EBF          59            16063         89
3EC0          65            16064         101
3EC1          59            16065         89
3EC2          65            16066         101
3EC3          59            16067         89
3EC4          65            16068         101
3EC5          59            16069         89
3EC6          5A            16070         90
3EC7          A5            16071         165
3EC8          56            16072         86
3EC9          55            16073         85
3ECA          56            16074         86
3ECB          55            16075         85
3ECC          56            16076         86
3ECD          55            16077         85
3ECE          56            16078         86
3ECF          55            16079         85
3ED0          56            16080         86
3ED1          55            16081         85
3ED2          56            16082         86
3ED3          55            16083         85
3ED4          56            16084         86
3ED5          55            16085         85
3ED6          56            16086         86
3ED7          55            16087         85
3ED8          56            16088         86
3ED9          55            16089         85
3EDA          5A            16090         90
3EDB          A5            16091         165
3EDC          65            16092         101
3EDD          59            16093         89
3EDE          55            16094         85
3EDF          59            16095         89
3EE0          55            16096         85
3EE1          65            16097         101
3EE2          55            16098         85
3EE3          95            16099         149
3EE4          56            16100         86
3EE5          55            16101         85
3EE6          59            16102         89
3EE7          55            16103         85
3EE8          65            16104         101
3EE9          55            16105         85
3EEA          6C            16106         108
3EEB          A9            16107         169
3EEC          5A            16108         90
3EED          A5            16109         165
3EEE          65            16110         101
3EEF          59            16111         89
3EF0          55            16112         85
3EF1          65            16113         101
3EF2          55            16114         85
3EF3          95            16115         149
3EF4          56            16116         86
3EF5          A5            16117         165
3EF6          55            16118         85
3EF7          59            16119         89
3EF8          65            16120         101
3EF9          59            16121         89
3EFA          65            16122         101
3EFB          65            16123         101
3EFC          5A            16124         90
3EFD          95            16125         149
3EFE          65            16126         101
3EFF          59            16127         89
3F00          65            16128         101
3F01          59            16129         89
3F02          65            16130         101
3F03          59            16131         89
```

Listing 2 Continues

for the TRS-80 from Micro-Mega

The Original GREEN-SCREEN



The eye-pleasing Green-Screen fits over the front of your TRS-80 Video Display and gives you improved contrast with reduced glare. You get bright luminous green characters and graphics like those featured by more expensive CRT units.

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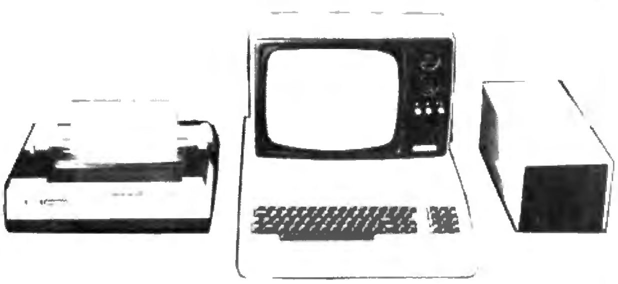

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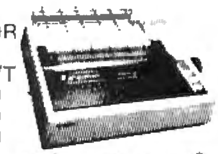

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Listing 2 Continued

3F04	65	16132	101
3F05	59	16133	89
3F06	65	16134	101
3F07	59	16135	89
3F08	6A	16136	106
3F09	A5	16137	165
3F0A	55	16138	85
3F0B	59	16139	89
3F0C	55	16140	85
3F0D	59	16141	89
3F0E	55	16142	85
3F0F	59	16143	89
3F10	6C	16144	108
3F11	A5	16145	165
3F12	65	16146	101
3F13	55	16147	85
3F14	65	16148	101
3F15	55	16149	85
3F16	6A	16150	106
3F17	A5	16151	165
3F18	55	16152	85
3F19	59	16153	89
3F1A	55	16154	85
3F1B	59	16155	89
3F1C	65	16156	101
3F1D	59	16157	89
3F1E	65	16158	101
3F1F	65	16159	101
3F20	5A	16160	90
3F21	95	16161	149
3F22	5A	16162	90
3F23	A5	16163	165
3F24	65	16164	101
3F25	59	16165	89
3F26	65	16166	101
3F27	55	16167	85
3F28	65	16168	101
3F29	55	16169	85
3F2A	66	16170	102
3F2B	A5	16171	165
3F2C	69	16172	105
3F2D	59	16173	89
3F2E	65	16174	101
3F2F	59	16175	89
3F30	65	16176	101
3F31	59	16177	89
3F32	5A	16178	90
3F33	A5	16179	165
3F34	6C	16180	108
3F35	A9	16181	169
3F36	55	16182	85
3F37	59	16183	89
3F38	55	16184	85
3F39	65	16185	101
3F3A	55	16186	85
3F3B	95	16187	149
3F3C	56	16188	86
3F3D	55	16189	85
3F3E	59	16190	89
3F3F	55	16191	85
3F40	65	16192	101
3F41	55	16193	85
3F42	65	16194	101
3F43	55	16195	85
3F44	65	16196	101
3F45	55	16197	85
3F46	5A	16198	90
3F47	A5	16199	165
3F48	65	16200	101
3F49	59	16201	89
3F4A	65	16202	101
3F4B	59	16203	89
3F4C	65	16204	101
3F4D	59	16205	89
3F4E	5A	16206	90
3F4F	A5	16207	165
3F50	65	16208	101
3F51	59	16209	89
3F52	65	16210	101
3F53	59	16211	89
3F54	65	16212	101
3F55	59	16213	89
3F56	5A	16214	90
3F57	A5	16215	165
3F58	5A	16216	90
3F59	A5	16217	165
3F5A	65	16218	101
3F5B	59	16219	89
3F5C	65	16220	101
3F5D	59	16221	89
3F5E	65	16222	101
3F5F	59	16223	89
3F60	5A	16224	90
3F61	A5	16225	165
3F62	55	16226	85
3F63	59	16227	89
3F64	55	16228	85
3F65	59	16229	89
3F66	65	16230	101
3F67	59	16231	89
3F68	5A	16232	90
3F69	A5	16233	165

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defined as the upper left corner of the most significant digit's chararacter block (16 by 9 bit block). In the Color Computer, address 1536 decimal (600H) is the start of page 1 graphic screen memory. Allowable screen positions for the 3-digit display depend on the graphic mode. Use Table 1 to determine which values to POKE into 16286 and 16287.

Demonstration Program

The demonstration program in Program Listing 3 uses the machine language routine. It displays three different numeric values in three different screen locations. The center display is a 3-digit random generated number. The display in the upper left corner is a 3-digit value representing the game score. The upper right corner contains a 3-digit display equal to the number of tries.

The program begins with a changing random number displayed in the center of the screen. After a fixed time interval, the display stops changing. If any two digits in this display match, 10 points are added to the score. If all three match, 100 points are added. Pressing S on the keyboard starts the next try. The number of tries is displayed on the upper right corner of the screen. The game ends after 100 tries.

Line 540 defines the random number display location. Line

C1, C2	0 0	0 1	1 0	1 1
SCREEN 1,0	GREEN	YELLOW	BLUE	RED
SCREEN 1,1	BUFF	CYAN	MAGENTA	ORANGE

Color Coding

FOR THE ABOVE EXAMPLE, 8 IS DISPLAYED AS A BLUE FOREGROUND AGAINST A YELLOW BACKGROUND IN SCREEN 1,0 WHEN IN PMODE 1,n OR PMODE 3,n

Fig. 1d.

•	Char. Size In Pixels		Resolution		Increment Per	Last Char. Position	Start Of
PMODE	Horiz.	Vert.	Horiz.	Vert.	Line	First Line	Last Line
4,N	16	9	1	1	20H	061AH	1CCOH
3,N	8	9	2	1	20H	061AH	1CCOH
2,N	—	—	—	—	—	—	—
1,N	8	9	2	2	20H	061AH	1CCOH

Pixel Resolution: PMODE 4,N PMODE 3,N PMODE 1,N

Table 1 is based on graphics starting in page 1 of graphic memory. If graphics start in any other page add 600H times Page Number (N) to "Last Character Position First Line" and "Start of Last Line." Last character position in each line equals the first character position plus 1AH.

Program Listing 3

```
420 REM
430 REM DEMO PROGRAM
435 REM SHIP CANNOT DROP CHARGE AT SCREEN LEFT
440 REM
445 REM CHECKS FIRE BUTTON CLOSURE
450 PMODE1,1
455 REM RESTORE V TO SHIP LOCATION
460 COLOR 2,1:PCLS
465 REM DROP DEPTH CHARGE
470 LINE(0,0)-(255,191),PSET,B
```

Listing 3 Continues

560 calls the machine language routine. The display location for the number of tries is set in line 700 and the score location is established in line 720.

Beyond Numbers

Although the machine language program restricts itself to numeric displays, the imaginative programmer can extend this to alphabetic and special characters.

The demonstration program can be converted to a One-Armed Bandit game by adding special characters in place of the random numbers. These special characters should reside in a table separate from the numeric character table. The Basic calling program could access the machine language routine to the character set by POKEing the table's starting address into locations 16335 and 16336. ■

Frederick Battista designs process and plant automation systems for BASF Wyandotte Corp. Engineering Group.

Listing 3 Continued

```
475 REM ALLOWS SUB MOVE DURING CHARGE DROP
480 DRAW"BM88,120;U60E15R30F15D60L60"
490 PAINT(90,60),4,2
495 REM CHARGE DROPPING
500 SR=0:K=0:TR=0
510 SCREEN 1,0
515 REM CHARGE EXPLODES
520 TIMER=0:Y=40
525 REM CHARGE HIT BOTTOM
530 N=RND(999)
535 REM DESTROY SUB
540 POKE16286,10:POKE16287,12
545 REM CLEAN UP REMAINS
550 PMODE 1,1
555 REM CHECKS TO SEE IF SUB 2 WAS DESTROYED, IF SO SETS NEW SUB 2 POS
ITION
560 A=USR(N)
565 REM SETS NEW SUB 1 POSITION
570 B=TIMER
580 Y=Y+3
585 REM REMOVES CHARGE FROM SCREEN AFTER HITTING BOTTOM
590 IF Y>=70 THEN Y=70
595 REM MOVES SUB 1 TO NEW POSITION
600 LINE(148,70)-(178,Y-3),PRESET
610 LINE(148,70)-(178,Y),PSET
615 REM SUB 1 LASER ROUTINE PPOINT CHECKS FOR LASER HIT
620 IF B<120 THEN530
630 LINE(148,70)-(178,70),PRESET
635 REM FIRES LASER-WON'T FIRE IF SHIP TOO FAR LEFT
640 LINE(148,70)-(178,40),PSET
650 N1=FIX(N/100):R1=N-N1*100
655 REM POSITION SUB 2
660 N2=FIX(R1/10):N3=R1-N2*10
670 IF N1=N2 OR N1=N3 OR N2=N3 THEN SR=10
675 REM SUB 2 LASER ROUTINE
680 S=RND(20):IF RND(5)=3 THEN GOSUB 700:IFPPOINT(H+S,57)=4 THEN HT=HT
+1
690 TR=TR+SR:SR=0
695 REM FIRE SUB 2 LASER
700 POKE16286,6:POKE16287,0
710 D=USR(TR)
715 REM END ROUTINE
720 K=K+1:POKE16286,6:POKE16287,50
730 Y$=INKEY$
740 L=USR(K)
750 IF K=100 THEN 780
760 IF Y$="S" THEN 520
770 GOTO 730
775 REM RESTORE COMPUTER TO POWER UP STATE
780 C$=INKEY$
790 IF C$="R" THEN 500
800 GOTO 780
```


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Create readable insert cards.

Cassbox

Charles E. Gillen
1458 Greenmont Court
Reston, VA 22090

Necessity, not inspiration, forced me to design a program to create neat, readable cassette insert cards. That previously irksome chore is now fast and easy, and my tape collection never looked better.

Cassbox (Program Listing 1) was written for the Microline 80 printer. For those without a Microline I wrote Baby Cassbox (Program Listing 2) to be used with any standard 80-column printer. Though Baby is not as fancy, the two programs have a number of features in common.

Common Features

- The insert card format is displayed on your screen. The printer turns out a finished insert just the right size, complete with marks where to cut and fold.
- The insert card can hold 13 text lines on the front and four on the back. The separate line for the tape title is easily visible when your tapes are stacked. The format is similar to the original tape manufacturer's insert.
- Typing @ before the first letter centers text lines.
- An edit mode permits changes or corrections before and after printing. Up to nine copies can be printed in a single run.

Cassbox Extras

The deluxe version handles all three Microline 80 character sizes producing lines 17, 35 or 57 letters long; the first two are set using # or $ to begin a line and the 57-letter mode requires no flag. The tape title side of the insert card can be one or two

```
|----------------------------------------|   CUT

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                ATTENTION
                ATTENTION
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|----------------------------------------|   CUT
```

Fig. 1. Cassbox Sample

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lines. The one-line title is printed right down the middle.

Baby Cassbox

Since the junior version uses the 80 character per line mode only, it produces 35 character maximum lines. The result is more than adequate for most applications but is utilitarian compared to the custom designed look produced by the Microline 80 version.

Listings Compared

The two listings do not resemble each other at all. Cassbox is dense, while the junior version looks simple. The programs use the same variable and constant names wherever possible. Studying the junior version will show you the mechanics of the fancier Cassbox. This will help if you need to modify Cassbox for a different multi-font printer (such as the Epson or the Base 2). The M80 printer control codes are translated early in Cassbox (lines 220–280) into constants used frequently in the program's LPRINT section. Exchanging M80 codes with those required by your printer makes the conversion a cinch. You will still have to fiddle with the line lengths.

The listings are pain free. You can use the Auto command to the end without being caught by an out-of-series line number and not one REM statement is the target of a GOTO or GOSUB. Leave them out if you wish, or put them in later. Cassbox is as bombproof as I could make it. Cassbox has few instructions and Baby Cassbox almost none. Simple prompts are built in.

The Program

The initialization section of Cassbox, down to line 280, contains almost everything used in the program more than once, particularly strings. After the brief instructions, the program recycles itself if you forget to turn on the printer. At line 320 the menu INKEY$ loop controls all of the action as follows:

1 = Do Front
2 = Do Back
3 = Do Title
4 = Edit Front
5 = Edit Back
6 = Edit Title
7 = Print
8 = Erase All

Input

Starting with Option 1 you will be prompted to input up to 13 lines under a format line. The format line shows the maximum distance you can type in any character size as well as the middle points for those sizes. The two-column format is useful for listing programs or songs in two equal columns.

The program will not stop you from entering a line too long for the character size selected, but the LPRINT section will hack off the surplus text without mercy.

After entering the text hit Enter a few times to reach the bottom of the screen. Another Enter will bypass the invitation to edit and return you to the menu to do the insert back or title section.

Before you Do Back, try Edit Back. Line 16 has a sample message for routine printing. Change this string, initialized on listing line 190, to your name. The message will always be printed unless you add so many entries on the back that line 16 is overwritten. To skip the message, use the Erase All selection to wipe it clean.

To Do Title Cassbox asks: "One line or two?" This wrinkle was demanded by my son the rock 'n roll fan and his friends who wanted to show both group names and album titles clearly.

After inputting the lines you will be asked if you want to change anything before returning to the menu. Do not feel pressured; you can make changes later too.

Editing

If you goofed in line 8 on the front, just Edit Front, hit the 8 key and presto—you see *everything* down to and including line 8. The question mark shows you are in the input mode. You will have to retype the whole line for any correction. After Enter, if you have no more changes another Enter brings you back to the menu.

Printing

The Print command first asks

Program Listing 1

```
100 '     ***********************************
110 '     *      CASSETTE BOX LPRINTER      *
120 '     *      BY CHARLES E. GILLEN       *
130 '     *    U.S. EMBASSY, SEOUL, ROK     *
140 '     *       APO SAN FRAN 96301        *
150 '     *    ( VERSION 9, 24 JUL 81 )     *
160 '     ***********************************
170 '
180 REM INITIALIZATION
190 CLS:CLEAR2000:DEFINTA-Z:DIMPL$(19):AR$=CHR$(92):GB$=CHR$(176):CL$="CHAN
GE LINE NUMBER":CU$="  CUT":FO$="  FOLD":PL$(16)="@$FROM: THE GILLEN COLLEC
TION"
200 F1$="END POINTS:      BIG = "+AR$+"          MEDIUM = "+AR$+"
SMALL = "+AR$+CHR$(199)+"----------"+GB$+"BIG----#"+GB$+"MED------"+GB$+"SML
---$--------------------":F2$="##  "
210 DL$=CHR$(124)+STRING$(39,"-")+CHR$(124):BL$="DO NOT TYPE A COMMA OR A C
OLON"+STRING$(2,10)+"START LINE:  @ = CENTER, AND/OR  # =  BIG,  $ = MEDIUM
":PS$=STRING$(63,".")
220 REM CONTROL CODES FOR MICROLINE-80 PRINTER
230 BIG$=CHR$(31) ' DOUBLE WIDTH CHARACTERS, 40 CPL
240 MED$=CHR$(30) ' NORMAL 10 CHARACTERS PER INCH, 80 CPL
250 SML$=CHR$(29) ' CONDENSED 16.5 TO THE INCH, 132 CPL
260 S6$=CHR$(27)+"6" ' SPACE SIX LINES PER INCH
270 S8$=CHR$(27)+"8" ' SPACE EIGHT LINES PER INCH
280 SL$=CHR$(27)+"B" ' PRINT SHORTER LINE (TAB IN FROM EDGE)
290 REM GET INSTRUCTIONS, CHECK PRINTER ON
300 GOSUB650:IFPEEK(14312)=255THENRUN
310 REM MENU  MAIN LOOP
320 CLS:PRINTPS$:PRINT@215,"1 = DO FRONT":PRINTTAB(23)"2 = DO BACK":PRINTTA
B(23)"3 = DO TITLE":PRINT:PRINTTAB(23)"4 = EDIT FRONT":PRINTTAB(23)"5 = EDI
T BACK":PRINTTAB(23)"6 = EDIT TITLE":PRINT:PRINTTAB(23)"7 = PRINT"
330 PRINT:PRINTTAB(23)"8 = ERASE ALL":PRINT@960,PS$;
340 IN=VAL(INKEY$):ONINGOTO380,430,480,400,450,510,550,360:GOTO340
350 REM ERASE STRINGS IN MEMORY ON COMMAND
360 FORNL=1TO19:PL$(NL)="":NEXT:GOTO320
370 REM DO FRONT
380 CLS:PRINT@640,BL$:PRINTPS$:PRINT:PRINTF1$:FORNL=1TO13:PRINTUSINGF2$;NL;
:INPUTPL$(NL):NEXT
390 REM EDIT - DISPLAY FRONT
400 CLS:PRINTF1$:FORNL=1TO13:PRINTUSINGF2$;NL;:PRINT"  "PL$(NL):NEXT
410 LC$="":PRINT@983,CL$;:INPUTLC$:GOSUB930:IFCL=0THEN320ELSEIFCL<1ORCL>13T
HEN400ELSECLS:PRINTF1$:FORNL=1TOCL:PRINTUSINGF2$;NL;:PRINT"  "PL$(NL):NEXT:
PRINTUSINGF2$;CL;:INPUTPL$(CL):GOTO400
420 REM DO BACK
430 CLS:PRINT@256,BL$:PRINTPS$:PRINT:PRINTF1$:FORNL=14TO17:PRINTUSINGF2$;NL
;:INPUTPL$(NL):NEXT
440 REM EDIT - DISPLAY BACK
450 CLS:LC$="":PRINT@256,F1$:FORNL=14TO17:PRINTUSINGF2$;NL;:PRINT"  "PL$(NL
):NEXT:PRINT@983,CL$;:INPUTLC$:GOSUB930:IFCL=0THEN320ELSEIFCL<14ORCL>17THEN
450
460 CLS:PRINTBL$:PRINTF1$:FORNL=14TOCL:PRINTUSINGF2$;NL;:PRINT"  "PL$(NL):N
EXT:PRINTUSINGF2$;CL;:INPUTPL$(CL):GOTO450
470 REM DO TITLE
480 PRINT@343,"1 OR 2 LINES?";:GOSUB950:TL=VAL(INKEY$):IFTL<1ORTL>2ORTL=0TH
ENPRINT@343,CHR$(208);:GOSUB950:GOTO480ELSE490
490 CLS:PRINT@256,BL$:PRINT:PRINTF1$:PRINT"1   ";:INPUTPL$(18):IFTL=2THENPR
INT"2   ";:INPUTPL$(19)
500 REM EDIT - DISPLAY TITLE
510 CLS:LC$="":PRINT@256,F1$:PRINT"1      ";PL$(18):IFTL=2THENPRINT"2      ";
PL$(19)
520 PRINT@983,CL$;:INPUTLC$:GOSUB930:IFCL=0ORCL>TLTHEN320
530 CLS:PRINTBL$:PRINTF1$:IFCL=1THENPRINT"1      "PL$(18):INPUT"1   ";PL$(18
):GOTO510ELSEIFCL=2THENPRINT"1      "PL$(18):PRINT"2      "PL$(19):INPUT"2
";PL$(19):GOTO510
540 REM LPRINT SECTION
550 PRINT@727,"HOW MANY?";:GOSUB950:PR=VAL(INKEY$):IFPR=0THENPRINT@727,CHR$
(202);:GOSUB950:GOTO550ELSEFORHM=1TOPR
```

Listing 1 Continues

Listing continued

```
560 REM LPRINT FRONT
570 LPRINTS6$MED$SL$DL$CU$:LPRINT" ":FORNL=1TO13:GOSUB780:NEXT:LPRINT" ":LP
RINTMED$S8$DL$FO$
580 REM LPRINT TITLE
590 NL=18:IFTL=1THENLPRINT" ":GOSUB780:LPRINT" ":GOTO610ELSEGOSUB780:LPRINT
" ":NL=19:GOSUB780
600 REM LPRINT BACK
610 LPRINTS6$MED$DL$FO$:FORNL=14TO17:GOSUB780:NEXT:LPRINT" ":LPRINTSML$TAB(
10)"DESIGN & PRINTING: TRS-80 COMPUTER":LPRINTMED$DL$CU$
620 REM PRINT AGAIN OR ADVANCE PAPER
630 LPRINT" ":LPRINT" ":NEXTHM:FORLP=1TO4:LPRINT" ":NEXT:GOTO320
640 REM PROGRAM INTRODUCTION - INSTRUCTIONS
650 CLS:PRINTPS$:PRINT@393,"LPRINTER FOR CASSETTE BOX INDEX CARD INSERT":PR
INT
660 PRINTTAB(9)"AN ORIGINAL    FOR THE MICROLINE-80 PRINTER":PRINT:PRINTTAB
(20)"BY CHARLES E. GILLEN":PRINT@960,PS$;:FORTD=1TO1500:NEXT:CLS
670 PRINT"YOU CAN LPRINT:   13  INDEX LINES ON THE FRONT":PRINTTAB(19)"4  L
INES ON THE BACK":PRINTTAB(19)"   TITLE IN 1 OR 2 LINES"
680 PRINTPS$:PRINT"IN THREE DIFFERENT CHARACTER SIZES:":PRINT
690 PRINT"BIG:        BEGIN LINE WITH # SYMBOL        MAX = 17 LETTERS/LINE
700 PRINT"MEDIUM:     BEGIN LINE WITH $ SYMBOL        MAX = 35 LETTERS/LINE
710 PRINT"SMALL:      JUST TYPE AS USUAL              MAX = 57 LETTERS/LINE
720 PRINT:PRINT"FOR AUTO-CENTERING, FIRST SYMBOL MUST BE  @, THEN ADD  #  O
R  $":PRINT
730 PRINT"A FORMAT LINE WILL SHOW CENTER "GB$" AND END "CHR$(92)" POINTS FO
R EACH SIZE":PRINTPS$
740 PRINT:PRINT"TURN ON PRINTER"TAB(43)"AND HIT < SPACEBAR >";
750 IFINKEY$<>" "THEN750ELSECLS:RETURN
760 REM LPRINT SUB-ROUTINE FOR UNCENTERED & CENTERED LINES
770 REM  NOTE THAT LINES TOO LONG GET CUT TO RIGHT SIZE
780 LL=LEN(PL$(NL)):IFLEFT$(PL$(NL),1)="@"THEN830 ' GO CENTER
790 IFLEFT$(PL$(NL),1)="#"THENLPRINTBIG$"  "MID$(PL$(NL),2,17):RETURN ' 40
CPL
800 IFLEFT$(PL$(NL),1)="$"THENLPRINTMED$"   "MID$(PL$(NL),2,35):RETURN ' 80
 CPL
810 LPRINTSML$"      "LEFT$(PL$(NL),57):RETURN ' 132 CPL
820 REM LPRINT CENTERED LINE IN 40, 80 OR 132 CPL
830 TL$=PL$(NL):LL=LEN(TL$):IFMID$(TL$,2,1)<>"#"THEN860
840 IFLL>19THENLL=19:TL$=LEFT$(TL$,19) ' CUT IF LONG
850 TB=(25-LL)/2:LPRINTBIG$TAB(TB)MID$(TL$,3,17):GOTO910
860 IFMID$(TL$,2,1)<>"$"THEN890
870 IFLL>37THENLL=37:TL$=LEFT$(TL$,37)
880 TB=(45-LL)/2:LPRINTMED$TAB(TB)MID$(TL$,3,35):GOTO910
890 IFLL>58THENLL=59:TL$=LEFT$(TL$,58)
900 TB=(72-LL)/2:LPRINTSML$TAB(TB)MID$(TL$,2,57)
910 PL$(NL)=TL$:RETURN ' & DO NEXT LINE
920 REM "REDO" TRAP, BACK TO MENU
930 IFVAL(LC$)=0THEN320ELSECL=VAL(LC$):RETURN
940 REM BLINKER FOR TITLE, PRINT INPUTS
950 FORTD=1TO90:NEXT:RETURN
```

"How many?" You can run off a maximum of nine copies per Print command. This section is the only complicated part of Cassbox. The action begins when line 780 in Listing 1 measures the length of a text line and jumps to the centering routine at line 830 (if the first letter is the @ symbol). If centering is not called for, lines 790 and 800 print in the double-width or normal 80-column mode, or line 810 prints a condensed line.

The MID$ function is used to skip over the size flag and to hack off any excess length. The MID$ function is also used in the center and print section in lines 830–910. This part is a bit involved, but if you modify Cassbox for a different printer rather than using Baby Cassbox, pay attention to the number of letters the MID$ action will print (the last number inside the MID$ parentheses). Your printer may print a different number of characters for each size mode. You will have to change that number and the amount of tabbing.

If your printer is not an M80, see Fig. 2 for the control codes used in Cassbox. Replace them with the codes needed by your printer.

Line 390 also contains an LPRINT CHR$(27)"B" which tabs in from the paper edge. This was my personal preference and can be ignored.

The Beginning Programmer

The very first step in creating Cassbox was to measure an original insert card and then fool around with a few trial lines of Basic to see if I could LPRINT something to the same dimensions. These tests showed how long each printed line could be and how many lines I could fit on each part. Further development showed the need for help in formatting via prompt lines. I worked out the concept of flexible editing and things began to snowball.

Not until I felt sure the original objective was within my programming ability did I try to get fancy with the different character sizes of the M80 printer. The menu that makes Cassbox so easy to use was a very late idea. When the program seemed to work nicely I tried to rethink small bits of the Basic code in a more direct way. What sustained me through countless early versions of Cassbox was the original simple goal I had set: to print any kind of text arrangement within the confines of the insert card size. As I went along, the original goal became more sophisticated and inspired better programming. I frequently dipped into the Level II Manual for syntax help. Always decide what you want to do, try to do it, then do it better. ■

LPRINT CHR$(27)"8"	Set spacing at 8 lines per inch
LPRINT CHR$(27)"6"	Set spacing at 6 lines per inch
LPRINT CHR$(29)	Print 5 letters per inch
LPRINT CHR$(30)	Print 10 letters per inch
LPRINT CHR$(31)	Print 16.5 letters per inch

Fig. 2. Printer Control Codes

Charles Gillen, after spending most of his 20-year government service career abroad, hopes to return to the U.S. soon to personally witness the microcomputer boom.

```
1000 '      **************************************
1010 '      *        BABY CASSBOX  LPRINTER        *
1020 '      *  THIS IS THE BARE-BONES VERSION  *
1030 '      *            FOR ANY PRINTER             *
1040 '      *         BY CHARLES E. GILLEN          *
1050 '      *          U.S. EMBASSY, SEOUL           *
1060 '      *        APO SAN FRANCISCO 96301       *
1070 '      *     ( VERSION 2, 26 JULY 1981    ) *
1080 '      **************************************
1090 '
1100 REM INITIALIZATION
1110 CLS:CLEAR1000:DEFINTA-Z:DIMPL$(19)
1120 F1$="      ----------------C----------------"+CHR$(92)
1130 F2$="##  "
1140 CL$="CHANGE LINE NUMBER"
1150 DL$=":"+STRING$(39,"-")+":"
1160 BL$="BEGIN LINE WITH  @  FOR AUTO-CENTER.  NO COMMAS OR COLONS"
1170 REM TOP OF MENU LOOP
1180 CLS:PRINT"1 = DO FRONT      13 LINES
1190 PRINT"2 = DO BACK        4 LINES
1200 PRINT"3 = DO TITLE       2 LINES":PRINT
1210 PRINT"4 = EDIT FRONT
1220 PRINT"5 = EDIT BACK
1230 PRINT"6 = EDIT TITLE":PRINT
1240 PRINT"7 = PRINT":PRINT
1250 PRINT"8 = ERASE
1260 IN=VAL(INKEY$)
1270 ONINGOTO1340,1570,1800,1400,1630,1860,2060,1290:GOTO1260
1280 REM ERASE MEMORY
1290 FORNL=1TO19
1300      PL$(NL)=""
1310 NEXTNL
1320 GOTO1180
1330 REM DO FRONT
1340 CLS:PRINTBL$:PRINTF1$
1350 FORNL=1TO13
1360      PRINTUSINGF2$;NL;
1370      INPUTPL$(NL)
1380 NEXTNL
1390 REM EDIT FRONT
1400 CLS:PRINTBL$:PRINTF1$
1410 FORNL=1TO13
1420      PRINTUSINGF2$;NL;
1430      PRINT"  ";PL$(NL)
1440 NEXTNL
1450 LC$="":PRINT@983,CL$;
1460 INPUTLC$:GOSUB2030
1470      IFCL=0THEN1180
1480      IFCL<1ORCL>13THEN1400
1490 CLS:PRINTF1$
1500 FORNL=1TOCL
1510      PRINTUSINGF2$;NL;
1520      PRINT"  "PL$(NL)
1530 NEXTNL
1540 PRINTUSINGF2$;CL;
1550 INPUTPL$(CL):GOTO1400
1560 REM DO BACK
1570 CLS:PRINTBL$:PRINTF1$
1580 FORNL=14TO17
1590      PRINTUSINGF2$;NL;
1600      INPUTPL$(NL)
1610 NEXTNL
1620 REM EDIT BACK
1630 CLS:PRINTBL$:PRINTF1$
1640 FORNL=14TO17
1650      PRINTUSINGF2$;NL;
1660      PRINT"  ";PL$(NL)
1670 NEXTNL
1680 LC$="":PRINT@983,CL$;
1690 INPUTLC$:GOSUB2030
1700      IFCL=0THEN1180
1710      IFCL<14ORCL>17THEN1630
1720 CLS:PRINTBL$:PRINTF1$
1730 FORNL=14TOCL
1740      PRINTUSINGF2$;NL;
1750      PRINT"  ";PL$(NL)
1760 NEXTNL
1770 PRINTUSINGF2$;CL;
1780 INPUTPL$(CL):GOTO1630
1790 REM DO TITLE
1800 CLS:PRINTBL$:PRINTF1$
1810 FORNL=18TO19
1820      PRINTUSINGF2$;NL;
1830      INPUTPL$(NL)
1840 NEXTNL
1850 REM EDIT TITLE
1860 CLS:PRINTBL$:PRINTF1$
1870 FORNL=18TO19
1880      PRINTUSINGF2$;NL;
1890      PRINT"  ";PL$(NL)
1900 NEXTNL
1910 LC$="":PRINT@983,CL$;
1920 INPUTLC$:GOSUB2030
1930      IFCL=0THEN1180
1940      IFCL<18ORCL>19THEN1860
1950 CLS:PRINTBL$:PRINTF1$
1960 FORNL=18TOCL
1970      PRINTUSINGF2$;NL;
1980      PRINT"  "PL$(NL)
1990 NEXTNL
2000 PRINTUSINGF2$;CL;
2010 INPUTPL$(CL):GOTO1860
2020 REM "REDO" TRAP AND BACK TO MENU
2030      IFVAL(LC$)=0THEN1180
2040 CL=VAL(LC$):RETURN
2050 REM LPRINT ROUTINE
2060 PRINT@532,"PRINT HOW MANY?";
2070 PR$=INKEY$
2080      IFPR$=CHR$(13)THEN1180
2090      IFPR$=""THEN2070
2100      IFVAL(PR$)=0THEN1180
2110 REM LPRINT LOOP. HM = NUMBER OF COPIES
2120 FORHM=1TOVAL(PR$)
2130      REM LPRINT FRONT
2140      LPRINTDL$;"  CUT"
2150      LPRINT" "
2160      FORNL=1TO13
2170          IFLEFT$(PL$(NL),1)="@"THENGOSUB2450:GOTO2190
2180          GOSUB2510
2190      NEXTNL
2200      LPRINT" "
2210      LPRINTDL$;"  FOLD"
2220      REM LPRINT TITLE

2230      NL=18:IFLEFT$(PL$(NL),1)="@"THENGOSUB2450:GOTO2250
2240      GOSUB2510:GOTO2250
2250      IFTL=1THENLPRINT" ":GOTO2280
2260      NL=19:IFLEFT$(PL$(NL),1)="@"THENGOSUB2450:GOTO2280
2270      GOSUB2510
2280      LPRINTDL$;"  FOLD"
2290      REM LPRINT BACK
2300      FOR NL=14TO17
2310          IFLEFT$(PL$(NL),1)="@"THENGOSUB2450:GOTO2330
2320          GOSUB2510
2330      NEXTNL
2340      LPRINT" ":LPRINT" "
2350      LPRINTDL$;"  CUT"
2360      LPRINT" "
2370 NEXTHM ' LPRINT ANOTHER COPY IF NEEDED
2380 REM ADVANCE PAPER IF NO MORE LPRINTING
2390 FORLF=1TO6
2400      LPRINT" "
2410 NEXTLF
2420 REM ALL DONE. BACK TO MENU LOOP
2430 GOTO1180
2440 REM CENTER THE LINE
2450 TL$=MID$(PL$(NL),2,35)
2460 LL=LEN(TL$)
2470 TB=(43-LL)/2
2480 LPRINTTAB(TB)LEFT$(TL$,35)
2490 RETURN
2500 REM LPRINT ONE LINE
2510 LPRINT"   "LEFT$(PL$(NL),35):RETURN
```

Program Listing 2

Make your own MX-80 cable!

CABLEBREW

James H. DeFrancis
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I recently ordered an Epson MX-80 printer and printer cable by mail. On delivery the printer cable had not been included in the shipment. The omission was easily corrected with a simple phone call, but I could not bear to wait another 7–10 days for it to arrive. Therefore, I decided to assemble my own cable.

The assembly is simple. You need three components: approximately five feet of 34-conductor ribbon cable; a 34-position card edge connector; and an Amphenol #57-30360 38-contact connector plug.

If you do not have these in your spare parts box, you can purchase them from your local electronics retailer or computer store for approximately $5 each.

The Model III printer card located in the right rear bottom of the unit is not labeled. You have to identify the contact points before you can assemble the cable.

If you look at the Model III from the rear, the printer card contacts read evenly from left to right, 2, 4, 6 and so on through 34. Directly behind these contacts on the opposite side of the card the contacts read from left to right 1, 3, 5 and so on through 33.

Assemble the ribbon cable and edge card connector so the contact points match those of the printer card. The ribbon cable will extend out the rear of the Model III when it is in place. Match the contact points of the printer card connector to their appropriate contacts on the printer plug. Table 1 lists the printer card contacts and appropriate printer plug contacts. Unlisted contacts are not used, so do not connect them.

Before you connect the cable to your printer check to make sure none of the contact pins on the connectors are touching more than one conductor lead on the ribbon cable.

If you already own a Radio Shack printer cable, it will also work on the Epson, but it will not permit underlining, slashing zero, and so on. The Radio Shack cable's configuration does not allow for separation of the carriage return and line-feed commands. The Epson cable does. You can modify your present Radio Shack cable to perform these extra functions by configuring it to the listing in Table 1. You will have to make 11 disconnections. Table 2 shows the signal functions and their contact pin number for the Model III and Epson contacts. ■

James DeFrancis is employed by E.I. DuPont and Co. His hobbies are woodworking and woodcarving.

Radio Shack Pin #	to	Epson Pin #
1		1
3		2
5		3
7		4
9		5
11		6
13		7
15		8
17		9
21		11
23		12
25		13
2		19
4		20
6		21
8		22
10		23
12		24
14		25
16		26
18		27
20		28
22		29
24		30
28		32

Table 1

TRS-80 Pin #	Signal Function	Epson Pin #
1	STROBE—pulse to clock data	1
3	DATA 0—LSB of data byte	2
5	DATA 1—bit 1 of data byte	3
7	DATA 2—bit 2 of data byte	4
9	DATA 3—bit 3 of data byte	5
11	DATA 4—bit 4 of data byte	6
13	DATA 5—bit 5 of data byte	7
15	DATA 6—bit 6 of data byte	8
17	DATA 7—MSB of data byte	9
21	BUSY—Printer cannot receive data	11
23	PE—out of paper	12
25	SELECT—printer is selected	13
—	ACKNOWLEDGE—byte has been received	23
28	ERROR	32
2,4,6,8,10,12 14,16,18,20,22,24 27,31,33,34	GROUND	19,20,21,22,23,24 25,26,27,28,29,30
	All others not used	

Table 2

Combine programs and conserve energy.

Color Computer Pointers

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Decimal Address	Contents
0-1023	System use
1024-1535	Text screen memory
1536-16383	Program and variable storage
40960-49151	Color Basic
49152-65279	Cartridge memory
65280-65535	Input/Output

Fig. 1. 16K RAM Color Basic Memory Map

If you use a Color Computer the following discussion of memory allocation and pointer usage should provide two immediately useful capabilities: joining Basic programs, and maximizing available memory.

You may have had a good routine or subroutine in one program that you wanted to include in another. If you tried to load in the first program and then CLOAD the second without entering a New command you also found that CLOAD did a New command and prevented this method from working. This was not a limitation peculiar to the Color Computer. Manipulating pointers in memory with PEEK and POKE commands can combine as many programs as you want.

The "out of memory" message is particularly annoying if you already have the maximum amount of memory installed. If you are an Extended Basic user, you may be wasting up to 6K of valuable RAM.

The Key Box

Color Basic or
Extended Color Basic
Color Computer
4K RAM or above

Memory Allocation

The 6809 processor chip in the Color Computer can address 64,000 memory locations. Each of these memory locations can store information in the form of an instruction to the processor, or data which the processor uses. To the processor and to Basic, the Basic program is really data or information to operate on.

Look at how Color Basic divides up memory. Refer to Fig. 1. Basic programmers generally are concerned only with the memory area from address 1536 to 16383 where the Basic program resides. The computer uses the rest of memory to read and process our instructions and output the results. Part of this memory is Read Only Memory or ROM. The rest can either read or write data. The 16K of RAM in a 16K machine resides from address 0 to address 16383. The system uses part of this and it is unavailable to us.

Two Important Basic Pointers

Earlier, I referred to a range of addresses in memory from 1536 to 16383 that could hold our Basic program. Since a Basic program probably will not fill all that space all of the time, a pointer tells Basic where a program ends. This pointer resides in memory locations 27 and 28 and points two bytes to the right of our program's end. Since Basic programs can begin at various locations, a second pointer tells us where the current Basic program begins in memory. This pointer resides in memory locations 25 and 26.

These pointers are changeable so we can load programs anywhere in the available memory or combine programs as desired.

Pointer Format

Enter the command

```
PRINT PEEK(25);PEEK(26);
PEEK(27);PEEK(28)
```

```
PRINT PEEK(25);PEEK(26);PEEK(27);PEEK(28)

6          1          6          3

Pointer to beginning       Pointer to end of
of Basic program.          Basic program.
6 x 256 = 1536             6 x 256 = 1536
1 x 1   =    1             3 x 1   =    3
          ----                       ----
          1537                       1539

Address of beginning       Address of end of
of Basic program           Basic program
```

Fig. 2. Conversion of Pointer Addresses to Decimal Values

Four numbers should appear. The two numbers on the left constitute the pointer to the memory address of the beginning of your Basic program. The two numbers on the right point to the ending address of your Basic program.

```
Program A
10 REM THIS IS PROGRAM A
20 END

Program B
30 REM THIS IS PROGRAM B
40 END
```

Fig. 3. Programs which illustrate appending two programs in memory

You must convert these numbers to decimal addresses. Multiply the left number of the pair by 256 and add the result to the right number of the pair. See Fig. 2 for an example. To convert from a decimal address, divide by 256 and use that number as the left number; use the remainder as the right number.

Mechanics: Combining Programs

Enter and CSAVE the two programs in Fig. 3. We will add program B to the end of program A. The programs are numbered to eliminate line number conflicts. All of program A's line numbers are less than all of program B's line numbers. This is a restriction for this method to work. The Renum command of Extended Basic should eliminate any problems.

To combine the two programs follow Fig. 4. CLOAD program A into memory. You may list it at this point or make any corrections.

Now enter the command we used to look at the Basic pointers:

```
PRINT PEEK(25);PEEK(26);
PEEK(27); PEEK(28)
```

Change the begin Basic program pointer to whatever the end Basic pointer is, less two bytes. Enter the POKE command as shown in Fig. 4. The "less two bytes" is necessary because the end Basic program pointer is actually two bytes beyond where we want to be. Because this is a short program, we only had to POKE location 26. In a longer program, we would have had to POKE location 25 also.

At this point, if you enter a LIST command, your Basic program will disappear. The program is still there but Basic does not know it.

After doing a CLOAD for program B, we can do a list and find that we have only program B. POKE locations 25 and 26 back to their original form. Now list the program. You now have both programs together. Now you can CSAVE or make changes.

Reclaiming Wasted RAM

This section is for Extended Basic users only, because Extended Basic uses a slightly different memory map. Figure 5 shows eight pages of what is called graphics screen memory

```
CLOAD"A"                                      CLOAD program A
OK
PRINT PEEK(25);PEEK(26);PEEK(27);PEEK(28)
6  1  6  33                                   Display the pointers
POKE26,31                                     Change Basic pointer
CLOAD"B"                                      CLOAD program B
OK
POKE26,1                                      Reset Basic pointer
OK
```

Fig. 4. Procedure Appends Program B to Program A. PEEK gives different numbers if you use Extended Basic or if you key in Program A with more or less spaces. Use those numbers rather than the numbers above.

from location 1536 to 13823. This is used by Extended Basic to perform high resolution graphics. If you are not using graphics in your program, you can use this space in your Basic program. The Extended Basic manual covers this but leaves this one important point unclear. Unless you specify otherwise, four pages of graphics screen memory are reserved for you. Unless your program is using graphics, this space is wasted.

You can get back all but one page of this memory by entering a PCLEAR 1. We can recoup that last page of screen memory by POKEing locations 25 and 26 to 1536:

```
POKE25,6:POKE26,1
```

Now enter NEW. Displaying memory will show 14631, the same as on a 16K machine without Extended Basic. ■

Gill Gilliland is a systems analyst for South Central Bell Telephone Company. As amateur radio operator WD4BXA, he enjoys operating RTTY with his Color Computer.

Decimal Address	Contents
	Graphics Screen Memory
1536–3071	Page 1
3072–4607	Page 2
4608–6143	Page 3
6144–7679	Page 4
7680–9215	Page 5
9216–10751	Page 6
10752–12287	Page 7
12288–13823	Page 8
13824–16383	Program and variable storage

Fig. 5. Graphics screen memory

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Teach your children to add and subtract.

Model II Math Skills

Mike Kilroy
6213 Concerto Court
Dayton, OH 45449

This article describes the math quiz program I wrote to help my 10-year-old boys become more efficient with their simple math facts. The program picks random addition, subtraction, multiplication, division, and combinations of all these problems for the boys to practice with. I did however have a slight problem with persuading them to practice the problems and not dissect my program. To solve this problem I disabled the Break and Hold keys with short machine-language routines.

This program should also help you understand machine-language on your Model II a little better and at the same time hopefully help the kids become more efficient at their math.

Using the Program

To disable the Break and Hold keys the program jumps to the machine-language routines and then returns to Basic (see Fig. 1). Next, the program asks you to select the subject you want to practice. Enter A for addition skills, S for subtraction skills, M for multiplication skills, D for division skills, or C for a combination of all four skills. (Entering X enables the Break key and ends the program.) Next, enter your skill level (1–10) and the number of problems you want to work (10–100). If you enter less than 10 for the problems, you will get 10, the minimum number allowed. Likewise, 100 is the maximum number of problems allowed.

You are now ready to practice. The various score keeping parameters appear across the top of the screen: the number of problems you have completed right and wrong, your present percent score, the number of problems left to go, and the time. The time is a running clock showing the time remaining to answer the present problem. It counts down from 50 to zero. (I also disabled the Hold key so that the boys would not hit the Hold key to stop the clock.) The purpose of the clock is to show, at the end of the practice session, how much time was spent on the problems.

Problems are centered on the screen. A little saying appears at the bottom of the screen when you have typed in your answer. You may customize these sayings for your own children. There are two types of sayings; those given for correct answers and those given for incorrect answers. To answer a problem simply type in the answer and Enter. If you don't know the answer, the computer will help you. Type only an H and the answer will momentarily be displayed under the problem. Typing an H counts as one wrong, and you then have to type in the correct answer the computer showed you.

Scoring

After completing the problems, the program tells you how many problems you did, how many wrong answers you entered, your final percentage score and your speed. It also asks for "dad's code." The speed figure is based on total time used in answering the problems compared to the total amount of time available. If the speed is 60 percent it means that out of 50 possible time units available per problem, the boys used an average of 20 time units on each (50x(1 – .6)).

With Break disabled, the boys cannot clear the scores off the screen without my seeing them. When "dad's code" is entered it is not displayed on the screen. Also to prevent the boys from learning the code by looking on as I enter it, I've set this up to take 256 characters and search among all entered characters for the correct three-character long code! The code is defined in line 904. I use 435.

Machine-Language Routines

The two machine-language routines used in this program are called SETBRK and HLDKEY. They disable and enable the Break and Hold keys. The Model II provides mini-subroutines in machine language called "supervisor calls" which do most of the work. (For background on supervisor calls refer to your Model II Owners Manual, TRSDOS section, pages 4/9, 4/18 and 4/20A.)

The Hold key routine is short and easy to follow. Both this and the Break key routine are run right from the main Basic program.

To disable the Hold key refer to Program Listing 1. Load register B with the number 1 (that line is stored at address F240 in the computer's memory), load register A with the number 13, '1D' in

```
STARTER                    TYPE=F                Sun May 10 1981 130
—00.15.43     PAGE 1

                        BYTE 1...5...10...15...20...25...30...35...40...45...50...55...60...65
...70...75...80...85...90...95..100
R=1      .1 CLS.LOAD SETBRK.LOAD HLDKEY.BASIC MATH -M:62000.
---------------------------------------------------------------------
LRL= 1
```

Figure 1

The Key Box

CBasic
Model II
TRSDOS

hexadecimal (that line is stored at address F242), call the supervisor subroutine (this line is stored at address F244), then return from this subroutine to Basic (this line is stored at address F245). That's all there is to disabling the Hold key! The Model II does not make provisions for enabling the Hold key after you have disabled it. To re-enable it you must reset the computer.

Break Key Processing

The Break key processing is more complex. The manual explains the enter and exit conditions after processing the Break key. The Break key's function is to send the computer off to a subroutine in its memory whenever it is pressed. To do this, the computer must know where to jump to in memory as soon as it is pressed. Our subroutine disables this jump when we do not want this key active and enables the jump again when we want it active. This supervisor call is designed exactly for this purpose, but we need separate routines to do each of these. The subroutine shown in Program Listing 2 starts at location F2B0. There are three parts to it; each is separately called from the main Basic program.

The first part is at F2B0 to F2B4. This checks to see if the Break key is presently enabled or disabled. When you first run this program, address location F2BF will be zero. I use this address as a flag to tell me if the key is enabled or disabled; zero means the Break key is presently enabled; one means disabled. We load register A with the number at this location, transfer it to the memory location pointed to by register HL, then return to the Basic program. The computer defines the address pointed to by register HL as the location of our Basic program's X variable. (See page 3/144 of the Basic section in your manual.)

Line 30 in our Basic program then checks if X is zero, or if the key is enabled. If it is, we jump to our subroutine starting at F2C0 in memory to disable it. F2C0 puts zero into register HL. In addition we need to put the number 3 into register A and call the supervisor routine with a CF command (line F2C5). As page 4/18 explains, this will disable the key if and only if there presently is no Break key program pointed to in memory. If there is a Break key already pointed to in memory, this command tells us where the present Break key subroutine is located in memory. This address will be located in the HL register.

So far the program tells us where the old Break key program is located in memory. Save this old address in memory somewhere so we can put it back to enable the key when we want it again. Address F2C6 saves that old address at memory location

```
F240:  06 01   LD   B,01
F242:  3E 1D   LD   A,1D
F244:  CF      RST  08
F245:  C9      RET
```

Program Listing 1

```
F2B0:  3A BF F2  LD   A,(F2BF)
F2B3:  77        LD   (HL),A
F2B4:  C9        RET
F2B5:  00        NOP
F2B6:  00        NOP
F2B7:  00        NOP
F2B8:  00        NOP
F2B9:  00        NOP
F2BA:  00        NOP
F2BB:  00        NOP
F2BC:  00        NOP
F2BD:  00        NOP
F2BE:  00        NOP
F2BF:  00        NOP
F2C0:  21 00 00  LD   HL,000
F2C3:  3E 03     LD   A,03
F2C5:  CF        RST  08
F2C6:  22 E7 F2  LD   (F2E7),HL
F2C9:  21 F2 F2  LD   HL,F2F2
F2CC:  3E 03     LD   A,03
F2CE:  CF        RST  08
F2CF:  3E 01     LD   A,01
F2D1:  32 BF F2  LD   (F2BF),A
F2D4:  00        NOP
F2D5:  C9        RET
F2D6:  00        NOP
F2D7:  00        NOP
F2D8:  00        NOP
F2D9:  00        NOP
F2DA:  00        NOP
F2DB:  00        NOP
F2DC:  00        NOP
F2DD:  00        NOP
F2DE:  00        NOP
F2DF:  00        NOP
F2E0:  21 00 00  LD   HL,0000
F2E3:  3E 03     LD   A,03
F2E5:  CF        RST  08
F2E6:  21 02 60  LD   HL,6002
F2E9:  3E 03     LD   A,03
F2EB:  CF        RST  08
F2EC:  3E 00     LD   A,00
F2EE:  32 BF F2  LD   (F2BF),A
F2F1:  00        NOP
F2F2:  C9        RET
```

Program Listing 2

✓See List of Advertisers on Page 455

F2E7 for later use.

Now that we know the old address, we can disable the Break key in address F2C9 through F2CE. Remember, we want to disable Break and then enable it later. My approach is to point to my own Break key subroutine every time the key is pressed. I return from the subroutine each time the key is pressed. I put address F2F2, which is the address of a Return command, into register HL, then load register A with 3, then call the supervisor call. The number in register HL now becomes the *new* address of the Break key subroutine. In this case we have pointed to a Return command as the whole Break key program.

Now, each time the key is pressed the present program running in the computer will stop, and the computer will jump to this new Break key subroutine which tells it to return to what it was doing without any other action. The result is no more Break key! Address F2CF through F2D1 sets the flag to show that the key is presently disabled. Then we return to the main Basic math program with the Break key disabled.

```
TRS-80 Model II DEBUG Program
F240   06 01 3E 1D CF C9 00 00   00 00 00 00 00 00 00 00   ..>.............
```

Program Listing 3

```
TRS-80 Model II DEBUG Program
F2B0   3A BF F2 77 C9 00 00 00   00 00 00 00 00 00 00 00   :..w............
F2C0   21 00 00 3E 03 CF 22 E7   F2 21 F2 F2 3E 03 CF 3E   !..>.."..!..>..>
F2D0   01 32 BF F2 00 C9 00 00   00 00 00 00 00 00 00 00   .2..............
F2E0   21 00 00 3E 03 CF 21 69   00 00 00 00 00 00 00 00   !..>..!i>..>.2
F2F0   F2 00 C9 00 00 00 00 00   00 00 00 00 00 00 00 00   ................
```

Program Listing 4

We enable the Break key again with the subroutine located at address F2E0 through F2F2. First we remove the present Break key processing program address by loading HL with zero, A with 3, and calling the supervisor call (RST 8). Next we load HL with the original saved address of the break processor. Notice we saved the original address at location F2E7. That put it right where we needed it for this enabling routine! No need to get the address from elsewhere. We load HL with this address, load A with 3, call RST 8 and we have restored the original function of the Break key. Again we set our flag to zero to indicate the key is enabled.

We need Basic's DEFUSR and USR( ) commands to make use of the machine-language subroutines from our Basic math program. The DEFUSR command defines the starting point of your machine-language subroutine (see page 3/32 of the owner's manual). You are allowed to define up to nine of these. I've defined four as line 20 of the Basic program shows. The hexadecimal addresses and the starting point of each one of the machine-language subroutines we've just discussed match up. I use the USR command to return a one or zero from the subroutine located at F2B0 in memory as X. I use the remaining USR commands to force the computer to switch from Basic to my subroutines and then return to continue the Basic program where it left off. Returning to Basic from these subroutines is very simple: use a return (C9) in machine language.

Debug

Use TRSDOS Debug to enter the machine-language programs into the computer. First, type in Clear to clear all memory to prevent any confusion. To turn on Debug enter the command "DEBUG ON" in the TRSDOS ready mode. Enter "DEBUG" to activate the Debug program (see page 2/25 in TRSDOS section).

Now enter the machine-language programs I've listed in Listings 1 and 2. I've relisted these two programs in Listings 3 and 4 just as they will appear after you type them in under the Debug program. The cursor will be blinking, waiting for a command in the Debug program. Type H to list the legal commands available. Type M to enter the start address of our program. Then enter the address F240. Next press the F1 key to move the cursor into the memory block. You are now ready to type in the machine-language program starting at address F240. Copy Listing 3 into the memory block and then press the F2 key to save this program in memory. Next, repeat this same procedure for the rest of the program beginning at address F2B0. After you have entered Listings 3 and 4 type S to return to TRSDOS.

To save on disk use the Dump command (see page 2/40A of the owner's manual). You need to give these programs names just like Basic programs. I've called them SETBRK and HLDKEY. The commands to save are:

- DUMP SETBRK {START = F2B0, END = F2F2}
- DUMP HLDKEY {START = F240, END = F245}

Enter these commands to save what you just typed with the Debug program on your disk.

Now you are ready to build a Do file to automatically start the math program.

Do file

The purpose of the Do file is to load these two machine-language programs into memory at start up, and then load Basic and your program. Fig. 1 shows the Do file "STARTER", which I built with the Build command. I reserved all memory above 62000 (F230 hexadecimal) for my machine-language programs so they would not be interfered with by any Basic programs.

You may then use the command Auto Starter to automatically do the file Starter after you initialize the computer at turn on. That way all you need do is Enter the date and you will immediately go to the math program with no steps in between. ■

Program Listing 5

```
10 'YOU MUST LOAD "setbrk" AND "hldkey" FIRST .
20 DEFUSR0=&HF240:DEFUSR1=&HF2C0:DEFUSR2=&HF2B0:DEFUSR3=&HF2E0
30 X=USR0(X):X=USR2(X):IF X=0 THEN X=USR1(X)
40 ONERRORGOTO930
50 DEFSTR A,D,E:DEFINT F,T,X,Y,Z,S:GOSUB450
60 A1=CHR$(26):A2=CHR$(25):A3=CHR$(30):A4=CHR$(31):A5=CHR$(150):A6=CHR$(24)
:A8=" I HELPED !! "
70 PRINTA1;A4:CLS:PRINT@850,"MODEL II MATH SKILLS"
80 PRINT@1337,"Copyright Dec 15, 1980"
90 PRINT@1581,"By Mike Kilroy"
100 FOR T=0 TO 2000:PRINT@0,CHR$(02):NEXT
110 PRINTA3;A2:CLS:T1=0:T=0:T2=0:P4=0:P=0:P1=0:Q=0
120 PRINTTAB(25)A1;"  PICK ONE OF THE FOLLOWING  ";A2
130 PRINT@270,A1;"A";A2;"DDITION SKILLS "
140 PRINT@430,A1;"S";A2;"UBTRACTION SKILLS "
150 PRINT@590,A1;"M";A2;"ULTIPLICATION SKILLS "
160 PRINT@750,A1;"D";A2;"IVISION SKILLS "
170 PRINT@910,A1;"C";A2"OMBINATION OF ABOVE"
180 PRINT@1230,A1;" COMMAND ";A2;CHR$(24);:INPUT A
185 IFA="A"ORA="S"ORA="M"ORA="D"ORA="C"THENGOSUB350
190 IFA="A"THEN260
200 IFA="S"THEN1000
210 IFA="M"THEN2000
220 IFA="D"THEN3000
230 IF A="X" THEN 920
240 IFA="C"THEN5000ELSE GOSUB420
250 GOTO180
260 P=0:P1=0
270 A7="+":Z1=X+Y:GOSUB 700
280 IFZ=Z1THENP=P+1:GOSUB830 ELSEP1=P1+1:GOTO320
290 GOSUB430
300 GOSUB400
310 IFQ-P<0THEN860 ELSEIFP4=0THEN270 ELSE5000
320 GOSUB840
330 GOSUB430
340 GOTO 270
350 CLS:PRINT@900,A1;" ENTER SKILL LEVEL (1 TO 10) ";A2;CHR$(24);
360 INPUT S:IFS<1 OR S>10THEN GOSUB420ELSEGOTO380
370 GOTO350
380 PRINT@1220,A1;" HOW MANY PROBLEMS ";A2;CHR$(24);:INPUTQ
390 IF Q<10THENQ=10 ELSEIF Q>100THENQ=100
395 T2=Q*50
400 X=RND(S*10):Y=RND(S*10)
410 RETURN
420 PRINT:PRINT:PRINT D(RND(10))
430 FORT=0 TO300:PRINT@0,CHR$(02):NEXT
440 RETURN
450 D(0)="YOU DUMBY !!!!   YOU CAN'T DO THAT"
460 D(1)="WHEN YOUR BROTHER DIED THEY PROBABLY BURIED YOU !!!"
470 D(2)="MY TOILET IS SMARTER THAN YOU"
480 D(3)="YOU HAVE MARBLES FOR A BRAIN"
490 D(4)="YOU SMELL LIKE A  SEWER, BUT THAT'S BESIDE THE POINT!!!!!"
500 D(5)="WHY IS IT THAT YOU DO SUCH IDIOTIC THINGS?"
510 D(6)="You're as dumb as me............... unplugged!!!!!!"
520 D(7)="My you have pretty legs......."
530 D(8)="Why did you do that - - try again."
540 D(9)="You're mother wears army boots - but that's no excuse!!!!"
550 D(10)="Why not put at least a little effort into getting this right?"
560 E(0)="Good job buddy"
570 E(1)="Germans are smart too"
580 E(2)="Very good, chops!!!!"
590 E(3)="You're almost as smart as ME !!!!!!"
600 E(4)="What did you do plug your self into my memory!!!"
610 E(5)="That away"
620 E(6)="You look so ugly  that nobody could tell your a math king"
630 E(7)="When your brother died they probably buried him!!!!!!"
640 E(8)="Your a math king"
650 E(9)="I'L bet your bad at spelling"
660 E(10)="I wonder if you can spell as well as you are at math"
670 RETURN
680 PRINT@1056,A6;Z1;"    ";A1;A8;A2
690 T1=T1-50:Z=Z1:A8=" I HELPED !! ":F=1:RETURN
700 B$="":T=50:PRINTA4:PRINT@815, USING"###";X
710 PRINT@894,A7:PRINT@895, USING"###";Y
720 PRINT@975,A5;A5;A5;A5;A5
730 PRINT@1056,A6;:Y1=13:X1=16
740 A0="":A0=INKEY$:PRINT@(Y1,X1),A0;:GOSUB780:IF A0=""THEN740
750 IFA0="H"THENGOSUB 680ELSEIFA0=CHR$(08)THENX1=X1-1ELSEX1=X1+1
760 IFA0=CHR$(13)OR A0="H"THEN Z=VAL(B$):RETURN
770 IFA0=CHR$(08)THENB$=LEFT$(B$,X1-16):GOTO740ELSEB$=B$+A0:GOTO740
780 T=T-1:PRINT@70,A1;"TIME";A2:PRINT@230,T;CHR$(02):IFT=0THENA8=" TIMES UP
":A0="H"
790 P3=INT(((P-P1)/P)*100):IFP3<0THENP3=0
800 PRINT@0,A1;"RIGHT";A2;"  ";A1;"WRONG";A2;"  ";A1;"PERCENT";A2;"  ";A1;"
TO GO";A2
810 PRINT@161,P;"    ";P1;"     ";P3;"%";"    ";Q-P
820 IFA0=CHR$(11)THEN110ELSE RETURN
830 PRINT@1063,A1;" RIGHT ";A2:PRINT@1521,E(RND(10))
835 T1=T1+T:RETURN
840 IFF=0THENPRINT@1063,A1;" WRONG ";A2
850 T1=T1-20:PRINT@1521,D(RND(10)):F=0:RETURN
860 CLS:P2=10-P1:IFT1<0THENT1=0
870 PRINT@160,A1;"     PROBLEMS     ";A2;"     ";A1;" PROBLEMS WRONG ";A2
```

Listing continues

Listing continued

```
880 PRINT@326,Q,,P1:IFP3<0THENP3=0
890 PRINT@960,A1;" YOUR SCORE IS: ";A2;P3;"%"
895 PRINT@1360,A1;" SPEED ";A2;(T1/T2)*100;"%"
900 B$="":PRINT@1760,A1;" DAD'S CODE ";A2;
902 D=INKEY$:IFD=""THEN902 ELSE B$=B$+D
904 IF D=CHR$(13)THEN V=INSTR(B$,"435") ELSE 902
906 IF V=0THEN PRINT@1780,"BAD CODE":GOTO900 ELSE 110
920 X=USR2(X):IF X=1THEN X=USR3(X):CLS:PRINTCHR$(30);"BYE!!!"
925 STOP
930 RESUME NEXT
1000 P=0:P1=0
1010 A7="-":Z1=X-Y:GOSUB700
1020 IF Z=Z1THENP=P+1:GOSUB830 ELSEP1=P1+1:GOTO1060
1030 GOSUB430
1040 GOSUB400
1050 IFQ-P<0THEN860 ELSEIFP4=0THEN1010 ELSE5000
1060 GOSUB840
1070 GOSUB430
1080 GOTO1010
2000 P=0:P1=0
2010 A7="X":Z1=X*Y:GOSUB700
2020 IFZ=Z1THENP=P+1:GOSUB830 ELSEP1=P1+1:GOTO2060
2030 GOSUB430
2040 GOSUB400
2050 IFQ-P<0THEN860 ELSEIFP4=0THEN2010 ELSE5000
2060 GOSUB840
2070 GOSUB430
2080 GOTO2010
3000 P=0:P1=0
3010 W=X/Y:W2=INT(W):IFW2<>WTHENGOSUB400 ELSE3015
3011 GOTO3010
3015 Z1=W:GOSUB4000
3018 Y1=13:X1=17:GOSUB740
3020 IFZ=Z1THENP=P+1:GOSUB830 ELSEP1=P1+1:GOTO3060
3030 GOSUB430
3040 GOSUB400
3050 IFQ-P<0THEN860 ELSEIFP4=0THEN3010 ELSE5000
3060 GOSUB840
3070 GOSUB430
3080 GOTO3010
4000 B$="":T=50:PRINTA4:PRINT@1215, USING"###";X
4010 PRINT@1251, USING"###";Y;:PRINTCHR$(169):PRINT@1134,CHR$(152);CHR$(152
);CHR$(152);CHR$(152);CHR$(152)
4020 RETURN
5000 P4=1:P5=RND(4):ONP5GOTO270,1010,2010,3010
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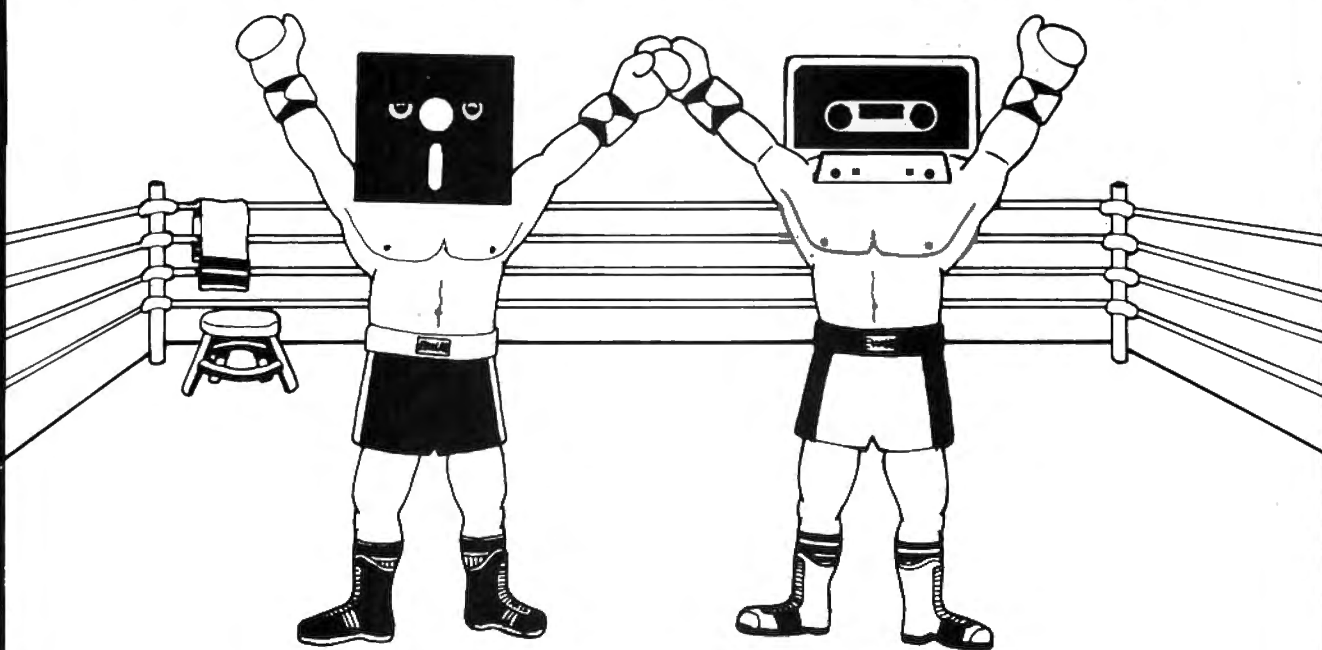

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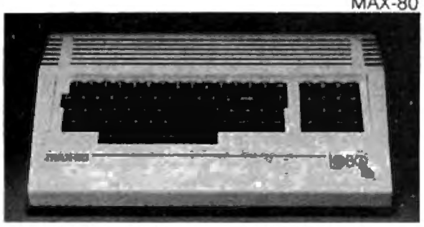

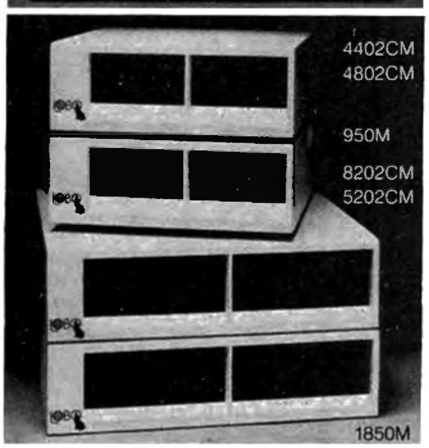

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Modify Microchess for Model III play.

Model III Microchess

The Key Box
Basic Level II
Model III
16K RAM

Mohan Embar
1234 Folkstone Court
Wheaton, IL 60187

Microchess 1.5, sold for the TRS-80 Level II computer, is a 4K chess-playing program. Included are three skill levels and provisions to set up the board, castle king or queen side, capture *en passant*, change the skill level, play the next move, show the square numbers, exchange sides and start a new game. The graphics are nice too.

Unfortunately, Microchess will not run on the Model III. Eager for a challenge I undertook the task.

Program Listing 1. Assembly Language

```
        ;       * MICROCHESS FOR THE MODEL III *
        ;BY     MOHAN EMBAR
        ;       1234 FOLKSTONE CT
        ;       WHEATON, IL 60187
        ;
        ;* * * * * * * * * * * * * * * * * * * * * * * * * * *
        ;*               THIS PROGRAM WILL LOAD                 *
        ;*          MICROCHESS 1.5 ON TO THE MODEL III          *
        ;*        IT REPLACES THE NORMAL MICROCHESS LOADER      *
        ;*      TO USE, SET MEMORY SIZE TO 32670 AND ADVANCE    *
        ;*      MICROCHESS TAPE TO SECOND, LONG, MAIN PROGRAM   *
        ;* * * * * * * * * * * * * * * * * * * * * * * * * * *
        ;
        ;       SET UP EQUATES
        ;
01C9    CLRSCR  EQU     1C9H    ;ROM CLEAR SCREEN ROUTINE
70C0    MSTART  EQU     70C0H   ;START ADDRESS FOR MICROCHESS
7FA0    MFINIS  EQU     7FA0H   ;END ADDRESS OF MICROCHESS
1997    SNERR   EQU     1997H   ;SYNTAX ERROR ROUTINE
3C00    SCREEN  EQU     3C00H   ;START OF SCREEN MEMORY
44EC    RESIGN  EQU     44ECH   ;INTERCEPT PROGRAM FLOW
41FD    START   EQU     41FDH   ;ENTER MICROCHESS HERE
40C0    BEGIN   EQU     40C0H   ;WHERE PROGRAM REALLY RESIDES
4D88    SPACE   EQU     4D88H   ;CANCEL OLD SPACE CODE LOC.
0EE0    LENGTH  EQU     0EE0H   ;LENGTH OF MICROCHESS
        ;
        ;       ROM CASSETTE I/O ROUTINES
        ;
0293    LFIND   EQU     293H    ;FIND LEADER & SYNC BYTE
0235    INBYTE  EQU     235H    ;INPUT A CASSETTE BYTE
01F8    MTROFF  EQU     1F8H    ;TURN MOTOR OFF
        ;
        ;       MAIN PROGRAM
```

Listing continues

My Investigation

I disassembled the Model I Microchess loader to get some idea of the tape format. A full description is listed in Fig. 1, and a flowchart of the loader is presented in Fig. 2. The conflict was due to the new ROM in the Model III. After disassembling the Model III cassette I/O routines, I found these problems:

- Microchess is loaded at starting address 40C0H (16576 decimal), but 4210H (16912 decimal) is used for the cassette status byte. Thus one byte is overwritten and the system crashes.
- The Resign command does not work. I think the Model III interrupts cause this.
- The new special characters cause the spade character (ASCII code 192) to be printed instead of a space, which is the Model I counterpart to this code. I corrected most of this, but

not all.

The Solution

My solution to the first two problems is to load Microchess into high memory, turn off the tape recorder, disable the interrupts and block load the entire program back to 40C0H. This way 4210H will be untouched. Since Microchess runs in 4K, all addresses above 5000H (20480 decimal) will be unused.

After you resign, all memory addresses will be restored to the

Leader
255 zero bytes followed by an A5H synchronization byte.

Main Program
3808 bytes, to be loaded at addresses 40C0H-4FA0H

Checksum Byte
One byte sum of all 3808 bytes of main program, disregarding overflow

Instructions
1024 bytes of instructions to be loaded at video display addresses 3C00H-3FFFH

Fig. 1. Tape Format of Microchess 1.5

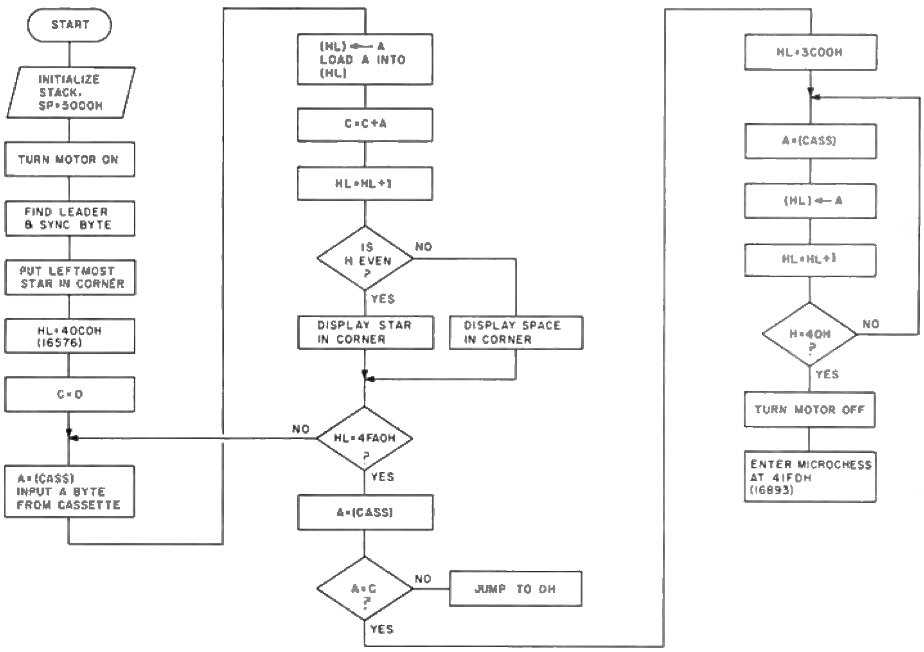

Fig. 2. Flowchart of Model I Microchess loader

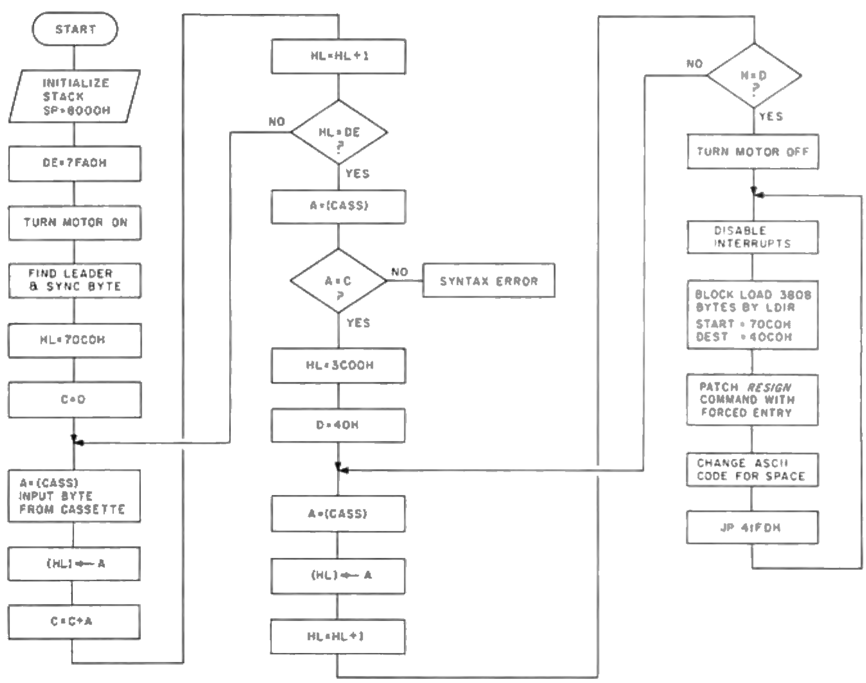

Fig. 3. Flowchart of Model III adaptation of Microchess loader

Listing continued

```
                          ;
7FA1                             ORG     7FA1H        ;START OF LOADER
7FA1 310070                      LD      SP,7000H     ;INITIALIZE STACK
7FA4 11E00E                      LD      DE,LENGTH    ;LENGTH INTO DE
7FA7 CD9302                      CALL    LFIND        ;FIND LEADER
7FAA 21C070                      LD      HL,MSTART    ;START LOADING INTO HL
7FAD 0E00                        LD      C,0          ;ZERO CHECKSUM COUNTER
7FAF CD3502               INPUT  CALL    INBYTE       ;READ A BYTE
7FB2 77                          LD      (HL),A       ;AND STORE
7FB3 81                          ADD     A,C          ;COMPUTE CHECKSUM
7FB4 4F                          LD      C,A          ;AND STORE IN C
7FB5 23                          INC     HL           ;INCREMENT POINTER
7FB6 1B                          DEC     DE           ;DECREMENT LENGTH
7FB7 7A                          LD      A,D          ;IS LENGTH EQUAL
7FB8 B3                          OR      E            ;TO ZERO ?
7FB9 20F4                        JR      NZ,INPUT     ;IF NOT, CONTINUE
7FBB CD3502                      CALL    INBYTE       ;IS CHECKSUM
7FBE B9                          CP      C            ;OKAY ?
7FBF C29719                      JP      NZ,SNERR     ;IF NOT, GET LOST.
7FC2 21003C                      LD      HL,SCREEN    ;ELSE DISPLAY
7FC5 1640                        LD      D,40H        ;INSTRUCTIONS ON SCREEN
7FC7 CD3502               DISPLY CALL    INBYTE       ;... READ A BYTE
7FCA 77                          LD      (HL),A       ;DISPLAY IT
7FCB 23                          INC     HL           ;NEXT LOCATION
7FCC 7C                          LD      A,H          ;ALL DONE YET ?
7FCD BA                          CP      D            ;TEST TO SEE...
7FCE 20F7                        JR      NZ,DISPLY    ;CONTINUE DISPLAYING
7FD0 CDF801                      CALL    MTROFF       ;TURN OF TAPE RECORDER
7FD3 F3                          DI                   ;DISABLE INTERRUPTS
7FD4 21C070               REENTR LD      HL,MSTART    ;TRANSFER MICROCHESS
7FD7 11C040                      LD      DE,BEGIN     ;TO WHERE IT
7FDA 01E00E                      LD      BC,LENGTH    ;REALLY GOES
7FDD EDB0                        LDIR                 ;BY BLOCK LOAD
7FDF 21D47F                      LD      HL,REENTR    ;FIX RESIGN
7FE2 22EC44                      LD      (RESIGN),HL  ;COMMAND
7FE5 3E20                        LD      A,20H        ;FIX BOARD DISPLAY
7FE7 32884D                      LD      (SPACE),A    ;BY CHANGING A LOCATION
7FEA C3FD41                      JP      START        ;GO TO MICROCHESS 1.5
7FA0                             END     7FA0H
00000 TOTAL ERRORS
```

original contents for a new game. The last problem is solved by a change which tells Microchess to use ASCII code 20H instead of C0H as the new space code. The flowchart for the new loader program is shown in Fig. 3.

Included are a Basic program and an Assembly language listing. Here are instructions on how to use both:

- Type the program and save it for future use.
- With the Basic version, answer the memory size question with 32670.
- Load the program using CLOAD for Basic or SYSTEM for the Assembly language version.
- Execute the program by entering a slash (/) for the Assembly language version, or by typing Run for Basic. Be sure the long main program is ready to load, not the first short one!
- For the Basic version, hit enter in response to the Ready Tape? prompt.
- The usual asterisks should flash in the upper-right corner as Microchess loads.
- After the instructions are displayed, press the stop button on the tape recorder and hit enter to play.

Happy Checkmating! ■

Mohan Embar's hobbies include chess, the piano, and his micro.

```
5 POKE16402,201
10 DATA49,0,128,17,160,127,205,147,2,33,192,112,14,0,205,53,2,11
9,129,79,35,124,186,32,245,125,187,32,241,205,53,2,185,194,151,2
5,33,0,60,22,64,205,53,2,119,35,124,186,32,247,205,248,1,243,33,
192,112,17
20 DATA192,64,1,225,14,237,176,33,215,127,34,236,68,62,32,50,136
,77,195,253,65
30 DEFINTX,Y:FOR X = 32673 TO 32751:READ Y:POKE X,Y:NEXT X:INPUT
"READY TAPE";A$
40 POKE 16526,161:POKE 16527,127
50 X = USR(0)
```

Program Listing 2. Basic Program

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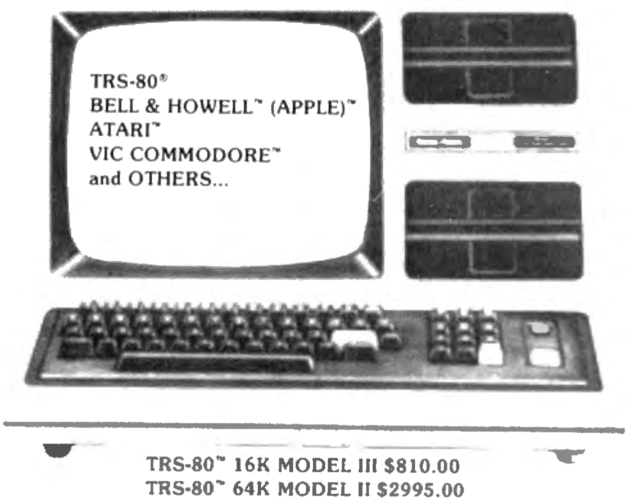

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Optimize the Color Computer's display.

Test Patterns

Richard L. Kilmon
106 East Green Valley Circle
Green Valley
Newark, DE 19711

Color displays are not only fun but serve a useful purpose as well. Some of the fun and effectiveness is reduced if your tv is not optimized for the computer. In the operator's manual Tandy suggests a few short programs to adjust your tv. My program is a dot bar generator. With it you see how the image is centered, shaped, colored and aligned.

The program, written in Extended Basic, includes sound and has a menu and four subroutines separated for clarity by REM statements. These can be removed.

After making your selection from the menu you will hear a beep when you push the key. The pattern will come up quickly. Wrong pattern? Push enter and the menu returns.

Menu Choices

V is for video centering. The image is similar to a target display. Chances are the circles will look like eggs. Puns aside, most tv yokes are not wound precisely enough to give a truly linear image. The designers compensate by providing height and linearity controls. The slight distortions go unnoticed for tv viewing, but the computer accents them.

The Key Box

Extended Color Basic
Color Computer
16K RAM

```
10 REM ***TEST  PATTERNS***
20 REM ***RICHARD KILMON***
30 REM ***JUNE  20, 1981***
40 REM
50 REM - LINES 70 TO 160 SET UP THE SCREEN MENU -
60 REM - ***************************************** -
70 SOUND100,2
80 CLS:PRINT:PRINT
90 PRINT"WHICH OF THE FOLLOWING TESTS DO YOU WISH TO EXECUTE ?"
100 PRINT
110 PRINT"    V=VIDEO CENTERING TEST"
120 PRINT"    C=COLOR BAR TEST"
130 PRINT"    H=CROSSHATCH"
140 PRINT"    D=DOTS"
150 PRINT:PRINT:PRINT
160 PRINT"PUSH ENTER TO RETURN TO THE MENU"
170 REM
180 REM - LINES 210 TO 290 BRANCH TO THE APPROPRIATE
190 REM -SUBROUTINES ONCE THE MENU ITEM HAS BEEN SELECTED -
200 REM - ************************************************** -
210 A$=INKEY$
220 IF A$="V"       THEN 330
230 IF A$="C"       THEN 470
240 IF A$="H"       THEN 680
250 IF A$="D"       THEN 820
260 IF A$=CHR$(13) THEN  70
270 IF A$=""        THEN 210
280 SOUND100,2
290 GOTO210
300 REM
310 REM - LINES 330 TO 430 EXECUTE THE VIDEO CENTERING ROUTINE -
320 REM - ******************************************************** -
330 SOUND100,2
340 PMODE4,1
350 PCLS
360 SCREEN1,1
370 COLOR7,5
380 LINE(0,0)-(255,191),PSET
390 LINE(255,0)-(0,191),PSET
400 LINE(0,0)-(255,191),PSET,B
410 CIRCLE(128,96),20
420 CIRCLE(128,96),95
430 GOTO 950
440 REM
450 REM - LINES 470 TO 640 EXECUTE THE COLOR BAR ROUTINE -
460 REM - ************************************************* -
470 SOUND100,2
480 CLS
490 A$=STRING$(4,143)
500 B$=STRING$(4,159)
510 C$=STRING$(4,175)
520 D$=STRING$(4,191)
530 E$=STRING$(4,207)
540 F$=STRING$(4,223)
550 G$=STRING$(4,239)
560 H$=STRING$(4,255)
570 X$=A$+B$+C$+D$+E$+F$+G$+H$
580 FOR Y=0 TO 14
590 PRINT X$;
600 NEXT Y
610 I$=STRING$(3,255)
620 PRINT@480,A$+B$+C$+D$+E$+F$+G$+I$;
630 SET(62,30,8):SET(63,30,8):SET(62,31,8):SET(63,31,8)
640 GOTO950
650 REM
660 REM - LINES 680 TO 780 EXECUTE THE CROSSHATCH ROUTINE -
670 REM - *************************************************** -
680 SOUND100,2
690 PMODE4,1
700 PCLS
710 SCREEN1,1
720 FOR X=0 TO 255 STEP 25
730 LINE(X,0)-(X,191),PSET
740 NEXT X
750 FOR Y=0 TO 191 STEP 25
760 LINE(0,Y)-(255,Y),PSET
770 NEXT Y
780 GOTO 950
790 REM
800 REM - LINES 820 TO 900 EXECUTE THE DOTS ROUTINE -
810 REM - ********************************************* -
820 SOUND100,2
830 PMODE4,1
840 PCLS
850 SCREEN1,1
860 FOR X=20 TO 255 STEP 20
870 FOR Y=20 TO 191 STEP 20
880 PSET(X,Y,5)
890 NEXT Y
900 NEXT X
910 REM
920 REM - LINES 950 TO 970 RETAINS THE SCREEN UNTIL THE ENTER KEY
930 REM - IS PUSHED, THEN THE PROGRAM RETURNS TO THE MENU ON LINE 70 -
940 REM - ************************************************************* -
950 A$=INKEY$
960 IF A$<>CHR$(13) GOTO 950
970 GOTO 70
```

Program Listing

Adjust the height control until the black vertical interval lines are at the top and bottom. Increase the height until the lines disappear. If they do not disappear at the same time adjust the linearity control and try again. The circle on your display should start to look better. Next, fine tune the circle. Here you will probably have to settle for improvement rather than perfection.

Adjust your tv for squareness, using the horizontal hold.

C is for color bars. The color bars should be (left to right) green, yellow, blue, red, buff, cyan, magenta and orange. Turn the tv color saturation control all the way down. Then bring it up until you have pastels. Continue to increase the control until the colors degrade. Adjust to just below this point, and then adjust the hue control to the proper colors.

You still may not get the colors right. The control may already be down near the end or may not have much effect. Auto color circuits may mess you up. Defeat them if you can. If you are familiar with the tv, you may want to tweak your color phase circuit.

Brightness and contrast are probably too high. Set your screen to your liking. Everything interacts slightly; you may have to readjust the color saturation.

H is for crosshatch. This display looks like a fishnet. All boxes should be the same size. The lines should be one color. Three colored lines around the screen's edge may mean you have a serious dynamic linearity problem. This will take knowledgeable tweaking.

D stands for dots. Each center dot should be a single colored dot. Dots merging with each other indicate a static convergence problem. Use some more knowledgeable tweaking. ■

Richard Kilmon supervises the repair of analytical equipment for the Analytical Instrument division of DuPont Corporation.

✓See List of Advertisers on Page 455

Strain out all the prime numbers.

The Sieve of Erathosthenes

D. R. Cecil
Texas A & I
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Erathosthenes, one of the ancient Greek mathematicians, is best known for his sieve to produce prime numbers.

His sieve method consisted of writing down all positive integers 1,2,3 . . . up to some desired integer N. Then you cast out all multiples of two, and proceed through the list again casting out multiples of three and so on. The remaining numbers are primes less than or equal to N.

I presented this idea to a group of teachers during a problem-solving computer workshop. The program I showed them displayed only primes. The workshop participants thought a program which displayed all the positive integers up to N and then visually blanked out the non-primes by twos, then threes, and so on would be a great teaching device. They were eager for me to write such a program.

The Key Box

Model I or Model III
2K RAM
Cassette Basic

The resulting program, written for a TRS-80 Model I, is shown in the Listing. This program should run on other machines having the PRINT @ and PRINT USING commands. These commands ensure proper formatting of the numbers and determine the positions to blank out.

When "END" appears in the lower right corner of the screen, all computations are finished and the original input number is displayed. All other numbers shown are primes. Line 380 stops the screen from scrolling up, so hit break to exit the program and get the ready prompt.

```
0 '*************** THE SIEVE OF ERATOSTHENES ***************
1 '***************  BY D.R.CECIL, JULY,1981  ***************
2 'THIS PROGRAM DISPLAYS ALL INTEGERS 1 TO AN INPUTED VALUE N
3 'AND LEAVES THE LAST 150 OR SO (IF N IS >= 150) ON THE SCREEN,
4 'THEN THE NON-PRIMES ARE BLANKED OUT,FIRST THE MULTIPLES
5 'OF 2,THEN THE MULTIPLES OF 3, ETC. WHEN THE WORD "END"
6 'APPEARS AT THE BOTTOM RIGHT OF THE SCREEN THEN ALL NUMBERS
7 'DISPLAYED ARE PRIME.
8 '
9 '
10 CLS:INPUT"PRIMES LESS THAN WHAT NUMBER ";N
15 Q=0: INPUT"# YOU WANT A FACTOR OF";M
20 DIM A(N),B(N) :CLS
30 '
40 '***** PRINT THE INTEGERS, TEN PER ROW ;AND SET A(I)=I *****
50 FOR I=1 TO N
60    PRINTUSING"####";I;:A(I)=I
70    IF INT(I/10)-I/10=0 THEN PRINT
80 NEXT I
90 '
100 '*****       DETERMINE WHICH PLACES TO BLANK OUT       *****
110 T=10*INT((N-150)/10)
120    IF T<0 THEN T=0
130 FOR I=T+1 TO N
140    B(I)=4*I+24*INT((I-1)/10)-6.4*T
150 NEXT I
160 '
170 '*****    START THE SIEVE , USING MULTIPLES OF 2    *****
180 I=2
190    IF A(I)=0 THEN 230
200 FOR J=1 TO N
210   IF A(J)<>I AND INT(A(J)/I)=A(J)/I THEN A(J)=0:IF J>T THEN 290
220 NEXT J
230 I=I+1:IF I>SQR(N) THEN 370
240 '
250 '*****     HAS I NOT BEEN BLANKED OUT YET?    *****
260 IF  A(I)<>0 THEN 200  ELSE 230
270 '
280 '*****     THIS BLANKS OUT THE INTEGER J     *****
290 IF B(J)-4>=1024 THEN B(J)=B(J)-1024
300 PRINT@B(J)-4,"";:PRINTUSING"%  %";"    ";
305 IF J=M THEN Q=Q+1:IF Q=1 THEN PRINT@941,M;" HAS FACTOR ";I;
310 '
320 '***** THIS SHOWS WHAT DIVISOR IS CURRENTLY IN USE *****
330 PRINT@1010,B(J);"I=";I;
340 GOTO 220
350 '
360 '****************    THE    END    ****************
370 PRINT@1010,"END ,N=";N;
380 GOTO 380
```

Program Listing

Lines 50-80 display positive integers 1,2,... up to N and leave the last 150 on the screen. If you plan to have four-place primes appear (such as 1,009), put five # symbols in the Print Using command of line 60 and also change line 140 to read

```
140 B(I)=5*I+14*INT ((I-1)/10)-6.4*T
```

Matrix A indicates the integers, with A(J) =J. Line 210 tests whether I divides A(J), and if so, sets A(J) to zero to indicate A(J) is not prime. The B matrix blanks out the integer J if J is some multiple of I. B(J)- 4 indicates the start of the four screen locations to be changed to blanks by line 300.

The divisors used for testing, and the testing for multiples, occur in lines 180-230. You need not test any divisor larger than SQR(N), since if N=x*y then either x or y must be less than or equal to SQR(N). Additionally, any factor of N has a prime subfactor, so only prime values of I need be used for divisors. Line 190 assures that only primes are used.

If the sieve is operating too fast and if N is not too large, you might insert a timing loop to slow down the blanking out. This can be done by changing line 310 to:

```
310 FOR L = 1 TO 200 : NEXT L
```

If you want a prime divisor of some number in the last 150 or so displayed, add the following two lines:

```
15 Q = 0 : INPUT "#YOU WANT A FACTOR OF" ; M
305 IF J = M THEN Q=Q+1: IF Q=1
 THEN PRINT @ 941, M;
 " HAS FACTOR " ; I;
```

A good introductory essay on primes and on number theory can be found in *Mathematics Today: Twelve Informal Essays* edited by L.A. Steen and published by Springer-Verlag, New York. ■

David Cecil is employed by Texas A&I University in the math department. He and his wife also own and operate a needlecraft store.

✓See List of Advertisers on Page 455

Playing music on the Color Computer.

Music Marvel

Steve Blyn
227 Hampton Green
Staten Island, NY 10312

For the mentally retarded, each small accomplishment is major progress. As a teacher of retarded students, I have noticed how much they enjoy music. This enjoyment has always been limited to listening, singing simple songs, or playing with simple band instruments. My TRS-80 Color Computer has, to some degree, changed that.

The Program

Music Marvel helps the retarded person play music on the

> ***The Key Box***
> **Color Computer**
> **Color Basic and**
> **Extended Color Basic**
> **16K RAM**

Program Listing 1. Extended Color Basic

```
10 'MUSIC MARVEL
20 'COPYRIGHTED <C> 1981 BY S.BLYN STATEN ISLAND,N.Y.
30 CLS3
40 PRINT@256,"**  'MUSIC         MARVEL'  **"
50 FOR T= 1 TO 600: NEXT T
60 CLS(3)
70 PRINT        " directions for the instructor"
80 PRINT"********************************"
90 PRINT" THIS PROGRAM CONTAINS 2 SONGS"
100 PRINT" 1.  three blind mice    AND"
110 PRINT
120 PRINT " 2.  row,row,row,your boat "
130 PRINT
140 PRINT"   SONG 1 WILL PLAY NOTE NUMBERSAND THEN SHOW PICTURES
."
150 PRINT" LEARNER MUST THEN PRESS FLASHEDNUMBER TO PLAY SONG'S
NOTES."
160 PRINT"    AFTER EACH SONG A CHOICE OF SONG #1 OR SONG #2 IS
GIVEN.        PRESS #9 TO END."
170 FOR Q=0 TO 63: SET(Q,2,8):SOUND 150,1:NEXT Q: FOR W = 63 TO
0 STEP -1:  SET(W,31,8):NEXT W
180 FOR X=1 TO 5000:NEXT X
190 GOTO490
200 REM"DRAWING NUMBERS AND HAVING STUDENT PLAY THE SONG 'THREE
BLIND MICE'"
210 DATA 3,125,2,108,1,89,3,125,2,108,1,89,5,147,4,133,4,133,3,1
25,5,147,4,133.4,133,3,125,5,147,8,176,8,176,7,170,6,159,7,170,8
,176,8,176,5,147,5,147,8,176,8,176,8,176,7,170,6,159,7,170,8,176
,8,176,5,147,5,147,5,147,8,176,8,176,7,170,6,159,7,170
220 DATA 8,176,8,176,8,176,5,147,4,133,3,125,2,108,1,89,-1
230 READ A:IF A=-1 THEN GOTO 270 ELSE ON A GOSUB 880,930,1000,10
50,1130,1210,1280,1350
240 A$= INKEY$:IF A$="" THEN 240
250 IF VAL(A$)<>A THENGOTO240
260 READB:SOUNDB, 5:GOTO 230
270 PCLS:PMODE4,1:SCREEN1,1
280 GOSUB640:CLS:SOUND125,10:SOUND108,10:SOUND89,15:SOUND125,10:
SOUND108,10:SOUND89,15
290 SOUND147,10:SOUND133, 6:SOUND133,6:SOUND125,15:SOUND147,10:S
OUND133, 6:SOUND133.6:SOUND125,15
300 GOSUB 640
310 SOUND147,6:SOUND176,8:SOUND176,6:SOUND170,6:SOUND159,6:SOUND
170,6:SOUND176,6:SOUND176,8:SOUND147,10
320 GOSUB 640
330 SOUND147,8:SOUND176,6:SOUND176,6:SOUND176,6:SOUND170,6:SOUND
159,6:SOUND170,6:SOUND176,8:SOUND176,8:SOUND147,10
340 SOUND147,6:SOUND147,6:SOUND176,8:SOUND176,8:SOUND170,8:SOUND
159,6 :SOUND170.6:SOUND176,6:SOUND176,6:SOUND176,6:SOUND147,10:S
OUND133,8:SOUND125,10:SOUND108,10:SOUND89,12
350 GOSUB640
360 GOSUB 640:FOR X=1 TO 400: NEXT X
```

Listing 1 continues

Listing 1 continued

```
370 CLS:GOSUB380:GOTO1430
380 REM "HAPPY FACE"
390 PCLS 4: PMODE 3,1:SCREEN1,1:COLOR 3
400 CIRCLE(128,96),90,3:CIRCLE(128,96),92:CIRCLE(128,96),94
410 CIRCLE( 95,55),9
420 CIRCLE(161,55),9
430 CIRCLE(128,72),75,3,.5,.17,.35
440 CIRCLE(128,106),35,3,1,0,.5
450 FORX=1TO4:PAINT( 0 , 0),X,3:PAINT (95,55),X,3:PAINT(161,55),
X,3:PAINT (128,120),X,3:NEXT X
460 FORX=1TO1400:NEXTX
470 RETURN
480 REM" 3 BLIND MICE"
490 FOR X= 1 TO 2
500 GOSUB 1010:SOUND 125,7:GOSUB930:SOUND108,7:GOSUB880:SOUND89,
8:NEXT X
510 FOR X=1TO2:GOSUB1140:SOUND147,8
520 FORR=1TO2:GOSUB1060:SOUND 133,4:NEXT R: GOSUB 1010:SOUND125,
8:
530 NEXT X
540 PCLS
550 GOSUB1140:SOUND 147,4:GOSUB 1360:SOUND 176,6:GOSUB 1360:SOUN
D 176,4:GOSUB 1290:SOUND170,4:GOSUB 1220:SOUND159,4:GOSUB1290:SO
UND 170,4:GOSUB 1360:SOUND 176,4:GOSUB1360:SOUND 176,6
560 GOSUB1140:SOUND 147,8:GOSUB 1140:SOUND 147,4
570 FOR X=1 TO 3:GOSUB 1360:SOUND 176,4:NEXT X
580 GOSUB1290:SOUND170,4:GOSUB 1220:SOUND 159,4: GOSUB1290:SOUND
 170,4: GOSUB 1360: SOUND 176,6: GOSUB 1360: SOUND 176,4: GOSUB
1140: SOUND 147,6
590 FOR Y=1 TO 200:NEXT Y
600 GOSUB1140:SOUND147,6:GOSUB 1140:SOUND 147,4:GOSUB 1360: SOUN
D 176,6: GOSUB 1360: SOUND 176,4: GOSUB 1290: SOUND 170,6: GOSUB
 1220: SOUND 159,4: GOSUB 1290: SOUND 170,4
610 FOR X=1 TO 3:GOSUB1360:SOUND176,4:NEXT X
620 GOSUB1140:SOUND 147,8:GOSUB1060:SOUND 133,6:GOSUB1010:SOUND1
25,8:GOSUB940:SOUND108,8:GOSUB890:SOUND89,10:GOSUB640:GOSUB640
630 RESTORE:GOTO 210
640 PMODE 4,1: PCLS
650 REM"THREE MOVING MICE"
660 SCREEN1,1
670 LINE(100,96)-(180,96),PSET:LINE(100,93)-(180,93),PSET
680 CIRCLE( 80,96),20,1,1,.60,.99
690 CIRCLE(140,96),40,1,1,.50,.99
700 CIRCLE(175,80 ),15,1,1,.67,.20:CIRCLE(180,76),3
710 DRAW"BM175,66;H6;D4"
720 PAINT (140,58),7,5:PAINT (181,75),5,7
730 FOR Y= 1TO 50:NEXT Y
740 LINE(60,150)-(140,150),PSET:LINE(60,147)-(140,147),PSET
750 CIRCLE(100,150),40,1,1,.50,.99
760 CIRCLE(40,150),20,1,1,.60,.99
770 CIRCLE(135,134),15,1,1,.67,.20:CIRCLE(140,130),3
780 DRAW"BM135,120;H6;D4"
790 PAINT (100,115),7,5:PAINT(141,129),5,7
800 FOR Y=1TO 50:NEXT Y
810 LINE(139,42)-(221,42),PSET:LINE(139,39)-(221,39),PSET
820 CIRCLE(180,42),40,1,1,.50,.99
830 CIRCLE(120,42),20,1,1,.60,.99
840 CIRCLE(215,26),15,1,1,.67,.20:CIRCLE(220,22),3
850 DRAW"BM215,12;H 6;D4":PAINT(175, 5),7,5:PAINT(221,22),5,7
860 FORY=1TO 50:NEXT Y
870 RETURN
880 REM "DRAWING A # 1"
890 PMODE 4,1:PCLS:SCREEN 1,1
900 LINE(128,40)-(128,140),PSET
910 FORJ=1TO20:NEXTJ
920 RETURN
930 REM "DRAWING A # 2"
940 PMODE4,1:PCLS:SCREEN1,1
950 LINE(100,140)-(163,140),PSET
960 CIRCLE(128,126),30,1,1,.45,.75
970 CIRCLE(128,66),30,1,1,.60,.25
980 FORJ=1TO20:NEXTJ
990 RETURN
1000 REM"DRAWING A # 3"
1010 PMODE 4,1:PCLS:SCREEN1,1
1020 CIRCLE(128,126),30,1,1,.75,.35:CIRCLE(128,66),30,1,1,.7,.25
1030 FORJ=1TO30:NEXT J
1040 RETURN
1050 REM"DRAWING A # 4"
1060 PMODE 4,1:SCREEN1,1
1070 PCLS
1080 LINE(158,40)-(158,140),PSET
1090 LINE(80,40)-(80,100),PSET
1100 LINE(80,100)-(180,100),PSET
1110 FORJ=1TO20:NEXT J
```

Listing 1 continues

Listing 1 continued

```
1120 RETURN
1130 REM "DRAWING A # 5"
1140 PMODE4,1
1150 PCLS:SCREEN1,1
1160 LINE(110, 82)-(110,40),PSET
1170 LINE(110,40)-(170,40),PSET
1180 CIRCLE(135,110),37,1,1,.65,.39
1190 FORJ=1TO 20:NEXT J
1200 RETURN
1210 REM"DRAWING A # 6"
1220 PMODE4,1
1230 PCLS:SCREEN1,1
1240 CIRCLE (134, 90),56,1,1,.25,.85
1250 CIRCLE(145,115),32
1260 FORJ=1TO20:NEXT J
1270 RETURN
1280 REM "DRAWING A # 7"
1290 PMODE4,1
1300 PCLS:SCREEN1,1
1310 LINE (158,40)-(128,140),PSET
1320 LINE (158,40)-(99,40),PSET
1330 FOR J=1TO20:NEXT J
1340 RETURN
1350 REM"DRAWING A # 8"
1360 PMODE4,1
1370 PCLS:SCREEN1,1
1380 CIRCLE(128,120),30,1
1390 CIRCLE(128,60),30,1
1400 FOR J=1TO20:NEXT J
1410 RETURN
1420 REM"DRAWING CHOICE OF 1 OR 2"
1430 PCLS:PMODE4,1:SCREEN1,1
1440 LINE(32,23)-(32,123),PSET
1450 CIRCLE (80,83),9 :LINE(98,91)-(98,77),PSET:CIRCLE(100,79),5
,1,1,.6,.35:LINE(98,84)-(107,91),PSET
1460 LINE(150,120)-(210,120),PSET
1470 CIRCLE(178,108),30,1,1,.45,.75
1480 CIRCLE(178,48),30,1,1,.60,.25
1490 REM"CHOICE BETWEEN THE TWO SONGS"
1500 R$=INKEY$:IF R$="" THEN 1500 ELSE R=VAL(R$)
1510 RESTORE
1520 READB:IFB<>-1THEN1520
1530 IF R= 1 THEN 480
1540 IF R=2 THEN 1570
1550 IF R= 9 THEN 2310
1560 GOTO1490
1570 REM"ROW,ROW,ROW,YOUR BOAT"
1580 FOR X=1TO3: GOSUB890:SOUND 89,10:NEXT X
1590 GOSUB940:SOUND108,6
1600 GOSUB1010:SOUND125, 8
1610 GOSUB1010:SOUND125,5
1620 GOSUB940:SOUND108,5
1630 GOSUB1010:SOUND125,5
1640 GOSUB1060:SOUND133,5
1650 GOSUB1140:SOUND147, 8
1660 FORX=1TO3:GOSUB1360:SOUND176,4:NEXT X
1670 FORX=1TO3:GOSUB1140:SOUND147,4:NEXT X
1680 FOR X=1TO3:GOSUB1010:SOUND125,4:NEXT X
1690 FOR X=1TO3:GOSUB890:SOUND 89,6:NEXT X
1700 GOSUB1140:SOUND147,5
1710 GOSUB1060:SOUND133,4
1720 GOSUB1010:SOUND125,5
1730 GOSUB940:SOUND108,4
1740 GOSUB890:SOUND89, 8
1750 GOSUB 1760:GOTO 2170
1760 REM"MOVING THE BOAT"
1770 PCLS
1780         PMODE4,1:SCREEN1,1
1790 CIRCLE(28,28),10:PAINT (28,28),5,7
1800 CIRCLE(5,144),50,1,1,.75,.95
1810 LINE(50,127)-(169,127),PSET:LINE(50,125)-(169,125),PSET
1820 CIRCLE(170,96),30,1,1,.01,.25
1830 LINE(17,96)-(200,96),PSET
1840 LINE(26,100)-(200,100),PSET
1850 LINE(200,96)-(180,80),PSET
1860 LINE(180,80)-(14,96),PSET
1870 LINE(195,95)-(175,80),PSET
1880 LINE(148,98)-(102,172),PSET
1890 LINE(150,98)-(104,172),PSET
1900 CIRCLE(40,172),40,1,.5,.0,.49:CIRCLE(40,152),40,1,.5,.0,.49
:CIRCLE(40,132),40,1,.5,.0,.49
1910  DRAW"BM99,172;R10;D10;L10;U10;":PAINT(104,173),5,7
1920 CIRCLE(120,172),40,1,.5,.0,.49:CIRCLE(120,152),40,1,.5,.0,.
49:CIRCLE(120,132),40,1,.5,.0,.49
1930 CIRCLE(200,172),40,1,.5,.0,.49:CIRCLE (200,152),40,1,.5,.0,
```

Listing 1 continues

TRS-80. It flashes large high-resolution numbers on the screen while the song "Three Blind Mice" is played. The numbers correspond to the notes of the song. After the song, three mice appear on the screen.

Next, it's the student's turn to play. A number is flashed on the screen without the accompanying sound. The student must press the corresponding number on the keyboard. When the correct number is pressed the note will sound. Pressing the wrong number does nothing. There are no negatives in the program. Retarded people have enough negatives in their lives, without adding a computer to the list.

After all the numbers have appeared on the screen, and all the correct responses have been made, the computer plays back the song, and then displays a happy face.

Then the user is asked to press either one or two. Choosing one replays "Three Blind Mice," and number two repeats the original procedure with a second song, "Row, Row, Row Your Boat." The graphics for the second song are of a moving rowboat. The user can play these songs as many times as he likes. Pressing the number nine ends the program.

The retarded people who have used this program are delighted with it. It gives them a good sense of accomplishment and self-worth. They felt as if they had actually played music.

There are two versions of the program presented here. Program Listing 1 is of the original 16K Extended Color Basic version. Program Listing 2 is 16K Color Basic.

Other Uses

The program also works well with young children. There is no reading involved. Young users can also get that same feeling of accomplishment. ■

Steve Blyn was awarded an honorable mention in the Johns Hopkins First National Search for handicapped computer applications for his entry, a program for retarded learners.

Listing 1 continues

```
.49:CIRCLE(200,132),40,1,.5,.0,.49
1940 PAINT(92, 90),5,7:PAINT(75,122),5,7:PAINT(150,122),5,7
1950 FORG=1 TO  50:NEXTG
1960 PCLS    :PMODE 4,1:SCREEN1,1
1970 CIRCLE(15,144),50,1,1,.75,.95
1980 CIRCLE (28,28),10:PAINT(28,28),5,7
1990 LINE(61,127)-(189,127),PSET:LINE(61,125)-(189,125),PSET
2000 CIRCLE(190,96),30,1,1,.01,.25
2010 LINE(37,96)-(220,96),PSET
2020 LINE(40,100)-(222,100),PSET
2030 LINE(220,96)-(200,80),PSET
2040 LINE(200,80)-(34,96),PSET
2050 LINE(215,95)-(195,80),PSET
2060 LINE(168,96)-(217,172),PSET
2070 LINE(170,96)-(219,172),PSET
2080 DRAW"BM214,172;R10;D10;L10;U10;":PAINT(219,173),5,7
2090 CIRCLE(60,172),40,1,.5,.0,.49:CIRCLE(60,152),40,1,.5,.0,.49
:CIRCLE(60,132),40,1,.5,.0,.49
2100 CIRCLE(140,172),40,1,.5,.0,.49:CIRCLE (140,152),40,1,.5,.0,
.49:CIRCLE(140,132),40,1,.5,.0,.49
2110 CIRCLE(220,172),40,1,.5,.0,.49:CIRCLE(220,152),40,1,.5,.0,.
49:CIRCLE(220,132),40,1,.5,.0,.49
2120 PAINT(180,88),5,7:PAINT(80,105),5,7:PAINT(190,105),5,7
2130 FOR Z=1 TO  50: NEXT Z
2140 RETURN
2150 GOTO2150
2160 GOSUB1770
2170 DATA 1,89,1,89,1,89,2,108,3,125,3,125,2,108,3,125,4,133,5,1
47,8,176,8,176,8,176,5,147,5,147,5,147,3,125,3,125,3,125,1,89,1,
89,1,89,5,147,4,133,3,125,2,108,1,89,-1
2180 READ C:IF C=-1 THEN GOTO2220 ELSE ON C GOSUB 880, 930, 1000
,1050, 1130, 1210, 1280. 1350
2190 C$=INKEY$:IFC$=""THEN 2190
2200 IF VAL(C$)<>C THEN GOTO 2190
2210 READD:SOUNDD, 8:GOTO 2180
2220 REM"REPLAY OF SONG AND PICTURES"
2230 GOSUB1770
2240 SOUND89,10:SOUND 89,10:SOUND89,10
2250 SOUND108,6:SOUND125,10:SOUND125,6:SOUND108,6:SOUND125,6:SOU
ND133,6:SOUND147,10
2260 SOUND176,5:SOUND176,5:SOUND176,5
2270 SOUND147,5:SOUND147,5:SOUND147,5:SOUND125,5:SOUND125,5:SOUN
D125,5:SOUND89,5:SOUND89,5:SOUND89,5
2280 SOUND147,6:SOUND133,5:SOUND125,6:SOUND108,5:SOUND89,10
2290 GOSUB 1770
2300 FOR X = 1 TO 1500: NEXT X:GOSUB380:GOTO 1430
2310 PCLS    :FOR M=50 TO 200 STEP 5:SOUND M,1:NEXT M:FOR K=1 TO
200:NEXT K: FOR N = 200 TO 50 STEP -5: SOUND N,1:NEXT N
2320 CLS(8)
2330 END
```

Program Listing 2. Color Basic

```
1 REM"MUSIC"
2 CLS3
3 'COPYRIGHT BY S.BLYN-N.Y.-1981
4 PRINT"  directions for the instructor"
5 PRINT"*********************************"
6 PRINT" THIS PROGRAM CONTAINS 2 SONGS"
7 PRINT" 1.  three blind mice     AND"
8 PRINT
9 PRINT" 2.  row,row,row,your boat "
10 PRINT"   SONG 1 WILL PLAY NOTE NUMBERSAND THEN SHOW PICTURES.
"
11 PRINT" LEARNER MUST THEN PRESS FLASHEDNUMBER TO PLAY SONG'S N
OTES."
12 PRINT"     AFTER EACH SONG A CHOICE OF SONG #1 OR SONG #2 IS G
IVEN.          PRESS #9 TO END."
13 FORQ=0TO63:SET(Q,2,8):SOUND150,1:NEXTQ:FORW=63TO0STEP-1:SET(W
,31,8):NEXTW
14 PRINT@448,"          music          marvel        ";:PRINT@ 480,"
 PRESS <ENTER> TO BEGIN     ";:INPUT EN$
15 GOTO43
16 REM"DRAWING NUMBERS AND HAVING STUDENT PLAY THE SONG 'THREE B
LIND MICE'"
17 DATA 3,125,2,108,1,89,3,125,2,108,1,89,5,147,4,133,4,133,3,12
5,5,147,4,133,4,133,3,125,5,147,8,176,8,176,7,170,6,159,7,170,8,
176,8,176,5,147,5,147,8,176,8,176,8,176,7,170,6,159,7,170,8,176,
8,176,5,147,5,147,5,147,8,176,8,176,7,170,6,159,7,170
18 DATA 8,176,8,176,8,176,5,147,4,133,3,125,2,108,1,89,-1
19 READA:IFA=-1THENGOTO23ELSEONAGOSUB62,66,69,72,75,78,81,84
```

Listing 2 continues

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Listing 2 continued

```
20 A$=INKEY$:IFA$=""THEN20
21 IFVAL(A$)<>ATHENGOTO20
22 READB:SOUNDB,5:GOTO19
23 GOSUB58:SOUND125,10:SOUND108,10:SOUND89,15:SOUND125,10:SOUND1
08,10:SOUND89,15
24 SOUND147,10:SOUND133,6:SOUND133,6:SOUND125,15:SOUND147,10:SOU
ND133,6:SOUND133,6:SOUND125,15
25 GOSUB58
26 SOUND147,6:SOUND176,8:SOUND176,6:SOUND170,6:SOUND159,6:SOUND1
70,6:SOUND176,6:SOUND176,8:SOUND147,10
27 GOSUB58
28 SOUND147,8:SOUND176,6:SOUND176,6:SOUND176,6:SOUND170,6:SOUND1
59,6:SOUND170,6:SOUND176,8:SOUND176,8:SOUND147,10
29 SOUND147,6:SOUND147,6:SOUND176,8:SOUND176,8:SOUND170,8:SOUND1
59,6:SOUND170,6:SOUND176,6:SOUND176,6:SOUND176,6:SOUND147,10:SOU
ND133,8:SOUND125,10:SOUND108,10:SOUND89,12
30 GOSUB58:FORX=1TO400:NEXTX
31 CLS:GOSUB32:GOTO88
32 REM "HAPPY FACE"
33 CLS0:FORX=18TO45:SET(X,5,8):SET(X,25,8):NEXTX
34 FORY=5TO25:SET(18,Y,8):SET(19,Y,8):SET(44,Y,8):SET(45,Y,8):NE
XTY
35 SET(25,10,7):SET(38,10,7)
36 SET(26,10,7):SET(37,10,7)
37 FORX=27TO36:SET(X,20,5):NEXTX
38 SET(26,19,5):SET(37,19,5):SET(25,18,5):SET(38,18,5)
39 FORT=1TO10:RESET(25,10):RESET(38,10):RESET(26,10):RESET(37,10
):SOUND100,1:FORU=1TO30:NEXTU:SET(25,10,7):SET(38,10,7):SET(26,1
0,7):SET(37,10,7):NEXTT
40 FORX=1TO1400:NEXTX
41 RETURN
42 REM" 3 BLIND MICE"
43 FORX=1TO2
44 GOSUB70:SOUND125,7:GOSUB66:SOUND108,7:GOSUB62:SOUND89,8
45 GOSUB70:SOUND125,7:GOSUB66:SOUND108,7:GOSUB62:SOUND89,8
46 FORR=1TO2:GOSUB76:SOUND147,8
47 GOSUB73:SOUND133,4:GOSUB73:SOUND133,4:GOSUB70:SOUND125,8:
48 NEXTR
49 GOSUB76:SOUND147,4:GOSUB85:SOUND176,6:GOSUB85:SOUND176,4:GOSU
B82:SOUND170,4:GOSUB79:SOUND159,4:GOSUB82:SOUND170,4:GOSUB85:SOU
ND176,4:GOSUB85:SOUND176,6
50 GOSUB76:SOUND147,8:GOSUB76:SOUND147,4
51 GOSUB85:SOUND176,4:GOSUB85:SOUND176,4:GOSUB85:SOUND176,4
52 GOSUB82:SOUND170,4:GOSUB79:SOUND159,4:GOSUB82:SOUND170,4:GOSU
B85:SOUND176,6:GOSUB85:SOUND176,4:GOSUB76:SOUND147,6
53 FORY=1TO200:NEXTY
54 GOSUB76:SOUND147,6:GOSUB76:SOUND147,4:GOSUB85:SOUND176,6:GOSU
B85:SOUND176,4:GOSUB82:SOUND170,6:GOSUB79:SOUND159,4:GOSUB82:SOU
ND170,4
55 FORE=1TO3:GOSUB85:SOUND176,4:NEXTE
56 GOSUB76:SOUND147,8:GOSUB73:SOUND133,6:GOSUB70:SOUND125,8:GOSU
B67:SOUND108,8:GOSUB63:SOUND89,10:GOSUB58:GOSUB58
57 RESTORE:GOTO17
58 ' MOVING MICE
59 GOSUB155
60 FORY=1TO50:NEXTY
61 RETURN
62 '111
63 CLS0
64 CLS0:FORX=1TO18:PRINT@5*X-1,1;:NEXTX
65 RETURN
66 '222
67 CLS2:FORX=1TO18:PRINT@5*X-1,2;:NEXTX
68 RETURN
69 '333
70 CLS3:FORX=1TO18:PRINT@5*X-1,3;:NEXTX
71 RETURN
72 '444
73 CLS4:FORX=1TO18:PRINT@5*X-1,4;:NEXTX
74 RETURN
75 '555
76 CLS5:FORX=1TO18:PRINT@5*X-1,5;:NEXTX
77 RETURN
78 '666
79 CLS6:FORX=1TO18:PRINT@5*X-1,6;:NEXTX
80 RETURN
81 '777
82 CLS7:FORX=1TO18:PRINT@5*X-1,7;:NEXTX
83 RETURN
84 '888
85 CLS8:FORX=1TO18:PRINT@5*X-1,8;:NEXTX
86 RETURN
87 REM"DRAWING CHOICE OF 1 OR 2"
88 FORX=1TO8:CLS(X):SOUND100,1:NEXTX
89 CLS0:PRINT@264,"1";:PRINT@271,"OR";:PRINT@279,"2";
90 REM"CHOICE BETWEEN THE TWO SONGS"
```

Listing 2 continues

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80 Track, Double	40-0053	$349	80 Track, Double	45-0053	$399

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80 Track, Single	41-1003	$269	80 Track, Single	$319
80 Track, Double	41-1004	$349	80 Track, Double	$369

We sell two brands of disk drives for the TRS-80: the TEAC and the Tandon. The TEAC disk drive has a 1 year warranty, the Tandon has a 90 day warranty. The TEAC uses a lead screw actuator, the Tandon uses a split band type actuator. The track to track access rate for the Tandon is 5 milliseconds, as opposed to 25 milliseconds for the TEAC. The TRS-80 Model III requires a faster drive speed than the Model I, therefore the Tandon works better with the Model III. With the slower drive speed requirements of the Model I, the TEAC is a more reliable drive. We have both 40 track and 80 track drives with either single or dual head. All drives are capable of double density. These drives are available either bare or complete with power supply and cabinet. A cable is required to hook up the drives. We have both two-drive and four-drive cables. All drives come with complete instructions for hooking up a system. TEACs and Tandons can be intermixed with other drives on the same system.

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The disk drives we sell for the Model III are the Tandon drives. Drive 0 includes the controller board, power supply, cables and all mounting hardware. Complete instructions are included for installation. It takes 30 minutes to an hour to install disk drives in a Model III. No soldering is required. TRSDOS operating system is not included in this low price.

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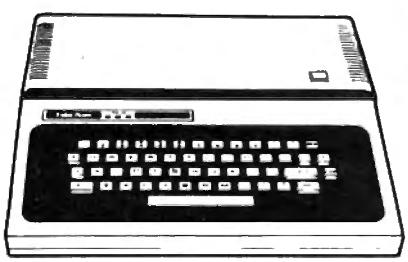

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Listing 2 continued

```
91 R$=INKEY$:IFR$=""THEN91ELSER=VAL(R$)
92 RESTORE
93 READB:IFB<>-1THEN93
94 IFR=1THEN42
95 IFR=2THEN98
96 IFR=9THEN136
97 GOTO90
98 REM"ROW,ROW,ROW,YOUR BOAT"
99 FORV=1TO3:GOSUB63:SOUND89,10:NEXTV
100 GOSUB67:SOUND108,6
101 GOSUB70:SOUND125,8
102 GOSUB70:SOUND125,5
103 GOSUB67:SOUND108,5
104 GOSUB70:SOUND125,5
105 GOSUB73:SOUND133,5
106 GOSUB76:SOUND147,8
107 FORM=1TO3:GOSUB85:SOUND176,4:NEXTM
108 FORL=1TO3:GOSUB76:SOUND147,4:NEXTL
109 FORK=1TO3:GOSUB70:SOUND125,4:NEXTK
110 FORW=1TO3:GOSUB63:SOUND89,6:NEXTW
111 GOSUB76:SOUND147,5
112 GOSUB73:SOUND133,4
113 GOSUB70:SOUND125,5
114 GOSUB67:SOUND108,4
115 GOSUB63:SOUND89,8
116 GOSUB117:GOTO122
117 REM"MOVING THE BOAT"
118 GOSUB139
119 FORT=1TO500:NEXTT
120 RETURN
121 GOTO121
122 DATA 1,89,1,89,1,89,2,108,3,125,3,125,2,108,3,125,4,133,5,14
7,8,176,8,176,8,176,5,147,5,147,5,147,3,125,3,125,3,125,1,89,1,8
9,1,89,5,147,4,133,3,125,2,108,1,89,-1
123 READC:IFC=-1THENGOTO127ELSEONCGOSUB62,66,69,72,75,78,81,84
124 C$=INKEY$:IFC$=""THEN124
125 IFVAL(C$)<>CTHENGOTO124
126 READD:SOUNDD,8:GOTO123
127 REM"REPLAY OF SONG AND PICTURES"
128 GOSUB117
129 SOUND89,10:SOUND89,10:SOUND89,10
130 SOUND108,6:SOUND125,10:SOUND125,6:SOUND108,6:SOUND125,6:SOUN
D133,6:SOUND147,10
131 SOUND176,5:SOUND176,5:SOUND176,5
132 SOUND147,5:SOUND147,5:SOUND147,5:SOUND125,5:SOUND125,5:SOUND
125,5:SOUND89,5:SOUND89,5:SOUND89,5
133 SOUND147,6:SOUND133,5:SOUND125,6:SOUND108,5:SOUND89,10
134 GOSUB117
135 FORX=1TO1500:NEXTX:GOSUB32:GOTO88
136 PCLS:FORM=50TO200STEP5:SOUNDM,1:NEXTM:FORK=1TO200:NEXTK:FORN
=200TO50STEP-5:SOUNDN,1:NEXTN
137 CLS(8)
138 END
139 CLS0
140 MM=0
141 FORYY=1TO15
142 PRINT@100+MM,CHR$(135)+CHR$(140)+CHR$(140)+CHR$(200)+CHR$(14
0)+CHR$(140)+CHR$(139);
143 PRINT@132+MM,CHR$(141)+CHR$(131)+CHR$(131)+CHR$(194)+CHR$(13
1)+CHR$(131)+CHR$(142);
144 PRINT@68+MM,CHR$(128)+CHR$(128)+CHR$(201);
145 PRINT@164+MM,CHR$(128)+CHR$(128)+CHR$(198);
146 SOUND200,2:SOUND170,1
147 PRINT@68+MM,CHR$(128);
148 PRINT@100+MM,CHR$(128);
149 PRINT@132+MM,CHR$(128);
150 PRINT@164+MM,CHR$(128);
151 MM=MM+1
152 NEXTYY
153 PRINT@115,CHR$(135);:PRINT@147,CHR$(141);
154 RETURN
155 CLS0
156 JJ=0
157 FORKL=1TO45
158 Y$=CHR$(247)+CHR$(253)+CHR$(254)+CHR$(251)
159 U$=CHR$(167)+CHR$(173)+CHR$(174)+CHR$(171)
160 F$=CHR$(231)+CHR$(237)+CHR$(238)+CHR$(235)
161 PRINT@320+JJ,Y$;
162 PRINT@319+JJ,CHR$(128);
163 PRINT@176+JJ,U$;
164 PRINT@175+JJ,CHR$(128);
165 PRINT@454+JJ,F$;
166 PRINT@453+JJ,CHR$(128);
167 SOUND250,1
168 JJ=JJ+1
169 NEXTKL
170 RETURN
```

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LOAD 80

Generate mazes for games or graphics.

Kwikmaze

Dan Rollins
370 N. Cerritos
Apt. 15-A
Azusa, CA 91702

Maze generating programs operate very slowly. I have faced this fact ever since my first attempts at making mazes with a 4K Level I. Some algorithms are faster than others, and there are specific tricks which speed up Basic programs. There are even hardware modifications which make the computer run faster. But even with all these speed-ups, a maze like that shown in Fig. 1 will take as long as five minutes to complete! Basic is just too slow for generating mazes.

Assembly-language coding is ideal for this application. The maze in Fig. 1 did not take 3-5 minutes to generate; Kwikmaze drew it in less than four seconds.

Face That Assembly Language

Kwikmaze is my first full-length Assembly-language program. Writing and debugging an Assembly-language program can be a painful and time consuming task. If you plan to program in Assembly language get a feel for the opcodes; know the Z80 chip's limitations. The *Z80 Cookbook* (Scelbi Publishers) is a good place to start. Learn your editor/assembler and debugging programs and be comfortable using them. Study other people's code and learn how the CPU flags operate. Then write short, simple programs which you fully understand.

In my case, I felt I knew mazes in and out. So this was a logical choice for my machine language debut. The algorithm for maze generation is straightforward:

1) Determine height and width.

2) Create a pair of pointers to keep track of the current element (or cell) being accessed.

3) Initialize these pointers, randomly if desired.

4) Check cells in four directions and determine which have not been accessed.

5) If there is no move available, adjust the pointers until they are at a previously visited cell bordering an unvisited cell.

6) Choose randomly among the bordering unvisited cells.

7) Move the pointers to the new cell, creating an exit from the current cell and an entrance to the new one.

8) Loop to step four until all cells have been visited.

In Basic, the pointers usually access a two-dimensional array, and the array elements are given values indicating doors in various direction combinations. The array is then interpreted for the print routine. I wanted to see what was going on during program execution so I chose to use screen memory as my array workspace. I also kept the walls two pixels wide for symmetry, making the maximum maze 31 cells wide by 23 cells high (713 cells). You can create much larger mazes—up to about 10,000 cells—for a really impressive printout to show your friends if you make some minor changes to the machine-language program and add a print routine.

How It Works

Kwikmaze follows closely the algorithm outlined above. First, I determine the height and width of the maze and pass these from Basic as the USR argument. Using these values, the INIT portion of the program calculates the minimum and maximum values for the X and Y (horizontal and vertical) pointers—the borders of the maze. To determine the number of cells multiply height by width.

This routine is complicated by the fact that I wanted the maze, whatever its size, to be positioned directly in the center of the screen. I added and subtracted offsets from the position

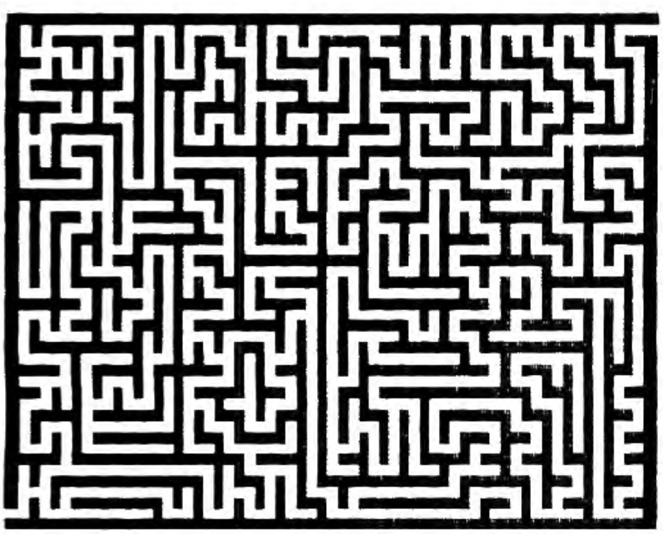

Figure 1

Program Listing 1

```
00100 ;                    KWIKMAZE
00200 ;This program creates a maze of varying size on the
00300 ;screen of your TRS-80.  It requires input of the
00400 ;height and width of the desired maze. The height
00500 ;must be in the range 3 >= height =< 31.  The width
00600 ;must be in the range 3 >=  width =< 23.
00800 ;
00900 ;To access from BASIC, use :
```

Listing 1 Continues

The Key Box

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16K RAM

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of the center cell to define the borders of the maze. These borders are placed in a table and the IY index register keeps track of their values.

All cells are initialized to an "unvisited" condition by painting the screen white. The X,Y pointers are initialized arbitrarily at the very center of the maze.

Steps 4–8 of the above algorithm are tied to the Set/Reset/Point routine starting at line 1360. This routine expects the DE register pair to contain an X,Y coordinate pair. Depending on the entry point, the routine either sets, resets or tests a pixel. Entry at Point returns the CPU flag Z if the coordinate is unlit and NZ if it is lit. This is a self-modifying program and is therefore unsuitable for ROM programming.

Note that only two changes are needed for the routine to do its work on non-video RAM (for the larger mazes mentioned above or the ability to move a completed maze directly to the screen). Line 1680 loads DE with the start of video memory which is added to HL and used as a pointer to the screen byte to test or change. Change that line to load DE with a different memory page and the action will take place without changing the screen. Line 1530 loads DE with 64, the length of a line of screen memory. If you are creating a maze wider than 31 cells, increase this value accordingly.

FINDMV determines the possible directions of motion by pointing DE to a neighboring cell and calling Point. If, upon return, the Z flag is set, then the cell has been visited and that direction is invalid. If the flag is NZ then the cell has not been visited so the bit corresponding to the direction of the cell being tested is set in the C register. At DONCHK the C register is tested. If it is still zero, a scan routine is invoked until a valid direction is found.

When at least one direction is available (C register does not equal zero) then the MAKEMV routine is called. This routine chooses one of the valid directions randomly, using the Z80's refresh register as a random number. A single bit in the A

Listing 1 Continued

```
               01000 ;                     UU = USR ( width * 256 + height)
               01100 ;
               01200 ;A 713 cell maze is created in less than 5 seconds!
               01300 ;
7E00           01400         ORG     7E00H
7E00 CD7F0A    01500         CALL    0A7FH           ;get height & width
7E03 CBC4      01502         SET     0,H
7E05 CBC5      01504         SET     0,L             ;must be ODD
7E07 22A27E    01600         LD      (HEIGHT),HL     ;store them
               01602 ;
               01700 ;Enter here to draw maximum size maze (31 x 23)
               01702 ;
7E0A CD217E    01705 MAXSIZ  CALL    INIT            ;white-out screen and
               01710                                 ;intialize edges
7E0D 2AA07E    01715 MAIN    LD      HL,(COUNT)
7E10 2B        01720         DEC     HL
7E11 22A07E    01725         LD      (COUNT),HL
7E14 7C        01730         LD      A,H             ;check for finished
7E15 B5        01735         OR      L
7E16 CA7D7E    01740         JP      Z,DONE          ;<<< MAIN loop EXIT
               01745 ;
7E19 CDFC7E    01750         CALL    FINDMV          ;determine possible moves
               01755 ;
7E1C CD667F    01760         CALL    MAKEMV          ;clear the cell & door
7E1F 18EC      01765         JR      MAIN            ;loop till done
               01770 ;
               01775 ;
7E21 21003C    01800 INIT    LD      HL,3C00H
7E24 36BF      01900         LD      (HL),0BFH
7E26 11013C    02000         LD      DE,3C01H
7E29 01FF03    02100         LD      BC,1023
7E2C EDB0      02200         LDIR                    ;white-out the screen
7E2E 112F00    02300         LD      DE,47
7E31 0680      02400         LD      B,128
7E33 CDA47E    02500 BLANK   CALL    RESET
7E36 14        02600         INC     D
7E37 10FA      02700         DJNZ    BLANK           ;blank bottom line
7E39 FD219C7E  02800         LD      IY,EDGTBL       ;point to edge table
7E3D 3AA37E    02900         LD      A,(WIDTH)
7E40 3D        03000         DEC     A
7E41 CB27      03100         SLA     A
7E43 47        03200         LD      B,A
7E44 3E3F      03300         LD      A,63
7E46 90        03400         SUB     B
7E47 FD7700    03500         LD      (IY+0),A        ;calculate WEST edge
7E4A 3E3F      03600         LD      A,63
7E4C 80        03700         ADD     A,B
7E4D FD7701    03800         LD      (IY+1),A        ;               EAST edge
7E50 3AA27E    03900         LD      A,(HEIGHT)
7E53 3D        04000         DEC     A
7E54 47        04100         LD      B,A
7E55 3E17      04200         LD      A,23
7E57 90        04300         SUB     B
7E58 FD7702    04400         LD      (IY+2),A        ;calculate NORTH edge
7E5B 3E17      04500         LD      A,23
7E5D 80        04600         ADD     A,B
7E5E FD7703    04700         LD      (IY+3),A        ;              SOUTH edge
7E61 2AA27E    04800         LD      HL,(HEIGHT)     ;H = width, L = height
7E64 45        04900         LD      B,L
7E65 5C        05000         LD      E,H
7E66 1600      05100         LD      D,0
7E68 62        05200         LD      H,D
7E69 6A        05300         LD      L,D
7E6A 19        05400 LOOP1   ADD     HL,DE           ;COUNT = HEIGHT * WIDTH
7E6B 10FD      05500         DJNZ    LOOP1
7E6D 22A07E    05600         LD      (COUNT),HL      ;calculate # of cells
7E70 163F      05700         LD      D,63
7E72 1E17      05800         LD      E,23            ;start in center of screen
7E74 CDA47E    05900         CALL    RESET
7E77 14        06000         INC     D
7E78 CDA47E    06100         CALL    RESET
7E7B 15        06200         DEC     D               ;clear starting cell
7E7C C9        06300         RET             ;back to MAIN loop
               06400 ;
               06410 ;
7E7D 1600      06500 DONE    LD      D,0     ;draw entrance and exit
7E7F FD5E03    06600         LD      E,(IY+3)
7E82 CDA47E    06700 DLOOP1  CALL    RESET
7E85 14        06800         INC     D
7E86 7A        06900         LD      A,D
7E87 FDBE00    07000         CP      (IY+0)
7E8A 20F6      07100         JR      NZ,DLOOP1
               07200 ;
7E8C 167F      07300         LD      D,127
7E8E FD5E02    07400         LD      E,(IY+2)
7E91 CDA47E    07500 DLOOP2  CALL    RESET
7E94 15        07600         DEC     D
7E95 7A        07700         LD      A,D
7E96 FDBE01    07800         CP      (IY+1)
7E99 20F6      07900         JR      NZ,DLOOP2
7E9B C9        08300         RET                     ;<<<<<<< program EXIT
               08305                                 ;back to BASIC
               08400 ;
               08500 ;Following addresses are used only by the program.
               08600 ;
7E9C 03        08700 EDGTBL  DEFB    3       ;XMIN
7E9D 7B        08800         DEFB    123     ;XMAX
7E9E 01        08900         DEFB    1       ;YMIN
7E9F 2D        09000         DEFB    45      ;YMAX
7EA0 CA02      09100 COUNT   DEFW    714
               09200 ;
               09300 ;These addresses must be supplied by the user
               09400 ;  via the USR() argument unless entry at MAXSIZ
               09500 ;
7EA2 17        09600 HEIGHT  DEFB    23      ;maximum height and width
7EA3 1F        09700 WIDTH   DEFB    31
               09800 ;
               09900 ;SET/RESET/POINT ROUTINE
               10000 ;       At entry D = X, E = Y
               10100 ; if entry at POINT, Z flag is SET if pixel NOT lit
               10200 ;
7EA4 3E86      10300 RESET   LD      A,86H
7EA6 1806      10400         JR      PLOT
7EA8 3EC6      10500 SET     LD      A,0C6H
7EAA 1802      10600         JR      PLOT
7EAC 3E46      10700 POINT   LD      A,46H
7EAE 32E47E    10800 PLOT    LD      (OPCODE),A
```

Listing 1 Continues

Listing 1 Continued

```
7EB1 C5       10900          PUSH   BC
7EB2 E5       11000          PUSH   HL
7EB3 D5       11100          PUSH   DE
7EB4 0E01     11200          LD     C,1             ;set up SIDE-OFFSET value
7EB6 CB3A     11300          SRL    D               ;divide X by 2
7EB8 3801     11400          JR     C,SKP5  ;remainder? Pixel on RIGHT if so
7EBA 0D       11500          DEC    C       ;  else OFFSET = 0 :pixel on LEFT
7EBB 6A       11600 SKP5     LD     L,D
7EBC 2600     11700          LD     H,0
              11800 ;
7EBE 7B       11900          LD     A,E             ;get Y ordinate
7EBF 114000   12000          LD     DE,64
7EC2 B7       12100          OR     A               ;clear carry for SBC
7EC3 ED52     12200          SBC    HL,DE
7EC5 C603     12300          ADD    A,3
7EC7 D603     12400 DIV3     SUB    3               ;divide  Y  value by 3
7EC9 19       12500          ADD    HL,DE           ;adjust screen ptr up 64
7ECA FE03     12600          CP     3               ;until it won't go again
7ECC 30F9     12700          JR     NC,DIV3
7ECE CB27     12800          SLA    A       ;mult remainder by 2: A = 0,2,4
7ED0 81       12900          ADD    A,C     ;add SIDE-OFFSET: A = 0,1,2,3,4,5
7ED1 47       13000          LD     B,A
7ED2 CB20     13100          SLA    B
7ED4 CB20     13200          SLA    B
7ED6 CB20     13300          SLA    B               ;get value for opcode
              13400 ;
7ED8 11003C   13500          LD     DE,3C00H
7EDB 19       13600          ADD    HL,DE           ;HL => BYTE to change
              13700 ;
7EDC 3AE47E   13800 SKP6     LD     A,(OPCODE)
7EDF 80       13900          ADD    A,B
7EE0 32E47E   14000          LD     (OPCODE),A
7EE3 CBC6     14100          SET    0,(HL)          ;this is changed during
7EE4          14200 OPCODE   EQU    $-1             ; execution.
7EE5 D1       14300          POP    DE
7EE6 E1       14400          POP    HL
7EE7 C1       14500          POP    BC
7EE8 C9       14600          RET
              14700 ;
              14800 ;this routine expects C register to hold bits
              14900 ; 8=WEST 4=SOUTH 2=EAST 1=NORTH (and combinations).
              15000 ;   RETURNS A = random direction of entry possibilities
              15100 ;
7EE9 ED5F     15200 RNDNUM   LD     A,R     ;REFRESH register is random
7EEB E60F     15300          AND    15
7EED 47       15400          LD     B,A
7EEE 3E02     15500          LD     A,2
7EF0 CB2F     15600 RSHIFT   SRA    A
7EF2 3002     15700          JR     NC,RSKP
7EF4 CBDF     15800          SET    3,A
7EF6 10F8     15900 RSKP     DJNZ   RSHIFT
7EF8 A1       16000          AND    C       ;is result a valid direction?
7EF9 28EE     16100          JR     Z,RNDNUM        ;no, get another
7EFB C9       16200          RET                    ;yes, pass it to caller
              16300 ;
              16400 ;
7EFC 62       17100 FINDMV   LD     H,D
7EFD 6B       17200          LD     L,E     ;COPY X,Y INTO HL
7EFE 0E00     17300          LD     C,0
7F00 7B       17400 CHKNTH   LD     A,E
7F01 FDBE02   17500          CP     (IY+2)          ;Y = MINIMUM ?
7F04 280A     17600          JR     Z,CHKSTH        ;yes, try SOUTH
7F06 1D       17700          DEC    E
7F07 1D       17800          DEC    E               ;no, check cell above
7F08 CDAC7E   17900          CALL   POINT           ;is cell "open" ?
7F0B 5D       18000          LD     E,L


7F0C 2802     18100          JR     Z,CHKSTH        ;no, try SOUTH
7F0E CBC1     18200          SET    0,C             ;yes, set NORTH bit in C
              18300 ;
7F10 7B       18400 CHKSTH   LD     A,E
7F11 FDBE03   18500          CP     (IY+3)          ;Y = YMAX ?
7F14 280A     18600          JR     Z,CHKWST
7F16 1C       18700          INC    E
7F17 1C       18800          INC    E
7F18 CDAC7E   18900          CALL   POINT
7F1B 5D       19000          LD     E,L
7F1C 2802     19100          JR     Z,CHKWST
7F1E CBD1     19200          SET    2,C             ;set SOUTH bit in C
              19300 ;
7F20 7A       19400 CHKWST   LD     A,D
7F21 FDBE00   19500          CP     (IY+0)          ;X = XMIN ?
7F24 280B     19600          JR     Z,CHKEST
7F26 D604     19700          SUB    4
7F28 57       19800          LD     D,A
7F29 CDAC7E   19900          CALL   POINT
7F2C 54       20000          LD     D,H
7F2D 2802     20100          JR     Z,CHKEST
7F2F CBD9     20200          SET    3,C             ;set WEST bit in C
              20300 ;
7F31 7A       20400 CHKEST   LD     A,D
7F32 FDBE01   20500          CP     (IY+1)          ;X = XMAX ?
7F35 280B     20600          JR     Z,DONCHK
7F37 C604     20700          ADD    A,4
7F39 57       20800          LD     D,A
7F3A CDAC7E   20900          CALL   POINT
7F3D 54       21000          LD     D,H
7F3E 2802     21100          JR     Z,DONCHK
7F40 CBC9     21200          SET    1,C             ;set EAST bit in C
              21300 ;
7F42 79       21400 DONCHK   LD     A,C     ;if C = 0 there was no move
7F43 B7       21500          OR     A
7F44 C0       21600          RET    NZ              ;at least 1 move possible
              21605                                 ;  so return to MAIN loop
              21700 ;
7F45 7A       21800 SCAN1    LD     A,D     ;no move, scan screen for opening
7F46 C604     21900          ADD    A,4             ;adjust X one cell WEST
7F48 57       22000          LD     D,A
7F49 FD7E01   22100          LD     A,(IY+1)
7F4C BA       22200          CP     D
7F4D 3010     22300          JR     NC,SCAN2        ;if X > XMAX then
7F4F FD5600   22400          LD     D,(IY+0)        ;  X becomes XMIN
7F52 7B       22500          LD     A,E
7F53 C602     22600          ADD    A,2             ;adjust Y SOUTH
7F55 5F       22700          LD     E,A
```

Listing 1 Continues

register, rotated a random number of times, is masked by the C register. When the random bit is also on in the C register, a valid move has been determined. Otherwise the process repeats. The result is very random and makes any maze created unique.

When a valid direction is found, MAKEMV simply resets the pixels between the current and new cells (makes a "door") and resets the two pixels which are the interior of the cell, leaving X,Y (the DE register pair) pointing to the newly created cell.

After each cell is created, the variable Count is decremented. When this counter goes to zero, the maze is finished. Control passes to Done which resets lines leading into and away from the maze, creating the entrance and exit. These could be placed at any two parts of the maze as there is only one direct route between any two cells. I chose the bottom left and top right corners so they will be physically as far apart as possible. The return instruction at line 1080 is the exit from the program.

The Basic Program

Program Listing 2 is one example of how to use Kwikmaze. The first part of the program (lines 80–150) reads the data lines and POKEs the machine code into place. The POKEs start at 32256 (7E00H) and go to 32692 (7FB48) so be sure to set memory size below 32256. Note that the data is in hexadecimal format. It is read as strings and interpreted as numeric bytes for the POKEs. This method saves typing. Also, you may use the data lines as a hex dump of the program for entry with Debug or other monitor. The drawback of the hex format is that the loading time is longer than for decimal data (30 seconds). A star flashes in the top left corner of your screen to show that all is well.

Once the machine code is in place, you are prompted for the size of the maze. Width is the number of columns of cells across the screen, height is the number of rows from top to bottom. The Basic program traps

Listing 1 Continued

```
7F56 FD7E03   22800          LD     A,(IY+3)
7F59 BB       22900          CP     E
7F5A 3003     23000          JR     NC,SCAN2        ;if Y > YMAX then
7F5C FD5E02   23100          LD     E,(IY+2)        ;  Y becomes YMIN
7F5F CDAC7E   23200 SCAN2    CALL   POINT           ;if cell is "doorless"
7F62 20E1     23300          JR     NZ,SCAN1        ;  then try another
7F64 1896     23400          JR     FINDMV          ;else check for moves
              23500 ;
7F66 CDE97E   23600 MAKEMV   CALL   RNDNUM          ;return one of N, S, E, W
7F69 CB4F     23700          BIT    1,A
7F6B 2035     23800          JR     NZ,EAST
7F6D CB57     23900          BIT    2,A
7F6F 2013     24000          JR     NZ,SOUTH
7F71 CB5F     24100          BIT    3,A
7F73 201E     24200          JR     NZ,WEST
              24300 ;


              24305 ;each routine clears the "door" from the current cell,
              24310 ;clears the new cell itself, and updates the X,Y pointer.
              24315 ;
7F75 1D       24400 NORTH    DEC    E
7F76 CDA47E   24500          CALL   RESET
7F79 14       24600          INC    D
7F7A CDA47E   24700          CALL   RESET
7F7D 1D       24800          DEC    E
7F7E CDA47E   24900          CALL   RESET
7F81 15       25000          DEC    D
7F82 182D     25100          JR     MMEXIT
              25200 ;
7F84 1C       25300 SOUTH    INC    E
7F85 CDA47E   25400          CALL   RESET
7F88 14       25500          INC    D
7F89 CDA47E   25600          CALL   RESET
7F8C 1C       25700          INC    E
7F8D CDA47E   25800          CALL   RESET
7F90 15       25900          DEC    D
7F91 181E     26000          JR     MMEXIT
              26100 ;
7F93 15       26200 WEST     DEC    D
7F94 CDA47E   26300          CALL   RESET
7F97 15       26400          DEC    D
7F98 CDA47E   26500          CALL   RESET
7F9B 15       26600          DEC    D
7F9C CDA47E   26700          CALL   RESET
7F9F 15       26800          DEC    D
7FA0 180F     26900          JR     MMEXIT
              27000 ;
7FA2 14       27100 EAST     INC    D
7FA3 14       27200          INC    D
7FA4 CDA47E   27300          CALL   RESET
7FA7 14       27400          INC    D
7FA8 CDA47E   27500          CALL   RESET
7FAB 14       27600          INC    D
7FAC 14       27700          INC    D
7FAD CDA47E   27800          CALL   RESET
7FB0 15       27900          DEC    D
7FB1 CDA47E   28000 MMEXIT   CALL   RESET
7FB4 C9       28100          RET                  ;back to MAIN loop
0000          28200          END
00000 TOTAL ERRORS
```

errors. The first portion of the machine code also makes certain that the dimensions are odd to keep the maze centered in the screen.

The routine at lines 180–430 allows you to run a dot through a constantly changing maze. Starting at the entrance, press the arrow keys to move the dot. A new maze is created at random intervals, so sometimes you will need to judge whether to retain your current position hoping the new maze will give easy access to the exit, or try to improve your position. You are scored according to the length of time needed to traverse from entrance to exit.

If you are not interested in games, delete lines 180–440 and use:

```
180 H = RND(20) + 3 :W = RND(28) + 3
190 UU = USR(H + W*256)
200 FOR DELAY = 1 TO 1000 :NEXT
210 GOTO 180
```

Kwikmaze is now a dazzling, hypnotic display. ■

Dan Rollins is a numerical control machinist and a computer science student at Citrus College.

```
10 '    *** KWIKMAZE ***
20 ' ** by DAN ROLLINS **
30 '     ** 08/03/81 **
40 DEFINT A-Z
50 CS=0 : ADDR= 32256  '* 7E00 HEX
60 CLS :PRINT@ 472,"KWIKMAZE" :PRINT@ 533,"BY DAN ROLLINS"
70 PRINT@ 973,"LOADING MACHINE CODE, PLEASE STANDBY";
75 '
    * Routine converts hex DATA to decimal for POKEs
    * line 110 not needed when data is good
    * line 120 is optional

80 READ A$ :IF A$="END" GOTO 150
90    B$=LEFT$(A$,1) :C$=RIGHT$(A$,1)
100   X=ASC(B$)-48+(B$>"9")*7 :Y=ASC(C$)-48+(C$>"9")*7
110   CS=CS+X+Y                          '* calculate checksum
120   PRINT@ 0,CHR$(32+(CS AND 1)*10); '* blink star
130   POKE ADDR,X*16+Y :ADDR=ADDR+1
140 GOTO 80
150 IF CS<> 6330 CLS :PRINT" ** BAD DATA **" :END
160 POKE 16526,0 :POKE 16527,126
170 ' * disk users erase to here ->  DEFUSR0=&H7E00
180 CLS :INPUT"HEIGHT OF MAZE (3-23) ";H
190 IF H<3 OR H>23 THEN 180 ELSE H=INT(H/2)*2+1
200 INPUT"WIDTH  OF MAZE (3-31) ";W
210 IF W<3 OR W>31 THEN 200 ELSE W=INT(W/2)*2+1
220 X=1 :Y=22 + H :SC=0 :D=0
230 UU=USR(W * 256 + H)  ' * draw a maze
240    FOR J=1 TO RND(H+V)+25
250       GOSUB 340 :IF D=1 LET J=101 '* exit loop gracefully
260    NEXT J                          '* when dot at maze exit
270 IF D<>1 THEN 230
280 CLS :PRINT "          YOUR SCORE IS ==> ";SC
290 PRINT@ 960,"HIT <ENTER> TO PLAY AGAIN";
300 K$=INKEY$ : FOR DELAY=1 TO 50 :NEXT
310 PRINT@ 964,"          "; :FOR DELAY=1 TO 50 :NEXT
320 IF K$=CHR$(13) THEN 180 ELSE 290

330 '* move the dot

340 RESET(X,Y) :RESET(X+1,Y) :FOR DELAY=1 TO 15 :NEXT
350 SC=SC+1 :AR=PEEK(14400)
360 X1=0 :Y1=0
370 IF AR AND 8 THEN Y1=-1
380 IF AR AND 16 THEN Y1=1
390 IF AR AND 32 THEN X1=-2
400 IF AR AND 64 THEN X1=2
410 IF POINT(X+X1,Y+Y1) THEN SET(X,Y) :SET(X+1,Y) :RETURN
420 X=X+X1 :Y=Y+Y1 :SET(X,Y) :SET(X+1,Y)
430 IF X>123 THEN D=1
440 RETURN
999 '
     **  The program loads  from 7E00H to 7FB4H  **
     ** Entry at 7E00H from BASIC : USR(W*256+H) **
     ** Entry at 7E03H expects L=height, H=width **
     ** Entry at 7E0A draws largest (31x23) maze **
     * 7E00H
1000 DATA CD,7F,0A,CB,C4,CB,C5,22,A2,7E,CD,21,7E,2A,A0,7E
1010 DATA 2B,22,A0,7E,7C,B5,CA,7D,7E,CD,FC,7E,CD,66,7F,18
1020 DATA EC,21,00,3C,36,BF,11,01,3C,01,FF,03,ED,B0,11,2F
1030 DATA 00,06,80,CD,A4,7E,14,10,FA,FD,21,9C,7E,3A,A3,7E
1040 DATA 3D,CB,27,47,3E,3F,90,FD,77,00,3E,3F,80,FD,77,01
1045 '* 7E50H
1050 DATA 3A,A2,7E,3D,47,3E,17,90,FD,77,02,3E,17,80,FD,77
1060 DATA 03,2A,A2,7E,45,5C,16,00,62,6A,19,10,FD,22,A0,7E
1070 DATA 16,3F,1E,17,CD,A4,7E,14,CD,A4,7E,15,C9,16,00,FD
1080 DATA 5E,03,CD,A4,7E,14,7A,FD,BE,00,20,F6,16,7F,FD,5E
1090 DATA 02,CD,A4,7E,15,7A,FD,BE,01,20,F6,C9,03,7B,01,2D
1095 '* 7EA0H
1100 DATA CA,02,17,1F,3E,86,18,06,3E,C6,18,02,3E,46,32,E4
1110 DATA 7E,C5,E5,D5,0E,01,CB,3A,38,01,0D,6A,26,00,7B,11
1120 DATA 40,00,B7,ED,52,C6,03,D6,03,19,FE,03,30,F9,CB,27
1130 DATA 81,47,CB,20,CB,20,CB,20,11,00,3C,19,3A,E4,7E,80
1140 DATA 32,E4,7E,CB,C6,D1,E1,C1,C9,ED,5F,E6,0F,47,3E,02
1145 '* 7EE0H
1150 DATA CB,2F,30,02,CB,DF,10,F8,A1,28,EE,C9,62,6B,0E,00
1160 DATA 7B,FD,BE,02,28,0A,1D,1D,CD,AC,7E,5D,28,02,CB,C1
1170 DATA 7B,FD,BE,03,28,0A,1C,1C,CD,AC,7E,5D,28,02,CB,D1
1180 DATA 7A,FD,BE,00,28,0B,D6,04,57,CD,AC,7E,54,28,02,CB
1190 DATA D9,7A,FD,BE,01,28,0B,C6,04,57,CD,AC,7E,54,28,02
1195 '* 7F40H
1200 DATA CB,C9,79,B7,C0,7A,C6,04,57,FD,7E,01,BA,30,10,FD
1210 DATA 56,00,7B,C6,02,5F,FD,7E,03,BB,30,03,FD,5E,02,CD
1220 DATA AC,7E,20,E1,18,96,CD,E9,7E,CB,4F,20,35,CB,57,20
1230 DATA 13,CB,5F,20,1E,1D,CD,A4,7E,14,CD,A4,7E,1D,CD,A4
1240 DATA 7E,15,18,2D,1C,CD,A4,7E,14,CD,A4,7E,1C,CD,A4,7E
1245 '* 7F90H
1250 DATA 15,18,1E,15,CD,A4,7E,15,CD,A4,7E,15,CD,A4,7E,15
1260 DATA 18,0F,14,14,CD,A4,7E,14,CD,A4,7E,14,14,CD,A4,7E
1270 DATA 15,CD,A4,7E,C9
1280 DATA  END
```

Program Listing 2


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VERSALEDGER II™ comes with a professionally-written 160 page manual designed for first-time users. The VERSALEDGER II™ manual will help you become quickly familiar with VERSALEDGER II™, using complete sample data files supplied on diskette and more than 50 pages of sample printouts.

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Every **VERSABUSINESS**™ module is guaranteed to outperform all other competitive systems, and at a fraction of their cost. If you are not satisfied with any **VERSABUSINESS**™ module, you may return it within 30 days for a refund. Manuals for any **VERSABUSINESS**™ module may be purchased for $25 each, credited toward a later purchase of that module.

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*CP/M is a trademark of Digital Research · *XEROX is a trademark of Xerox Corp.

Tired Of Your GENERAL LEDGER?

VERSA-LEDGER II

★ THE ULTIMATE PERSONAL CHECK REGISTER
★ A PROFESSIONAL ACCOUNTING SYSTEM
★ A PERSONAL FINANCIAL MANAGER
★ A SMALL BUSINESS ACCOUNTING SYSTEM
★ A COMPLETE GENERAL LEDGER

FOR YOUR TRS-80* MODEL I II, III or 16 • APPLE II* • I.B.M.* • XEROX* • ATARI* PET/CBM* • OSBORNE* • ALL MICROSOFT BASIC COMPUTERS

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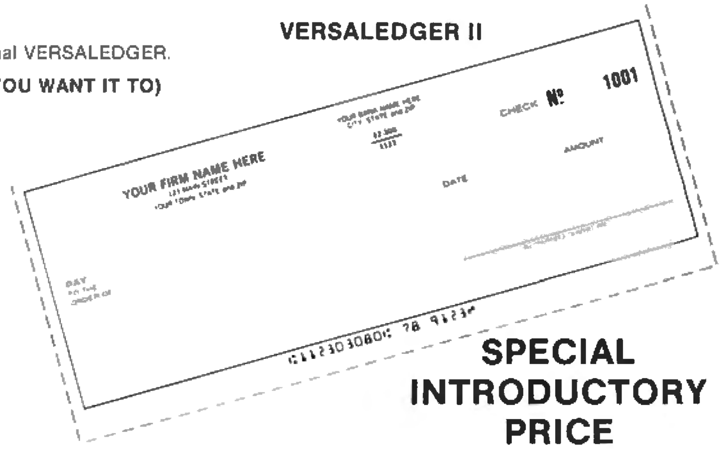
HOW IT WORKS . . . .

VERSALEDGER II is a complete accounting system that grows as you or your business grows. To start, your VERSA-LEDGER II acts as a simple method of keeping track of your checkbook. Just enter your check number, date and whom the check is made out to. As you or your business grows, you may add more details to your transactions ..... account number, detailed account explanations, etc.

VERSALEDGER II



- VERSALEDGER II is an expanded and enhanced version of our original VERSALEDGER.
- VERSALEDGER II gives you an instant cash balance at anytime. **(IF YOU WANT IT TO)**
- VERSALEDGER II can be used as a small personal checkbook register. **(IF YOU WANT IT TO)**
- VERSALEDGER II can run your million dollar corporation. **(IF YOU WANT IT TO)**
- VERSALEDGER II prints checks. **(IF YOU WANT IT TO)**
- VERSALEDGER II stores all check information forever. **(IF YOU WANT IT TO)**
- VERSALEDGER II can distribute one check to multiple expense accounts. **(IF YOU WANT IT TO)**
- VERSALEDGER II can handle more than one checkbook. **(IF YOU WANT IT TO)**
- VERSALEDGER II can be used to replace a general ledger. **(IF YOU WANT IT TO)**
- VERSALEDGER II prints balance sheets and income statements. **(IF YOU WANT IT TO)**
- VERSALEDGER II can interact with any of the other four modules of the VERSABUSINESS SYSTEM.

SPECIAL INTRODUCTORY PRICE
$149.95
($199.95 after Dec. 31, 1982)

- VERSALEDGER II comes with a professionally written manual (created for the first-time computer user), which includes sample report print-outs.
- VERSALEDGER II HAS AN ALMOST UNLIMITED CAPACITY . . .
  (300 checks per month on single density 5¼" disk drives such as the TRS-80 Model I)
  (500 checks per month on the Apple II)
  (2400 checks per month on the TRS-80 Model III)
  (6000 checks per month on the TRS-80 Model II)
  (3000 checks per month on single density 8" CP/M)
  (almost unlimited capacity on hard disk drive)
- VERSALEDGER II OUTPERFORMS ALL OTHER COMPETITIVE SYSTEMS NOW AVAILABLE TO MICROCOMPUTER USERS, AT A FRACTION OF THE COST (AND WE OFFER A 30-DAY MONEY BACK GUARANTEE TO BACK UP OUR CLAIM!)

— CAN BE USED WITH 1 or MORE DISK DRIVES with 48K —

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- ★ THE ULTIMATE ACCOUNTS RECEIVABLE SYSTEM
- ★ HANDLES ALL ACCOUNTS RECEIVABLE FUNCTIONS
- ★ QUICK PERIODIC SUMMARIES AND REPORTS
- ★ PERFECT FOR PERSONAL OR BUSINESS USE
- ★ EXPANDS TO HANDLE LARGE CORPORATE RECEIVABLES

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HOW IT WORKS . . . . .

VERSARECEIVABLES is a complete menu driven accounts receivable system. It keeps track of all information related to who owes you or your company money. It prints all necessary statements, invoices and all summary reports to keep you in touch with the flow of money owed to your company. In short, **VERSARECEIVABLES** is a complete invoicing and monthly statement generating system which keeps track of current and past due receivables.

- VERSARECEIVABLES invoices your customers. **(IF YOU WANT IT TO)**
- VERSARECEIVABLES prints customer mailing labels. **(IF YOU WANT IT TO)**
- VERSARECEIVABLES generates monthly (or periodic) statements at any time. **(IF YOU WANT IT TO)**
- VERSARECEIVABLES uses commonly available preprinted statements and invoices. **(IF YOU WANT IT TO)**
- VERSARECEIVABLES allows partial payments on open invoices. **(IF YOU WANT IT TO)**
- VERSARECEIVABLES prints out all commonly used ACCOUNTS RECEIVABLE reports to give you a total picture of money owed to your company. **(IF YOU WANT IT TO)**
- VERSARECEIVABLES keeps a history of each account, both current and aged. **(IF YOU WANT IT TO)**
- VERSARECEIVABLES is ideal for doctors, lawyers, small and large businesses.
- VERSARECEIVABLES HAS AN ALMOST UNLIMITED CAPACITY . . . .

VERSARECEIVABLES

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400 customers and transactions per month on single density 5¼" disk drives such as the TRS-80 Model I
600 per month on the APPLE II
2400 per month on the TRS-80 MODEL III
6000 per month on the TRS-80 MODEL II
3000 per month on single density 8" CP/M
Almost unlimited on hard disk drive systems

Above capacities are estimates and depend on the customer-transaction mix and the amount of disk space available.

VERSARECEIVABLES HAS BEEN CREATED WITH THE FIRST TIME COMPUTER USER IN MIND

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100 Ready-To-Run Business Programs

**(ON CASSETTE OR DISKETTE).....Includes 128 Page Users Manual.....
Inventory Control.....Payroll.....Bookkeeping System.....Stock Calculations.....
Checkbook Maintenance.....Accounts Receivable.....Accounts Payable.....**

BUSINESS 100 PROGRAM LIST

NAME	DESCRIPTION
1 RULE78	Interest Apportionment by Rule of the 78's
2 ANNU1	Annuity computation program
3 DATE	Time between dates
4 DAYYEAR	Day of year a particular date falls on
5 LEASEINT	Interest rate on lease
6 BREAKEVN	Breakeven analysis
7 DEPRSL	Straightline depreciation
8 DEPRSY	Sum of the digits depreciation
9 DEPRDB	Declining balance depreciation
10 DEPRDDB	Double declining balance depreciation
11 TAXDEP	Cash flow vs. depreciation tables
12 CHECK2	Prints NEBS checks along with daily register
13 CHECKBK1	Checkbook maintenance program
14 MORTGAGE/A	Mortgage amortization table
15 MULTMON	Computes time needed for money to double, triple, etc.
16 SALVAGE	Determines salvage value of an investment
17 RRVARIN	Rate of return on investment with variable inflows
18 RRCONST	Rate of return on investment with constant inflows
19 EFFECT	Effective interest rate of a loan
20 FVAL	Future value of an investment (compound interest)
21 PVAL	Present value of a future amount
22 LOANPAY	Amount of payment on a loan
23 REGWITH	Equal withdrawals from investment to leave 0 over
24 SIMPDISK	Simple discount analysis
25 DATEVAL	Equivalent & nonequivalent dated values for oblig.
26 ANNUDEF	Present value of deferred annuities
27 MARKUP	% Markup analysis for items
28 SINKFUND	Sinking fund amortization program
29 BONDVAL	Value of a bond
30 DEPLETE	Depletion analysis
31 BLACKSH	Black Scholes options analysis
32 STOCVAL1	Expected return on stock via discounts dividends
33 WARVAL	Value of a warrant
34 BONDVAL2	Value of a bond
35 EPSEST	Estimate of future earnings per share for company
36 BETAALPH	Computes alpha and beta variables for stock
37 SHARPE1	Portfolio selection model-i.e. what stocks to hold
38 OPTWRITE	Option writing computations
39 RTVAL	Value of a right
40 EXPVAL	Expected value analysis
41 BAYES	Bayesian decisions
42 VALPRINF	Value of perfect information
43 VALADINF	Value of additional information
44 UTILITY	Derives utility function
45 SIMPLEX	Linear programming solution by simplex method
46 TRANS	Transportation method for linear programming
47 EOQ	Economic order quantity inventory model
48 QUEUE1	Single server queueing (waiting line) model
49 CVP	Cost-volume-profit analysis
50 CONDPROF	Conditional profit tables
51 OPTLOSS	Opportunity loss tables
52 FQUOQ	Fixed quantity economic order quantity model
53 FQEOWSH	As above but with shortages permitted
54 FQEOQPB	As above but with quantity price breaks
55 QUEUECB	Cost-benefit waiting line analysis
56 NCFANAL	Net cash-flow analysis for simple investment
57 PROFIND	Profitability index of a project
58 CAP1	Cap. Asset Pr. Model analysis of project
59 WACC	Weighted average cost of capital
60 COMPBAL	True rate on loan with compensating bal. required
61 DISCBAL	True rate on discounted loan
62 MERGANAL	Merger analysis computations
63 FINRAT	Financial ratios for a firm
64 NPV	Net present value of project
65 PRINDLAS	Laspeyres price index
66 PRINDPA	Paasche price index
67 SEASIND	Constructs seasonal quantity indices for company
68 TIMETR	Time series analysis linear trend
69 TIMEMOV	Time series analysis moving average trend
70 FUPRINF	Future price estimation with inflation
71 MAILPAC	Mailing list system
72 LETWRT	Letter writing system-links with MAILPAC
73 SORT3	Sorts list of names
74 LABEL1	Shipping label maker
75 LABEL2	Name label maker
76 BUSBUD	DOME business bookkeeping system
77 TIMECLCK	Computes weeks total hours from timeclock info.
78 ACCTPAY	In memory accounts payable system-storage permitted
79 INVOICE	Generate invoice on screen and print on printer
80 INVENT2	In memory inventory control system
81 TELDIR	Computerized telephone directory
82 TIMUSAN	Time use analysis
83 ASSIGN	Use of assignment algorithm for optimal job assign.
84 ACCTREC	In memory accounts receivable system-storage ok
85 TERMSPAY	Compares 3 methods of repayment of loans
86 PAYNET	Computes gross pay required for given net
87 SELLPR	Computes selling price for given after tax amount
88 ARBCOMP	Arbitrage computations
89 DEPRSF	Sinking fund depreciation
90 UPSZONE	Finds UPS zones from zip code
91 ENVELOPE	Types envelope including return address
92 AUTOEXP	Automobile expense analysis
93 INSFILE	Insurance policy file
94 PAYROLL2	In memory payroll system
95 DILANAL	Dilution analysis
96 LOANAFFD	Loan amount a borrower can afford
97 RENTPRCH	Purchase price for rental property
98 SALELEAS	Sale-leaseback analysis
99 RRCONVBD	Investor's rate of return on convertable bond
100 PORTVAL9	Stock market portfolio storage-valuation program

☐ TRS-80 Cassette Version	$99.95
☐ TRS-80 (Mod-I or III), Pet, Apple or Atari Versions	$99.95
☐ TRS-80 Mod-II, IBM, Osborne and CP/M Versions	$149.95

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System Diagnostic

For Cassette or Disk

IS YOUR COMPUTER WORKING CORRECTLY? ARE YOU SURE?

Tests every component of your TRS-80 for proper operation.

DISK $99.95

CASSETTE $94.95

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ROM: Checksum test
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Video Display: Character generator, video RAM, and video signal tests
Keyboard: Every key contact tested
Line Printer: Character test
Cassette Recorder: Read/write/verify data
RS-232-C Interface: Read sense switches (Model I), connector fault, data transmission, framing, data loop, baud rate generator
Disk Drives: Disk controller, drive select and restore, track seek and verify read, read/write/verify all tracks and sectors, formatting, disk drive timer, disk head cleaner
Model I: single or double density, 35, 40 or 80 track drives
Model 3: single or double density, 35, 40 or 80 track drives
single or double sided drives

--- One program adapts to any system configuration and hardware.
--- Individual tests of each device with operator monitoring and intervention.
--- Continuous system tests run continually for hours, with diagnostic reports optionally written on line printer.
--- Complete instructions and documentation.

SPECIFY TRS-80™ MODEL I OR MODEL III

SMART TERMINAL

Enables your TRS-80 to be used as a data communications terminal to a time-sharing system, computer bulletin board, or another computer, via the RS-232-C interface.

- MEMORY BUFFER holds data for transmission or data received from other computer.
- CASSETTE or DISK may be used to load or save data from memory.
- AUTOMATIC TRANSMISSION of data from memory.
- AUTOMATIC STORAGE of incoming data at user's option.
- TRANSMIT or RECEIVE WITH VERIFICATION options included for communication between two TRS-80s using Smart Terminal.
- Full CONTROL KEYS, including control key mapping into any ASCII character. True BREAK key. Lower case supported on Model I.
- Buffered LINE PRINTER ECHO for incoming data.
- Disk and cassette files fully compatible with ELECTRIC PENCIL™ and SCRIPSIT™ programs.
- BAUD RATE and RS-232-C CHARACTERISTICS can be reset from within the program.
- SAVE PROGRAM option creates "personalized" back-up copy of program with all options set as specified by user.
- ONE PROGRAM supports both cassette and disk systems. Program is compatible with PMC-80 and other TRS-80 "work alike" computers.

Model I or III Version **supplied on cassette $69.75**
supplied on diskette $74.95
Model II (CP/M) Version **$79.95**

MON-3 and MON-4

The TRS-80 Monitor Programs #3 and #4 are powerful utility programs enabling you to interact directly with the TRS-80 in Machine Language. They are as useful for beginners as for advanced programmers.

- BEGINNERS can learn to interact directly with the computer in Machine Language.
- 40-PAGE MANUAL provided with each program.
- SIMPLE commands, easy to use.

The Features Of The Monitor Programs Enable You To The Following.....

- DISPLAY memory in different ways.
- DISASSEMBLE memory to see Machine Language commands.
- MOVE and COMPARE memory areas.
- SEARCH through memory to find specific values.
- MODIFY memory in various ways.
- RELOCATE object programs.
- PRINT output on video display or line printer.
- READ and WRITE object tapes in SYSTEM Format.
- UNLOAD programs using low RAM on disk.
- SAVE and READ disk files (MON-4 Only).
- INPUT and OUTPUT of disk sectors (MON-4 Only).
- SEND and RECEIVE data over RS-232-C Interface (MON-4 Only).
- Create SYMBOLIC Tapes (MON-3) or Files (MON-4) of Disassembled output for Editor/Assembler program.

MON-3 (For Cassette Systems) $39.95
MON-4 (For Disk Systems) $49.95

MAILING LIST

Maintains mailing lists of up to 1326 names (48K version). Add, change, delete, or find names. Machine language sort according to information in ANY field (first or last name, address, city, state, zip code). Three or four line labels printed in 1, 2, 3, or 4 columns, in master list, or on video display.

TRS-80 Model 1/3 Disk Version $69.95
IBM PC Disk Version $79.95

HOME BUDGET

Keeps track of your monthly and year-to-date income and expenses. Income and expenses classified by code numbers for identification of categories. Data includes date, code number, amounts and check number (optional). Computes monthly and year-to-date summaries showing income tax deductions. All output printed on video display or line printer at user's option. Complete instructions for customizing to suit your own budget.

TRS-80 Model 1/3 Cassette Version $29.95
TRS-80 Model 1/3 Disk Version $49.95
IMB PC Disk Version $59.95

SMALL BUSINESS ACCOUNTING

Based on Dome Bookkeeping Record #612, this program keeps track of income, expenditures, and payroll for a small business. Receipts and expenditures can be entered on a daily, weekly, or monthly basis. Program computes monthly, through last month, and year to date summaries. Payroll section (included in disk version only) keeps record of employees and paychecks with up to six categories of payroll deductions. Computes employee payroll records and year-to-date payroll totals. Complete instructions for customizing to suit your own business.

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HSDS HARD DISK DRIVE SOFTWARE
- MAKES TRSDOS COMPATIBLE WITH MOST HARD DISK DRIVES
- ADDS MANY EXTRA FEATURES TO TRSDOS . . . $400 00

COMPROC (COMMAND PROCESSOR)
- AUTO YOUR DISK TO PERFORM ANY SEQUENCE OF INSTRUCTIONS THAT YOU NORMALLY GIVE FROM THE KEYBOARD (FOR EXAMPLE, INSERT THE DISKETTE, PRESS THE RESET BUTTON, YOUR COMMAND FILE COULD AUTOMATICALLY SHOW YOU THE DIRECTORY, SHOW THE FREE SPACE ON THE DIKSETTE LOAD A MACHINE LANGUAGE SUBROUTINE, LOAD BASIC, LOAD AND RUN A BASIC PROGRAM, AND SELECT A GIVEN ITEM ON YOUR MENU ALL WITHOUT TOUCHING THE KEYBOARD!)

MODEL-I VERSION . . . $20 00
MODEL-III VERSION . . . $30 00
NOT AVAILABLE FOR MODEL-II

DISCAT (DISKETTE CATALOG SYSTEM)
- THIS COMPREHENSIVE DISKETTE CATALOGUING INDEXING UTILITY ALLOWS THE USER TO KEEP TRACK OF THOUSANDS OF PROGRAMS IN A CATEGORIZED LIBRARY FILE INCLUDES PROGRAM NAMES AND EXTENSIONS PROGRAM LENGTH DISKETTE NUMBERS AND FREE SPACE ON EACH DISKETTE KEEP A COMPLETE CATALOG OF THE DIRECTORIES ON ALL YOUR DISKETTES IN ALPHABETICAL ORDER (SORTED ON EACH DISKETTE OR COMPLETE ALPHABETICAL LIST OF PROGRAMS ON ALL YOUR DISKETTES)

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MODEL-III VERSION . . . $50 00
MODEL-II VERSION (SEE MODEL-II UTILITY PACKAGE)

BLINK (BASIC LINK FACILITY)
- LINK FROM **BASIC** PROGRAM TO ANOTHER SAVING ALL VARIABLES
- THE CHAINED PROGRAM MAY EITHER REPLACE THE ORIGINAL PROGRAM OR CAN BE MERGED BY STATEMENT NUMBER

MODEL-I VERSION . . . $25.00
MODEL-III VERSION . . . $30 00
MODEL-II VERSION (SEE MODEL-II UTILITY PACKAGE . . . $50 00

INFINITE BASIC
- ADDS OVER 80 COMMANDS TO BASIC
- SORTING STRING CENTERING ROTATION TRUNCATION JUSTIFICATION DATA COMPRESSION STRING TRANSLATION COPYING SCREEN DISPLAY SCROLLING MATRIX OPERATIONS SIMULTANEOUS EQUATIONS (THROUGH MATRIX INVERSION) DYNAMIC ARRAY RESHAPING

MODEL-I VERSION . . . $50 00
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INFINITE BUSINESS
- ADD ON PACKAGE TO **INFINITE BASIC** (REQUIRES INFINITE BASIC)
- ADDS PACKED DECIMAL ARITHMETIC WITH 127 DIGIT ACCURACY (+.0*)
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- BINARY SEARCH OF SORTED AND UNSORTED ARRAYS (INSTANT SEARCH OF AN ELEMENT WITHIN AN ARRAY)
- HASH CODES

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MODEL-III VERSION . . . $30 00
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REMODEL-PROLOAD
- THE ULTIMATE RENUMBERING PROGRAM RENUMBERS ALL OR PART OF A PROGRAM (ALLOWS PARTIAL RENUMBERING IN MIDDLE OF PROGRAMS)
- PARTIAL OR COMPLETE MERGE OF TWO CASSETTE PROGRAMS

MODEL-I VERSION . . . $35 00
MODEL-III VERSION . . . $35 00
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COPSYS
- COPY AND VERIFY ALL MACHINE LANGUAGE (SYSTEM) TAPES WRITTEN IN STANDARD FORMAT IF YOU BUY A MACHINE LANGUAGE PROGRAM **COPSYS** ALLOWS YOU TO EASILY COPY THE PROGRAM ONTO ANOTHER CASSETTE AS A BACKUP

MODEL I VERSION . . . $15 00
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MODEL II SPEEDUP—FAST DISK I/O
THIS IS AN ENHANCEMENT FOR TRSDOS 2.0 THAT WILL RADICALLY DECREASE DISK ACCESS TIME.

- DISKS BOOT FASTER TO DOS
- IMPROVE DISK I/O UNDER BASIC

NEW

MODEL II ONLY . . . $99.95

MODEL II FASTBACK — FULL DISK BACKUP IN 55 SECONDS
IN BUSINESS TIME IS MONEY, AND ONE BACKUP IS WORTH A THOUSAND TEARS.
- WORKS ON SYSTEMS WITH 2 OR MORE DRIVES
- CAN REPLACE YOUR EXISTING TRSDOS 1 2 or 2 0 BACKUP UTILITY

NEW

MODEL II ONLY . . . $75 00

MODEL-II UTILITY PACKAGE
- ESSENTIAL FOR EVERY MOD-II OWNER
- RECOVER AND REPAIR FILES AND DIRECTORIES (BY JUST ENTERING A SINGLE COMMAND)
- XCOPY SIMILAR TO COPY BUT CAN COPY ANY NUMBER OF FILES AT ONE TIME FASTER AND MORE ACCURATE THAN COPY SINCE RECORDS ARE COPIED IN GROUPS RATHER THAN ONE RECORDS AT A TIME USING XCOPY YOU CAN COPY FILES THAT CAN NOT BE COPIED USING THE COPY COMMAND
- SZAP PROVIDES THE CAPABILITY TO READ AND MODIFY ANY SECTOR ON A DISKETTE
- XHIT CAN BE USED TO REPAIR A DISKETTE DIRECTORY
- DCS DIRECTOR CATALOG SYSTEM IS A UTILITY FOR THE MANAGEMENT OF USER DISKETTES SETS OF A MULTIPLE DISKETTE DIRECTORY FILE (WITH UP TO 1200 INDIVIDUAL FILE NAMES) ALLOWS SELECTIVELY LISTED OR PRINTED LISTS OF DIRECTORY FILES IN COMBINED SORTED ORDER (FOR EXAMPLE LISTED ALPHABETICALLY BY DISKETTE OR A COMPOSITE ALPHABETICAL LIST OF ALL YOUR DISKETTES!)
- DEBUG-II ADDS SEVERAL FEATURES TO THE PRESENT TRSDOS DEBUG UTILITY INCLUDING SINGLE INSTRUCTION CYCLE AUTO (LOOP) BREAKPOINTS, SUBROUTINE CALLING BREAK-KEY DETECTION AND MANY OTHERS

MODEL-II ONLY . . . $150 00

MODEL-II DEVELOPMENT SYSTEM
- THIS PACKAGE IS A MUST FOR ASSEMBLY LANGUAGE PROGRAMMERS
- INCLUDES THE **MICROSOFT EDITOR ASSEMBLER** PLUS WITH ENHANCEMENTS FOR THE MODEL-II
- A COMPLETE DISASSEMBLER
- SUPERZAP FOR READING AND MODIFY ANY SELECTOR ON A DISKETTE

MODEL-II ONLY . . . $125 00

MOD-II BASIC CROSS REFERENCE UTILITY
- LIST OR PRINT A SORTED CROSS REFERENCE TO ALL NUMBERS OR VARIABLES WITHIN A PROGRAM
- LIST OF PRINT ALL LINE NUMBERS CONTAINING A SPECIFIED STRING OF CHARACTERS

MODEL II ONLY . . . $50 00

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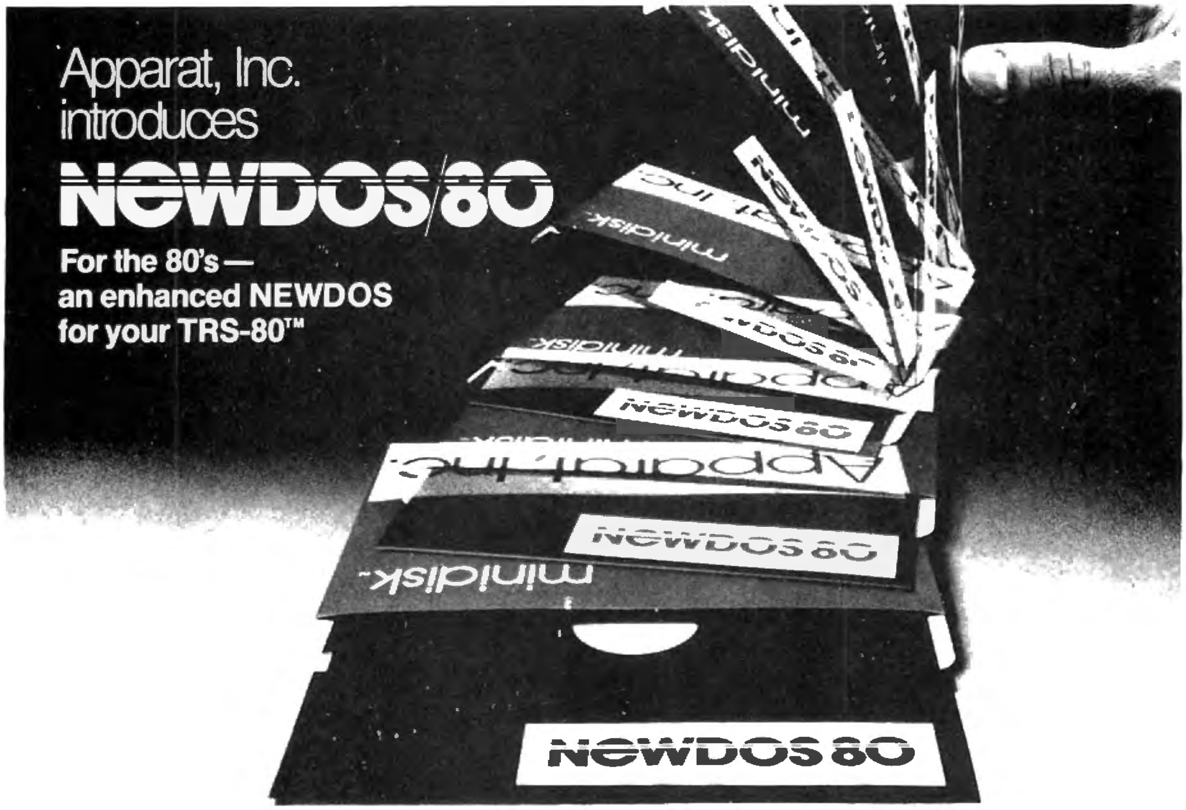

Apparat, Inc., announces the most powerful Disk Operating System for the TRS-80™. It has been designed for the sophisticated user and professional programmer who demands the ultimate in disk operating systems.

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  Will allow the MODEL III to read disk from MODEL I and to write disks the MODEL I can read, making it easy to move programs between the two machines.
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  Directories can be expanded three times the normal number of available entries, even on DOS disks. This is extremely useful when using double density.
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  To allow sections of BASIC programs to be deleted and replaced with lines from a disk file during program execution. Also allows merging of non-ASCII format files.
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  Allows the programmer to keep some variables and release the space used by the rest; also specific variables may be erased releasing the space they use.
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  Scrolling has been modified to allow the user to display programs page by page, in addition to the regular line scrolling.
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  Keys in MODEL I repeat when held down. Entering "R" as a DOS command causes the previous DOS command to be repeated.
- **ROUTING FOR DEVICE HANDLING**
  To send input and output from one device (display, printer, keyboard, etc.) to others or to a routine in main memory.
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  The Disassembler will now write a source code file to disk, which the editor assembler can read and edit.
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  Features to allow chain files to be written from SCRIPSIT; also chaining may be switched on and off without changing chain file positioning, and may be executed via CMD "xxx" and DOS-CALL.
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  Has the ability to scan diskettes or disk files to find the occurences of specific values. Also will generate disk file passwords and hashcode.
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  Basic function CMD "O" provides direct or indirect in-memory sort of multiple arrays.
- **MERGING OF NON-ASCII BASIC PROGRAMS**
- **BASIC SINGLE STEPPING**

- New BASIC commands that supports files with variable record lengths up to 4095 Bytes long.
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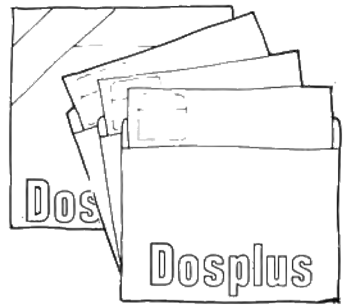
From

MICRO SYSTEMS SOFTWARE, INC.



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THE ORIGINAL DOSPLUS CONTAINS ALL OF THE FOLLOWING FEATURES .....

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10) Supports mixed mode (single & double density) automatically
11) Allows disable-enable to break key
12) Allows user to define step rate per drive and re-configure system disk
13) Allows for efficient use of double-headed drives
14) Built in screen printer (shift [CLEAR] with [BREAK] key abort
15) Multiple command chaining with "DO"
16) Built in memory test with CLEAR command
17) New printer driver which allows complete forms control and paging
18) Automatic serial printer driver with optional auto linefeed
19) Execute any DOS command from BASIC and return to BASIC
20) Free space map of diskette with optional output to printer
21) Copy with variable length files
22) Complete RS232 control from keyboard with status check
23) Create and pre-allocate files from DOS
24) Display current date and time from DOS
25) More information from Directory with optional printer output
26) Enter DEBUG with shift [BREAK] to allow use of [BREAK] from BASIC
27) New DISKDUMP/CMD sector display/modify program (works with filespecs)
28) New DISKZAP/CMD single/double density disk editor
29) New BACKUP (more reliable, no more pack ID check)
30) New FORMAT (more reliable, no need to bulk erase disk first)
31) New MAP utility (maps out disk, showing where files are located)

PLUS New DOSPLUS Z80 Extended Disk BASIC

1) Faster loads and saves
2) BASIC Reference utility (lines, variables, keywords, printer option)
3) BASIC Renumber utility (renumber section of text, block text move)
4) Shorthand features for almost ANY direct command (LOAD, SAVE, etc.)
5) Shorthand features for editing (listing and editing with single key)
6) CMD"M" instantly displays currently set variables
7) Global search and replace in BASIC text
8) Line printer TAB to 255
9) OPEN"E" to end of sequential file (for output)
10) DI (delete and insert text line)
11) DU (duplicate text line)
12) ",R" & ",V" options after LOAD and RUN (files open & save variable)
13) OPEN"D" allowed (Model II compatible) equal to OPEN"R"
14) DOS commands from BASIC
15) Automatic, error-free variable length records
16) Single step execution with TRON (fabulous for debugging)
17) CRUNCH (BASIC program compressor)
18) New TBASIC (tiny BASIC) offers full BASIC commands
19) TBASIC and DOSPLUS together only use 8K of RAM (40K left in 48K TRS-80)

PLUS ** 7 MORE UTILITIES **

1) Single drive copy
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5) Transfer (moves all user files from one disk to another)
6) Spooler (allows printing of text while freeing up the CPU)
7) Crunch (Basic program compressor)

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1. BASIC array sort - multi key, multi array
2. Tape/Disk - Disk/Tape utility (with relocator)
3. Input@ (controlled screen input)
4. Random access and ASCII modification on Diskdump
5. BASIC checks for active 'DO'
6. Backup and Format from a 'DO' file
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9. Repeat last DOS command with '/' ENTER
10. Short directory (file name and extension) available
11. Short directory of Model III TRSDOS disks
12. Single file convert from Model III TRSDOS
13. COMPLETE device routing supported (DOS and BASIC)
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    - Also includes the new DOSPLUS Z80 disk basic VER 1.6

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The codebook describes the data file format and the labels to be used for all statistical printouts. The four programs have been designed for complete codebook creation and editing. They are menu-driven and have incorporated several automatic error-checking routines.

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MAXI STAT is the most useful statistical analysis package on the market today. It was written and designed to allow maximum flexibility in designing your own analysis.

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ABOUT THE BOOK

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In 1977 David Lien wrote the Original Level I TRS-80 Learner's Manual furnished with all Model I computers. This step-by-step, illustrated, nonintimidating manual introduced thousands of beginners to the concepts and practices of BASIC programming. The manual was a huge success, and won universal acclaim as the best BASIC training manual ever written. Dr. Lien's teaching style created an immediate rapport with novice users, helping them to feel more comfortable with their computers, and more curious to about programming. Translated into numerous foreign languages, it soon became the world's best selling tutorial-style computer book. A revised version is still sold by Radio Shack.

Level II BASIC was introduced in 1978 and Dr. Lien wrote **LEARNING LEVEL II** released by Compusoft Publishing. This book was bought by thousands of users at $16.95, and quickly became the standard training manual for Level II BASIC (although the book is NOT sold by Radio Shack). In addition to teaching users how to take advantage of the power of Level II BASIC, this book helped bridge the gap between Level I and Level II.

In his own unique style, Dr. Lien has used his great expertise to create the most comprehensive training manual ever written on BASIC programming for all TRS-80 computers. Completely reorganized and updated. **LEARNING TRS-80 BASIC** clearly instructs you in BASIC programming for TRS-80 Models I, II, III and 16 in a smooth flowing, easy-to-understand tutorial style. In addition to complete descriptions of each BASIC command, one or more sample programs are included to illustrate each command's use. Even the "know-it-all" programmer who thinks he knows all there is to know about BASIC will find a wealth of information not available elsewhere on use of PEEKs and POKEs, sorting techniques, disk BASIC usage, error handling and more. Schools teaching BASIC programming will find this to be an ideal textbook, with question and answer approaches and exercises at the end of each section that help the student make sure he understands the most important concepts, and is ready to move on to the next section.

Whether you're a beginner or an expert programmer, whether you're studying alone at home, or in a class with a teacher, **IF YOU OWN A TRS-80, YOU NEED A COPY OF THIS BOOK.**

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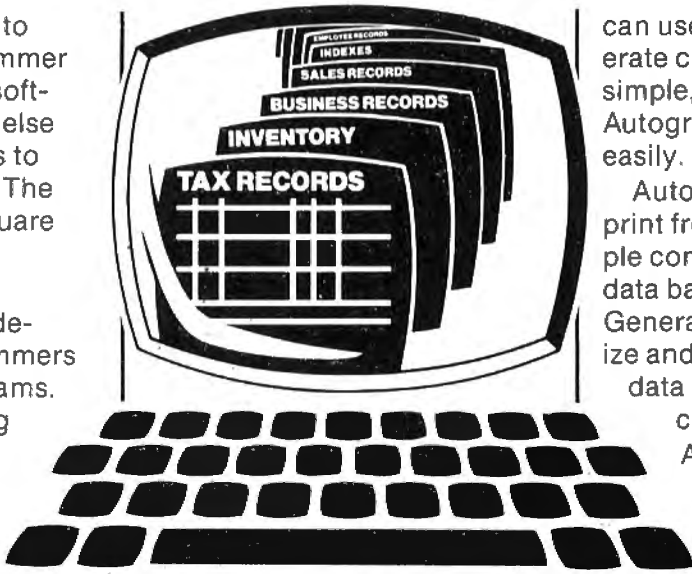

Until now, you either had to hire an expensive programmer to custom tailor existing software to your business, or else try to adapt your business to someone else's software. The classic dilemma of the square peg in the round hole.

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- ☐ Page spacing may be set from 0 to 255 lines
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BLUE PENCIL comes with a 50,000 word dictionary (equivalent to a Webster's Pocket Dictionary.) Typical proofing time for a 60,000 word text file is under two minutes. Requires 32K minimum, 1 disk drive. **$89.95**

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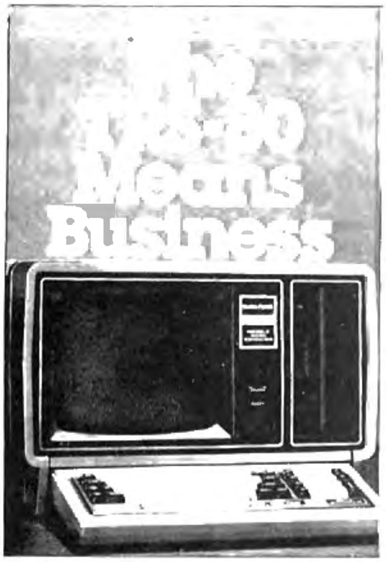

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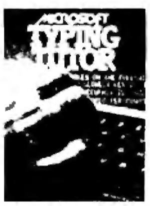

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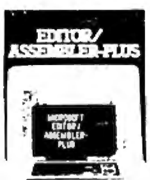

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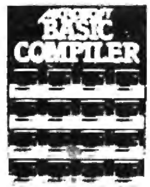

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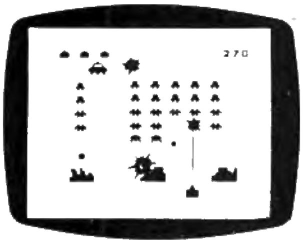

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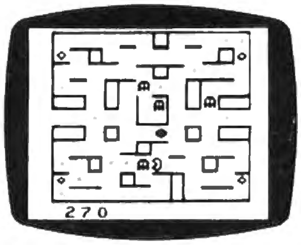

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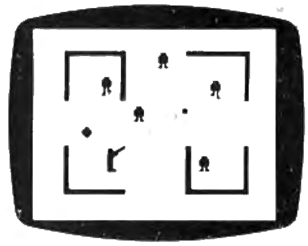

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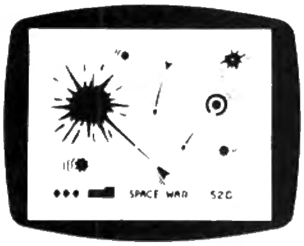

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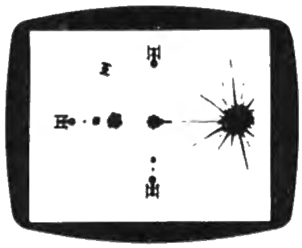

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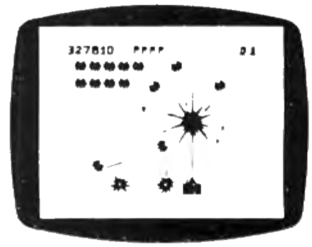

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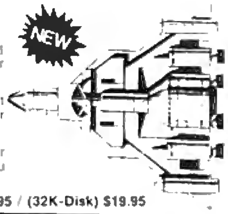

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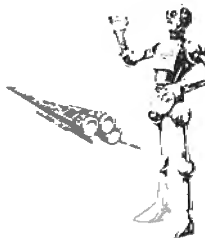

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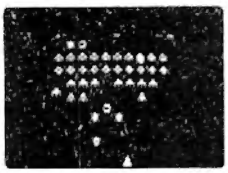

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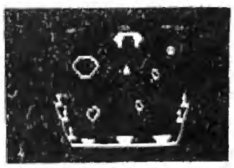

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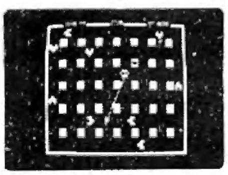

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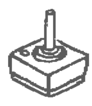

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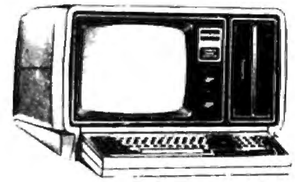

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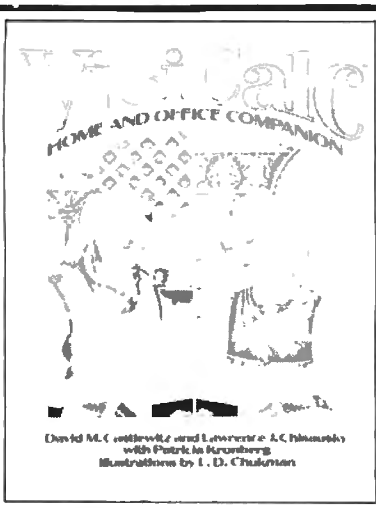

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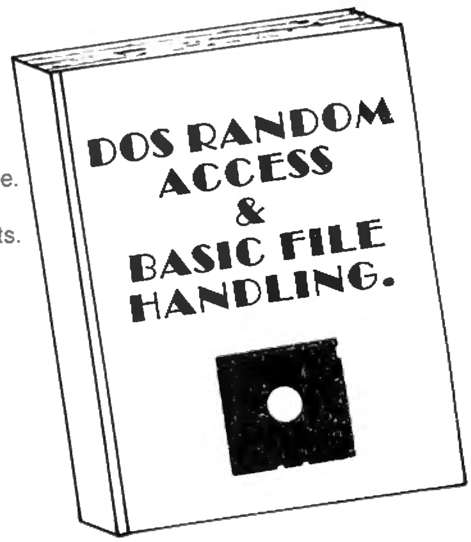

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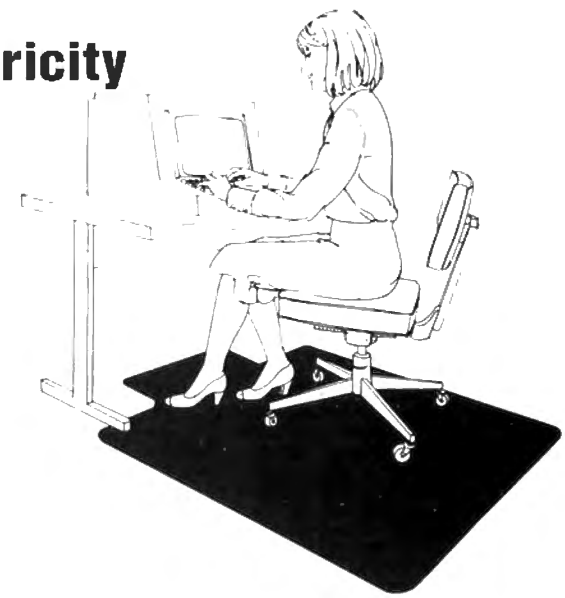

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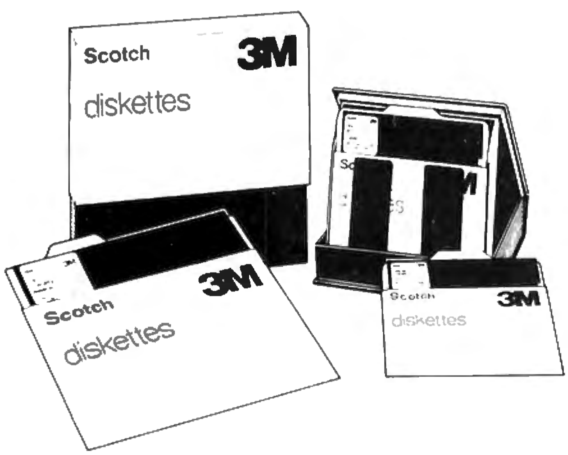

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How we talk to the computer.

The Evolution of the Language

Ken Waltjen
2311 Lincoln Blvd.
Tracy, CA 95376

Most TRS-80 owners first program in Basic. Because of this, they have little idea of how languages evolved. A language like Basic constitutes a pseudo-machine that is easier to deal with than the actual hardware.

The logical evolution of languages suggests where the language you use (or the language you want to learn) fits, and illuminates some of the mystery surrounding your machine.

The Magic of Hardware and Binary

The first step in understanding your machine and how a programming language works is to understand the magic of binary and hardware. This is not a thorough discussion of hardware or central processing unit (CPU) functions. It should make the function of hardware *believable* and clarify the relationship between binary and electrical hardware.

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Fig. 1 is a block diagram of a simple CPU. Here is a description of the functional parts:

- Clock—Master system timing device. It runs at a constant speed.
- Timing and Control Generator—It divides the clock into a sequence of orderly pulses by enabling one box at a time.
- Instruction Register—This is where we deposit our binary instruction for processing.
- Adder—The arithmetic unit of our sample processor. On command, it will add the data loaded into its input ports.
- Input and Output Holding Registers—These provide temporary operand storage for operation of the processor.

Defining Instructions

After defining some instructions we can combine the hardware and the binary. All these numbers will be in binary notation.

```
1000 = Load the 'A' operand
0100 = Load the 'B' operand
0010 = Add 'A' to 'B'
0001 = Write sum to output register
```

Assume that we have loaded 1000 into the instruction register. As our 1 bit circulates in the timing generator, it arrives at the square adjacent to the MSD of the instruction register (where we now also have a 1). Gate A will be enabled and operand A will be loaded. As the timing bit continues to circulate, it is paired with zeros in the other instruction register locations so nothing else happens during this instruction cycle.

Loading 0100 into the instruction register on the next cycle will enable gate B and the B operand will be loaded. By performing a logically listed set of instructions we can

```
1    VIDEO:    EQU     3C00H          ;EQU is an
assembler directive. No code is produced. The symbol VIDEO is interchangeable with
the value 3C00H. The H following 3C00 invokes a radix conversion in the assembler.

2    COUNT:    EQU     1023           ;COUNT = 1023

3    DATA:     DEFB    'A'            ;Define a storage
location named DATA, and store the binary equivalent of 'A' there. The assembler will
convert 'A' to its ASCII value.

4    BEGIN:    LD      HL,VIDEO       ;The HL register
pair now contains 0011 1100 0000 0000 in binary. The label BEGIN: associates that
symbol with the program location defined by the current line.

5              LD      DE,VIDEO + 1   ;Arithmetic
operations may be used to modify constants for assembly.
```

Example 1

"The first step away from binary is also the first step away from the machine."

```
      16
    ----
       8
     ---
       4
      --
       2
       -
11111111
   -----
      32
  ------
      64
 -------
     128
--------
     256
```

Table 1. Condensed Notation

add two operands together and output the result.

If we coded 1100 that would be a load A, load B instruction. We could code a 1111. That would carry out the entire operation in one instruction cycle rather than four.

The way that the binary code controls the internal data and control paths of the CPU is called microcoding. Some CPUs are microprogrammable.

Stepping Away

The first step away from binary is also the first step away from the machine. Binary notation makes it too hard to recall many complex instructions. Instructions are just binary patterns. To help the programmer, some form of condensed notation had to be found.

In Table 1 the eight binary bits are divided into all possible combinations. One binary number eight bits long (byte) can be divided into several digits with varying radix. Each digit in any radix needs a separate symbol. Since most people (even programmers!) would have difficulty remembering a sequence of symbols 32 characters long, any form of condensation of the binary number should use four binary positions or less. Using two binary digits provides less compression of the binary information than necessary. Three or four binary digits provide sufficient compression. These radix (hex or base 16, and octal or base 8) are the most common for binary compression.

The CPU still needs binary numbers to do its processing. If numbers are entered in another radix, then they must be converted by a program to binary. The first step up in languages allows the programmer to communicate in a different radix than binary. Source code must be entered, then modified by a program, and then stored as the object code to be executed by the machine. T-Bug is an example of this level of programming language. Much math and other tasks are left to the programmer at this level.

The Z-80 uses octal fields to break up the instruction word. When Zilog's instructions are broken into these fields, they remain reasonably intelligible. Programmers started using hex notation for more compression and introduced the first level of mystery into programming. For example, register-to-register loads (LD r,r') in octal are 1rr', where r = a number from 1–7 to select a desired register. All register-to-register loads have the same opcode of 1XX. In hex, the opcode changes, based on the register selected, so a load instruction cannot be recognized as easily. LD, A,C in octal is 171. LD D,E in octal is 123. The operation code (1XX) is the same in both instructions. These two instructions in hex are 79 and 53. In hex they appear to have nothing in common.

Upward to Assembly Language

Given this powerful new tool (radix conversion program), you can write a program that converts all alphanumeric characters to binary codes. A short, cryptic name could represent an operation. That and the ability to equate constants and program locations with symbols are the bases of assembly language processors.

The programmer no longer deals with the hardware functions directly. To program effectively in assembly language, the programmer must know the architecture of the CPU. The architecture is a symbolic model

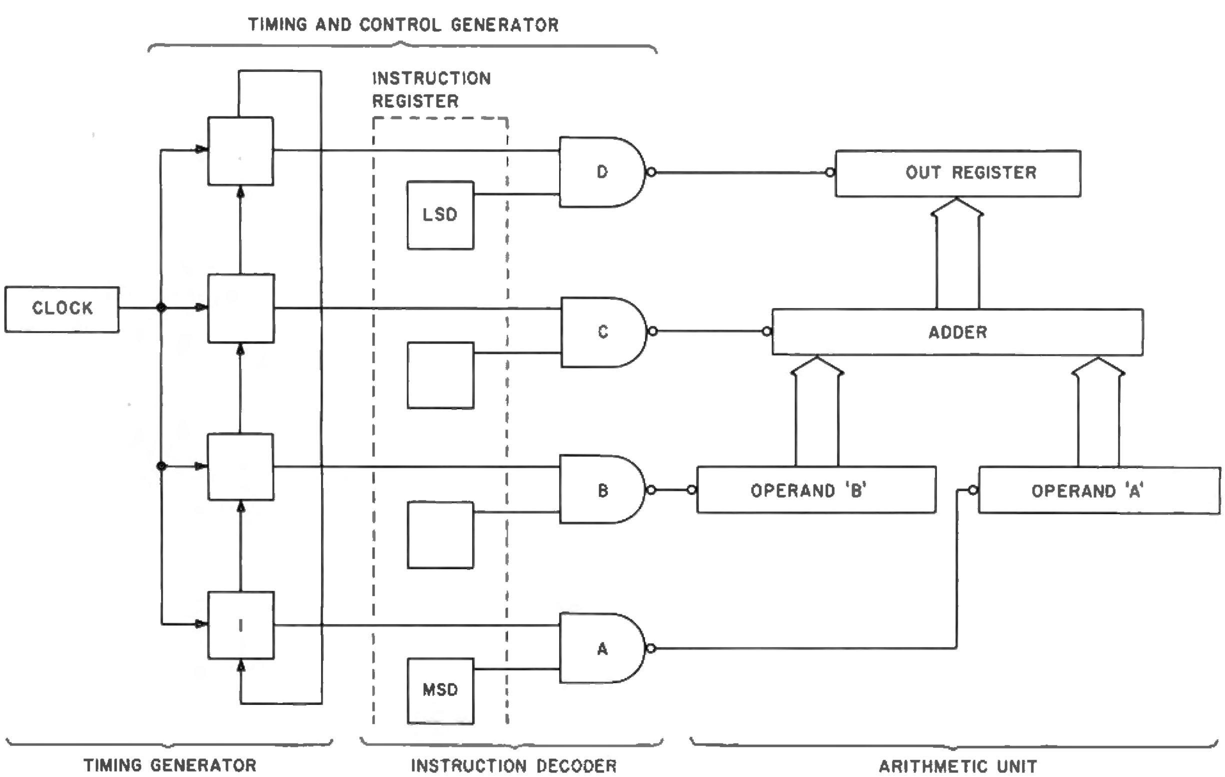


Figure 1

✓See List of Advertisers on Page 455

"Macro assemblers allow the programmer to define a series of operations and to associate them with a label."

of the CPU hardware optimized for easy understanding. The programmer must know the instruction set for his machine and the mnemonics that represent each instruction. The mnemonic representation of an instruction is for the convenience of the programmer. For example, the load instruction LD A,C is easier to recognize than 01 111 001 (binary). Remember that the programmer's source code will be read by another program (the assembler), and it must be formatted to meet the reading program's requirements. The final added complexity of assembly language is the addition of instructions that do not produce executable machine code. This class of instructions, called assembler directives, controls the assembler program while it assembles the source code.

The following example will clarify the new terms listed above:

1. VIDEO: EQU 3C00H ;EQU is an assembler directive. No code is produced. The symbol video is interchangeable with the value 3C00H. The H following 3C00 invokes a radix conversion in the assembler.
2. COUNT: EQU 1023 ;COUNT = 1023.
3. DATA: DEFB 'A' ;define a storage location named DATA, and store the Binary equivalent of 'A' there. The assembler will convert 'A' to its ASCII value.
4. BEGIN: LD HL,VIDEO ;The HL register pair now contains 0011 1100 0000 0000 in Binary. The label BEGIN: associates that symbol with the program location defined by the current line.
5. LD DE,VIDEO + 1 ;Arithmetic operations may be used to modify constants for assembly.

These lines of code illustrate many features of assembly language programming. The task of the programmer is made considerably easier by these tools.

Macro assemblers allow the programmer to define a series of operations and to associate them with a label. When this label appears in the source code it is replaced by the previously defined set of instructions. This is the first level of programming where one line of source code produces more than one line of machine code.

Compilers

Assemblers are powerful programming tools, but they have a major disadvantage. Only the target machine can use assembly language code. If the code machine were independent the programmer would no longer have to know the architecture of the machine he was programming.

Compilers achieve machine independence by substituting a pseudo-machine with its architecture defined by the language specification. For example, you access the output device by print statements in Basic. On the TRS-80 a print statement writes information into the video memory. On another machine it may write information into a teletype. The command Print specifies output to the console device regardless of what hardware configuration exists.

The compiler converts a uniform, standardized source code into object code for the specific machine. That means that every family of machine requires its own compiler. Programs are transferable from one family of machine to another family only after being re-compiled for the target environment. Because each machine requires its own compiler, small differences in the language specifications have crept in, requiring changes to the source codes to make them truly interchangeable. This almost total divorce from the architecture

"The number of passes that the compiler makes over the source code depends on the individual compiler."

and hardware of your machine makes the transition from knowing your pseudomachine to knowing your real machine a difficult step.

With machine independence, the high level language was a reality. All high level languages are implemented with one of the following compilers. (Yes, Basic is a compiler!!)

The first two types of compilers have one thing in common. They both convert the entire source file to object code simultaneously. The number of passes that the compiler makes over the source code depends on the individual compiler. Once this compilation is complete the source file becomes unnecessary. The object file (/cmd file on TRS-80) is a complete stand-alone program. It cannot be modified by altering the source without recompilation! These compilers cannot be used in the immediate mode. Program debugging requires modification to the source code and recompilation.

Four Compilations

- Inline. One-time, multi-pass translation from source code to object code. The program logic (algorithm) and flow remain the same in the object code as in the source code. All required routines must reside (including I/O) in the body of the resulting program.
- Threaded. The source code is reduced to a series of calls and arguments. The calls are made to a series of routines (sometimes called the operating time system, or run time system) that exist as object codes within the compiler. These routines and the call list with arguments are the final compiled program. The remaining compilers allow source input to be compiled and executed immediately. Program development is less painful, but the execution speed may be greatly reduced.
- Incremental. Most often called an interpreter, the TRS-80 uses this form of compilation for Basic. The source file is read one line at a time. The object code is produced (usually threaded) and executed before the next source line is compiled. The compiled object program is not saved as a stand-alone program. Every time the program is executed the source must be compiled and executed. The compiler is a required resident part of every program. (Might as well put it in ROM, right?)
- Combined Incremental and Threaded. Some languages (notably FORTH) use their threaded compilation capability in the incremental mode. This is the best of both worlds. Immediate mode is available for debugging and stand-alone object code can be produced for the final program.

To learn Basic you studied a pseudomachine. To learn about your TRS-80 and computers in general, assembly language is the next step back towards the machine. You have to learn the architectural model as well as the instruction set and the layout of the hardware. Though not an easy step Basic gives you some portals to the real machine. Instructions like PEEK, POKE and VARPTR provide some insight. Also, the most difficult part of programming, the algorithmic process, is already an old friend. ■

LOAD 80

Send your screen graphics to your printer.

Pixel Printer

Charles E. Gillen
1458 Greenmont Court
Reston, VA 22090

When beautiful listings and fancy word-slinging begin to bore, what more? Graphics in the standard TRS-80 format. This program LPRINTs any pure graphic design you can sketch on a video worksheet. More than that—once you make a trial print, you can call for the same design in a new size, at a different position on the paper, or in a lighter or darker tone. You can even alter part of your design and print again. You can reverse the image to print a negative rather than positive.

The Key Box
Basic Level II
Model I
16K RAM
Line printer required

Limitations

Though your design reproduces in blocks which exactly conform to the TRS-80 format, they will be composed of the standard alphanumeric characters available on your keyboard and printer. You can achieve a solid tone with a printer set to 132 columns per line, with 8 lines per inch spacing. Less satisfactory is a printer that has only 80 columns; setting it to 6 lines per inch still conforms to the TRS-80 pixel proportions, but the overall tone will be less dense and even.

Getting your own design into the program and then onto paper is faster (and easier) than redrawing a rough sketch on a fresh video worksheet. Aside from the fascination of seeing your design turned into a printout, ease of input is this program's best feature—only one keystroke per pixel.

Type the program in Listing 1 into your TRS-80, turn on the printer, and take a practice run. Run. Hit any key to pass the title, answer how many columns, then observe the demonstration. Hit the Y key, and after the program prints the aeroplane, it shows the design data and print parameters, and then displays a menu. Before you pull the printout from your machine, press the @ key several times and the paper will meet you half-way.

The R (Restart) key clears the decks and runs again. You can use this key later when you finish one original design and want to do another. You change your design one line at a time with the L option. The P option heading the menu produces another aeroplane with the current LPRINT values.

Flexibility

Select the M option for the change mode. Using the aeroplane, practice changing the LPRINT TAB setting, and the overall picture size (the program rejects efforts to run off the paper), and practice varying the overall tone by picking a different character. A chart of all the alphanumeric CHR$ codes is built-in to refresh your memory.

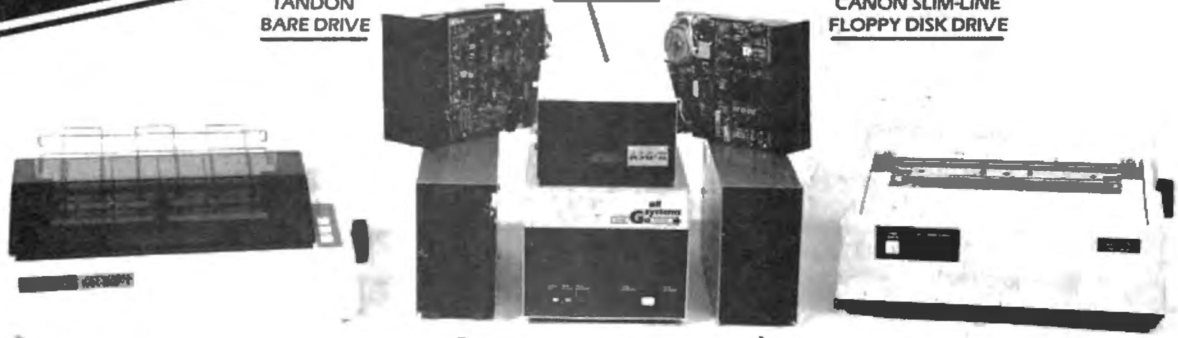
You can reverse the picture with a single keystroke. You can decline to change any option: Enter to retain the value used during the previous print cycle. When you have printed enough aeroplanes, press R for Restart.

Going Solo

Take a small design drawn on a video worksheet and count the maximum height in pixels (not in character lines, but the familiar X,Y size), then the maximum width in pixels. This information defines the size of an imaginary frame holding the design, and also dimensions the number of strings to be input. Then answer questions about tab, size and print characters.

Look at the top line of pixels in your design. As you scan from left to right hit a zero to mark every dark pixel and either a period or space to leave a blank. Anything but the zero prints a blank pixel. Enter after the last zero in the line, and input the remaining lines using the same technique. The design data for the aeroplane demonstration shows several shortcuts to speed up and simplify the input process. Do not input a design string with a leading space; use the period to help count spaces accurately.

SMART MOVES...



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"This program LPRINTS any pure graphic design you can sketch on a video worksheet."

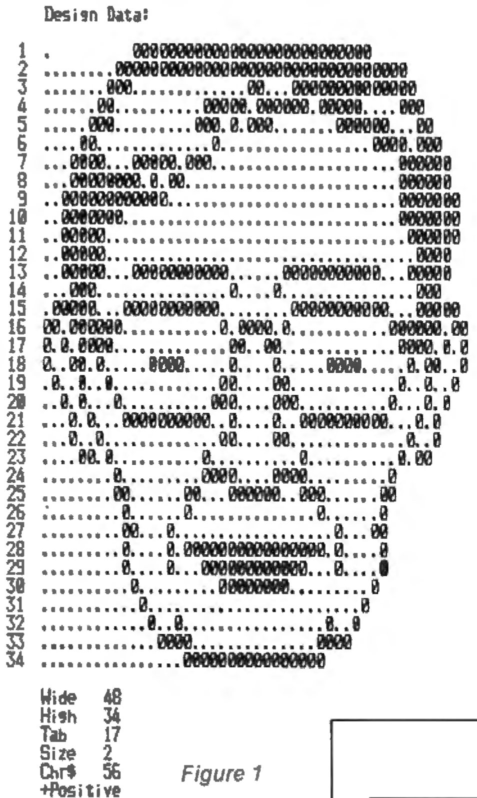

Figure 1

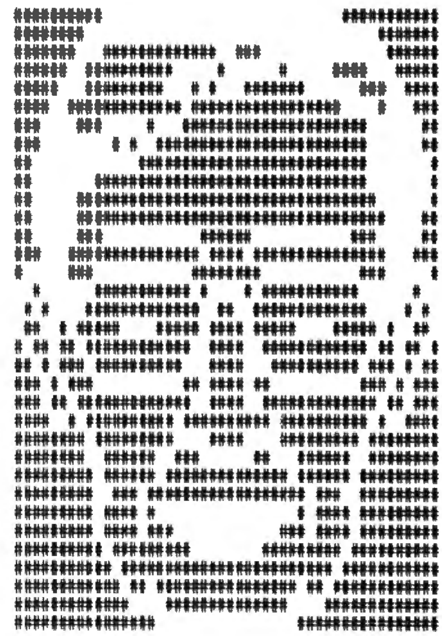

Figure 2

If you have a numeric keypad, your fingers will soon learn the rhythm and easily drum the zero, period and enter keys to type in the pixels. After you have entered the final string, you can print or if you made a major mistake select to input your design all over again. After making your first print, check the optional design data below the picture. You can use it to correct an error or add a refinement. The data makes a handy reference you can file away. To change more than one line, select the L option from the menu as often as needed. If you want no design data to intrude on your masterpiece, decline the option and continue to the menu.

The reversed image option yields nicer results if you plan a blank pixel frame around your design. In reverse, this prints dark and prevents the white design from running into the paper.

The printer width in columns limits input designs to less than 131 or 79 pixels (the same as 65 or 39 characters). However the height of the design—the length down the page—is unlimited. You can print a long design or message using an oversized alphabet of your own creation, though if you get too ambitious you might need more than the 2000 bytes cleared by line 170. Inputting custom lettering in a vertical format is easy as you handle only one letter at a time. Experiment with small designs first; the program can enlarge them later.

Program Listing 1

```
100 REM      ***** PIXEL PRINTER GRAPHIC UTILITY *****
110 REM      *     FOR A 132-COL, 8-LPI PRINTER       *
120 REM      *     OR AN 80-CPL, 6-LPI PRINTER        *
130 REM      *     DESIGNED BY CHARLES E. GILLEN      *
140 REM      *     U.S. EMBASSY   APO S.F. 96301      *
150 REM      ***** VERSION 8 ***** 25 MARCH 1981 *****
160 REM
170 CLS:CLEAR2000:DEFINTA-Z:PRINTCHR$(23):PRINT@452,"P I X E L
   P R I N T E R":GOSUB560:PRINT@214,"TURN ON YOUR PRINTER":PRIN
T:PRINTTAB(17)"TYPE  1  IF IT HAS 80 COLUMNS":PRINTTAB(17)"TYPE
 2  IF IT HAS 132 COLUMNS
180 IN$=INKEY$:IFIN$="1"THEN190ELSEIFIN$="2"THEN200ELSE180
190 CW=80:MX=2:TB=0:GOTO210
200 CW=132:MX=3:TB=10
210 CLS:PRINT@474,"WANT A DEMO?
220 IN$=INKEY$:IFIN$="Y"THEN230ELSEIFIN$="N"THEN240ELSE220
230 D=1:VD$="+Positive":BK$=STRING$(MX,56):WT$=STRING$(MX,32):WD
=39:HI=16:DIMA$(HI):NR=56:GOSUB580:GOTO440
240 CLS:PRINT"** DESIGN PHASE **":PRINT:INPUT"WIDTH  IN PIXELS";
WD:IFWD=0ORWD>(CW-1)THEN240
250 PRINT:INPUT"HEIGHT IN PIXELS";HI:IFHI=0THEN250ELSEDIMA$(HI):
GOTO270
260 CLS:PRINT"SIZE OR TAB TOO BIG....TRY AGAIN
270 PRINT:INPUT"LPRINT AT TAB   ";TB:IFTB>63THENPRINT:PRINT"TAB
CAN'T BE OVER 63":GOTO270
280 PRINT:INPUT"SIZE FACTOR     ";MX:IF(CW-(TB+1))<(WD*MX)THEN26
0
290 PRINT:PRINT"WANT TO SEE CHR$ CHART?
300 IN$=INKEY$:IFIN$="Y"THEN310ELSEIFIN$="N"THEN330ELSE300
310 PRINT:PRINT"SELECT 1 ASCII CODE FROM THIS CHART:
320 IFINKEY$=""THEN320ELSEGOSUB550
330 PRINT:INPUT"SELECT WHAT CHR$ CODE";NR:IFNR<33ORNR>95THENCLS:
GOTO290
340 PRINT:PRINT"POSITIVE OR NEGATIVE PRINT?":BK$=STRING$(MX,NR):
WT$=STRING$(MX,32):VD$="+Positive"
350 IN$=INKEY$:IFIN$="P"THENCLS:VD=0:GOTO370ELSEIFIN$="N"THEN360
ELSE350
```

Listing continues

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"Your fingers will soon learn the rhythm and easily drum the zero, period and enter keys . . ."

Listing continued

```
360 VD=1:BK$=STRING$(MX,32):WT$=STRING$(MX,NR):VD$="-Negative"
370 CLS:IFCTHENPRINT@460,"NOW PRINTING CHANGES":GOTO440ELSEPRINT
"WIDTH  IN PIXELS    ";WD:PRINT"HEIGHT IN PIXELS    ";HI:PRINT"LPR
INT TAB            ";TB:PRINT"SIZE FACTOR          ";MX:PRINT"LPRINT
USING  CHR$("NR")":PRINTTAB(14)VD$
380 PRINT:PRINT"PREPARE TO INPUT "HI" LINES OF "WD" PIXELS FOR Y
OUR DESIGN
390 PRINT:PRINT"INPUT BLACK PIXELS AS  0  AND WHITE PIXELS AS  .

400 IFINKEY$=""THEN400
410 PRINT"        "STRING$(WD,61):FORPH=1TOHI:PRINTUSING"##";PH;:P
RINT"  ";:INPUTA$(PH):NEXT
420 PRINTTAB(40)"P = PRINT    R = REDRAW
430 IN$=INKEY$:IFIN$="P"THEN440ELSEIFIN$="R"THEN370ELSE430
440 FORHH=1TOHI:FORMM=1TOMX:LPRINTTAB(TB);:FORWW=1TOWD:WW$=MID$(
A$(HH),WW,1):IFWW$<>"0"THENLPRINTWT$;:GOTO460 ' PRINT WHITE
450 LPRINTBK$; ' PRINT BLACK
460 NEXTWW:LPRINTCHR$(32):NEXTMM,HH:IFDTHEN490
470 PRINT:PRINTTAB(40)"SEE DESIGN DATA?
480 IN$=INKEY$:IFIN$="Y"THEN490ELSEIFIN$="N"THEN510ELSE480
490 FORLF=1TO4:LPRINTCHR$(32):NEXT:LPRINT"    Design Data:":LPRI
NTCHR$(32):FORPD=1TOHI:LPRINTUSING"##";PD;:LPRINT"  ";A$(PD):NEX
TPD:LPRINTCHR$(32)
500 LPRINT"    Wide  ";WD:LPRINT"    High  ";HI:LPRINT"    Tab
 ";TB:LPRINT"    Size  ";MX:LPRINT"    Chr$  ";NR:LPRINT"    "VD
$:FORLF=1TO8:LPRINTCHR$(32):NEXT:D=0
510 CLS:PRINT"P = PRINT AGAIN":PRINT"M = CHANGE MODE":PRINT"L =
CHANGE LINE":PRINT"R = RESTART":PRINT"@ = LINEFEED":C=0
```

Listing continues

Modifying the Program

You can add a routine to CSAVE and CLOAD the design strings to create a library of your favorite graphics. If you can control your printer with software commands, consider incorporating your codes for line spacing and column width. You can place the code for the 80 column configuration before the GOTO in Line 190 or you can place the code for 132 column operation at the end of Line 200.

I down-converted this any-printer version from one developed for the Microline-80, which would be a great bargain even without its excellent TRS-80 graphics. To restore this program to a Microline configuration, change the value of NR in Line 230 to 191, to print the demo using CHR$(191). You can expand the CHR$(HELP!) routine at Line 550 to display the graphic codes as well. Add the command code to set the Microline-80 in the 132/8 print mode. This program cheerfully gives a reverse-video LPRINT as well, so your design can exactly duplicate the CRT.

With the Microline-80, avoid printing

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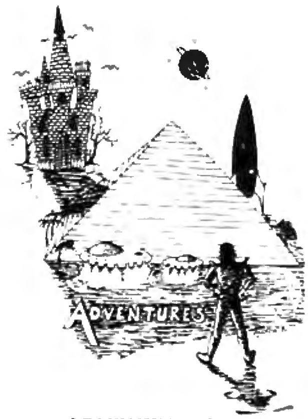

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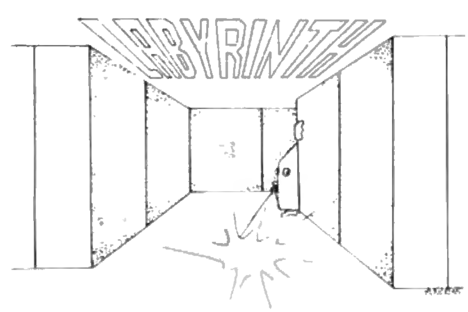
TINY COMPILER is written in BASIC. It generates native, relocatable 6502 or 6809 code. It comes with a 20 page manual and can be modified or augmented by the user. $24.95 on tape or disk for OSI or TRS-80 Color.

LABYRINTH — 16K EXTENDED COLOR BASIC — With amazing 3D graphics, you fight your way through a maze facing real time monsters. The graphics are real enough to cause claustrophobia. The most realistic game that I have ever seen on either system. $14.95. (8K on OSI)



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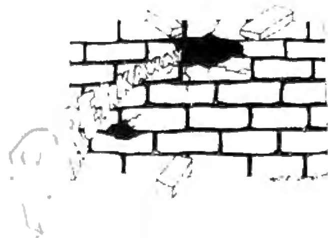

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TRS-80 COLOR SINCLAIR OSI VIC-20

"Back in the Dark Ages of computer graphics the asterisk was the character most used for primitive pictures."

Listing continued

```
520 IN$=INKEY$:IFIN$="@"THENLPRINTCHR$(32):GOTO520ELSEIFIN$="P"T
HEN440ELSEIFIN$="M"THENCLS:C=1:GOTO270ELSEIFIN$="L"THEN530ELSEIF
IN$="R"THENRUNELSE520
530 PRINT:INPUT"CHANGE LINE #";CL:IFCL>HITHEN510ELSEPRINTUSING"#
#";CL;:PRINT"   "A$(CL):PRINTUSING"##";CL;:PRINT" ";:INPUTA$(CL)
:GOTO510
540 END ' *** BELOW IS  CHR$(HELP!)  SUBROUTINE ***
550 Y=0:CLS:FORX=33TO95:PRINTXCHR$(X)"   ";:Y=Y+1:IFY>7THENPRINT
:Y=0:NEXTELSENEXT
560 IFINKEY$=""THEN560ELSECLS:RETURN
570 REM SAMPLE PICTURE BELOW
580  A$(1)="..................................00.0"
590  A$(2)="0.....000000000..................000.00"
600  A$(3)=".0......0....0.00.0.............0000.00"
610  A$(4)="0..0.000.00000..000000000000000000000"
620  A$(5)=".0000000000000000000000000000"
630  A$(6)="0..0.0000000000000000"
640  A$(7)=".0....0..0"
650  A$(8)="0.....0.0.........0"
660  A$(9)=".....0.0.....00000"
670 A$(10)=".....000..........0"
680 A$(11)=".
690 A$(12)="000000....000000..000....000....0000"
700 A$(13)=".0    0    0       0 0  0 0    0    0"
710 A$(14)=".0     0   000     0  00  0   0      0"
720 A$(15)=".0    0    0       0      0    0    0"
730 A$(16)="000000    000000  000    000    0000"
740 RETURN ' NOTE METHOD FOR BLANK LINE IN A$(11) ABOVE
```

large masses of solid black (CHR$191) in a large design. If the print head pauses before printing a new line it is overheated and quitting for a while to cool down. Small designs or those having equal amounts of light and dark pixels cause no problem when you use CHR$(191).

This program provides an opportunity for non-graphic printer owners to LPRINT pixel shapes using the alphabet and other keys. This is not "poor man's graphics" because the option of picking any keyboard character permits some interesting experiments. Back in the Dark Ages of computer graphics the asterisk was the character most used for primitive pictures, but you will find many others that are often more appropriate for a particular design. The 8 (eight) produces a nice effect, and the # sign gives a fairly solid mass.

If you want more than one character in a design, modify the program to provide a medium pixel, in addition to the dark ones and the blanks. ■

Charles Gillen majored in graphic design.

You could design a better computer!

Computer Assisted Electronics Design

John Harper
R#1 Box 252
Lawrenceburg, IN 47025

Designing electronic circuits involves time consuming, tedious calculations. Even after you make these calculations, a certain amount of trial and error is often necessary. The five programs solve some circuit design problems and make parts of the design process less difficult.

Before you can design an electronic circuit, you must organize your data to conform with your circuit design equations. To use a capacitor that is valued in picofarads in an electronic formula that evaluates capacitance in farads, you must convert picofarads into farads. The convert program (see Program Listing 1) does this. You enter the value in the form you have, and the equivalent value is returned. A more detailed description of this program and the other four appear in the individual program descriptions below.

Once the formula tells you the value of the electronic component you must find this component value in a store. While it normally is unnecessary to use the exact value calculated, you would like the actual component value as close as possible to the calculated value. Finding a particular value is not always easy. It is sometimes convenient to combine two components in such a way that the combined value equals your desired value. The formula program (see Program Listing 2) does this. You enter the number of components you will combine and the individual value of each and the computer calculates the combined value.

One practical reason for calculating precise component values is in the construction of resonant circuits. A resonant circuit is designed to operate at a specific frequency. To construct such a circuit, you must combine a specific value of capacitance and inductance which will resonate at your desired frequency. Program Listing 3 (CIRCUIT/RES) will calculate these component values. Enter the resonant frequency you want and either capacitance or inductance. When you have entered these two values, the computer calculates the third (unknown) value which will yield circuit resonance at your desired frequency.

The last two programs (Program Listings 4 and 5), are examples of specific filter circuits. Program Listing 4 (BAND/REJ), is a passive band reject filter. This circuit is composed of inductors and capacitors combined to block a specific range (band) of frequencies without interfering with frequencies above or below this band. Enter the high and low frequency range in which you wish the signal blocked. The computer cal-

Program Listing 1

```
10 CLS
20 PRINT"CONVERSION PROGRAM"
30 PRINT:PRINT"DO YOU WISH TO CONVERT MEASURES OF:"
40 PRINT TAB(20);"(1) CAPACITANCE"
50 PRINT TAB(20);"(2) INDUCTANCE"
60 PRINT TAB(20);"(3) FREQUENCY"
70 PRINT:INPUT"ENTER CHOICE (1,2, OR 3)";C
80 ON C GOTO 90,600,960
90 REM * CAPACITANCE *
100 CLS
110 PRINT "CONVERSION OPTIONS"
120 PRINT:PRINT
130 REM
140 PRINT TAB(5);"FROM";TAB(23);"INTO"
150 PRINT"(1) FARADS";TAB(20);"MICROFARADS"
160 PRINT"(2) FARADS";TAB(20);"PICAFARADS"
170 PRINT"(3) MICROFARADS";TAB(20)"PICAFARADS"
```

Listing 1 Continues

farads	into	microfarads
farads	into	picofarads
microfarads	into	picofarads
microfarads	into	farads
picofarads	into	farads
picofarads	into	microfarads
henries	into	microhenries
henries	into	millihenries
microhenries	into	henries
millihenries	into	henries
hertz	into	kilohertz
hertz	into	megahertz
kilohertz	into	hertz
megahertz	into	hertz

Table 1

The Key Box

Model I or III
16K RAM
Cassette or Disk Basic
Printer

Listing 1 Continues

```
180 PRINT"(4) MICROFARADS";TAB(20)"FARADS"
190 PRINT"(5) PICAFARADS";TAB(20)"FARADS"
200 PRINT"(6) PICAFARADS";TAB(20)"MICROFARADS"
210 PRINT"(7)RETURN TO MAIN MENU"
220 PRINT:INPUT"ENTER CHOICE (1-7)";C
230 ON C GOTO 240,300,360,420,480,540,10
240 CLS:PRINT"CONVERT FARADS INTO MICROFARADS"
250 INPUT"ENTER VALUE (IN FARADS) TO BE CONVERTED";F
260 M=F*(10[6)
270 PRINT:PRINT F;"  FARADS   =";M;"  MICROFARADS"
280 PRINT:PRINT:INPUT"PRESS ENTER TO CONTINUE";A$
290 GOTO 100
300 CLS:PRINT"CONVERT FARADS INTO PICAFARADS"
310 INPUT"ENTER VALUE (IN FARADS) TO BE CONVERTED";F
320 P=F*(10[12)
330 PRINT:PRINT F;"FARADS  =  ";P;"  PICAFARADS"
340 PRINT:PRINT:INPUT"PRESS ENTER TO CONTINUE";A$
350 GOTO 100
360 CLS:PRINT"CONVERT MICROFARADS INTO PICAFARADS"
370 INPUT"ENTER VALUE (IN MICROFARADS) TO BE CONVERTED";M
380 P=M*(10[6)
390 PRINT:PRINT M;"MICROFARADS  =  ";P;"  PICAFARADS"
400 PRINT:PRINT:INPUT"PRESS ENTER TO CONTINUE";A$
410 GOTO 100
420 CLS:PRINT"CONVERT MICROFARADS INTO FARADS"
430 INPUT"ENTER VALUE (IN MICROFARADS) TO BE CONVERTED";M
440 F=M*(10[-6)
450 PRINT:PRINT M;"MICROFARADS  =  ";F;"  FARADS"
460 PRINT:PRINT:INPUT"PRESS ENTER TO CONTINUE";A$
470 GOTO 100
480 CLS:PRINT"CONVERT PICAFARADS INTO FARADS"
490 INPUT"ENTER VALUE (IN PICAFARADS) TO BE CONVERTED";P
500 F=P*(10[-12)
510 PRINT:PRINT P;"PICAFARADS  =  ";F;"  FARADS"
520 PRINT:PRINT:INPUT"PRESS ENTER TO CONTINUE";A$
530 GOTO 100
540 CLS:PRINT"CONVERT PICAFARADS INTO MICROFARADS"
550 INPUT"ENTER VALUE (IN PICAFARADS) TO BE CONVERTED";P
560 M=P*(10[-6)
570 PRINT:PRINT P;"FARADS  =  ";M;"  MICROFARADS"
580 PRINT:PRINT:INPUT"PRESS ENTER TO CONTINUE";A$
590 GOTO 100
600 REM * INDUCTANCE *
610 CLS
620 PRINT"CONVERSION OPTIONS"
630 PRINT:PRINT
640 PRINT TAB(5);"FROM";TAB(23);"INTO"
650 PRINT"(1) HENRIES";TAB(20);"MICROHENRIES"
660 PRINT"(2) HENRIES";TAB(20)"MILLIHENRIES"
670 PRINT"(3) MICROHENRIES";TAB(20)"HENRIES"
680 PRINT"(4) MILLIHENRIES";TAB(20)"HENRIES"
690 PRINT"(5) RETURN TO MAIN MENU"
700 PRINT:PRINT:INPUT"ENTER CHOICE (1-5)";C
710 ON C GOTO 720,780,840,900,10
720 CLS:PRINT"CONVERT HENRIES INTO MICROHENRIES"
730 INPUT"ENTER VALUE (IN HENRIES) TO BE CONVERTED";H
740 M=H*(10[6)
750 PRINT:PRINT H;"HENRIES  = ";M;"  MICROHENRIES"
760 PRINT:PRINT:INPUT"PRESSENTER TO CONTINUE";A$
770 GOTO 610
780 CLS:PRINT"CONVERT HENRIES INTO MILLIHENRIES"
790 INPUT"ENTER VALUE (IN HENRIES) TO BE CONVERTED";H
800 M=H*(10[3)
810 PRINT:PRINT H;"HENRIES  =  ";M;"  MILLIHENRIES"
820 PRINT:PRINT:INPUT"PRESS ENTER TO CONTINUE";A$
830 GOTO 610
840 CLS:PRINT"CONVERT MICROHENRIES INTO HENRIES"
850 INPUT"ENTER VALUE(IN MICROHENRIES) TO BE CONVERTED";M
860 H=M*(10[-6)
870 PRINT:PRINT M;"MICROHENRIES =  ";H;"  HENRIES"
880 PRINT:PRINT:INPUT"PRESS ENTER TO CONTINUE";A$
890 GOTO 610
900 CLS:PRINT"CONVERT MILLIHENRIES INTO HENRIES"
910 INPUT"ENTER VALUE (IN MILLIHENRIES) TO BE CONVERTED";M
920 H=M*(10[-3)
930 PRINT:PRINT M;"MILLIHENRIES  =  ";H;"  HENRIES"
940 PRINT:PRINT:INPUT"PRESS ENTER TO CONTINUE";A$
950 GOTO 610
960 REM * FREQUENCY  *
970 CLS
980 PRINT"CONVERSION OPTIONS"
990 PRINT:PRINT
1000 PRINT TAB(5);"FROM";TAB(23);"INTO"
1010 PRINT"(1) HERTZ";TAB(20);"KILOHERTZ"
1020 PRINT"(2) HERTZ";TAB(20);"MEGAHERTZ"
1030 PRINT"(3) KILOHERTZ";TAB(20);"HERTZ"
1040 PRINT"(4) MEAGHERTZ";TAB(20);"HERTZ"
1050 PRINT"(5) RETURN TO MAIN MENU"
1060 PRINT:INPUT"ENTER CHOICE (1-5)";C
1070 ON C GOTO 1080,1140,1200,1260,10
1080 CLS:PRINT"CONVERT HERTZ TO KILOHERTZ"
1090 INPUT"ENTER VALUE (IN HERTZ) TO BE CONVERTED";H
1100 K=H*(10[-3)
1110 PRINT:PRINT H;"HERTZ  =  ";K;"  KILOHERTZ"
1120 PRINT:PRINT:INPUT"PRESS ENTER TO CONTINUE";A$
1130 GOTO 970
1140 CLS:PRINT"CONVERT HERTZ INTO MEGAHERTZ"
1150 INPUT"ENTER VALUE (IN HERTZ) TO BE CONVERTED";H
1160 M=H*(10[-6)
1170 PRINT:PRINT H;"HERTZ  =  ";M;"  MEGAHERTZ"
1180 PRINT:PRINT:INPUT"PRESS ENTER TO CONTINUE";A$
1190 GOTO 970
1200 CLS:PRINT"CONVERT KILOHERTZ INTO HERTZ"
1210 INPUT"ENTER VALUE (IN KILOHERTZ) TO BE CONVERTED";K
1220 H=K*(10[3)
1230 PRINT:PRINT K;"KILOHERTZ  =  ";H;"  HERTZ"
1240 PRINT:PRINT:INPUT"PRESS ENTER TO CONTINUE";A$
1250 GOTO 970
1260 CLS:PRINT"CONVERT MEGAHERTZ TO HERTZ"
1270 INPUT"ENTER VALUE (IN MEGAHERTZ) TO BE CONVERTED";M
1280 H=M*(10[6)
1290 PRINT:PRINT M;"MEGAHERTZ  =  ";H;"HERTZ"
1300 PRINT:PRINT:INPUT"PRESS ENTER TO CONTINUE";A$
1310 GOTO 970
```

culates the necessary component values and draws the resulting circuit on the line printer indicating all components and values.

Program Listing 5 (Lowpass), is another example of a filter circuit. This time you are designing an active filter using resistors, capacitors, and an integrated circuit. This filter blocks signals above a specific frequency. Enter the desired cutoff frequency and the computer calculates the necessary component values and draws the circuit on the line printer.

These five programs aid in the construction of circuits designed to operate at a specific frequency. You can use the programs separately or combined. One supplies information used by another. Thus they serve for a wide range of applications. Warning: these programs do not determine the suitability of any circuit for your intended use. Once you enter the required input, the computer will return a circuit or a component value, no matter how absurd or ineffective it may be for your use.

Convert

The programs require you to enter data via the keyboard in a specific form. One program may require you to enter a frequency in hertz while another program may require you to enter the frequency in megahertz. Convert eliminates the need of manually converting data from your form to the form the computer requires.

The program displays a table of conversions that it can perform. Select your conversion by entering the number that appears beside it. Once you have made this selection, the computer instructs you to enter the value you wish to convert. If, for example, you wish to convert picofarads to farads, enter the value in picofarads and the computer will return the equivalent value in farads.

Table 1 lists the conversions the program can make.

Formula

Finding electronic components (resistors, capacitors, inductors, and coils) with the exact (or even approximate) value you need can be difficult. This program bypasses this circuit design obstacle by calculating the performance of multiple electronic components when these components are combined in series or parallel. In this way, you can combine two or more standard components (those stocked by most electronic stores), to arrive at the value you need.

The program uses standard electronic formulas for calculating the combined values. Table 2 shows a complete list of these formulas. As listed, the program will calculate the results of connecting from 2–10 components. If you wish to calculate the results of connecting more than 10 items, add the appropriate dimension statements to the beginning of the program. If you

(I) Ohms Law for Direct Current
- (a) Current = Voltage ÷ Resistance
- (b) Voltage = Current • Resistance
- (c) Resistance = Voltage ÷ Current
- (d) Power = Voltage • Current

(II) Resistors In Parallel
- (a) Two Resistors

  Total Resistance = $(R_1 \cdot R_2) \div (R_1 + R_2)$
- (b) More than Two Resistors

  Total Resistance = $1 \div (\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \dots + \frac{1}{R_N})$

  Where: $R_1, R_2, R_3, \dots, R_N$ are The Individual Resistors

(III) Resistors In Series

Total Resistance = $R_1 + R_2 + R_3 + \dots + R_N$

(IV) Capacitors In Parallel

Total Capacitance = $C_1 + C_2 + C_3 + \dots + C_N$

(V) Capacitors In Series
- (a) Two Capacitors

  Total Capacitance = $(C_1 \cdot C_2) \div (C_1 + C_2)$
- (b) More Than Two Capacitors

  Total Capacitance = $1 \div (\frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \dots + \frac{1}{C_N})$

  Where: $C_1, C_2, C_3, \dots, C_N$ are The Individual Capacitors

(VI) Inductors In Series — No Mutual Inductance

Total Inductance = $L_1 + L_2 + L_3 + \dots + L_N$

(VII) Inductors In Parallel—No Mutual Inductance
- (a) More Than Two Inductors

  Total Inductance = $1 \div (\frac{1}{L_1} + \frac{1}{L_2} + \frac{1}{L_3} + \dots + \frac{1}{L_N})$
- (b) Two Inductors

  Total Inductance = $(L_1 \cdot L_2) \div (L_1 + L_2)$

  Where: $L_1, L_2, L_3, \dots, L_N$ Are The Individual Inductors

(VIII) Coil Winding Formulas—Single Layer Coil
- (a) Inductance = $(N \cdot R)^2 \div [(9 \cdot R) + (10 \cdot L)]$
- (b) Number of Turns = $\sqrt{I \cdot [(9 \cdot R) + (10 \cdot L)]} \div R$

Where:
- I = Inductance
- L = Length of Coil
- R = Radius
- N = Number of Turns

Table 2

Program Listing 2

```
10 CLS
20 INPUT"DO YOU WISH OUTPUT TO LINE PRINTER (Y/N)";P$
30 CLS:PRINT"P R O G R A M     M E N U"
40 PRINT TAB(20);"(1)  OHMS' LAW FOR DIRECT CURRENT"
50 PRINT TAB(20);"(2)  RESISTANCE FORMULAS"
60 PRINT TAB(20);"(3)  CAPACITANCE FORMULAS"
70 PRINT TAB(20);"(4)  INDUCTANCE FORMULAS"
80 PRINT TAB(20);"(5)  COIL WINDING FORMULAS"
90 PRINT:INPUT"ENTER CHOICE";V
100 ON V GOTO 110  ,470  ,820  ,1170 ,1520
110 CLS:PRINT"OHM'S LAW FOR DIRECT CURRENT"
120 PRINT:PRINT TAB(20);"DO YOU WISH TO CALCULATE:"
130 PRINT TAB(30);"(1)  CURRENT"
140 PRINT TAB(30);"(2)  VOLTAGE"
150 PRINT TAB(30);"(3)  RESISTANCE"
160 PRINT:PRINT TAB(30);"(4)  RETURN TO MAIN MENU"
170 PRINT:PRINT:INPUT"ENTER CHOICE";C
180 ON C GOTO 200  ,280  ,350  ,30
190 GOTO 110
200 CLS:PRINT"CALCULATE CURRENT:"
210 INPUT"ENTER VOLTAGE IN VOLTS";E
220 INPUT"ENTER RESISTANCE IN OHMS";R
230 I=E/R:PRINT TAB(10),"CURRENT IN AMPERS  =  ";I
240 IF P$="N" GOTO 260
250 LPRINT"VOLTAGE IN VOLTS  =  ";E:LPRINT"RESISTANCE IN OHMS  =  ";R:LPRIN
T"CURRENT IN AMPERS  =  ";I
260 A$=INKEY$:IF A$="" GOTO 260
270 GOTO 420
280 CLS:PRINT"CALCULATE VOLTAGE:"
290 INPUT"ENTER CURRENT IN AMPERS";I
300 INPUT"ENTER RESISTANCE IN OHMS";R
310 E=I*R:PRINT TAB(10),"VOLTAGE IN VOLTS  =  ";E
320 IF P$="N" GOTO 340
330 LPRINT"CURRENT IN AMPERS  =  ";I:LPRINT"RESISTANCE IN OHMS  =  ";R:LPRI
NT"VOLTAGE IN VOLTS  =  ";E
340 A$=INKEY$:IF A$="" GOTO 260  ELSE 420
350 CLS:PRINT"CALCULATE RESISTANCE IN OHMS:"
360 INPUT"ENTER CURRENT IN AMPERS";I
370 INPUT"ENTER VOLTAGE IN VOLTS";E
380 R=E/I:PRINT TAB(10);"RESISTANCE IN OHMS  =  ";R
390 IF P$="N" GOTO 410
400 LPRINT"CURRENT IN AMPERS  =  ";I:LPRINT"VOLTAGE IN VOLTS  =  ";E:LPRINT
"RESISTANCE IN OHMS  =  ";R
410 A$=INKEY$:IF A$="" GOTO 410  ELSE 420
420 CLS:PRINT"POWER EXPENDED IN LOAD RESISTANCE"
430 P=E*I
440 PRINT TAB(10)"POWER EXPENDED  =  ";P
450 IF P$="Y":LPRINT"POWER EXPENDED  =  ";P
460 A$=INKEY$:IF A$="" GOTO 460  ELSE 110
470 CLS:PRINT"RESISTANCE FORMULAS"
480 PRINT:PRINT TAB(20);"DO YOU WISH TO CALCULATE:"
490 PRINT TAB(30);"(1)  RESISTORS IN SERIES"
500 PRINT TAB(30);"(2)  RESISTORS IN PARALLEL"
510 PRINT:PRINT TAB(30);"(3) RETURN TO MAIN MENU"
520 PRINT:INPUT"ENTER CHOICE";C
530 ON C GOTO 540  ,680  ,30
540 CLS:PRINT"RESISTANCE IN SERIES"
550 INPUT"ENTER NUMBER OF RESISTORS IN SERIES";N
560 R=0
570 FOR A=1 TO N
580 PRINT "ENTER RESISTANCE (IN OHMS) OF RESISTOR # ";A
590 INPUT R(A):NEXT
600 FOR A=1 TO N:R=R(A)+R:NEXT
610 CLS:FOR A=1 TO N:PRINT"RESISTOR # ";A;" =";R(A):NEXT
620 PRINT @ 400, "TOTAL CIRCUIT RESISTANCE  =  ";R
630 IF P$="N" GOTO 670
640 FOR A=1 TO N:LPRINT "RESISTOR # ";A;" =";R(A):NEXT
650 LPRINT TAB(20);"TOTAL CIRCUIT RESISTANCE  =  ";R
660 FOR X=1 TO 5:LPRINT CHR$(13);" ":NEXT
670 A$=INKEY$:IF A$="" GOTO 670  ELSE 470
```

Listing 2 Continues

Listing 2 Continued

```
680 CLS:PRINT"RESISTANCE IN PARALLEL"
690 INPUT"ENTER NUMBER OF RESISTORS IN PARALLEL CIRCUIT";N
700 FOR A=1 TO N
710 PRINT "ENTER RESISTANCE (IN OHMS) OF RESISTOR # ";A
720 INPUT R(A):NEXT
730 IF N>2 GOTO 760
740 R=(R(1)*R(2))/(R(1)+R(2))
750 GOTO 610
760 R=0
770 FOR A=1 TO N
780 R=1/R(A)+R
790 NEXT
800 R=1/R
810 GOTO 610
820 CLS:PRINT"CAPACITANCE FORMULAS"
830 PRINT:PRINT TAB(20);"DO YOU WISH TO CALCULATE:"
840 PRINT TAB(30);"(1)  CAPACITORS IN PARALLEL"
850 PRINT TAB(30);"(2)  CAPACITORS IN SERIES"
860 PRINT:PRINT TAB(30);"(3)  RETURN TO MAIN MENU"
870 INPUT"ENTER CHOICE";C
880 ON C GOTO 890  ,1030 ,30
890 CLS:PRINT"CAPACITANCE IN PARALLEL"
900 INPUT"ENTER NUMBER OF CAPACITORS IN CIRCUIT";N
910 R=0
920 FOR A=1 TO N
930 PRINT"ENTER CAPACITANCE (IN PICAFARADS) OF CAPACITOR # ";A
940 INPUT R(A):NEXT
950 FOR A=1 TO N:R=R(A)+R:NEXT
960 CLS:FOR A=1 TO N:PRINT"CAPACITOR # ";A;" =";R(A):NEXT
970 PRINT @ 400, "TOTAL CIRCUIT CAPACITANCE  =  ";R
980 IF P$="N" GOTO 1020
990 FOR A=1 TO N:LPRINT "CAPACITOR # ";A;" =";R(A):NEXT
1000 LPRINT TAB(20);"TOTAL CIRCUIT CAPACITANCE  =  ";R
1010 FOR X=1 TO 5:LPRINT CHR$(13);" ":NEXT
1020 A$=INKEY$:IF A$="" GOTO 1020 ELSE 820
1030 CLS:PRINT"CAPACITANCE IN SERIES:"
1040 INPUT "ENTER NUMBER OF CAPACITORS IN SERIES CIRCUIT";N
1050 FOR A=1 TO N
1060 PRINT"ENTER CAPACITANCE (IN PICAFARADS) OF CAPACITOR # ";A
1070 INPUT R(A):NEXT
1080 IF N>2 GOTO 1110
1090 R=(R(1)*R(2))/(R(1)+R(2))
1100 GOTO 960
1110 R=0
1120 FOR A=1 TO N
1130 R=1/R(A)+R
1140 NEXT
1150 R=1/R
1160 GOTO 960
1170 CLS:PRINT"INDUCTANCE FORMULAS (WITH NO MUTUAL INDUCTANCE)"
1180 PRINT:PRINT TAB(20);"DO YOU WISH TO CALCULATE:"
1190 PRINT TAB(30);"(1)  INDUCTORS IN SERIES"
1200 PRINT TAB(30);"(2)  INDUCTORS IN PARALLEL"
1210 PRINT:PRINT TAB(30);"(3)  RETURN TO MAIN MENU"
1220 INPUT"ENTER CHOICE";C
1230 ON C GOTO 1240 ,1380 ,30
1240 CLS:PRINT"INDUCTANCE IN SERIES"
1250 INPUT"ENTER NUMBER OF INDUCTORS IN CIRCUIT";N
1260 R=0
1270 FOR A=1 TO N
1280 PRINT"ENTER INDUCTANCE (IN MICROHENRIES) FOR INDUCTOR # ";A
1290 INPUT R(A):NEXT
1300 FOR A=1 TO N:R=R(A)+R:NEXT
1310 CLS:FOR A=1 TO N:PRINT"INDUCTOR # ";A;" =";R(A):NEXT
1320 PRINT @ 400, "TOTAL CIRCUIT INDUCTANCE  =  ";R
1330 IF P$="N" GOTO 1370
1340 FOR A=1 TO N:LPRINT "INDUCTOR # ";A;" =";R(A):NEXT
1350 LPRINT TAB(20);"TOTAL CIRCUIT INDUCTANCE  =  ";R
1360 FOR X=1 TO 5:LPRINT CHR$(13);" ":NEXT
1370 A$=INKEY$:IF A$="" GOTO 1370 ELSE 1170
1380 CLS:PRINT"INDUCTANCE IN PARALLEL --NO MUTUAL INDUCTANCE"
1390 INPUT"ENTER NUMBER OF INDUCTORS IN CIRCUIT";N
1400 FOR A=1 TO N
1410 PRINT"ENTER INDUCTANCE (IN MICROHENRIES) OF INDUCTOR #";A
1420 INPUT R(A):NEXT
1430 IF N>2 GOTO 1460
1440 R=(R(1)*R(2))/(R(1)+R(2))
1450 GOTO 1310
1460 R=0
1470 FOR A=1 TO N
1480 R=1/R(A)+R
1490 NEXT
1500 R=1/R
1510 GOTO 1310
1520 CLS:PRINT"COIL WINDING FORMULAS:"
1530 PRINT TAB(1);"DO YOU WISH TO CALCULATE:"
1540 PRINT TAB(3);"(1)  INDUCTANCE--GIVEN -- # OF TURNS, LENGTH,AND RADIUS"
1550 PRINT TAB(3);"(2)  NUMBER OF TURNS ---GIVEN - LENGTH,RADIUS, AND INDUC
TANCE"
1560 PRINT TAB(3);"(3)  RETURN TO MAIN MENU"
1570 INPUT"ENTER CHOICE";C
1580 ON C GOTO 1590 ,1720 ,30
1590 CLS:PRINT"CALCULATE INDUCTANCE:"
1600 INPUT"ENTER NUMBER OF TURNS";N
1610 INPUT"ENTER MEAN RADIUS IN INCHES";A
1620 INPUT"ENTER LENGTH OF COIL IN INCHES";B
1630 L=((N*A)[2)/((9*A)+(10*B))
1640 PRINT:PRINT "GIVEN THE ABOVE DATA, THE INDUCTANCE =  ";L
1650 IF P$="N" GOTO 1710
1660 LPRINT"NUMBER OF TURNS =  ";N
1670 LPRINT"MEAN RADIUS IN INCHES =  ";A
1680 LPRINT"LENGTH OF COIL IN INCHES  =  ";B
1690 LPRINT"INDUCTANCE IN MICROHENRYS =  ";L
1700 FOR X=1 TO 5:LPRINT CHR$(13);" ":NEXT
1710 A$=INKEY$:IF A$="" GOTO 1710 ELSE 1520
1720 CLS:PRINT"CALCULATE NUMBER OF TURNS"
1730 INPUT "ENTER LENGTH OF COIL IN INCHES";B
1740 INPUT"ENTER INDUCTANCE DESIRED";L
1750 INPUT"ENTER MEAN RADIUS IN INCHES";A
1760 N=(SQR(L*((9*A)+(10*B))))/A
1770 PRINT:PRINT"GIVEN THE ABOVE DATA,  THE NUMBER OF TURNS NEEDED FOR DESI
RED INDUCTANCE =  ";N
1780 GOTO 1650
1790 END
```


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are to use over ten components for a desired operating point you may be doing something wrong.

When program execution begins, the following main menu is displayed and you select the topic of your choice.

```
Main Menu:
(1) Ohm's Law for Direct Current
(2) Resistance Formulas
(3) Capacitance Formulas
(4) Inductance Formulas
(5) Coil Winding Formulas
```

Once you have selected from the main menu, a second menu is displayed. If you selected resistance formulas by entering number two from the main menu, the following category menu would be displayed.

```
Resistance Formulas:
Do you wish to calculate:
(1) Resistors in Series
(2) Resistors in Parallel
(3) Return to Main Menu
Enter Choice?
```

At this point, you enter the number (1, 2, or 3), which represents the circuit configuration you are working with. For example, enter 2 if you intend to combine the resistors in parallel.

Once you have made this choice, the program proceeds as follows asking you to enter the number of resistors in parallel in the circuit.

Enter the number of resistors you intend to combine. For example, use 2. The program next asks you to enter the resistance (in ohms) of resistor number one (I shall use 75 ohms as my example), and to enter the resistance (in ohms) of resistor number two (100 ohms is my second choice). The program will then display the total circuit resistance which in this example is 42.8571.

This is the resistance obtained when you combine 75 and 100 ohm resistors in parallel. The program will stop at this point until you press a key (any key continues program execution). When a key is pressed, the program will return to the resistance formulas

```
FREQUENCY            =    775    MEGAHERTZ
INDUCTANCE           =    8.4345    MICROHENRIES


INDUCTIVE REACTANCE **************
INDUCTANCE           =    8.4345E-06    HENRIES
FREQUENCY            =    7.75E+08    HERTZ
INDUCTIVE REACTANCE =    41050.7    OHMS


CIRCUIT RESONANCE ***********************
FREQUENCY            =    775    MEGAHERTZ
INDUCTANCE           =    8.43451    MICROHERTZ
CAPACITANCE          =    5.00002E-03    PICAFARADS
RESONANT FREQUENCY   =    775.398    MEGAHERTZ


CAPACITIVE REACTANCE ********************
FREQUENCY            =    7.75001E+08    HERTZ
CAPACITANCE          =    5.00001E-15    FARADS
CAPACITIVE REACTANCE=    41093    OHMS


IMPEDANCE -- CAPACITANCE AND INDUCTANCE IN PARALLEL
***************************************************
INDUCTIVE REACTANCE  =    41050.7    OHMS
CAPACITAVE REACTANCE =    41093    OHMS
TOTAL IMPEDANCE      =    3.99561E+07




FILTER DESIGN
*************



              8.43451  uH
             --*****--
          11          11
..........1            1........... 775.398  Mhz
          11          11
             --( )--
               5.00002E-03  Pfd
```

Figure 1

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category menu.

From this point, you can examine the results of connecting different resistors or return to the main menu. Break stops program execution.

Resonant Frequency

Determining component values of resonant circuits for filters or amplifiers involves time-consuming calculations. Since the resonant frequency determines the frequency at which the circuit will operate, make these calculations accurately. This program takes the time and effort out of this process and reduces human error in making the calculations.

Enter the component values as instructed during program execution. The computer calculates: inductive reactance, capacitive reactance, circuit impedance, and draws the parallel filter circuit with component values needed to achieve the desired resonant frequency. This sample execution describes this process more fully.

First, enter the resonant frequency you wish to obtain. I will use 775. Then enter the capacitance in picofarads. In working with these circuits, I found I sometimes know the capacitance I intend to use and at other times I know the inductance. For this reason this program calculates either capacitance or inductance. You must enter resonant frequency and either capacitance or inductance. If you know the capacitance you would like the circuit designed around, enter that capacitance. If not, enter any trial value. The program will ask you to enter inductance. In this sample run, I shall assume ignorance of the capacitance, and enter five here and let the program continue.

Next enter inductance in microhenries. I shall use 8.4345 microhenries in this example. The program now has all the input necessary and will make the calculations, print these values, draw the filter circuit and list its component values (see Fig. 1).

Table 3 shows the formulas this program uses.

BAND/REJ

When working with a radio frequency circuit or even when receiving a weak radio frequency (rf) signal in the presence of a strong one, you often need to block an interfering signal or band of signals. A band reject filter constructed with capacitors and inductors prevents unwanted rf energy from entering a circuit. When using this filter, you select a range (band) of frequencies you wish to block. Once you have selected this reject range, calculate the necessary values of capacitors and inductors which, when combined correctly, will block this unwanted band of frequencies. Frequencies above and below the limits you set for the filter pass without interference.

The BAND/REJ program eliminates the tedious calculations in finding the correct values of the electronic components needed to reject your specific

(I) Inductive Reactance $= 2 \cdot \pi \cdot F \cdot L$

(II) Capacitive Reactance $= 1 \div (2 \cdot \pi \cdot F \cdot C)$

(III) Resonant Frequency $= 1 \div (2 \cdot \pi \cdot \sqrt{L \cdot C})$

Where:

L = Inductance
F = Frequency
C = Capacitance
π = 3.14

Table 3

$L = (0.318 \cdot R) \div (F_2 - F_1)$
$C = [(7.96 \cdot (F_2 - F_1)) \cdot (10 \uparrow 4)] \div (F_1 \cdot F_2 \cdot R)$
$L_2 = [.076 \cdot (F_2 - F_1) \cdot R] \div (F_1 \cdot F_2)$
$C_2 = [3.18 \cdot (10 \uparrow 5)] \div [(F_2 - F_1) \cdot R]$

Where:

L, L_2 = Individual Inductors
C, C_2 = Individual Capacitors
F_2 = High Frequency
F_1 = Low Frequency
R = Line Load

Table 4

```
L1     =   4.77   MICROHENRYS
C1     =   8.89261E-03   PICAFARADS
L2     =   5.0021E-05   MICROHENRYS
C2     =   848   PICAFARADS
C2/2   =   424   PICAFARADS
L1/2   =   2.385   MICROHENRYS
2C1    =   .0177852   PICAFARADS
2L2    =   1.00042E-04   MICROHENRYS
WHEN HIGH FREQUENCY =   775
AND LOW FREQUENCY   =   770
AND LINE LOAD (OHMS)=   75


                424                              424
          -----++++++++++-----          -----++++++++++-----
          1                  1          1                  1
          1                  1          1                  1
          1                  1          1                  1
          1                  1          1                  1
          1                  1          1                  1
---------------**********-------------------------**********---------------
1    1         1.00042E-04                        1.00042E-04
1    *                            *                              *
1    *                            *                              *
1      4.77                         2.385                          4.77
1    *                            *                              *
1    *                            *                              *
1    *                            *                              *
##   75    OHMS
##  INPUT
1    +                            +                              +
1    +                            +                              +
1      8.89261E-03                  .0177852                       8.89261E-03

1    +                            +                              +
1    +                            +                              +
1    +                            +                              +
---------------------------------------------------------------------------


SYMBOLS
*******



*  =  INDUCTOR
+  =  CAPACITOR
```

Figure 2

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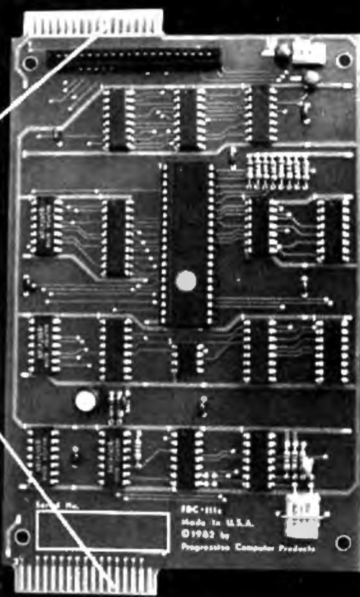

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range of frequencies. Enter the low and high frequency where the signal will be blocked. The only other input is input line load. Once you have entered these three values, the program calculates all component values and draws the filter circuit on the line printer. A sample execution follows, and a list of formulas appears in Table 4.

First, enter upper frequency in megahertz, then enter lower frequency in megahertz, and then enter line load in ohms.

In my example I shall use 775 megahertz (MHz) for the upper frequency, 770 for the lower frequency and 75 ohms for the line load. These values are all you need supply. The program calculates the component values needed to block this range of frequencies, then lists these values on the line printer and draws the filter circuit with all component values listed on the circuit (see Fig. 2).

Lowpass

You can often design an active filter by using a standard circuit normalized to a base frequency. To use this process in designing your filter circuit, begin your analysis with the normalized circuit. There is a wide variety of these circuits, each with its own advantages and disadvantages. This program uses the equal-component-value, Salen-Key, second-order low pass filter circuit.

To look at this base frequency circuit, load and run the Lowpass program. When program execution begins, this circuit (normalized to 10k and 1KHz cutoff frequency) is drawn on the line printer (see Fig. 3). This shows you what the circuit looks like and the component values needed to establish the normalized frequency.

To modify this circuit to work at your particular cutoff frequency, enter your cutoff frequency and which component you wish to vary (resistors or capacitors) when instructed to do so by the computer. In my example I use a cutoff frequency of 2KHz and vary the capacitors. The computer redraws the filter circuit with the new component values to obtain your operation frequency (see Fig. 4).

Be sure your cutoff frequency is within the operating limits of the integrated circuit being used. The program does not determine the suitability of this circuit for your use, nor does it determine if the frequency you

```
EQUAL-COMPONENT-VALUE, SALLEN-KEY SECOND-ORDER LOW-PASS FILTER
NORMALIZED TO 10K AND 1KHZ CUTOFF FREQUENCY

          *------[[[[[-----*-----[[[[[--------*
          .      39000     .     39000        .
          .                .                  .
          .                .                  .
        ----               .                  .
         --                .                  .
          -                .                  .
                           .                  .
                           .  .               .
                           .  ..              .
                           ....-.             .
                              .  .            .
                              .   .  741      .
                              .    .----------*------OUT
                              .   .           .
                              .  .            .
O----[[[[[----*---[[[[[---*---.+.             .
     10000    .   10000   .   ..              .
              .           .   .               .
              .           .                   .
              .           .                   .
              -           -                   .
         .016 UF             .016 UF          .
              -           -                   .
              .           .                   .
              .           .                   .
              .         ----                  .
              .          --                   .
              .           -                   .
              .                               .
              .                               .
              .................................


SYMBOL TABLE
[[[[[        RESISTOR  (IN OHMS)

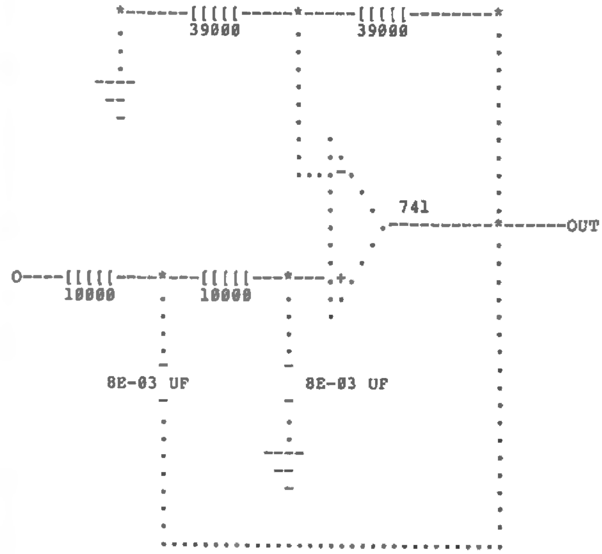

-
             CAPACITOR  (IN MICAFARADS)
-
```

Figure 3

See List of Advertisers on Page 455

select is within the ICs operating range. You must determine these facts for yourself. The computer will assume your desired operating frequency will work and will draw a circuit. ■

```
LOW PASS ACTIVE FILTER
CUTOFF FREQUENCY  =    2   KHZ
```




```
SYMBOL TABLE
[[[[[      RESISTOR  (IN OHMS)

-
           CAPACITOR  (IN MICAFARADS)
-
```

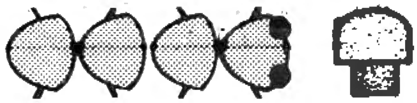
Figure 4

Program Listing 3

```
10 CLS
20 INPUT "ENTER FREQUENCY IN MEGAHERTZ";F
30 INPUT "ENTER CAPACITANCE IN PICAFARAD";C
40 LC=25330/(F[2):L=LC/C
50 PRINT "INDUCTANCE NEEDED TO OBTAIN CIRCUIT RESONANCE  =    "
60 PRINT L;"  MICROHENRYS"
70 INPUT "PRESS ENTER TO CONTINUE";A$
80 CLS
90 PRINT"INDUCTIVE REACTANCE"
100 PRINT"XL=2*PI*F*L"
110 PRINT
120 LPRINT "FREQUENCY              =  ";F;"  MEGAHERTZ"
130 F=(10[6)*F
140 INPUT"ENTER INDUCTANCE IN MICROHENRIES";I
150 LPRINT "INDUCTANCE             =  ";I;"  MICROHENRIES"
160 I=(10[-6)*I
170 FOR J=1 TO 5:LPRINT CHR$(13);" ":NEXT
180 XL=2*3.14*F*I
190 PRINT "INDUCTANCE =  ";I;"  HENRIES"
200 PRINT "FREQUENCY  =  ";F;"  HERTZ"
210 PRINT "INDUCTIVE REACTANCE =  ";XL;"  OHMS"
220 LPRINT"INDUCTIVE REACTANCE ***************"
230 LPRINT"INDUCTANCE           =  ";I;"  HENRIES"
240 LPRINT"FREQUENCY            =  ";F;"  HERTZ"
250 LPRINT"INDUCTIVE REACTANCE =  ";XL;"  OHMS"
260 FOR J=1 TO 5:LPRINT CHR$(13);" ":NEXT
270 CLS
280 GOSUB 550
290 XC=1/(2*3.14*F*C)
300 PRINT"FREQUENCY             =  ";F;"  HERTZ"
310 PRINT"CAPACITANCE           =  ";C;"  FARADS"
320 PRINT"CAPACITIVE REACTANCE  =  ";XC;"  OHMS"
330 LPRINT "CAPACITIVE REACTANCE *********************"
340 LPRINT "FREQUENCY           =  ";F;"  HERTZ"
350 LPRINT "CAPACITANCE         =  ";C;"  FARADS"
360 LPRINT "CAPACITIVE REACTANCE=  ";XC;"  OHMS"
370 FOR J=1 TO 5:LPRINT CHR$(13);" ":NEXT
380 CLS
390 PRINT "IMPEDANCE -- CAPACITANCE AND INDUCTANCE IN PARALLEL"
400 IF XL<XC GOTO 430
410 Z=(XL*XC)/(XL-XC)
420 GOTO 450
```

Listing 3 Continues

COLORPEDE



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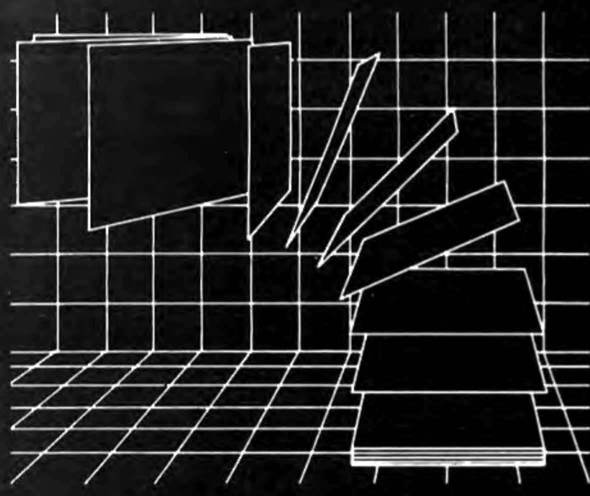

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Listing 3 Continued

```
430 Z=(XC*XL)/(XC-XL)
440 CLS
450 PRINT "INDUCTIVE REACTANCE  =  ";XL;"  OHMS"
460 PRINT "CAPACITAVE REACTANCE =  ";XC;"  OHMS"
470 PRINT "TOTAL IMPEDANCE      =  ";Z
480 LPRINT"IMPEDANCE -- CAPACITANCE AND INDUCTANCE IN PARALLEL"
490 LPRINT"*****************************************************"
500 LPRINT "INDUCTIVE REACTANCE  =  ";XL;"  OHMS"
510 LPRINT "CAPACITAVE REACTANCE =  ";XC;"  OHMS"
520 LPRINT "TOTAL IMPEDANCE      =  ";Z
530 FOR J=1 TO 5:LPRINT CHR$(13);" ":NEXT
540 GOTO 740
550 CLS
560 REM*CALCULATE CAPACITANCE TO ESTABLISH CIRCUIT RESONANCE*
570 F=(10[-6)*F:I=(10[6)*I
580 C=(25330/(F[2))/I
590 FQ=F:IQ=I:CQ=C
600 PRINT "CIRCUIT RESONANCE"
610 LPRINT"CIRCUIT RESONANCE ************************"
620 LPRINT"FREQUENCY              =  ";F;"  MEGAHERTZ"
630 LPRINT"INDUCTANCE             =  ";I;"  MICROHERTZ"
640 LPRINT"CAPACITANCE            =  ";C;"  PICAFARADS"
650 I=(10[-6)*I:C=(10[-12)*C:F=(10[6)*F
660 FR=1/(2*3.14*(SQR(I*C)))
670 FR=(10[-6)*FR
680 LPRINT"RESONANT FREQUENCY  =  ";FR;"  MEGAHERTZ"
690 FOR J=1 TO 5:LPRINT CHR$(13);" ":NEXT
700 PRINT"INDUCTANCE             =  ";I;"  HENRYS"
710 PRINT"CAPACITANCE            =  ";C;"  PICAFARADS"
720 PRINT"CIRCUIT RESONANCE   @  ";PR;"  MEGAHERTZ"
730 RETURN
740 LPRINT "FILTER DESIGN"
750 LPRINT "**************"
760 FOR J=1 TO 5:LPRINT CHR$(13);" ":NEXT
770 LPRINT"              ";IQ;" uH"
780 LPRINT"              --*****--"
790 LPRINT"           11        11"
800 LPRINT"...........1          1............";PR;" Mhz"
810 LPRINT"           11        11"
820 LPRINT"              --(  )--"
830 LPRINT"                 ";CQ;" Pfd"
```

```
10 REM* L-C BAND-REJECT FILTER  *
20 CLS
30 PRINT "L=0.318*R/(F2-F1)------C=(7.96(F2-F1)*10[4)/(F1*F2*R)------L2=(.0
796*(F2-F1)*R)/(F1*F2)-----C2=(3.18*(10[5))/((F2-F1)*R)"
40 PRINT:PRINT:INPUT"ENTER UPPER FREQUENCY (MHZ)";F2
50 INPUT"ENTER LOWER FREQUENCY (MHZ)";F1
60 INPUT"ENTER LINE LOAD (IN OHMS)";R
70 L1=(0.318*R)/(F2-F1)
80 C1=(7.96*(F2-F1)*(10[4))/(F1*F2*R)
90 L2=(.0796*(F2-F1)*R)/(F1*F2)
100 C2=(3.18*(10[5))/((F2-F1)*R)
110 PRINT "L1 =  ";L1
;"C1  =   ";C1
;"L2  =   ";L2
;"C2  =   ";C2
120 PRINT"C2/2 = ";C2/2
;"L1/2 =  ";L1/2
;"2*C1 =  ";2*C1
;"2*L2 =  ";2*L2
130 FOR K=1TO5:LPRINT CHR$(13)" ":NEXT
140 LPRINT"L1     =  ";L1;"  MICROHENRYS"
150 LPRINT"C1     =  ";C1;"  PICAFARADS"
160 LPRINT"L2     =  ";L2;"  MICROHENRYS"
170 LPRINT"C2     =  ";C2;"  PICAFARADS"
180 LPRINT"C2/2   =  ";C2/2;"  PICAFARADS"
190 LPRINT"L1/2   =  ";L1/2;"  MICROHENRYS"
200 LPRINT"2C1    =  ";2*C1;"  PICAFARADS"
210 LPRINT"2L2    =  ";2*L2;"  MICROHENRYS"
220 LPRINT"WHEN HIGH FREQUENCY =  ";F2
230 LPRINT"AND LOW FREQUENCY   =  ";F1
240 LPRINT"AND LINE LOAD (OHMS)=  ";R
250 FOR X=1 TO 5:LPRINT CHR$(13);" ":NEXT
260 LPRINT TAB(15);C2/2;TAB(45);C2/2
270 LPRINT TAB(10);"-----++++++++++-----";TAB(40);"-----++++++++++-----"
280 FOR X=1 TO 5:LPRINT TAB(10);"1";TAB(29);"1";TAB(40);"1";TAB(59);"1":NEX
T
290 LPRINT "---------------**********----------------------**********--------
-------"
300 LPRINT"1";TAB(5);"1";TAB(15);2*L2;TAB(45)2*L2
310 FOR X=1 TO 5
320 IF X=3 GOSUB 360
330 LPRINT"1";TAB(5);"*";TAB(35);"*";TAB(62);"*";
340 NEXT
350 GOTO 370
360 LPRINT"1";TAB(6);L1;TAB(36);L1/2;TAB(63);L1:RETURN
370 LPRINT"00  ";R;"  OHMS"
380 LPRINT"00  ";"INPUT"
390 FOR X=1 TO 5
400 IF X=3 GOSUB 440
410 LPRINT"1";TAB(5);"+";TAB(35);"+";TAB(62);"+"
420 NEXT
430 GOTO 460
440 LPRINT"1";TAB(6);C1;TAB(36);2*C1;TAB(63);C1:RETURN
450 GOTO 370
460 LPRINT"------------------------------------------------------------------
------"
470 FOR JK=1 TO 5:LPRINT CHR$(13);" ":NEXT
480 LPRINT "SYMBOLS"
490 LPRINT "*******"
500 FOR JK=1 TO 2:LPRINT CHR$(13);" ":NEXT
510 LPRINT"*  =  INDUCTOR"
520 LPRINT"+  =  CAPACITOR"
530 FOR JK=1 TO 5:LPRINT CHR$(13);" ":NEXT
```

Program Listing 4

```
10 CLS
20 PRINT"LOW-PASS ACTIVE FILTER DESIGN"
30 LPRINT"EQUAL-COMPONENT-VALUE, SALLEN-KEY SECOND-ORDER LOW-PASS FILTER"
40 LPRINT"NORMALIZED TO 10K AND 1KHZ CUTOFF FREQUENCY"
50 R3=39000:R2=39000:R1=10000:C1=.016
60 F=1:GOTO 220
70 J=2
80 CLS:PRINT"YOU MAY NOW CHANGE THIS CIRCUIT TO ACHIEVE YOUR DESIRED FREQUE
NCY"
90 INPUT"ENTER CUTOFF FREQUENCY (IN KHZ)";F
100 INPUT"ENTER DAMPING (MUST BE LESS THAN 2)";D
110 PRINT"DO YOU WISH TO CHANGE THEFREQUENCY SMOOTHLY BY VARRYING THE RESIS
TORS (1) OR IN STEPS BY VARRYING THE CAPACITORS (2)"
120 INPUT M
130 R2=39000*(2-D)
140 IF M=2 GOTO 170
150 R=1/F:R1=10000*R
160 GOTO 190
170 C=F/1
180 C1=.016/C
190 FOR X=1 TO 5:LPRINT CHR$(13);" ":NEXT
200 LPRINT "LOW PASS ACTIVE FILTER"
210 LPRINT "CUTOFF FREQUENCY  =   ";F;"  KHZ"
220 FOR X=1 TO 5:LPRINT CHR$(13);" ":NEXT
230 LPRINT TAB(10)"*------[[[[[-----*-----[[[[[--------*"
240 LPRINT TAB(10)"."TAB(16);R3;TAB(27);".";TAB(32);R2;TAB(46)"."
250 LPRINTTAB(10)"."TAB(27)"."TAB(46)"."
260 LPRINT TAB(10)"."TAB(27)"."TAB(46)"."
270 LPRINT TAB(8)"-----"TAB(27)"."TAB(46)"."
280 LPRINT TAB(9)"--"TAB(27)"."TAB(46)"."
290 LPRINT TAB(10)"-"TAB(27)"."TAB(46)"."
300 LPRINT TAB(27)"."TAB(30)"."TAB(46)"."
310 LPRINT TAB(27)"."TAB(30)".."TAB(46)"."
320 LPRINT TAB(27)"..."TAB(30)".-."TAB(46)"."
330 LPRINT TAB(30)".  ."TAB(46)"."
340 LPRINT TAB(30)".    .  741"TAB(46)"."
350 LPRINT TAB(30)".     .----------*------OUT"
360 LPRINT TAB(30)".    ."TAB(46)"."
370 LPRINT TAB(30)".  ."TAB(46)"."
380 LPRINT"O----[[[[[----*---[[[[[---*---.+."TAB(46)"."
390 LPRINTTAB(4);R1;TAB(14)"."TAB(17);R1;TAB(26)"."TAB(30)".."TAB(46)"."
400 LPRINTTAB(14)"."TAB(26)"."TAB(30)"."TAB(46)"."
410 LPRINT TAB(14)"."TAB(26)"."TAB(46)"."
420 LPRINT TAB(14)"."TAB(26)"."TAB(46)"."
430 LPRINT TAB(14)"-"TAB(26)"-"TAB(46)"."
440 LPRINT TAB(8);C1;"UF" TAB(27);C1;"UF" TAB(46)"."
450 LPRINT TAB(14)"-"TAB(26)"-"TAB(46)"."
460 LPRINT TAB(14)"."TAB(26)"."TAB(46)"."
470 LPRINT TAB(14)"."TAB(26)"."TAB(46)"."
480 LPRINT TAB(14)"."TAB(24)"----"TAB(46)"."
490 LPRINT TAB(14)"."TAB(25)"--"TAB(46)"."
500 LPRINT TAB(14)"."TAB(26)"-"TAB(46)"."
510 LPRINT TAB(14)"."TAB(46)"."
520 LPRINT TAB(14)"."TAB(46)"."
530 LPRINT TAB(14)"................................."
540 FOR X=1 TO 5:LPRINT CHR$(13);" ":NEXT
550 LPRINT"SYMBOL TABLE"
560 LPRINT"[[[[[       RESISTOR  (IN OHMS)
570 LPRINT CHR$(13);" "
580 LPRINT"-"
590 LPRINT"            CAPACITOR  (IN MICAPARADS)"
600 LPRINT"-"
610 FOR X=1 TO 5:LPRINT CHR$(13);" ":NEXT
620 IF J=2 GOTO 640
630 GOTO 70
640 END
```

Program Listing 5

See List of Advertisers on Page 455

Get enhanced printouts from a limited system.

PRINPUT

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Any Model I TRS-80 which has a printer attached can be used for word processing. While some of these computers are used as dedicated devices, others are just dabbling dilettantes.

The dedicated TRS-80 which is heavily used for word processing typically has a high-quality printer, a lowercase video modification, a general-purpose word processing program in machine language (like Electric Pencil or Scripsit), and an operator trained in the software.

Consider the variations which may describe a machine used by an amateur: The machine may not have lowercase display; the user may not own a general-purpose program; the general-purpose word processor is not always suitable; or the user may want programs that are easy for untrained operators to use.

There is plenty of sophisticated help around for the dedicated; this article is for the amateur. It's for the computer that doesn't even have a lowercase modification (although the information may be useful even to those who do). It's also for the user who wants to write special-purpose word processing programs in Basic. For people who do a lot of word processing with standard programs, this article offers special features.

The Missing Case

One problem you face is that the computer's keyboard does not respond like a typewriter. The unmodified video displays all characters as uppercase, since the computer is designed to interpret unshifted entries as uppercase. To input a lowercase ASCII code, you must press the shift key. This is not appropriate for word processing, since lowercase is used more frequently in most kinds of text.

Changing case can be treated as either an input problem (solved by modifying the computer's input functions) or as an output problem (solved by inverting the case of alphabetic characters as they go to the printer). But there is no reason to modify the keyboard and video drivers on a machine which cannot display lowercase letters on the CRT. Instead, it is better to leave these drivers alone, but ensure that the printer driver can substitute uppercase letters for shifted input, and vice versa.

There are different ways of accomplishing this, depending on the printer. If your printer requires a special driver routine stored in RAM, it may be most efficient to modify the driver. If your printer works on the routine in Level II ROM, or if you just don't want to modify the drivers, use the routine in Program Listing 1. To use this program, the value of variable DR must be assigned the correct address for the printer driver (the one printed in the listing is the ROM address). Determine this address by the formula

DR = PEEK(16422) + PEEK(16423)*256

when the printer is working.

Program Listing 1 sets up a machine-language interception of the printer routine. It examines the character being transferred to the printer, and changes the case. As written the converter packs the routine into a string variable, which means it must be added to the beginning of a word-processing program. But by deleting line 3 and assigning the variable AD an address value in high RAM, the program can be stored in protected memory.

Feeding the Computer

The problem of inputting text is somewhat more complex. Level II Basic provides several ways of feeding ASCII text into the computer's memory, but none of them are ideal for word processing.

The two most obvious solutions have substantial, and similar, drawbacks. One way to manipulate the text to be printed is to edit the program itself, putting the text into LPRINT statements or data statements which will be read during a program run. Another way is to use input statements to enter the text while the program is running. But there are many drawbacks. Commas or double quotes cannot be handled easily, and control codes cannot be

```
0 REM * PRINTER OUTPUT <SHIFT> INVERTER - LOADS VX$
  INSERT APPROPRIATE DRIVER ADDRESS
1 DR=1421 ' ROM Driver Address * DATA CHECKSUM = 3061
2 DATA 245,121,254,124,48,20,254,97,56,4,62,224,24,10,254,91,48,
8,254,65,56,4,62,32,129,79,241,195
3 VX$=STRING$(29,201):X=VARPTR(VX$):AD=PEEK(X+1)+PEEK(X+2)*256
4 FORA=ADTOAD+27:READY:POKEA,Y:NEXT:P=DR:GOSUB6
5 P=AD:A=16422:GOSUB6:END
6 H=INT(P/256):L=P-H*256:POKEA,L:POKEA+1,H:RETURN
```

Program Listing 1

incorporated into the text except by longer strings. There is no way of distinguishing uppercase from lowercase text, since these functions are controlled by the ROM interpreter, and text cannot be automatically formatted to a certain length.

You get around all these problems by writing the text during an INKEY$ loop. A crude version of such a routine is given in Program Listing 2. With this method you can limit the size of input by assigning a maximum string length to the variable MAX. This kind of input will accept commas and quotes freely, and conditional statements can be added to include or exclude control codes, to make substitutions, etc.

There are still problems, however. For instance, there is still no ready way of distinguishing shifted input from unshifted letters. Change the routine by typing in these lines:

```
40 X = ASC (X$):IF X>96 AND X<123
   THEN PRINT CHR$(143); ELSE
   PRINT X$;
45 Q$ = Q$ + X$:IF LEN(Q$) = MAX
   THEN RETURN
```

Now the program prints a graphic block on the CRT whenever a shifted alphabetic character is entered, instead of the character itself. Although you cannot actually see the letter typed, this is not a terribly serious problem. Since the actual code is stored in variable Q$, just print Q$ to be sure that the letters are correct.

Another problem, however, is more subtle. Program Listing 2 adds any control codes to the string indiscriminately. Although the left arrow, or delete key, appears to operate normally, it actually generates unusual strings. Suppose the string is to be the word "COMPUTER". The typist corrects an "N" to an "M" during input. The string appears on the screen as the eight-character string "COMPUTER", but the string Q$ will be 10 characters long: "CON" + CHR$(8) + "MPUTER." Some printers cause a backspace and overstroke in response to this string. Also, if you try to format the string by setting the variable MAX, each deletion counts against this maximum length.

This problem can be eliminated by inserting conditional tests into the routine, but that only aggravates another problem which is already bad enough in Listing 2. The input technique is slow. Machine response lags noticeably, and most typists experience lost letters. Apart from direct statement functions like Input, interpreter Basic just doesn't have the rapid response needed.

The need for speed is frequently a cue to use machine-language as an alternative. But machine-language programming is difficult to develop and to debug. The ideal compromise is the TRS-80's USR function. This alternative makes it possible to produce a Basic program with special input capabilities appropriate to word processing.

The USR function, however, is a very restrictive gate between machine language and Basic. It only passes numbers. How can you use the USR function to get the computer to accept and store strings?

In the computer's memory strings have to be stored somewhere, and their storage location is a numeric value. This is a value which the USR gate can transmit. In addition, the TRS-80 has a special function, VARPTR, which allows Basic to access the variable handling information of the ROM interpreter. So by using VARPTR in conjunction with the USR function, it is possible to get the machine language input routine and Basic to communicate about strings. Program Listing 3 shows how to set up a machine-language program which does this.

To use the subroutine you must set up an appropriate string variable in Basic. One way of doing this is by the string statement, which prepares a string of a specified length. The length of this string is used by the input subroutine to determine the maximum length of the entered string. For example, if you define A$ = STRING$ (60,0), the input is limited to 60 characters. A USR call is made, passing the VARPTR value to the machine-language input routine. The following line of Basic shows how this can be done:

```
100 A$ = STRING$(60,0):V = VARPTR
    (A$):X = USR (V)
```

While execution is in the USR routine, text can be input as in Program Listing 2, except that the response of the computer is instantaneous, and letters are not lost during rapid typing.

The USR routine handles the left arrow as in an input statement, without adding CHR$(8) to the string. (Program Listing 2 does not recognize the shift left arrow combination, which in Level II Basic deletes an entire line of text.)

If a letter is typed in with shift, a graphic block appears on the screen, and allows you to see text that will be printed uppercase. If enough characters are typed in to fill up the string, the keyboard only responds to Enter, which terminates the input, or to the left arrow. Once Enter is pressed, program execution returns to Basic. The string whose VARPTR value was sent to the input routine now has the text entered, and the string's length will be the input length, not the length originally defined.

This USR routine, called Prinput (for printer-oriented input), begins by getting the VARPTR address. The length of the string involved is stored at this address. This value is put in the B register as a counter. Prinput then gets the string's address from the next two bytes. Next, working as an input loop, Prinput over-writes the current string with characters entered from the keyboard.

The program makes sure that you cannot advance, or backspace, beyond the limits of the existing string. When Enter is pressed, the length of the input is poked into the VARPTR location, and control returns to Basic.

Using Prinput

With Prinput added to the store of input functions, most of the string processing and program logic can be left in Basic. In most word processing applications, text is placed in a string array to sequence its output. The best way to do this is to use an ordinary string variable for the input. Then transfer

```
0 REM * A simple BASIC input subroutine using INKEY$
10 Q$="":PRINTCHR$(14);
20 X$=INKEY$:IFX$=""THEN20
30 IFX$=CHR$(13)THENRETURN
40 PRINTX$;:Q$=Q$+X$:IFLEN(Q$)=MAXTHENRETURN
50 GOTO20
```

Program Listing 2

```
0 'BASIC PRINPUT USR ROUTINE. YOU MUST DELETE EITHER LINE 2
OR LINE 3 TO USE. LINE 3 IS USED IN A RUNNING PROGRAM TO PACK
ROUTINE IN A STRING. LINE 2 PUTS PROGRAM IN HIGH MEMORY (VALUES
MAY BE CHANGED) & SETS MEM SIZE BELOW IT.
1 DATA 205,127,10,229,70,4,35,94,35,86,72,62,14,205,58,3,205,132
,3,254,13,40,31,254,8,40,17,254,32,56,241,18,254,96,56,2,62,143,
205,58,3,19,16,223,4,27,121,184,56,247,62,8,24,215,121,144,209,1
8,62,13,195,58,3
2 POKE16561,127:POKE16562,126:CLEAR50:N=32385:N1=129:N2=126
3 CLEAR500:IV$=STRING$(75,0):V=VARPTR(IV$):N1=PEEK(V+1):N2=PEEK(
V+2)::N=N2*256+N1
4 Y=0:FORX=NTON+62:READC:Y=Y+C:POKEX,C:NEXTX:IFY<>5815THENPRINT"
BAD DATA":ENDELSEPOKE16526,N1:POKE16527,N2
```

Program Listing 3

```
0 REM * ENHANCED VERSION OF PRINPUT POKES ROUTINE INTO MEMORY
AND SETS MEM SIZE.
1 POKE16561,94:POKE16562,126:CLEAR50:FORX=32352TO32459:READN:C=C
+N:POKEX,N:NEXTX:IFC<>9751THENPRINT"BAD DATA":ENDELSEPOKE16526,9
6:POKE16562,126:DELETE0-3
2 DATA 205,127,10,229,70,4,35,94,35,86,72,26,183,40,8,205,58,3,1
9,16,246,24,66,62,14,205,58,3,205,132,3,254,32,48,35,254,13,40,6
0,254,8,40,46,56,239,254,11,56,21,254,24,32,231,121,144,40,227
3 DATA 111,27,62,8,205,58,3,45,32,247,65,24,214,254,9,32,2,62,94
,254,96,18,56,2,62,143,205,58,3,19,16,190,4,27,121,184,56,247,62
,8,24,182,121,144,209,18,62,13,195,58,3
```

Program Listing 4

the string to the array after calling Prinput.

Why not simply write text directly into the array, using VARPTR(A$ (N)) as a pointer? It is possible, but it won't work for the first element in the array, since the information Prinput recovers is misunderstood. And it can waste memory, since each array element is initialized to its maximum length, even though its length after the Prinput call may be shorter.

In fact, if memory space is a problem (and with word processing, it frequently is), the most economical way of using this version of Prinput is to set the length of the input string variable once early in the program. Restore it to maximum length by POKEing the desired value into its VARPTR address after the text is transferred to the array. This ensures that Basic will not reallocate string space every time a Prinput call is needed.

```
10 A$=STRING$(60,0):V=VARPTR
   (A$): ' USE ONCE
   .
   .
   .
900 X=USR(V):A$ (N)=A$:POKEV, 60
```

It is possible to POKE a smaller value for shorter inputs, but do not exceed the original value.

Programs that use Prinput should also include some capabilities for reviewing and editing text. Editing is available in Basic using left and right string statements, or possibly by direct POKEs into the string. The string address itself can be recovered by the following formula:

```
AD=PEEK(VARPTR(A$)+1)+
PEEK(VARPTR(A$)+2)*256
```

Going Further

Program Listing 4 is a somewhat more sophisticated, but also longer, version of Prinput. It allows you to reenter a string to make corrections and additions. The routine begins by scanning the string, searching for null bytes. It bypasses and displays any non-zero elements until a null is found, or until the end of the string is reached. You can use the VARPTR of an existing string, and Prinput will display it, leaving the cursor at the end of the string. You can delete letters or, if string length permits, add text to the end:

```
100 A$=A$ (N) :X=LEN(A$) :A$=
    STRING$ (60-X,0)
110 X=USR(VARPTR (A$)) : A$(N)=
    A$
```

Similarly, by POKEing a zero into the Nth position in the string, the Prinput call can be used to edit text at the Nth position. If N=0, the whole string can be replaced:

```
100 V=VARPTR(A$):AD=PEEK
    (V+1)+PEEK(V+2)*256
110 POKE AD+N,0 'SAVES FIRST N
    CHARACTERS
120 X=USR(V)
```

This version of Prinput also recognizes the shift left arrow combination for deleting an entire line of input, and responds to the right arrow key by displaying and adding the arrow, CHR$(94). This arrow can be used in printer output for a horizontal tab.

The assembler source code for this version is given in Program Listing 5. The program is designed to be easily modified.

The HL register pair is not used during the input loop. Therefore, it's possible to use these registers to gather information which will be passed back to Basic. For instance, you might want to return the number of spaces (" " or CHR$ (32)), or the position of the last space to justify or format the text. In Basic this can only be done by a slow For...Next loop.

All the machine-language routines discussed here contain no null bytes, and are completely relocatable. This means that any of them can be stored in string variables, packed into string constants or REM statements, or kept in reserved memory.

How these printer-oriented

routines are used is left up to you, the Basic programmer. But they make it easy for an amateur user of TRS-80s to do some sophisticated word processing.

You quickly get used to thinking of the capitals on the CRT as lowercase letters, and remembering to look for graphic blocks at the start of sentences.■

```
                 ;EXTENDED PRINPUT USR ROUTINE
                 ;BY STEPHEN MILLS/1981
                 ;ON CALLING FROM BASIC, PASS STRING VARPTR VALUE
                 ;N-CHARACTER INPUT FOR STRING$(N,0)
                 ;
                 ;NOTE: THIS VERSION ASSUMES THAT LEFT-ARROW
                 ;WILL BE INTERPRETED BY PRINTER AS A TYPE-
                 ;WRITER TAB.  TO CHANGE THIS MOVE THE 'WRITE'
                 ;INSTRUCTION AFTER 'NOTAB' TO POSITION
                 ;IMMEDIATELY AFTER 'NORMAL'
                 ;
033A             PRINT   EQU     33AH      ;ROM DISPLAY ROUTINE
7E4B                     ORG     7E4BH
7E4B 21607E      TEMP    LD      HL,ENTRY ;SET UP CODE
7E4E 228E40              LD      (16526),HL ;IN USR POINTER
7E51 215E7E              LD      HL,ENTRY-2 ;SET MEMORY SIZE
7E54 22B140              LD      (16561),HL
7E57 212C7E              LD      HL,ENTRY-52 ;ADJUST
7E5A 22A040              LD      (16544),HL ;CLEAR POINTER
7E5D C37200              JP      72H
7E60 CD7F0A      ENTRY   CALL    0A7FH     ;FETCH VARPTR VALUE
7E63 E5                  PUSH    HL        ;SAVE IT
7E64 46                  LD      B,(HL)    ;STORE STRING LENGTH
7E65 04                  INC     B         ;ADJUST FOR COUNTER
7E66 23                  INC     HL
7E67 5E                  LD      E,(HL)    ;GET LSB OF STRING
7E68 23                  INC     HL
7E69 56                  LD      D,(HL)    ;DE NOW HAS STRING ADDR
7E6A 48                  LD      C,B       ;WHERE STRING ADDITION
7E6B 1A          FIND    LD      A,(DE)    ;BEGINS
7E6C B7                  OR      A         ;TEST FOR 0
7E6D 2808                JR      Z,FOUND
7E6F CD3A03              CALL    PRINT     ;DISPLAY CURRENT CHAR
7E72 13                  INC     DE
7E73 10F6                DJNZ    FIND
7E75 1842                JR      BACKSP
7E77 3E0E        FOUND   LD      A,14      ;TURN ON CURSOR
7E79 CD3A03      MARK    CALL    PRINT
7E7C CD8403      SEARCH  CALL    384H      ;KEYBOARD INPUT
7E7F FE20                CP      32        ;TEST FOR NORMAL CHAR
7E81 3023                JR      NC,NORMAL ;CONTINUE IF NOT
7E83 FE0D                CP      13        ;CARRIAGE RETURN
7E85 283C                JR      Z,DONE
7E87 FE08                CP      8         ;IS IT A DELETION
7E89 282E                JR      Z,BACKSP
7E8B 38EF                JR      C,SEARCH
7E8D FE0B                CP      11 ;PASS DOWN ARROW & TAB
7E8F 3815                JR      C,NORMAL
7E91 FE18                CP      24 ;WHOLE LINE ERASE
7E93 20E7                JR      NZ,SEARCH
7E95 79                  LD      A,C
7E96 90                  SUB     B
7E97 28E3                JR      Z,SEARCH
7E99 6F                  LD      L,A ;PUT IN COUNTER
7E9A 1B          ERASE   DEC     DE        ;DECREMENT POINTER
7E9B 3E08                LD      A,8       ;ERASE ON SCREEN
7E9D CD3A03              CALL    PRINT
7EA0 2D                  DEC     L         ;DECREMENT COUNT
7EA1 20F7                JR      NZ,ERASE
7EA3 41                  LD      B,C       ;RESET STRING COUNT
7EA4 18D6                JR      SEARCH
7EA6 FE09        NORMAL  CP      9 ;CHECK FOR TYPEWRITER TAB
7EA8 2002                JR      NZ,NOTAB
7EAA 3E5E                LD      A,94 ;PUT IN ARROW
7EAC FE60        NOTAB   CP      96 ;CHECK FOR <SHIFT>
7EAE 12          WRITE   LD      (DE),A
7EAF 3802                JR      C,NOCHNG
7EB1 3E8F                LD      A,143 ;REPLACE BY GRAPHIC BLOCK
7EB3 CD3A03      NOCHNG  CALL    PRINT     ;DISPLAY BYTE
7EB6 13          JUMP    INC     DE
7EB7 10BE                DJNZ    FOUND
7EB9 04          BACKSP  INC     B ;RESET COUNTER
7EBA 1B                  DEC     DE
7EBB 79                  LD      A,C       ;FOR CORRECTION
7EBC B8                  CP      B         ;CAN'T BE EARLIER
7EBD 38F7                JR      C,JUMP    ;THAN 1ST BYTE
7EBF 3E08                LD      A,8       ;PRINT BACKSPACE
7EC1 18B6                JR      MARK
7EC3 79          DONE    LD      A,C       ;GET MAX LENGTH
7EC4 90                  SUB     B         ;CALCULATE STRING LENGTH
7EC5 D1                  POP     DE        ;RESTORE VARPTR
7EC6 12                  LD      (DE),A    ;STORE STRING LENGTH
7EC7 3E0D                LD      A,13      ;DO CAR. RETURN BEFORE
7EC9 C33A03              JP      PRINT     ;GOING BACK TO BASIC
7E4B                     END     TEMP
00000 TOTAL ERRORS
```

Program Listing 5

A new way to use Break.

On Break GOTO

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Most programs are usually full of little tests and traps to keep a user's input from making it bomb. Is the menu selection valid? Does the index exceed the limits of the array? Will we move off the screen? It seems the less experienced the user, the more complex the checks. Have you ever watched someone simply press Break to exit the sophisticated program you thought could handle anything?

The simple cure is to disable the Break key. The instruction POKE 16396,175 does this admirably. Processing a Break sends the Z80 through the restart table (RST-28H). We merely take control at the vector address (16396–16398d) and alter the A register so it is no longer a recognizable Break. Even this simple solution has a few options. We can XOR A, which clears the A register so it appears that no key was ever pressed. We can also ADD A, SUB A, rotate A, or load A with another value. In fact, we can do anything that prevents a one from remaining there. If other than zero, the program could INKEY$ the character and perform its own interrupt sequence.

If you have already used this method and forgot to restore the key as part of the program's exit procedure, welcome to the club. (Club members are allowed to kick the cat and utter one obscenity as they reboot to get out of automatic line numbering.) This makes the selective break POKE 16396,165 less exasperating. This break capitalizes on the difference in processing shifted and non-shifted characters. A little experimental testing finds register L to be constant and provides a mask that disables the Break key while allowing a shifted break to work.

Yet, this returns nothing or a one, and the program can no longer use the key for its own purpose. After thoroughly examining the situation (extensive trial and error) a new patch evolves. POKE 16396,123 POKE 16397,61 presents a beautiful use for garbage. This time both the Break and shifted Break return a value of three while a true Break is available using the shift down arrow control feature. This gives the Break key to your program, while still providing a true break using a control A.

What use the Break could have within a program can best be explained by an example. A file maintenance program making a sequential search has just printed the record you wanted. You press Break to stop the search. Since you now want to display a block of records on either side of it, you enter a GOTO instead of CONT. This requires that you know the line number to the command input routine or menu driver. A special key available to the program could signal your wish to stop the search and return to the program's command input routine. The user does not have to be concerned with the program's structure.

The difficulty in controlling

```
100 REM *=*=*=*=*   ON BREAK GOTO ... DEMONSTRATION   *=*=*=*=*
110 REM
120     IF PEEK(16396)=195 GOTO 310         ' PATCH INSTALLED ?
130        REM *=*=*  RESET MEMORY-SIZE  *=*=*
140           ADDR = PEEK(16561) + PEEK(16562) * 256 - 10
150           POKE 16562, ADDR / 256
160           POKE 16561, ADDR - PEEK(16562) * 256
170           CLEAR
180        REM *=*=*  ENTER CODE PATCH  *=*=*
190           POKE 16553,255                 ' ROM DATA-READ FIX
200           START = PEEK(16561) + PEEK(16562) * 256 + 1
210           FOR ADDR = START TO START + 9
220               READ CODE
230               POKE ADDR,CODE
240           NEXT ADDR
250        REM *=*=*  RESET VECTOR BACKWARDS FOR NO BOMB *=*=*
260           POKE 16398,START / 256
270           POKE 16397,START - PEEK(16398) * 256
280           POKE 16396,195                 ' JUMP TO PATCH
290 REM
300 REM *=*=*  INITIALIZE BASIC VARIABLES & CONSTANTS *=*=*
310    IF BREAK PRINT: PRINT "--USER ABORT--": GOTO 380
320           CLEAR 50
330           BREAK = -1
340 REM
350 REM *=*=*=*=*=*=*=*=*=*=*=*=*=*=*=*=*=*=*=*=*=*=*=*=*=*=*
360 REM *=*=*  NORMAL PROGRAM EXECUTION RESUMES  HERE *=*=*
370 REM
380    PRINT "MEMORY =" MEM, "INPUT = " A$, "COUNT = " X
390    PRINT , "TO EXIT TEST & RESTORE TRS-80, ENTER SPACES."
400    INPUT "HOW MANY SUBROUTINES TO STACK "; A$
410    IF A$="" GOTO 500                    ' EXIT PROGRAM
420       X=VAL(A$)
430       GOSUB 440                         ' EXERSICE STACK
440       PRINT, "MEMORY = "; MEM
450       X=X-1
460    IF X>0 GOTO 430 ELSE 400
470 REM
480 REM *=*=*=*=*=*=*=*=*=*=*=*=*=*=*=*=*=*=*=*=*=*=*=*=*=*=*=*=*
490 REM *=*=*  RESTORE MEMORY SIZE & BREAK VECTOR  *=*=*
500    X=PEEK(16561) + PEEK(16562) * 256 + 10
510    POKE 16396,201                       ' BREAK ADDR = RETURN
520    POKE 16562, X / 256
530    POKE 16561, X - PEEK(16562) * 256
540 REM BASIC POINTERS ARE OKAY, STRING BUFFER INCREASED BY 10
550 REM
560 REM *=*=*=* MACHINE CODE PATCH  *=*=*=*
570    DATA 205,143,27,  42,164,64,43,      195,30,29
580    REM  CALL 1B8F,   HL=(40AF)-1,       JP 1D1E
590    REM  RESET STACK, ADJ TOKEN POINTER, STATEMENT PROCESSOR
```

Program Listing 1

The Key Box

Model I

this is directly related to the program's complexity. Input statements require a Break-Enter sequence and have to check for the character's presence. Executing a simple GOTO from within a subroutine leaves the stack expanded with the parameters for all returns in active For loops. A Break request can only be INKEY$ in at pre-arranged levels and all higher routines must constantly check for the returning Break request flag.

What we really need is an ON Break GOTO nnn! Such a feature must not alter or delete any variables, including variable definitions. But it must reset the hardware stack, reposition the interpreter's token pointer, and resume program execution at a predetermined line as smoothly as a GOTO statement. The program in Listing 1 does this using a combination of Basic and machine code. As before, the key is trapped at the restart vector. The patch resets the hardware stack, positions the token pointer to the beginning of the Basic program, and resumes execution at the interpreter's statement-processing routine. The Basic program then provides the GOTO part of the feature. This means the first Basic instruction must know if this is a fresh run, or a returning Break. This is easy enough, since Run clears all variables unless they have actually been assigned a value. The existence of a known variable signals a returning Break; otherwise we assume a new run.

There is one potential problem. Error processing and Stop do not use this vector. These Breaks will not be trapped and control will leave the program. Under these circumstances, variables will be destroyed if the program is altered or a Run executed, while the patch, installed in protected memory will be unaffected. A plus factor is that Break will work in reverse, putting you into the program with one stroke. The problem is that the patch would be re-entered, consuming an additional amount of system memory. The solution is to divide the GOTO, having the first half check for the patch and the second half check for variables. The flowchart in Fig. 1 can best explain Basic's supporting role.

That is all there is to it. A small code patch and two conditional statements provide On Break GOTO nnn. To prevent a premature jump through the restart table, change the vector's return (201d) to a jump (195d) last. If the jump is not present, ten bytes of system memory are reserved. Line 140 determines the new memory size, and the following two lines reset it.

A word of caution for those who will use this technique for other applications. Only one of several closely related parameters has been changed. Re-sizing is not complete until the remaining pointers are also adjusted. Strings will still use this newly reserved space if the next available buffer position points above it! If the string buffer was smaller than what we reserved, we are now ready to punch values into the hardware stack. Clear will automatically reset the remaining pointers, using the one we have changed as the base position. So Clear now and save yourself some heartache.

The remaining statements enter the code and activate the patch. Control then resumes at the second conditional jump where program initialization is checked based upon the variable "Break" being true.

The test program makes a series of subroutine calls. This forces return parameters onto the stack, reducing the amount of available memory. The remaining memory is displayed after each call. Control eventually goes to the input line and prompts for another count. Whenever the Break key is pressed, the available memory is displayed to show that the stack has been reset. The last input value and the loop count are also printed to show that variables remain unaltered.

As mentioned, error processing will not be trapped. The On Error GOTO statement can be used anyplace after the last Clear. Effective error processing within the program could make it impossible for anyone to make an uncontrolled exit, short of pulling the plug.

Another application initializes the USR function to the break vector (400CH or 16396D). USR now gives Basic a *software* breakpoint. This could ease program design. High-level routines need not be cluttered with tests and traps watching for low level problems. Any level could print its error message and use the USR function as a direct patch back to the main line, circumventing all callers, and not worrying about expanding the stack.

Add these techniques to your scrapbook. The next time the Break key becomes a liability, change it to an asset.■

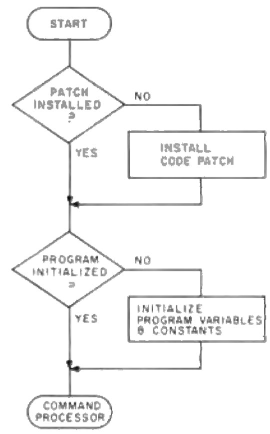

Fig. 1. Basic Program Support for Break GOTO nnn.

What happens when IBM Fortran meets TRS-80 Basic?

Analysis of Variance

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The analysis of variance program in Program Listing 1 was created by IBM. The original program form can be found in IBM "System/360 Scientific Subroutine Package", Programmer's Manual (GH20-0205-4). I converted the program from Fortran to TRS-80 Basic. I bought the manual from a used book store for 62 cents, tax included which goes to show that good software is where you find it.

What is the Scientific Subroutine Package?

The IBM Scientific Subroutine Package (SSP) is a collection of over 200 mathematical Fortran subroutines. Any special purpose program connects appropriate subroutines and then writes a main program to call them in the correct sequence. The SSP is similar to the scientific function subroutines in the appendix of the TRS-80 Level I manual.

The versatility of the SSP is due in a large part to the way Fortran handles subroutines on the IBM 360 system and its excellent structuring of the subroutines. In IBM 360 Fortran, any array data passed to a subroutine must be in a single dimension array or linear array. All data entered into a controlling main program must be placed into this array and leave space in the back of the array for intermediate values a subroutine may calculate.

Observe a data set composed of three rows and three columns. Normally you would enter the data into a variable dimensioned X(3,3). However, the SSP enters the data as the first nine (9) values of a variable dimensioned X(100).

Another characteristic of Fortran subroutines is that variable labels are unique to the subroutine so that a variable labeled X in the main program is different from a variable labeled X in the subroutine. In converting the subroutines to Basic, the variable labels in the subroutine should be compatible with variables elsewhere in the program. Because of this, many of the subroutine variables may have changed from their original form.

Analysis of Variance Program

The SSP analysis of variance program is composed of: (1) a main program to handle the input, lines 10–550, and output, lines 1880–2370, see Listing 1; (2) the subroutine AVDAT, which places the experimental data in specially distributed positions in the X# array; (3) the subroutine AVCAL, which calculates the sum of squares; and (4) the subroutine MEANQ, which performs the mean square operation of the analysis of variance. Program Listing 1, constructs the Basic program as a top-down or straight flow through program. REM statements delineate the convert SSP subroutines for easy reference.

The analysis of variance (ANOVA) program in Listing 1 will calculate the ANOVA of experiments with as many as five different factors and as many as three levels per factor. A more practical limit would be any experiment with less than 400 observations in five factors. All of the experimental data is calculated as

```
***************************** A N O V A *****************************
CONVERTED FORM IBM-SSP ANALYSIS OF VARIANCE. THIS PROGRAM
CALCULATES ANALYSIS OF VARIANCE PROBLEMS OF UP TO FIVE FACTORS
AND 10 LEVELS OF EACH AS ONE-OBSERVATIONS PER CELL.
STAND BY--SETUP IN PROGRESS
INPUT THE NUMBER OF FACTORS IN PROBLEM? 2
INPUT THE LEVELS OF EACH FACTOR
FOR FACTOR 1 OF 2 FACTORS
INPUT A 4 CHARACTER NAME OF FACTOR? A
INPUT THE NUMBER OF LEVELS IN THE FACTOR? 3
FOR FACTOR 2 OF 2 FACTORS
INPUT A 4 CHARACTER NAME OF FACTOR? B
INPUT THE NUMBER OF LEVELS IN THE FACTOR? 3<-

INPUT THE ANOVA MATRIX VALUES AS REQUESTED BELOW
LEVELS WITHIN A FACTOR ARE LISTED AS NUMBERS UNDER FACTOR
FACTOR   NONE   NONE   NONE   B   A   VALUE
          1      1      1     1   1   VALUE = ? 9
          1      1      1     1   2   VALUE = ? 12
          1      1      1     1   3   VALUE = ? 3
          1      1      1     2   1   VALUE = ? 7
          1      1      1     2   2   VALUE = ? 14
          1      1      1     2   3   VALUE = ? 5
          1      1      1     3   1   VALUE = ? 12
          1      1      1     3   2   VALUE = ? 20
          1      1      1     3   3   VALUE = ? 10<-
```

Fig. 1. Input Format for Analysis of Variance Program

```
*****************************************************************
GRAND MEAN = 10.22222222222222
SOURCE OF VARIATION              SS         DF         MS
  A                        134.2222    2          67.1111
  B                         64.8889    2          32.4444
  A  B                       8.4444    4           2.1111
TOTALS 207.5555555555556     DF      TOTAL = 8
DO YOU HAVE ANOTHER PROBLEM ? <-
```

Fig. 2. Output Format of Analysis of Variance Program Using Sample Values (see text)

The Key Box

Basic Level II
Model I
16K RAM

an ANOVA with one observation per cell. Almost any type of experimental design can fit into this ANOVA form except the partially replicated experiments.

Data Input

A sample of the data input format is shown in Fig. 1. The illustration is a two factor experiment with three levels per factor. First, the program requests you to Enter the number of factors in the experiment. It then requires a four character label and the number of levels for each factor. The actual experimental data is then entered.

In entering the data into the ANOVA program, Enter the data in the correct sequence since the data will land in a single dimension array. The data entry section of the program, lines 270–470, specifically identifies which data element of the experiment to enter. However, the program contains no data review function. If you make a mistake, you must start over.

Output Format

Fig. 2 shows the program output for the sample input in Fig. 1. The output includes the source of variation in the experiment, sum of squares, degrees of freedom and the mean square. When the program lists more than one factor on a line under the label source of variation, it refers to interaction sources of variation between the factors listed. The program does not calculate f ratios.

Verification of the Basic Program

Calculating accuracy is always important in statistical programs. In converting a program from one language to another, there is always a chance for a major blunder. To test the Basic program in Listing 1, I entered the sample experiment listed in the IBM SSP manual. The setup and actual data of the SSP manual sample experiment is shown in Fig. 3. Fig. 4 shows the resulting sum of squares output from the Basic program and that listed in the SSP manual.

The two programs produced almost identical results for the sum of squares for each variation source. The Basic program in Listing 1 produces the same output as the IBM Fortran program. The differences in the sum of squares in Fig. 4 usually occur in the sixth or seventh significant digit. This should be enough for most experimental applications. If you need greater precision in your experimental analysis, avoid the program in Listing 1.

Versatility of the Program

We converted the SSP program to Basic to tap the SSP versatility of the original which suits almost any experimental design within its limited factors and observations. The ANOVA of nested and multi-observation per cell experiments are constructed from the output of the program. Combining the sum of squares and degrees of freedom from listed sources of variation accomplishes this.

Take the ANOVA listed in Fig. 1. The experiment was a two factor experiment with three levels of each factor. If it were a single factor experiment with three observations per cell, the ANOVA program would produce the same analysis of variance. The listed sources of variation should condense into appropriate experimental form. In this example, assume that factor B is the three observations per cell. The B sum of squares and the A by B interaction sum of squares would be condensed in the error sum of squares, along with the degrees of freedom of each. The resulting condensed ANOVA is found in Fig. 5.

IBM Copyright Violation

I have respected the copyright to the original IBM program. Before starting this article, IBM personnel in Kansas City, Missouri determined that IBM had no proprietary rights to the programs in the Scientific Subroutine Package.

If you want a copy of the SSP, you can either poke around the dust filled enclosures of a used book store or you can write IBM Corporation, Technical Publications Department, 112 East Post Road, White Plains, New York 10601. ■

George Gille is an Associate Professor of Agriculture at Northwest Missouri State University.

Source of Variation	Experiment Sum of Squares: TRS-80 Program	Experiment Sum of Squares: IBM Program
A	229.0417	229.0416
B	722.6944	722.6943
A B	1382.0833	1382.0832
C	55.1111	55.1111
A C	42.0000	42.0000
B C	13.1389	13.1388
A B C	140.7500	140.7500
R	141.6806	141.6805
A R	18.8194	18.8194
B R	6.0278	6.0277
A B R	176.9722	176.9722
C R	40.7778	40.7777
A C R	50.5556	50.5555
B C R	62.6389	62.6388
A B C R	151.0278	151.0277

Fig. 4. Compares the Sum of Squares of the Sample Experimental Data in the SSP and the Basic Program Listing 1

Source of variation	SS	DF	MS
A	134.2222	2	67.1111
Error (B + A&B)	73.3333	6	12.2222
Total	207.5555	8	

Fig. 5. Adjusted Analysis of Variance for Output Shown in Fig. 2

Scientific Subroutine Package Sample Analysis of Variance

A four (4) factor experiment with the following factor levels:
Factor A with 4 levels.
Factor B with 3 levels.
Factor C with 3 levels.
Factor R with 2 levels.

Data values for the above sample experimental data.

Factors		B-1 A-1	B-1 A-2	B-1 A-3	B-1 A-4	B-2 A-1	B-2 A-2	B-2 A-3	B-2 A-4	B-3 A-1	B-3 A-2	B-3 A-3	B-3 A-4
	C-1	3	10	9	8	24	8	9	3	2	8	9	8
R-1	C-2	4	12	3	9	22	7	16	2	2	2	7	2
	C-3	5	10	5	8	23	9	17	3	2	8	6	3
	C-1	2	14	9	13	29	16	11	3	2	7	5	3
R-2	C-2	7	11	5	8	28	18	10	6	6	6	5	9
	C-3	9	10	27	8	28	16	11	7	8	9	8	15

Fig. 3. Sample Analysis from IBM SSP

Program Listing 1

```
10 CLEAR 500
20 DIM MS(50)
30 DIM F$(5)
40 DIM X#(1000),H$(5),LG(5),IE(5),KN(5),LA(5)
50 DIM SQ#(50),ND(50),SM#(50)
60 CLS:PRINT"************************* A N O V A ****************
*************"
70 PRINT STRINGS$(64,140)
80 PRINT"CONVERTED FORM IBM-SSP ANALYSIS OF VARIANCE. THIS PROGR
AM"
90 PRINT"CALCULATES ANALYSIS OF VARIANCE PROBLEMS OF UP TO FIVE
FACTORS"
100 PRINT"AND 10 LEVELS OF EACH AS ONE-OBSERVATIONS PER CELL."
110 PRINT STRING$(64,140):PRINT"STAND BY - SETUP IN PROGRESS"
120 FOR I=1 TO 1000:X#(I)=0.0000000000:NEXT I:PRINT STRING$(64,1
40)
130 INPUT"INPUT THE NUMBER OF FACTORS IN PROBLEM";K:PRINT STRING
$(64,140)
140 PRINT"INPUT THE LEVELS OF EACH FACTOR"
150 IF K > 5 THEN 2350
160 FOR I = K TO 5
170 H$(I) ="NONE"
```

Listing continues

Listing continued

```
180 LG(I) = 1
190 NEXT I
200 FOR I = 1 TO K
210 PRINT"FOR FACTOR ";I;" OF ";K" FACTORS
220 INPUT"INPUT A 4 CHARACTER NAME OF FACTOR";H$(I)
230 IF LEN(H$(I))>4 THEN 220
240 IF LEN(H$(I))<>4 THEN H$(I)=" "+H$(I):GOTO 240
250 INPUT"INPUT THE NUMBER OF LEVELS IN THE FACTOR";LG(I)
260 PRINT STRING$(63,140):NEXT I
270 CLS:PRINT"INPUT THE ANOVA MATRIX VALUES AS REQUESTED BELOW"
280 W1$="FACTOR   % %   % %   % %   % %   % %    VALUE"
290 W2$="          ####   ####   ####   ####   ####"
300 PRINT"LEVELS WITHIN A FACTOR ARE LISTED AS NUMBERS UNDER FAC
TOR"
310 GOSUB 2340
320 J = 1:L = 0
330 FOR I1 = 1 TO LG(5)
340 FOR I2 = 1 TO LG(4)
350 FOR I3 = 1 TO LG(3)
360 FOR I4 = 1 TO LG(2)
370 FOR I5 = 1 TO LG(1)
380 PRINT USING W2$;I1,I2,I3,I4,I5;
390 L=L+1
400 INPUT"     VALUE = "; X#(J)
410 IF L=13 THEN GOSUB 2340:L=0
420 J = J + 1
430 NEXT I5
440 NEXT I4
450 NEXT I3
460 NEXT I2
470 NEXT I1
480 M = LG(1) + 1
490 N = LG(1)
500 FOR I = 2 TO K
510 M = M * (LG(I) + 1)
520 N = N * LG(I)
530 NEXT I
540 MM = M + 20
550 IZ = 1
560 REM ************** START AVDAT *********************
570 MM = LG(1) + 1
580 FOR I = 2 TO K
590 MM = MM * (LG(I) + 1 )
600 NEXT I
610 N1 = MM + 1
620 N2 = N + 1
630 FOR I = 1 TO N
640 N1 = N1 - 1
650 N2 = N2 - 1
660 X#(N1) = X#(N2)
670 NEXT I
680 IE(1) = 1
690 FOR I = 2 TO K
700 IE(I) = IE(I-1) * (LG(I-1) + 1)
710 NEXT I
720 FOR I = 1 TO K
730 KN(I) = 1
740 NEXT I
750 N1 = N1 - 1
760 FOR I = 1 TO N
770 L = KN(1)
780 FOR J = 2 TO K
790 L = L + IE(J) * (KN(J) - 1)
800 NEXT J
810 N1 = N1 + 1
820 X#(L) = X#(N1)
830 FOR J = 1 TO K
840 IF (KN(J)  - LG(J)) = 0 THEN 870 ELSE 850
850 KN(J) = KN(J) + 1
860 GOTO 890
870 KN(J) = 1
880 NEXT J
890 NEXT I
900 REM ********** START AVCAL ***************
910 LA(1) = L + 1
920 FOR I = 2 TO K
930 LA(I) = LA(I-1) + IE(I)
940 NEXT I
950 FOR I = 1 TO K
960 L = 1
970 LL = 1
980 SV# = 0.0
990 NN = LG(I)
1000 ZN = NN
1010 IW = IE(I)
1020 LH = LA(I)
1030 FOR J = 1 TO NN
1040 SV# = SV# + X#(L)
1050 L = L + IW
1060 NEXT J
1070 X#(L) = SV#
1080 FOR J = 1 TO NN
1090 X#(LL) = NN * X#(LL) - SV#
1100 LL = LL + IW
1110 NEXT J
1120 SV# = 0.0
1130 IF (L - LH) >= 0 THEN 1210
1140 IF (L-LH + IW) > 0 THEN 1180
1150 L = L + IW
1160 LL = LL + IW
1170 GOTO 1030
1180 L = L + IW + 1 - LH
1190 LL = LL + IW + 1 - LH
1200 GOTO 1030
1210 NEXT I
1220 REM *********** START MEANQ ***********
1230 REM CHANGE N TO NZ
1240 NZ = LG(1)
1250 FOR I = 2 TO K
1260 NZ = NZ * LG(I)
1270 NEXT I
1280 LA(1) = LG(1)
1290 FOR I = 2 TO K
1300 LA(I) = LG(I) + 1
1310 NEXT I
```

Listing continues

Listing continued

```
1320 NN = 1
1330 LL = (2(K) - 1
1340 MS(1) = 1
1350 FOR I = 2 TO K
1360 MS(I) = MS(I-1)*2
1370 NEXT I
1380 FOR I = 1 TO LL
1390 SQ#(I) = 0.0
1400 NEXT I
1410 FOR I = 1 TO K
1420 KN(I) = 0
1430 NEXT I
1440 L = 0
1450 FOR I = 1 TO K
1460 IF (KN(I) - LA(I)) = 0 THEN 1530
1470 IF L > 0 THEN 1520
1480 KN(I) = KN(I) + 1
1490 IF (KN(I) - LG(I)) > 0 THEN 1530
1500 L = L + MS(I)
1510 GOTO 1540
1520 IF (KN(I) - LG(I))= 0 THEN 1540 ELSE 1500
1530 KN(I) = 0
1540 NEXT I
1550 IF L > 0 THEN 1560 ELSE 1590
1560 SQ#(L) = SQ#(L) + X#(NN) * X#(NN)
1570 NN = NN + 1
1580 GOTO 1440
1590 ZN = NZ
1600 GE# = X#(NN) / ZN
1610 FOR I = 2 TO K
1620 MS(I) = 0
1630 NEXT I
1640 NN = 0
1650 MS(1) = 1
1660 N9 = 1
1670 N8 = 1
1680 FOR I = 1 TO K
1690 IF (MS(I)) = 0 THEN 1720
1700 N9 = N9 * LG(I)
1710 N8 = N8 * (LG(I)-1)
1720 NEXT I
1730 Z9 = NZ * N9
1740 Z8 = N8
1750 NN = NN + 1
1760 SQ#(NN) = SQ#(NN)/Z9
1770 ND(NN) = N8
1780 SM#(NN) = SQ#(NN) / Z8
1790 IF (NN - LL) >= 0 THEN 1870
1800 FOR I = 1 TO K
1810 IF MS(I) = 0 THEN 1840
1820 MS(I) = 0
1830 GOTO 1860
1840 MS(I) = 1
1850 GOTO 1660
1860 NEXT I
1870 REM ****** END MEANQ ********
1880 REM ********* MAIN PROGRAM ************
1890 CLS:QQ=0
1900 PRINT"***********************************************************
***"
1910 PRINT"GRAND MEAN =";GE#
1920 PRINT"SOURCE OF VARIATION                              SS         DF
  MS"
1930 PRINT"-----------------------------------------------------------
-----"

1940 LL = (2(K) - 1
1950 IE(1) = 1
1960 FOR I = 2 TO K
1970 IE(I) = 0
1980 NEXT I
1990 FOR I = 1 TO 5
2000 U$ = B$
2010 NEXT I
2020 NN = 0
2030 SV# = 0.0
2040 NN = NN + 1
2050 L = 0
2060 FOR I = 1 TO K
2070 F$(I) = B$
2080 IF IE(I) = 0 THEN 2110
2090 L = L + 1
2100 F$(L) = H$(I)
2110 NEXT I
2120 SA# = SQ#(NN)
2130 NA = ND(NN)
2140 AA# = SM#(NN)
2150 FOR I=1 TO 5:PRINT USING "%     % ";F$(I);:NEXT I
2160 PRINT USING "#####.####";SA#;:PRINT USING " ## ";NA;
2170 PRINT USING " #####.####";AA#
2180 QQ=QQ+1
2190 IF QQ=10 OR QQ=24 THEN INPUT"<< PRESS ENTER FOR REST >>";QQ
$
2200 SV# = SV# + SQ#(NN)
2210 IF (NN-LL) >= 0 THEN 2290
2220 FOR I = 1 TO K
2230 IF IE(I) = 0 THEN 2260
2240 IE(I) = 0
2250 GOTO 2280
2260 IE(I) = 1
2270 GOTO 2040
2280 NEXT I
2290 N = N - 1

2300 PRINT"-----------------------------------------------------------
------"
2310 PRINT" TOTALS  ";SV#;"         DF TOTAL =";N
2320 INPUT"DO YOU HAVE ANOTHER PROBLEM ";QQ$
2330 IF QQ$="YES" THEN 120 ELSE 2360
2340 PRINT USING W1$;H$(5),H$(4),H$(3),H$(2),H$(1):PRINT STRING$
(63,140):RETURN
2350 CLS:PRINT"ANALYSIS TOO LARGE - USE TIME SHARE SYSTEM"
2360 PRINT"END OR PROGRAM"
2370 END
```

Use the Z80's interrupt versatility to soup up your Model I.

We Interrupt This Program. . .

Dennis Workman
15940 Jackson Oaks Drive
Morgan Hill, CA 95037

The Z80 microprocessor has the most versatile interrupt processing capabilities of any eight bit CPU. In most respects it equals or exceeds those available on minicomputers. A few simple hardware modifications can equip the Model I with the Z80's interrupt capabilities. The modifications will not introduce incompatibilities with software or operating systems not using the real time clock. The clock may be retained by installing a switch.

The Z80 has three *maskable* interrupt modes: Mode 0, Mode 1 and Mode 2. The modes are called maskable because they are enabled or disabled (masked) with software instructions. The Z80's one non-maskable interrupt is used in the Model I for reset purposes.

The Key Box

Model I

Mode 0 asserts an interrupt request by placing a low logic level on signal input line $\overline{\text{INT}}$. The line is brought out of the Model I through the expansion interface bus. If the interrupt system is enabled by the software, the Z80 acknowledges the interrupt by simultaneously asserting low logic levels on signal lines $\overline{\text{IORQ}}$ and $\overline{\text{M1}}$. These lines are not available as outputs. An output called $\overline{\text{INTAK}}$ is available on the expansion interface bus. $\overline{\text{INTAK}}$ is the logical AND of $\overline{\text{M1}}$ and $\overline{\text{IORQ}}$, and becomes a logic low when $\overline{\text{M1}}$ and $\overline{\text{IORQ}}$ are both low. When $\overline{\text{INTAK}}$ is low it becomes the responsibility of the interrupting device to place a single eight bit word on the data bus. The Z80 interprets this word as its next instruction.

Mode 0 is not useful in a Model I with the Basic interpreter in ROM. The reason for this lack of utility becomes obvious when you consider the repertoire of single byte instructions available with the Z80. None of these instructions can vector the CPU to an interrupt service routine except the restart instructions. All of these instructions vector the Z80 to a location in its address space occupied by the interpreter ROM.

Mode 1 also makes its presence known by asserting a low logic level on $\overline{\text{INT}}$. In this case Z80 responds by jumping to 38H. Similar to the non-maskable interrupt, in this mode program execution begins at a fixed address. The non-maskable interrupt vectors the CPU to 66H.

Mode 1 is used by the real time clock and the floppy disk controller processing routines. It is possible to utilize the Mode 1 interrupt by disrupting the normal processing routines exiting the interpreter ROM via hooks to low RAM. (See The Assembly Line, *80 Microcomputing*, October 1981.)

The Basic interpreter has a JP 4012H instruction at 38H. By disabling the real time clock, this interrupt mode could be used to access an interrupt service routine since 4012H lies above the interpreter. Another JP instruction could be placed at 4012H to vector the CPU to any location in RAM.

This interrupt mode has limited power. A polling routine must determine what device produced the interrupt.

Mode 2 is the most powerful Z80 interrupt mode. It is similar to the interrupt structure of most large computers. The interrupting device can directly vector the CPU to any location in its address space. No polling routines are required.

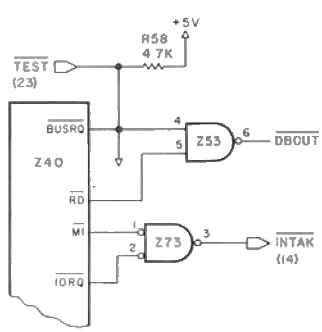

Fig. 1
Original Keyboard Circuitry

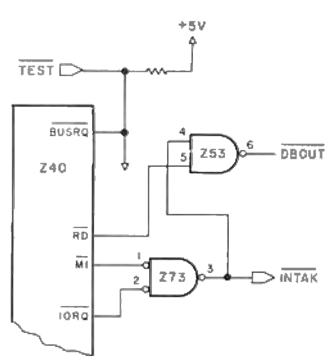

Fig. 2
Modified Keyboard Circuitry

The sequence of steps when the CPU is configured (by software) for Mode 2 are:

- The interrupting device asserts an interrupt by placing a logic low on the signal line $\overline{INT}$;
- Shortly after the end of the current instruction, Z80 acknowledges the interrupt by placing low logic levels on lines $\overline{M1}$ and $\overline{IORQ}$. ($\overline{INTAK}$ at the expansion bus output will go low.);

- The interrupting device must place an eight bit value on the data bus when $\overline{INTAK}$ is low. The Z80 reads this value on the rising edge of $\overline{INTAK}$;
- Z80 uses the eight bit value read above in conjunction with another eight bit value the programmer has previously placed in the I Register to form a 16 bit word. This word is referred to as a pointer;
- The 16 bit pointer is employed to point to the location in RAM containing the starting address of the interrupt service routine. The 16 bit pointer does not point to the service routine; it points to a location in RAM containing the starting address of the service routine;
- Z80 loads the eight bits of data contained in the memory location defined by the pointer into the lower eight bits of the program counter. The eight bits of data contained in the memory location defined by the pointer plus one are loaded into the higher eight bits of the program counter;
- Program execution begins at the address now in the program counter.

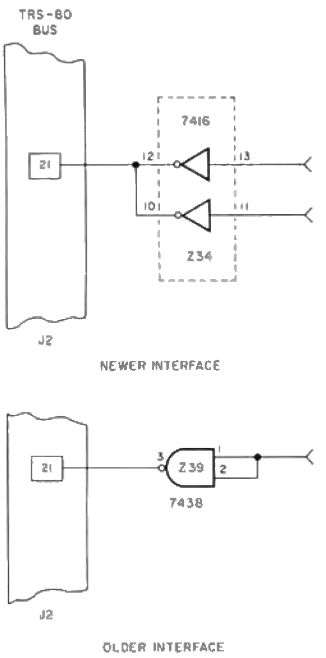

Fig. 3. Interface Comparison

When a non-maskable interrupt is accepted by Z80, further non-maskable interrupts are inhibited until the software enables them again.

Mode 2 allows direct access to 128 independent interrupt service routines which could correspond to 128 separate interrupting devices. Alternatively, a single device could elicit 128 different responses. It is possible to rate the interrupting devices so they do not interrupt one another.

Hardware Limitations

A variety of sources including "The Assembly Line" and the Radio Shack Model I technical manual state it is impossible to access Mode 2 interrupts due to inherent TRS-80 hardware limitations. Some sources describe these limitations as a lack of $\overline{M1}$ and $\overline{IORQ}$ at the expansion bus output, inherent software defects in the Basic interpreter, specially designed Z80's which do not allow this mode and others.

There are two reasons the Mode 2 will not work on an unmodified Model I. First, when interrupts are enabled by the software the real time clock generates an interrupt request as it does every 25 milliseconds. This request is interpreted as a valid Mode 2 request. The Z80 will be vectored to an invalid memory location and hang or boot a disk drive. I have long regarded the clock as a nuisance and welcomed this motivation to disable it.

Second, although Radio Shack obligingly provided the $\overline{INTAK}$ signal at the expansion bus output, they neglected to allow the data bus to read the data presented by the interrupting device. When $\overline{INTAK}$ is low the data bus is placed in a write state by the hardware and the external device is ignored.

Modifying the Hardware

A majority of TRS-80 users have probably never loosened the screws on their keyboards. Bold intimidating warnings scare many people away. Truth is, the Model I is a rugged indestructible piece of equipment. The risk of damage, if reasonable care is taken, is negligible. Radio Shack will bail you out if it does not go well.

You will need a small Phillips screwdriver, a soldering iron (25 watts or less) and solder, a small wirecutter, about a foot of 24–28 gauge wire, an Exacto knife and small needle nosed pliers.

Keyboard Unit Modification

Disassemble the keyboard unit and place the circuit side of the PC board up. Locate integrated circuit Z53. This IC is a 74LS132. Connect Pin 4 of Z53 directly to Pin 3 of Z73. Fig. 1 shows the unmodified circuitry. Fig. 2 shows the modified circuitry. Disconnect Pin 4 of Z53 from line going to the Z80 BUSRQ input. Cut Pin 4 of Z53 as close to the printed circuit board as possible using a small wirecutter. Carefully bend the cut pin to an approximately horizontal position. Solder a wire between the cut pin and pin 3 of Z73; the modification is complete.

With this modification the data bus exiting the keyboard unit is in the read state when $\overline{INTAK}$ is low. Previous operation of the keyboard will be unaffected.

Expansion Interface Modification

There are at least two generations of expansion interface units; the modifications required differ.

The older expansion interfaces are characterized by a buffered interface cable. The newer interfaces have no buffered interface cable. The newer interfaces source the $\overline{INT}$ signal to the keyboard unit from Pins 10 and 12 of Z34. The older units source $\overline{INT}$ from Pin 3 of Z39. Fig. 3 shows partial schematic diagrams for each unit.

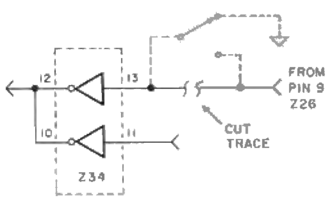

Fig. 4. Newer Modification

On newer interfaces cut the trace connecting Pin 9 of Z26 to Pin 13 of Z34. Ground Pin 13. Fig. 4 shows the modification and how to install a switch restoring the clock.

For older interfaces cut the trace connecting Pin 8 of Z30 to Pins 9 and 10 of Z35. Fig. 5 shows the modification and how to install a switch.

Fig. 6 details a simple interrupt generator. SW1, a dip switch, selects the interrupt vector. IC1 is an octal tri-state driver used to place the selected vector on the data bus when $\overline{INTAK}$ is low. Switch (pushbutton) SW2 generates the interrupt request.

Z80 interrupt capability is now available on your Model I. The new hardware and software capabilities are worthwhile particularly in applications characterized by a very busy CPU. ■

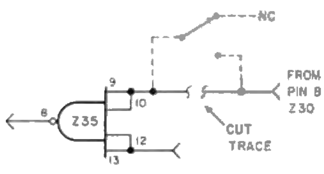

Fig. 5. Older Modification

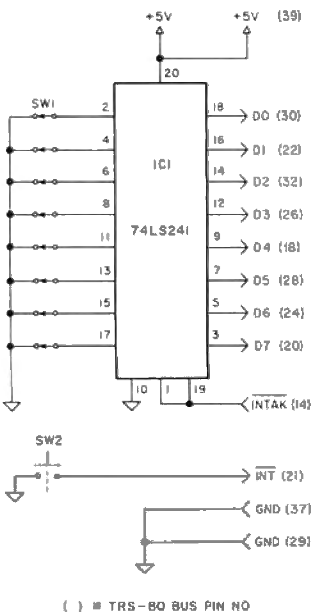

Fig. 6. Simple $\overline{INT}$ Generator

LOAD 80

If I marry your sister, will we be related?

The Family Tree

Richard W. Castor
345 South 51st Avenue
Bellwood, IL 60104

Computerized genealogies in recent literature are too sophisticated, detailed and overpowering for the average individual. The average family does not have the hardware needed for such programs.

To make computerized genealogies useful to the public, they should require minimal information from normal family records. Not everyone interested in ancestry has the time or inclination to do extensive research into public records.

Genealogy II, a stripped-down version of more comprehensive renditions, is written in Basic for a TRS-80 Level II 16K. It generates and manipulates a string matrix.

Genealogy II traces ancestry back four generations (to great-great-great grandparents) and identifies aunts, uncles, and first cousins from simple family records consisting of the names of the father, mother, and their children.

The names must be unique; use Jr., Sr., I, II, or III where ancestors have identical surnames and given names. If you use only the middle initial do not inadvertently destroy the uniqueness of the names involved.

Program Listing 1 generates the genealogical matrix G$(R,C) and provides a menu to edit, add, delete, display, and store its elements. Program Listing 2 manipulates G$(R,C) to form the ancestral list F$(N). Program Listing 3 manipulates G$(R,C) to create the family relationship matrix V$(R,V).

The matrices associated with these three programs are in Fig. 1. The program does not alphabetize the records. If you desire a better organized file, enter the data systematically based on generation or side of the family.

A written transcript of the record number and its associated name aids in future updates. Option two of Listing 1 displays this information.

The six Level II Basic string handling statements format Print # -1 and Input # -1 print string routines which reduce data transfer time to less than 3.5 seconds per family record (see Listing 1 lines 800–999). The Print # -1 routine empties the G$(R,C) matrix to reuse the memory for the print strings. Conversely, the Input # -1 routine nulls the print strings. Without this you would soon use up the available memory in a 16K system.

Delete the monitor display statements associated with print string formatting after you have used them for study or debugging.

Since string spacing is significant and must be identical for proper searching and sorting, omit both leading and trailing spaces. Pay particular attention to internal spacing between the elements of all names. Omit such punctuation as a comma between last and first names.

Genealogy II provides a starting point for a more comprehensive rendition of lineage. Each record in the genealogical matrix G$(R,C) can be expanded to include dates and places of birth and death, date and place of marriage and places of residence. For most individuals, blank or unknown entries exceed the known entries in such an expanded version.

You can organize and display the lineage and family relationships of any individual whose name appears under issue in a family record. The degree to which you accomplish this depends upon the completeness of each family record. The ancestry and family relationships become more complete as you enter more records. The pro-

The Key Box

Basic Level II
Model I
16K RAM

Program Listing 1

```
0  ON ERROR GOTO 20
10 CLEAR 7000:DIMG$(12,75)
15 DIML1(30),P$(30)
20 PRINTTAB(5)"***** GENEALOGY PROGRAM *****"
21 PRINTTAB(10)"***** MENU *****"
30 PRINT "TYPE  (1) TO BUILD A FILE"
40 PRINT TAB(6)"(2) TO SEE THE ENTIRE FILE"
50 PRINT TAB(6)"(3) TO SEE AN INDIVIDUAL RECORD"
60 PRINT TAB(6)"(4) TO MAKE CORRECTIONS"
70 PRINT TAB(6)"(5) TO SAVE THE CURRENT FILE ON CASSETTE"
80 PRINT TAB(6)"(6) TO UPDATE CURRENT FILE TAPE"
81 PRINT TAB(6)"(7) TO END PROGRAM"
90 INPUT Q:ON Q GOTO 110,340,600,400,800,900,1000
110 CLS:LET C=1
120 FOR C=1 TO 75:CLS:IFC>75 GOTO 800
130 PRINT"THIS IS RECORD #";C
140 INPUT "FATHER'S NAME:";G$(1,C)
150 INPUT "MOTHER'S NAME:";G$(2,C)
155 PRINT "TO END RECORD TYPE ***** (FIVE *'S) AS LAST RECORD"
160 PRINT "eNTER ISSUE:"
170 INPUT "1";G$(3,C):IF G$(3,C)="******" GOTO 281
180 INPUT "2";G$(4,C):IF G$(4,C)="******" GOTO 281
190 INPUT "3";G$(5,C):IF G$(5,C)="******" GOTO 281
200 INPUT "4";G$(6,C):IF G$(6,C)="******" GOTO 281
210 INPUT "5";G$(7,C):IF G$(7,C)="******" GOTO 281
220 INPUT "6";G$(8,C):IF G$(8,C)="******" GOTO 281
230 INPUT "7";G$(9,C):IF  G$(9,C)="******" GOTO 281
240 INPUT "8";G$(10,C):IF G$(10,C)="******" GOTO 281
250 INPUT "9";G$(11,C):IF G$(11,C)="******" GOTO 281
260 INPUT "10";G$(12,C):IF G$(12,C)="******" GOTO 281
281 IF FRE(X$)<200 THEN PRINT"WARNING---FILE END NEAR"
282 IF FRE(X$)<=0 GOTO 998
290 PRINT"TO ENTER ANOTHER RECORD, TYPE 1"
300 PRINT"OTHERWISE, TYPE 0"
310 INPUT A
320 IF A<>1 THEN P1=C:PRINT"FILE CLOSED":GOTO 20
```

Listing 1 Continues

Listing 1 Continued

```
330 NEXT C
340 CLS:PRINT"RECORD #";TAB(10)"NAME"
345 FOR C=1 TO P1
350 PRINTC,TAB(10)G$(1,C)
355 FOR N=1 TO 10
360 LET N1=10*N
365 IF C=N1 THEN INPUT"HIT ENTER TO CONTINUE";X:GOTO 375
370 NEXT N
375 NEXT C
380 INPUT"TO SEE THE MENU, HIT ENTER";X:GOTO 20
400 CLS:PRINT"IF THE RECORD NUMBER TO BE CHANGED IS KNOWN, TYPE
AND ENTER IT    HERE.  IF IT IS NOT KNOWN, TYPE 0"
410 INPUT C
420 IF C<>0 GOTO 480
430 INPUT "ENTER THE NAME (LAST, FIRST, MIDDLE) OF THE RECORD TO
 BE CHANGED"; G$
440 FOR C=1 TO P1
450 IF G$=G$(1,C) GOTO 480
455 IF G$=G$(2,C) GOTO 480
460 NEXT C
470 PRINT"NAME NOT IN FILE": GOTO 550
480 FOR T=1 TO 12
490 PRINTG$(T,C)
500 INPUT "IS THIS DATA CORRECT? eNTER YES OR NO"; B1$
510 IF B1$="YES" GOTO 530
520 INPUT "ENTER CORRECT DATA";G$(T,C)
530 PRINT"DATA NOW kEADS---";G$(T,C)
540 NEXT T
550 INPUT "FOR ANOTHER CORRECTION, TYPE 1; OTHERWISE, TYPE 0";X
560 IF X=1 THEN 400 ELSE 20
600 CLS:PRINT"IF THE RECORD NUMBER TO BE VIEWED IS KNOWN, TYPE A
ND ENTER IT     HERE.  IF IT IS NOT KNOWN, TYPE 0"
610 INPUT C
620 IF C<>0 GOTO 680
630 INPUT "ENTER THE NAME (LAST, FIRST, MIDDLE) OF THE RECORD TO
 BE VIEWED";G$
640 FOR C=1 TO P1
650 IF G$=G$(1,C) GOTO 680
655 IF G$=G$(2,C) GOTO 680
660 NEXT C
670 PRINT"NAME NOT IN FILE":GOTO 710
680 FOR T=1 TO 12
690 PRINTT, G$(T,C)
700 NEXT T
710 INPUT "FOR ANOTHER RECORD, TYPE 1; OTHERWISE, TYPE 0";X
720 IF X=1 THEN 600 ELSE 20
800 CLS:PRINT"NOTE CASSETTE COUNTER FOR START OF THIS FILE":INPU
T"PLACE CASSETTE IN <RECORD> MODE. WHEN READY, PRESS <ENTER>";X:
CLS:PRINTTAB(23)"***** cOPYING *****":PRINT
801 PRINT"THE LAST RECORD IN THIS FILE IS #";P1
805 C1=1:R1=1:P=1:D1=0:P$(P)=""
810 IFC1>P1THENPRINT"FORMATTING COMPLETE":C2=C1-1:L1(P)=D1:GOTO8
70
815 L=LEN(G$(R1,C1))
820 L$=STR$(L)
825 IFL<10THENL$=RIGHT$(L$,1):L$="0"+L$
830 IFL=>10THENL$=RIGHT$(L$,2)
840 IFG$(R1,C1)=""ORL=0THENL$="05":G$(R1,C1)=STRING$(5,32):L=5
845 G$(R1,C1)=L$+G$(R1,C1):L$=""
850 D1=D1+(L+2)
855 IF248-D1<L+2THENL1(P)=D1-(L+2):D1=L+2:P=P+1:P$(P)=""
860 P$(P)=P$(P)+G$(R1,C1)
861 PRINTP;D1,P$(P)
862 IFG$(R1,C1)="05*****"THENG$(R1,C1)="":R1=1:C1=C1+1:GOTO810
863 G$(R1,C1)="":R1=R1+1
864 IFR1=13THENR1=1:C1=C1+1
865 GOTO810
870 PRINT#-1,P,C2
875 FORP1=1TOP
876 PRINTP1;L1(P1),P$(P1)
880 PRINT#-1,L1(P1),P$(P1)
885 NEXTP1
890 PRINT"NUMBER OF RECORDS ";C2:P1=C2
895 PRINT"COMPLETE--NOTE TAPE LOCATION"
896 INPUT"DO YOU WANT A DUPLICATE DATA TAPE (Y/n)";A$:IFNOTA$="Y
"THENGOTO899
897 CLS:PRINT"NOTE CASSETTE COUNTER FOR START OF THIS FILE.":INP
UT"PLACE CASSETTE IN <RECORD> MODE. WHEN READY, PRESS <ENTER>";X
:CLS:PRINTTAB(21)"**** DUPLICATING ****":PRINT
898 PRINT"THE LAST RECORD IN THIS FILE IS #";P1:GOTO870
899 PRINT"SESSION COMPLETE":END
900 PRINT"PLACE TAPE CASSETTE IN <PLAY> MODE AT PROPER LOCATION"
:INPUT"WHEN READY, PRESS <ENTER>";X:CLS
905 INPUT #-1,P,C2
910 PRINT"THIS FILE CONTAINS ";P; "PRINT STATEMENTS":PRINT"THE L
AST RECORD ON FILE IS #";C2
915 FORP1=1TOP
920 INPUT #-1,L1(P1),P$(P1)
925 PRINTP1,L1(P1),P$(P1)
930 NEXTP1
935 PRINT"RETRIEVAL COMPLETE":INPUT"PRESS <ENTER> TO CONTINUE";X
:CLS
940 C1=1:R1=1:P1=1:D1=1
945 G$(R1,C1)=MID$(P$(P1),(D1+2),VAL(MID$(P$(P1),D1,2))):PRINTD1
;P1;R1;C1;G$(R1,C1)
950 D1=D1+2+VAL(MID$(P$(P1),D1,2)):IFD1=>L1(P1)THENP$(P1)="":P1=
P1+1:D1=1
955 IFC1>C2THENGOTO980
960 IFG$(R1,C1)="******"THENR1=1:C1=C1+1:GOTO945
965 R1=R1+1
970 IFR1=13THENR1=1:C1=C1+1
975 GOTO945
980 P1=C2:PRINT"DONE--MATRIX RESTORED":INPUT"PRESS <ENTER> TO CO
NTINUE";X:CLS
981 PRINT"TYPE (1) TO SEE CURRENT FILE"
982 PRINTTAB(6)"(2) TO SEE AN INDIVIDUAL RECORD"
983 PRINTTAB(6)"(3) TO CORRECT CURRENT FILE"
984 PRINTTAB(6)"(4) TO ADD TO CURRENT FILE"
985 INPUT U:ON U GOTO 340,600,400,990
990 FOR C=(P1+1) TO 75:IF C>75 PRINT "FILE FULL---ENTER OPTION 1
, 2, 3": GOTO 981
991 GOTO 130
998 LET P1=C
999 PRINT"FILE CLOSED"
1000 INPUT "HAS THIS FILE BEEN SAVED? TYPE YES OR NO"; A1$
1010 IF A1$="YES" THEN 1020 ELSE 20
1020 END
```

grams accomodate 75 such records, somewhat more than the average beginning genealogist can construct.

These programs use nearly all available memory of a 16K TRS-80 Level II. Although they run spaced as listed for ease of typing, compress them to conserve memory. Use a high-quality recording medium (Memorex MRX$_3$ Oxide or equivalent). A

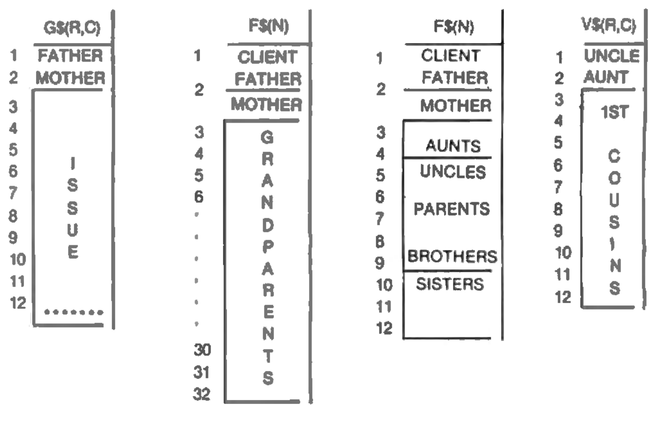

Fig. 1. String Matrices Constructed.

Program Listing 2

```
8  ON ERROR GOTO 110
10 CLS:CLEAR 7000:DIMG$(12,75 ):DIMF$(32),L1(30),P$(30)
15 PRINTTAB(24)"*** ANCESTRY ***"
20 PRINT"PLACE TAPE CASSETTE IN <PLAY> MODE AT PROPER LOCATION":
INPUT"WHEN READY, PRESS <ENTER>";X:CLS
25 INPUT#-1,P,C2
30 PRINT"THIS FILE CONTAINS ";P;" PRINT STATEMENTS":PRINT"THE LA
ST RECORD ON FILE IS ";C2
35 FORP1=1TOP
40 INPUT#-1,L1(P1),P$(P1)
45 PRINTP1,L1(P1),P$(P1)
50 NEXTP1
55 PRINT"RETRIEVAL COMPLETE":INPUT"PRESS <ENTER> TO CONTINUE";X:
CLS
60 C1=1:R1=1:P1=1:D1=1
65 G$(R1,C1)=MID$(P$(P1),(D1+2),VAL(MID$(P$(P1),D1,2))):PRINTD1;
P1;R1;C1;G$(R1,C1)
70 D1=D1+2+VAL(MID$(P$(P1),D1,2)):IFD1=>L1(P1)THENP$(P1)="":P1=P
1+1:D1=1
75 IFC1>C2THENGOTO100
80 IFG$(R1,C1)="******"THENR1=1:C1=C1+1:GOTO65
85 R1=R1+1
90 IFR1=13THENR1=1:C1=C1+1
95 GOTO65
100 P1=C2:PRINT"DONE--MATRIX RESTORED":INPUT"PRESS <ENTER> TO CO
NTINUE";X:CLS
110 CLS:INPUT "TYPE NAME OF INDIVIDUAL WHOSE ANCESTRY IS DESIRED
 (LAST FIRST        MIDDLE INITIAL)";F$(1)
120 FOR K=2 TO 32
125 LET F$(K) ="***********"
130 NEXT K
150 FOR C=1 TO P1
160 FOR R=3 TO 12
170 IF G$(R,C)=F$(1) GOTO 200
175 IF G$(R,C)="******" GOTO 185
180 NEXT R
185 NEXT C
190 INPUT"NAME NOT IN FILE. PRESS ENTER";X:GOTO110
200 INPUT "WHICH SIDE OF THE HOUSE IS DESIRED? TYPE FATHER
 OR MOTHER";H$
210 IF H$="FATHER" THEN  F$(2)=G$(1,C) ELSE F$(2)=G$(2,C)
240 FOR C=1 TO P1:FOR R=3 TO 12
250 IF G$(R,C)=F$(2) GOTO 270
255 IF G$(R,C)="******" GOTO 265
260 NEXT R
265 NEXT C: GOTO 1000
270 LET F$(3)=G$(1,C)
280 LET F$(4)=G$(2,C)
290 FOR C=1 TO P1:FOR R=3 TO 12
300 IF G$(R,C)=F$(3) GOTO 320
305 IF G$(R,C)="******" GOTO 315
310 NEXT R
315 NEXT C: GOTO 340
320 LET F$(5)=G$(1,C)
330 LET F$(7)=G$(2,C)
340 FOR C=1 TO P1:FOR R=3 TO 12
350 IF G$(R,C)=F$(4) GOTO 370
355 IF G$(R,C)="******" GOTO 365
360 NEXT R
365 NEXT C: GOTO 390
370 LET F$(6)=G$(1,C)
380 LET F$(8)=G$(2,C)
390 FOR C=1 TO P1:FOR R=3 TO 12
400 IF G$(R,C)=F$(5) GOTO 420
```

Listing 2 Continues

Listing 2 Continued

```
405 IF G$(R,C)="******" GOTO 415
410 NEXT R
415 NEXT C: GOTO 440
420 LET F$(9)=G$(1,C)
430 LET F$(11)=G$(2,C)
440 FOR C=1 TO P1:FOR R=3 TO 12
450 IF G$(R,C)=F$(7) GOTO 470
455 IF G$(R,C)="******" GOTO 465
460 NEXT R
465 NEXT C: GOTO 490
470 LET F$(13)=G$(1,C)
480 LET F$(15)=G$(2,C)
490 FOR C=1 TO P1:FOR R=3 TO 12
500 IF G$(R,C)=F$(6) GOTO 520
505 IF G$(R,C)="******" GOTO 515
510 NEXT R
515 NEXT C: GOTO 540
520 LET F$(10)=G$(1,C)
530 LET F$(12)=G$(2,C)
540 FOR C=1 TO P1:FOR R=3 TO 12
550 IF G$(R,C)=F$(8) GOTO 570
555 IF G$(R,C)="******" GOTO 565
560 NEXT R
565 NEXT C: GOTO 590
570 LET F$(14)=G$(1,C)
580 LET F$(16)=G$(2,C)
590 FOR C=1 TO P1:FOR R=3 TO 12
600 IF G$(R,C)=F$(9) GOTO 620
605 IF G$(R,C)="******" GOTO 615
610 NEXT R
615 NEXT C: GOTO 640
620 LET F$(17)=G$(1,C)
630 LET F$(19)=G$(2,C)
640 FOR C=1 TO P1:FOR R=3 TO 12
650 IF G$(R,C)=F$(11) GOTO  670
655 IF G$(R,C)="******" GOTO 665
660 NEXT R
665 NEXT C: GOTO 690
670 LET F$(21)=G$(1,C)
680 LET F$(23)=G$(2,C)
690 FOR C=1 TO P1:FOR R=3 TO 12
700 IF G$(R,C)=F$(13) GOTO 720
705 IF G$(R,C)="******" GOTO 715
710 NEXT R
715 NEXT C: GOTO 740
720 LET F$(25)=G$(1,C)
730 LET F$(27)=G$(2,C)
740 FOR C=1 TO P1:FOR R=3 TO 12
750 IF G$(R,C)=F$(15) GOTO 770
755 IF G$(R,C)="******" GOTO 765
760 NEXT R
765 NEXT C: GOTO 790
770 LET F$(29)=G$(1,C)
780 LET F$(31)=G$(2,C)
790 FOR C=1 TO P1:FOR R=3 TO 12
800 IF G$(R,C)=F$(10) GOTO 820
805 IF G$(R,C)="******" GOTO 815
810 NEXT R
815 NEXT C: GOTO 840
820 LET F$(18)=G$(1,C)
830 LET F$(20)=G$(2,C)
840 FOR C=1 TO P1:FOR R=3 TO 12
850 IF G$(R,C)=F$(12) GOTO 870
855 IF G$(R,C)="******" GOTO 865
860 NEXT R
865 NEXT C: GOTO 890
870 LET F$(22)=G$(1,C)
880 LET F$(24)=G$(2,C)
890 FOR C=1 TO P1:FOR R=3 TO 12
900 IF G$(R,C)=F$(14) GOTO 920
905 IF G$(R,C)="******" GOTO 915
910 NEXT R
915 NEXT C: GOTO 940
920 LET F$(26)=G$(1,C)
930 LET F$(28)=G$(2,C)
940 FOR C=1 TO P1:FOR R=3 TO 12
950 IF G$(R,C)=F$(16) GOTO 970
955 IF G$(R,C)="******" GOTO 965
960 NEXT R
965 NEXT C: GOTO 1000
970 LET F$(30)=G$(1,C)
980 LET F$(32)=G$(2,C)
1000 CLS
1010 IF H$="FATHER"THEN PRINT TAB(18)"*** PATERNAL ANCESTRY ***"
ELSE PRINT TAB(18)"*** MATERNAL ANCESTRY ***"
1020 PRINT:PRINTTAB(20) F$(1):PRINT
1030 IF H$="FATHER"THEN PRINTTAB(29)"FATHER" ELSE PRINTTAB(29)"M
OTHER"
1040 PRINT:PRINTTAB(20)F$(2)
1050 PRINT:PRINTTAB(26)"GRANDPARENTS"
1060 PRINT:PRINTF$(3),TAB(42)F$(4):PRINT
1070 INPUT"TO CONTINUE, HIT ENTER";X:CLS
1080 PRINT:PRINTTAB(23)"GREAT GRANDPARENTS"
1090 PRINT:PRINTF$(5),TAB(42)F$(6)
1100 PRINTF$(7),TAB(42)F$(8)
1110 PRINT:PRINTTAB(20)"GREAT GREAT GRANDPARENTS"
1120 PRINT:PRINTF$(9), TAB(42)F$(10)
1130 PRINTF$(11),TAB(42)F$(12)
1140 PRINTF$(13),TAB(42)F$(14)
1150 PRINTF$(15),TAB(42)F$(16)
1160 INPUT"TO CONTINUE, HIT ENTER";X:CLS
1170 PRINT:PRINTTAB(17)"GREAT GREAT GREAT GRANDPARENTS"
1180 PRINT:PRINTF$(17),TAB(42)F$(18)
1190 PRINTF$(19),TAB(42)F$(20)
1200 PRINTF$(21),TAB(42)F$(22)
1210 PRINTF$(23),TAB(42)F$(24)
1220 PRINTF$(25),TAB(42)F$(26)
1230 PRINTF$(27),TAB(42)F$(28)
1240 PRINTF$(29),TAB(42)F$(30)
1250 PRINTF$(31),TAB(42)F$(32)
1300 INPUT"DO YOU WANT THE OTHER SIDE OF THE HOUSE? IF YES, TYPE
 1;          OTHERWISE TYPE 0";X
1310 IF X=1 GOTO 110
1320 INPUT"DO YOU WANT TO TERMINATE THIS RUN? ENTER YES OR NO";A
$
1330 IF A$="NO" GOTO 110
1340 IF A$="YES" THEN END
```

lost bit can create havoc!

Enter the programs which follow and undertake challenging adventure—organizing your past. Genealogy II gets you started in the right direction. ■

Richard Castor has been an electronics engineer in both the public and private sectors for 30 years. He is currently a consultant for computer sorting systems.

```
8  ON ERROR GOTO 110
10 CLS:CLEAR  7000:DIMG$(12,75 ):DIMF$(12):DIMV$(12,10),L1(30),P
$(30)
15 PRINTTAB(18)"*** FAMILY RELATIONSHIPS ***"
20 PRINT"PLACE TAPE CASSETTE IN <PLAY> MODE AT PROPER LOCATION":
INPUT"WHEN READY, PRESS <ENTER>";X:CLS
25 INPUT#-1,P,C2
30 PRINT"THIS FILE CONTAINS ";P;" PRINT STATEMENTS":PRINT"THE LA
ST RECORD ON FILE IS #";C2
35 FORP1=1TOP
40 INPUT#-1,L1(P1),P$(P1)
45 PRINTP1,L1(P1),P$(P1)
50 NEXTP1
55 PRINT"RETRIEVAL COMPLETE":INPUT"PRESS <ENTER> TO CONTINUE";X:
CLS
60 C1=1:R1=1:P1=1:D1=1
65 G$(R1,C1)=MID$(P$(P1),(D1+2),VAL(MID$(P$(P1),D1,2))):PRINTD1;
P1;R1;C1;G$(R1,C1)
70 D1=D1+2+VAL(MID$(P$(P1),D1,2)):IFD1=>L1(P1)THENP$(P1)="":P1=P
1+1:D1=1
75 IFC1>C2THENGOTO100
80 IFG$(R1,C1)="******"THENR1=1:C1=C1+1:GOTO65
85 R1=R1+1
90 IFR1=13THENR1=1:C1=C1+1
95 GOTO65
100 P1=C2:PRINT"DONE--MATRIX RESTORED":INPUT"PRESS <ENTER> TO CO
NTINUE";X:CLS
110 CLS: INPUT"TYPE AND ENTER NAME OF INDIVIDUAL WHOSE FAMILY RE
LATIONSHIPS ARE DESIRED (LAST FIRST MIDDLE INITIAL)";F$(1)
120 FOR K=2 TO 12
121 LET F$(K)="***********"
122 NEXT K
123 FOR K=1 TO 12
124 FOR L=1 TO 10
125 LET V$(K,L)="***********"
126 NEXT L
127 NEXT K
150 FOR C=1 TO P1:FOR R=3 TO 12
160 IF G$(R,C)=F$(1) GOTO 180
165 IF G$(R,C)="******" GOTO 175
170 NEXT R
175 NEXT C:INPUT"NAME NOT IN FILE. PRESS ENTER";X:GOTO110
180 INPUT"WHICH SIDE OF THE HOUSE IS DESIRED? TYPE FATHER OR
MOTHER";H$
190 IF H$="FATHER" THEN F$(2)=G$(1,C) ELSE F$(2)=G$(2,C)
200 FOR C=1 TO P1:FOR R=3 TO 12
210 IF G$(R,C)=F$(2) GOTO 230
215 IF G$(R,C)="******" GOTO  225
220 NEXT R
225 NEXT C: GOTO 110
230 IF R=3 GOTO 270
240 FOR T=3 TO (R-1)
245 IF G$(T,C)="******" GOTO 300
250 LET F$(T)=G$(T,C)
255 IF G$(R,C)="******" GOTO 300
260 NEXT T
270 FOR T=(R+1) TO 12
275 IF G$(T,C)="******" GOTO 300
280 LET F$(T-1)=G$(T,C)
285 IF G$(R,C)="******" GOTO 300
290 NEXT T
295 STOP:PRINT" TYPE CONT TO CONTINUE"
300 FOR N=3 TO 12
310 GOSUB 340
320 NEXT N
330 GOTO 1000
340 FOR C=1 TO P1
350 IF F$(N)="******" GOTO 1000
360 IF F$(N)=G$(1,C) GOTO 390
370 IF F$(N)=G$(2,C) GOTO 390
380 NEXT C
390 FOR R=1 TO 12
400 LET V=(N-2)
410 LET V$(R,V)=G$(R,C)
420 IF G$(R,C)="******" GOTO 440
430 NEXT R
440 RETURN
1000 CLS
1010 IF H$="FATHER" THEN PRINT TAB(12)"**** PATERNAL FAMILY RELA
TIONSHIPS *****" ELSE PRINT TAB(12)"**** MATERNAL FAMILY RELATION
SHIPS *****"
1020 PRINT F$(1),TAB(32)F$(2)
1030 FOR V=1 TO 10
1040 PRINT TAB(20)"**** AUNTS & UNCLES *****","PAGE";V
1050 GOSUB 1130
1060 INPUT"FOR NEXT PAGE, HIT ENTER";X:CLS
1070 NEXT V
1080 INPUT "DO YOU WANT THE OTHER SIDE OF THE HOUSE? IF YES, TYP
E 1; OTHER-     WISE TYPE 0";X
1090 IF X=1 GOTO 110
1100 INPUT "DO YOU WANT TO TERMINATE THIS RUN? eNTER YES OR NO";
A$
1110 IF A$="NO" GOTO 110
1120 IF A$="YES" THEN END
1130 FOR R=1 TO 12
1140 IF R=3 THEN PRINT TAB(20)"**** FIRST COUSINS ****"
1150 PRINT TAB(20) V$(R,V)
1160 IF V$(R,V)="******" GOTO 1180
1170 NEXT R
1180 RETURN
```

Program Listing 3

80 micro BOOK SHELF

HOBBY COMPUTERS ARE HERE! If you want to come up to speed on how computers work—hardware and software—this is an excellent book. It starts with fundamentals and explains the circuits and the basics of programming, along with a couple of TVT construction projects, ASCII, Baudot, etc. This book has the highest recommendations as a teaching aid. $2.97.* BK7322

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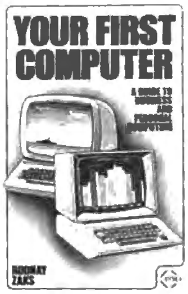

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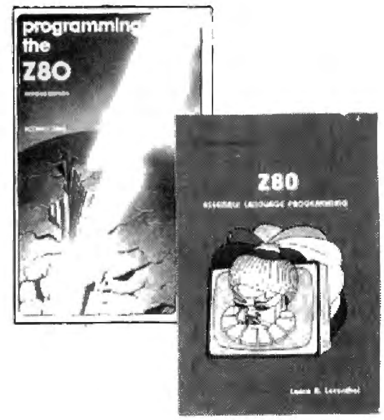

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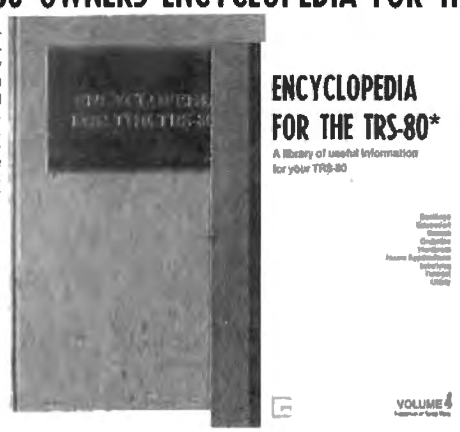

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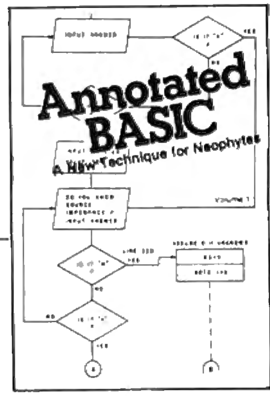

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```
0  CLS:PRINT"SAVE COMMAND IS BEING ACTIVATED..."
10 REM    SET MEMORY SIZE TO 32600
20 POKE16561,80:POKE16562,127:CLEAR50
30 REM
40 REM    READ STARTING ADDRESS IN HEX
50 READ ST$:FORI=1TO4:A$(I)=MID$(ST$,I,1)
60 A(I)=ASC(A$(I))-48+7*(A$(I)>"9"):NEXTI
70 ST = 4096*A(1) + 256*A(2) + 16*A(3) + A(4)
80 REM
90 REM    READ MACHINE CODE INSTRUCTIONS
100 REM   AND POKE INTO HIGH MEMORY LOCATION
110 READ I$:IFI$="END"THEN400
120 FORI=1TOLEN(I$)STEP2
130 A$(1)=MID$(I$,I,1):A$(2)=MID$(I$,I+1,1)
140 FORJ=1TO2:A(J)=ASC(A$(J))-48+7*(A$(J)>"9"):NEXTJ
150 POKEST,A(1)*16+A(2):ST=ST+1:NEXTI:GOTO110
160 DATA 7F5F,21F37FCDA728CDB31B
170 DATA B7C2191AD7C26C7F06063620
180 DATA 2310FBAFCD1202CD87022AA7
190 DATA 40D72B3E55CD640206067ECD
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220 DATA 007DCDEB7F7CCDEB7F7E23CD
230 DATA EB7FE5373FED52E1280810F1
240 DATA 79CD640218D610021806AFCD
250 DATA EB7F10FB79CD64023E78CD64
260 DATA 022AA44023232323237DCD64
270 DATA 027CCD6402CDF801C3191AF5
280 DATA 814FF1CD6402C950524F4752
290 DATA 414D204E414D4500,END
300 REM
400 REM   SET UP "SAVE" COMMAND
410 POKE 16801,95: POKE 16802,127
420 PRINT:PRINT:PRINT"AFTER ADDING THE SPECIAL LINE 0 TO YOUR PR
OGRAM,
TYPE "CHR$(34)"SAVE"CHR$(34)" AND PRESS ENTER.  AT THE
PROMPT, TYPE IN A SIX CHARACTER OR LESS PROGRAM NAME,
PREPARE THE CASSETTE TO RECORD, AND PRESS ENTER.  TO"
430 PRINT"LOAD THE PROGRAM, USE THE SYSTEM COMMAND.  AFTER
LOADING, ENTER A SLASH TO BEGIN NORMAL BASIC EXECUTION.":PRINT:P
RINT
```

Program Listing 1

You need a machine-language routine in high memory to establish a new Save command in Level II. When activated, this routine saves your Basic program on tape in a format readable by the System command. First, type in Program Listing 1 to load the machine-language instructions into high memory. You do not have to reserve memory with the memory size question; the program automatically does this in line 20. The source code for the same routine is in Program Listing 2. Although written for a 16K machine, it could easily be modified for any size.

Save Program Listing 1 on tape (using the CSAVE "S" command). Run the program, and see on the CRT verification that the Save command is ready. If you have some kind of error, recheck the listing.

The Key Box

Basic Level II
Model I or III
16K RAM

Add these two lines of code at the beginning of the Basic program:

```
0 REM..............................
1 ST = PEEK (16548) + 256*PEEK(16549)
 +5:FOR I = ST TO ST+29: READ X :
POKE I,X: NEXT I: DATA 205,248,26,35,
34,249,64,42,167,64,54,82,35,54,85,
35,54,78,35,175,119,42,167,64,62,
13,43,195,129,26: DELETE 1
```

Double check the numerical entries in the Data statement of line one, and enter Run. You must use line zero, REM (not the apostrophe shorthand), and exactly 30 periods. After running, do not be alarmed when listing to see strange symbols and screen action at line zero. Do not try to edit line zero once it is set up.

These two lines POKE a machine-language routine into the unused area behind the REM command of line zero. The routine jumps into ROM where the Basic Run command should have sent the computer. The starting point of this routine will be entered as the execution point for the System copy of the program. When you enter a slash at the *? prompt of the System procedure control transfers to our new routine, which in turn begins a Run. The source code for the routine POKEd into

```
                 ;
                 ;       SYSTEM-SAVE ROUTINE FOR BASIC
                 ;       BY RANDY HAWKINS
                 ;          6214 HIDDEN COVE
                 ;          CORPUS CHRISTI, TX
                 ;
                 ;       THIS ROUTINE STORED IN HIGH
                 ;       MEMORY WILL BE ACTIVATED BY
                 ;       THE COMMAND "SAVE" AND STORE
                 ;       A BASIC PROGRAM ON TAPE IN A
                 ;       FORMAT THAT CAN BE READ BY THE
                 ;       SYSTEM COMMAND. IF ENTERED AS A
                 ;       SYSTEM TAPE, YOU MUST FIRST SET
                 ;       MEMORY SIZE? AT 32600.    6/6/81
                 ;
41A1                     ORG     41A1H    ;REDIRECT "SAVE"
41A1 5F7F                DEFW    START    ;COMMAND TO START
7F5F                     ORG     7F5FH
7F5F 21F37F      START   LD      HL,NAME  ;MESSAGE "PROGRAM
7F62 CDA728              CALL    28A7H    ;NAME" TO SCREEN
7F65 CDB31B              CALL    1BB3H    ;INPUT NAME
7F68 B7                  OR      A        ;IF BREAK ...
7F69 C2191A              JP      NZ,1A19H   ;GO TO READY
7F6C D7          ONE     RST     10H
7F6D C26C7F              JP      NZ,ONE
7F70 0606                LD      B,6      ;FOLLOW INPUT
7F72 3620        TWO     LD      (HL),20H     ;WITH 6
7F74 23                  INC     HL           ;BLANKS
7F75 10FB                DJNZ    TWO
7F77 AF                  XOR     A
7F78 CD1202              CALL    0212H    ;DEFINE DRIVE
7F7B CD8702              CALL    0287H    ;WRITE LEADER
7F7E 2AA740              LD      HL,(40A7H)
7F81 D7                  RST     10H
7F82 2B                  DEC     HL
7F83 3E55                LD      A,55H    ;WRITE SYNC BYTE
7F85 CD6402              CALL    0264H
7F88 0606                LD      B,6
7F8A 7E          THREE   LD      A,(HL)   ;WRITE FILE NAME
7F8B CD6402              CALL    0264H
7F8E 23                  INC     HL
7F8F 10F9                DJNZ    THREE
7F91 ED5BF940            LD      DE,(40F9H)    ;END ADDRESS
7F95 2AA440              LD      HL,(40A4H)    ;START ADDRESS
7F98 3E3C        FOUR    LD      A,3CH    ;DATA HEADER CODE
7F9A CD6402              CALL    0264H
7F9D 0640                LD      B,40H    ;SAVE 64-BYTE BLOCK
7F9F 78                  LD      A,B
7FA0 CD6402              CALL    0264H
7FA3 0E00                LD      C,0      ;START CHECKSUM
7FA5 7D                  LD      A,L      ;TOTAL IN C REG
7FA6 CDEB7F              CALL    CHKSUM
7FA9 7C                  LD      A,H
7FAA CDEB7F              CALL    CHKSUM
7FAD 7E          FIVE    LD      A,(HL)
7FAE 23                  INC     HL
7FAF CDEB7F              CALL    CHKSUM
7FB2 E5                  PUSH    HL
7FB3 37                  SCF
7FB4 3F                  CCF
7FB5 ED52                SBC     HL,DE    ;CHECK FOR END
7FB7 E1                  POP     HL       ;OF PROGRAM
7FB8 2808                JR      Z,SIX
7FBA 10F1                DJNZ    FIVE
7FBC 79                  LD      A,C      ;OUTPUT C REGISTER
7FBD CD6402              CALL    0264H    ;(CHECKSUM TOTAL)
7FC0 18D6                JR      FOUR
7FC2 1002        SIX     DJNZ    SEVEN
7FC4 1806                JR      NINE
7FC6 AF          SEVEN   XOR     A
7FC7 CDEB7F      EIGHT   CALL    CHKSUM
7FCA 10FB                DJNZ    EIGHT
7FCC 79          NINE    LD      A,C      ;END OF PROGRAM ...
7FCD CD6402              CALL    0264H    ;SEND FINAL CHKSUM
7FD0 3E78                LD      A,78H    ;ENTRY POINT CODE
7FD2 CD6402              CALL    0264H
7FD5 2AA440              LD      HL,(40A4H)
7FD8 23                  INC     HL       ;EXECUTE ADDRESS
7FD9 23                  INC     HL       ;IS AT START OF
7FDA 23                  INC     HL       ;BASIC PROGRAM
7FDB 23                  INC     HL       ;PLUS 5 BYTES
7FDC 23                  INC     HL
7FDD 7D                  LD      A,L
7FDE CD6402              CALL    0264H
7FE1 7C                  LD      A,H
7FE2 CD6402              CALL    0264H
7FE5 CDF801              CALL    01F8H    ;STOP CASSETTE
7FE8 C3191A              JP      1A19H    ;GO TO READY
7FEB F5          CHKSUM  PUSH    AF       ;SUBROUTINE TO
7FEC 81                  ADD     A,C      ;COMPUTE CHKSUM
7FED 4F                  LD      C,A      ;AND OUTPUT BYTE
7FEE F1                  POP     AF       ;IN A REGISTER
7FEF CD6402              CALL    0264H
7FF2 C9                  RET
7FF3 50          NAME    DEFM    'PROGRAM NAME'
7FFF 00                  DEFB    0
1A19                     END     1A19H
00000 TOTAL ERRORS
```

Program Listing 2

line zero is in Program Listing 3.

CLOAD and run the special Save activator you typed in from Program Listing 1. You should see the message indicating that all went as planned and the Save command is ready. Type New to clear that program out of memory, and run the demonstration program in Program Listing 4; it already contains lines zero and one. Line zero will be altered and line one will be deleted. Run the program once to see it operate as a normal Basic program. Now type the word Save and enter. The TRS-80 prompts you for a program name. You can enter up to six characters to identify the program (call this program Demo). Before pressing Enter, set the cassette to record the new program just as in a normal CSAVE operation. You might save a second copy in case of a bad copy, but there is no verification like CLOAD? when using this step.

You can either turn off the computer or type New and remove your program. Rewind the tape and press play. Type System and at the *? prompt, enter Demo. At the second *? prompt type a slash and press Enter. The program should fill the screen with the graphics demonstration just as it did using the Run command a few moments before.

Because of the lack of a verification command, do not completely abandon the CSAVE command. During development of a new program, CSAVE the program as it changes. CSAVE a verified final copy and prepare a System-readable copy using the Save command for everyday use.

The starting address of the program is permanently stored on tape. Different TRS-80 models use different starting points for the beginning of a Basic program; a program you have saved on your Model III will probably not work on a friend's Model I. Disk systems alter the starting address also. However, any tape you prepare on your TRS-80 should always work on your TRS-80, and any identical TRS-80's. ■

Randy Hawkins, a chemical engineer, uses his TRS-80 for entertainment, personal and educational applications.

```
                 ;
                 ;       START BASIC EXECUTION ROUTINE
                 ;       BY RANDY HAWKINS
                 ;          6214 HIDDEN COVE
                 ;          CORPUS CHRISTI, TX
                 ;
                 ;       THIS IS THE ROUTINE WHICH IS
                 ;       POKED INTO THE REM STATEMENT
                 ;       AS OUTLINED IN THE ARTICLE.
                 ;       WHEN EXECUTED AT THE SYSTEM
                 ;       "SLASH" ENTRY, A NORMAL BASIC
                 ;       RUN COMMAND IS ENTERED AND
                 ;       ACTIVATED.          6/6/81
                 ;
42EE                     ORG     42EEH    ;START ADDRESS
42EE CDF81A              CALL    1AF8H    ;ROM ROUTINE
42F1 23                  INC     HL
42F2 22F940              LD      (40F9H),HL  ;END OF PROG
42F5 2AA740              LD      HL,(40A7H)  ;BUFFER ADD.
42F8 3652                LD      (HL),'R'
42FA 23                  INC     HL
42FB 3655                LD      (HL),'U'
42FD 23                  INC     HL
42FE 364E                LD      (HL),'N'
4300 23                  INC     HL
4301 AF                  XOR     A        ;ZERO BYTE
4302 77                  LD      (HL),A
4303 2AA740              LD      HL,(40A7H)
4306 3E0D                LD      A,13
4308 2B                  DEC     HL
4309 C3811A              JP      1A81H    ;ROM ENTRY POINT
0000                     END
00000 TOTAL ERRORS
```

Program Listing 3

```
0 REM...............................
1 ST=PEEK(16548)+256*PEEK(16549)+5:FORI=STTOST+29:READX:POKEI,X:
NEXTI:DATA205,248,26,35,34,249,64,42,167,64,54,82,35,54,85,35,54
,78,35,175,119,42,167,64,62,13,43,195,129,26:DELETE1
10 CLS:POKE16396,23:REM TO DISABLE THE BREAK KEY
20 FORZ=1TO3:FORI=15360TO16383STEP64
25 K=128+RND(63)
30 FORJ=0TO63:POKEI+J,K:NEXTJ
35 K=128+RND(63)
40 I=I+64:FORJ=63TO0STEP-1:POKEI+J,K
45 NEXTJ,I,Z:POKE16396,201
```

Program Listing 4

LOAD 80

A trace table to avoid a cluttered screen.

Clean Up Your TRON/TROFF

Arne Rohde
Pilevej 31
7600 Struer
Denmark

One of the main advantages of Basic on the TRS-80 is the ability to write and test programs interactively. Programs can be run immediately after making changes to them, without going through compilation and linking phases. Development time with Basic can be reduced significantly for smaller programs compared to similar compiled languages. Yet, when programs become larger and the logic more complicated, the time required to test and debug becomes more significant, and the quality of the testing tools available becomes more important. The testing and debugging tools may be built into the language itself, or be available as separate packages which can be used as required. One of the features built into Level II Basic on the TRS-80 is the trace facility.

The Key Box

Disk Basic
Model I
48K RAM

Program Tracing

How often have you encountered an error in a Basic program, but have been unable to determine the logic flow from the values of the variables at the time the error occurred? When you rerun the program, you can either set on the Basic trace function with the TRON command or embed instructions in the program to give a simulated trace, possibly with variable values displayed. Both methods have one major disadvantage: Any screen display will be destroyed unless the trace commands in the program direct the output to a printer. The Basic trace produces a mass of output unless carefully controlled with TRON and TROFF embedded in the program, especially in loops waiting for input with the INKEY$ function. The screen will fill with trace information, and any operator prompt will be lost.

A more useful trace function for many of the errors encountered during program development would be one which maintains a trace table in memory but only prints the results after the error has occurred. A trace function of this type is hidden during normal program execution; no program changes are required to run with or without the trace function. The disadvantages of this approach, apart from the increase in execution time, are that the trace table is of limited length, and variable values normally will not be stored. If variable values are required during the run, instructions to list these can be embedded in the program.

Program Listing 1 shows a routine which can be used to maintain a Basic trace table in memory. Data from the trace table can be printed either with a single Basic line executed directly from the keyboard, or with an error routine embedded in the program. An embedded routine can also be executed directly from the keyboard with a GOTO line number.

The routine was written for use with disk Basic; only a single line needs to be changed if it is used on a cassette-based system. The jump instruction in line 350 returns to DOS after initializing various pointers. For a tape system, the address in this instruction should return to the Basic Ready prompt. It was also written for a 48K system, with another routine resident from about FF00H, hence the start address FE00H. The start address can be changed (in line 180) to any desired value, and the routine reassembled. The relocation can be done manually, but the addresses in 12 of the instructions will have to be changed.

In disk operating systems, the routine is loaded before entering Basic; on entry to Basic, memory must be reserved for the routine. Alternately, after entering Basic, the routine could be POKEd into memory. In tape systems the routine can be written as a System tape and loaded after powering up the system. Again, memory must be reserved for the routine

The trace table has room for 10 entries. Unlike the built-in Basic trace, an entry will not be created for each command within a line. Instead the line number is associated with an execution count; this count is used each time a command is executed in the same line as the previous command. The maximum execution count is 255, and any excess count will be lost. Thus single-line loops will not fill up the trace table, whereas multi-line loops will have an entry for each line in the loop. When waiting for a key to be depressed, for example, the construct 200 A$ = INKEY$:IF A$ = "" THEN 200 should be used instead of

```
200 A$ = INKEY$
210 IF A$ = "" THEN 200
```

if the longest possible trace is desired. The latter will fill the table with line 200 and 210, the former will only have a single entry for line 200 with the remaining nine still showing the previous line numbers executed. An execution count greater than 255 will still be shown with the value 255.

Accessing Data

There are two methods for accessing data in the trace table. One is to type in a single line when data is needed; the other is to embed the access routine in the program so it will be executed when an error occurs or when a GOTO to the line is executed. For access from the keyboard, the address of the trace table must be known. As shown, it is resident from FE24H to FE41H, or −476 to −447 using the Basic method of addressing. Each entry in the table consists of three bytes, two for the line number and one for the execution count. The table can be printed with the line FOR I = −476 TO −449 STEP 3:PRINT PEEK(I) + 256*PEEK (I + 1);PEEK(I + 2):NEXT.

For automatic access, the trace table address is stored in the two bytes immediately preceding the routine entry point. The entry point can be found in the keyboard device control block at address 16406 and 16407. The program lines required for implementing an automatic print of the table are:

```
10 ON ERROR GOTO 65500
..........
65500 PRINT "ERROR";ERR/2 + 1;"IN LINE";ERL,"TRACE TABLE ENTRIES:"
65501 I! = PEEK(16406) + 256*PEEK(16407): IF I!>32767 THEN I! = I! − 65536
65502 I! = PEEK(I!-1*256 + PEEK(I! − 2):IF I!>32767 THEN I! = I! − 65536
65503 FOR I! = I! TO I! + 27 STEP 3:PRINT PEEK(I!) + 256*PEEK(I! + 1); PEEK(I! + 2),:NEXT:ON ERROR GOTO 0:END
```

Line 10 will cause control to be passed to line 65500 if an error occurs in the program. Line 65500 will first print the error number and the error line number, since the normal Basic error display has been suppressed. Line 65501 gets the routine start address from the keyboard device control block, and converts it to the required Basic format if it points to an address above 32767. Line 65502 will use this address to get the start address of the trace table, again converting it to Basic format. Line 65503 will then print the actual trace table entries. If the routine is required other than in an error trap, GOTO 65501 can be executed from the keyboard.

Lines executed directly from the keyboard and program lines with line numbers greater than 65279 will not be traced because of routine coding. The four lines used for printing the table will therefore not appear in the trace table listing, even though the trace routine is active while they are being executed.

Program Description

The normal Basic trace routine is resident in read-only memory, and can not be modified to provide the required trace information. However, the interpreter calls a keyboard scan routine immediately before executing each statement and before checking for trace on or off. The keyboard scan routine was a logical choice for inserting the trace code, with a check inserted to use the trace table only when a Basic program is executing. The call to the scan routine is found at address 1D1EH; the return address on the stack should be 1D21H. Other information has been put on the stack before getting to the keyboard routine, so the address can be found at displacement 14 from the current stack pointer value. The first statement in a program is not executed beginning at address 1D1EH, and the line number will not appear in the trace table unless it contains multiple statements.

The address of the next command to be executed has also

Program Listing

```
                 ;
                 ;KEYBOARD INTERCEPT AND TRACE ROUTINE
                 ;MAINTAINS TRACE TABLE FOR LINE NUMBERS < FF
00 (65280)
                 ;TOGETHER WITH ONE-BYTE EXECUTION COUNT (MAX
 255)
                 ;
                 ;PROGRAMMED BY ARNE ROHDE, PILEVEJ 31,
                 ;7600 STRUER, DENMARK, OCTOBER 1980
                 ;
FE00                         ORG     0FE00H
FE00              INTKYB     EQU     $                 ;INITIALISE
KEYBD ROUTINE
FE00 2A1640                  LD      HL,(4016H)        ;PRESENT DRI
VER ADDR
FE03 EB                      EX      DE,HL             ;ADDRESS TO
DE
FE04 2144FE                  LD      HL,KYBRUT         ;NEW ADDRESS

FE07 DF                      RST     24                ;COMPARE DE,
HL
FE08 280A                    JR      Z,CLRTAB          ;ALREADY ENT
ERED
FE0A EB                      EX      DE,HL             ;BACK TO HL
FE0B 22A4FE                  LD      (JPRET+1),HL      ;STORE IN RE
TURN
FE0E 2144FE                  LD      HL,KYBRUT         ;NEW KEYBOAR
D ROUTINE
FE11 221640                  LD      (4016H),HL        ;INSERT IN D
CB
FE14              CLRTAB     EQU     $
FE14 2124FE                  LD      HL,TRCTAB
FE17 3600                    LD      (HL),0            ;CLEAR TRACE
 TAB
FE19 1125FE                  LD      DE,TRCTAB+1
FE1C 011D00                  LD      BC,TRCTBE-TRCTAB-1
FE1F EDB0                    LDIR
FE21 C32D40                  JP      402DH             ;RETURN TO D
OS
                 ;
                 ;TRACE TABLE
FE24              TRCTAB     EQU     $
FE42              TRCTBE     EQU     TRCTAB+30         ;10 ENTRIES
OF 3 BYTES
FE3F              TABLIN     EQU     TRCTBE-3          ;CURRENT LIN
E NO
                 ;TABLE ADDRESS
FE42                         ORG     TRCTBE
FE42 24FE                    DEFW    TRCTAB            ;PRECEDES KY
BRUT
                 ;
                 ;KEYBOARD INTERCEPT ROUTINE
FE44              KYBRUT     EQU     $
FE44 210E00                  LD      HL,14             ;RETURN ADDR
 IN STACK
FE47 39                      ADD     HL,SP             ;ADDR TO HL
FE48 5E                      LD      E,(HL)            ;LSB TO E
FE49 23                      INC     HL
FE4A 56                      LD      D,(HL)            ;MSB TO D
FE4B 21211D                  LD      HL,1D21H          ;EXPECTED AD
DR
FE4E DF                      RST     24                ;COMPARE VAL
UE
FE4F 203F                    JR      NZ,DEBNCE         ;NOT EQ, IGN
ORE
FE51 210600                  LD      HL,6              ;OLD HL VALU
E IN STACK
FE54 39                      ADD     HL,SP
FE55 5E                      LD      E,(HL)            ;ADDR TO DE
FE56 23                      INC     HL
FE57 56                      LD      D,(HL)
FE58 1A                      LD      A,(DE)            ;NEXT CHAR T
O A
FE59 B7                      OR      A                 ;CHECK FOR 0

FE5A 2AA240                  LD      HL,(40A2H)        ;GET LINE NO

FE5D 200C                    JR      NZ,STORLN         ;NON-ZERO, S
TORE LINE
FE5F EB                      EX      DE,HL             ;ADDR TO HL
FE60 23                      INC     HL                ;BYPASS NEXT
 ADDR
FE61 7E                      LD      A,(HL)            ;CHECK FOR E
ND OF PROG
FE62 23                      INC     HL
FE63 B6                      OR      (HL)              ;CHECK NEXT
ADDR =0
FE64 282A                    JR      Z,DEBNCE          ;YES, IGNORE

FE66 23                      INC     HL
FE67 5E                      LD      E,(HL)            ;GET LINE NO

FE68 23                      INC     HL
FE69 56                      LD      D,(HL)
FE6A EB                      EX      DE,HL             ;LINE NO TO
HL
FE6B              STORLN     EQU     $
FE6B 7C                      LD      A,H               ;CHECK MSB=F
F
FE6C 3C                      INC     A                 ;LINE NO >65
279
FE6D 2821                    JR      Z,DEBNCE          ;YES, IGNORE

FE6F EB                      EX      DE,HL             ;LINE NO TO
```

Program continues

Program continued

```
 DE
 FE70 2A3FFE   00800          LD     HL,(TABLIN)      ;LAST LINE N
 O IN TABLE
 FE73 DF       00810          RST    24               ;COMPARE DE,
 HL
 FE74 3A41FE   00820          LD     A,(TABLIN+2)     ;PRESENT COU
 NT
 FE77 2811     00830          JR     Z,INCRPT         ;INCREMENT R
 EPEAT COUNT
 FE79 D5       00840          PUSH   DE               ;STORE LINE
 NO
 FE7A 2127FE   00850          LD     HL,TRCTAB+3      ;MOVE TABLE
 LEFT
 FE7D 1124FE   00860          LD     DE,TRCTAB
 FE80 011B00   00870          LD     BC,TRCTBE-TRCTAB-3
 FE83 EDB0     00880          LDIR
 FE85 E1       00890          POP    HL               ;LINE NO
 FE86 223FFE   00900          LD     (TABLIN),HL      ;STORE NEW N
 UMBER
 FE89 AF       00910          XOR    A
 FE8A          00920 INCRPT   EQU    $
 FE8A 3C       00930          INC    A                ;INCR COUNT
 FE8B 2803     00940          JR     Z,DEBNCE         ;OVER MAX CO
 UNT
 FE8D 3241FE   00950          LD     (TABLIN+2),A     ;STORE NEW
 FE90          00960 DEBNCE   EQU    $                ;DEBOUNCE RO
 UTINE
 FE90 118038   00970          LD     DE,3880H         ;KEYBOARD AR
 EA
 FE93 213540   00980          LD     HL,4035H         ;PREVIOUS VA
 LUES
 FE96          00990 NXKY     EQU    $
 FE96 CB03     01000          RLC    E                ;TO NEXT ADD
 R
 FE98 F8       01010          RET    M                ;NO CHANGE,
 RETURN
 FE99 2C       01020          INC    L                ;NEXT OLD VA
 LUE
 FE9A 1A       01030          LD     A,(DE)           ;GET KEYS
 FE9B AE       01040          XOR    (HL)             ;COMP WITH P
 REVIOUS
 FE9C 28F8     01050          JR     Z,NXKY           ;REPEAT IF S
 AME
 FE9E 0605     01060          LD     B,5              ;DELAY VALUE

 FEA0 CD6000   01070          CALL   0060H            ;DELAY ROUTI
 NE
 FEA3 C3E303   01080 JPRET    JP     03E3H            ;CONTINUE KE
 YBOARD ROUTINE
               01090                                  ;ADDRESS CHA
 NGED BY INITL
 FE00          01100          END    INTKYB
 00000 TOTAL ERRORS
```

been stored on the stack, and this value will be found at displacement six. If this address points to a byte containing binary zero, a new line is to be executed; the line number will be found at displacement three from the address. If the byte is non-zero, a new command within the current line is to be executed, and the current line number will be found at location 40A2H.

Lines 190–350 in the routine are used for initialization, and are usually executed only once. A check has been made for inadvertent execution more than once, to avoid an endless loop. The current keyboard driver address is compared to the routine entry point, and if identical no new address is stored in the keyboard device control block. Otherwise the trace routine start address is stored in the jump instruction JPRET; the current routine will be used after the trace routine has been executed. The trace table is then cleared, ready to accept trace information, followed by a jump to the DOS entry point (402DH). This address should be changed to 72H if the routine is used on a tape system.

Trace Table

The trace table itself is defined in lines 380–400, and consists of 10 entries, each three bytes long. The first two bytes in each entry are the line number, the last is the execution count. The trace table could be defined with any desired number of entries by changing the value in line 390, and reassembling the routine. More entries will require more storage and slow down execution of Basic programs since the whole table is moved for each new line executed. The current line will always be in the last table entry, easing access to the table at a cost in execution time. A circular table with pointers could have been used, but would have complicated the table access logic.

The keyboard intercept and trace routine starts with the label KYBRUT in line 460, and is preceded by the table start address to allow easy relocation of the table. The stack is accessed to check for the return address. If this is not equal to 1D21H the remainder of the routine is skipped. The current execution address is then found at displacement six in the stack. If this points to a non-zero byte the line number at 40A2H is used; otherwise, a check for end of program is made and the line number of the next line is found. Line numbers with the most significant byte equal to FFH will be ignored. This takes care of directly executed statements (line number FFFFH) and line numbers greater than 65279. If only directly executed statements are to be ignored, line 765 should be inserted with the statement AND L. If the current line number is equal to the last line number in the table then the execution count is incremented (unless it already contains the value 255). If the line numbers differ, the table is shifted left one entry, the new line number inserted in the last entry, and the execution count is set to one.

Since the routine is inserted in the keyboard scan procedure, it was logical to try and fix keyboard debounce. The debounce routine is found in lines 970–1070. If your system already contains an effective keyboard debounce routine these lines should be deleted. These lines, together with the return jump instruction, could also be used as an independent keyboard debounce, and will execute faster than the one in read-only memory if there is no change in keyboard status.

Modifications

The routine could be modified to increase the execution count to a two byte value if 255 as maximum is too restrictive. Modifications could also be made so only certain command types are traced, or so tracing could be switched off under program control to save execution time. It should also be possible to include single-stepping or slow execution, controlled from the keyboard or by the program being executed. Note: The routine is for Model I; changes will probably be required to run on Model III. ■

Take the tedium out of debugging.

Checksum

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Debugging long listings gets tedious whether you mind keying in listings or not. If you have a Model I or Model III Level II TRS-80, you can add this 800-byte program to the end of any Basic program to hasten debugging by producing checksums for the main program listing.

Generation of checksums must be simple, uniform and consistent. The Checksum listing in Program Listing 1 computes and displays a single checksum value for each program line. It also generates the total of all checksums in each successive block of ten program lines. The main program lines may contain multiple statements separated by a colon. The reader can then compare his checksums to those generated by the author of the program. They will show correct and incorrect program lines. The actual checksum value is the sum of the contents of all memory locations after the next-line pointer and up to the first remark statement on each line.

How do we find out what memory locations belong to each program line? Let's use the short "Formula 80" Basic program from the August 1981 issue as an example (Program Listing 2). Table 1 shows how the first two lines are stored in RAM on the Model I.

> *"How do we find out what memory locations belong to each program line?"*

The first two locations of each line point to the beginning of the next program line. The following two memory locations specify the program line number. If the line number were greater than 255, then location 17132 would contain the most significant byte of the line number. The succeeding memory locations contain the program statements in compression code format where applicable (see "Mysteries of the Level II ROM," *80 Microcomputing*, December 1980, p. 150). Each program ends with 0. The checksum value for line 100 of Listing 2 is the sum of the contents of addresses 17131–17138. The checksum value includes the line number but not the next line pointer (17129–17130). Thus the checksum value is independent of where the program line resides in RAM.

The Checksum listing should have high line numbers so the main program is not disturbed. The Checksum program in Listing 1 generates checksums for all program lines up to but excluding the lines of the Checksum program itself. Since Checksum appends the main Basic program listing and can run separately, it will not interfere with the variables tables, string or array storage area or protected memory (if used). The Checksum program can use the

Address	Contents	Meaning
17129	244	Next line
17130	66	at 17140
17131	100	This line
17132	0	Nr 100
17133	132	CLS
17134	58	:
17135	153	DEFINT
17136	65	A
17137	206	—
17138	87	W
17139	0	End of Line
17140	3	Next line
17141	67	at 17155
17142	110	This line
17143	0	Nr 110
17144	72	H
17145	79	O
17146	213	=
17147	51	3
17148	50	2
17149	58	:
17150	74	J
17151	213	=
17152	72	H
17153	79	O
17154	0	End of Line

Table 1

LINE	CHECKSUM
100	801
110	1071
120	768
130	1734
140	1932
150	1946
160	2389
170	1314
180	2004
190	2499
BLOCK 1	16458

HIT ENTER TO CONTINUE?_

Figure 1

The Key Box

Basic Level II
Model I or III

✓ See List of Advertisers on Page 455

same variables since running the main program automatically reestablishes the proper variables tables. An End statement separates the last line of the main program from the Checksum listing.

Program authors should integrate checksums for each line in their program listing so that users can double-check manually-entered listings. To generate checksums, the program author would perform the following steps:

Directions

- Enter manually or CLOAD as directed the debugged main program listing for which you desire checksums.
- Key in manually and add to the main program listing the Checksum listing in Listing 1.
- RUN 65000. The checksums for each line will display in 10 line blocks, and a block total will show as in Fig. 1.
- Copy the checksum for each line of the main program listing and the block total for each 10 lines.
- Edit each line and add either " ' (checksum)" or ":REM (checksum)". Add no space after the last character of the original line and the apostrophe. The remark form requires no space before or after the colon. Program Listing 3 shows the new listing. Table 2 shows how it is stored in RAM.
- Provide the block totals in a single figure or table for the magazine to print as part of the article.
- CSAVE the new program listing in Listing 3 (with lines 65000-65080 still appended) to tape. The publisher prints the listing from this tape.

The reader should manually key in the entire listing as shown in Listing 3, but omit the checksum values at the end of each program line. When the reader

```
65000 A = PEEK(16549)*256 + PEEK(16548): D = 0
65010 CLS: D = D + 1: E = 0: PRINT," LINE","CHECKSUM"
65020 FOR I = 1 TO 10: C = 0: L = PEEK(A + 3)*256 + PEEK(A + 2)
65030 IF L<65000 PRINT,L,: B = PEEK(A + 1)*256 + PEEK(A): ELSE 65070
65040 FOR J = A + 2 TO B - 1: F = PEEK(J): IF F = 147 C = C - 58: GOTO 65060
65050 C = C + F: NEXT J
65060 PRINT C: A = B: E = E + C
65070 NEXT I: PRINT: PRINT,"BLOCK";D,E: PRINT: IF L>64999 END
65080 PRINT,"HIT ENTER TO CONTINUE";: INPUT C: GOTO 65010
```

Program Listing 1. Checksum

```
100 CLS:DEFINTA-W
110 HO = 32:J = HO
120 GOSUB290:GOTO230
130 Z = SIN(.9*X)*15*P
140 IFPEEK(15350) = 32HO = HO - 2
150 IFPEEK(15350) = 64HO = HO + 2
160 A4 = A3:A3 = A2:A2 = A1:A1 = Z + 23
170 IFTIME<5A4 = 23
180 PRINTTAB(Z + 23)CHR$(124)CHR$(191);
190 PRINT@768 + HO,CHR$(134)CHR$(143)CHR$(137);
200 Y = 702 + J:PRINT@Y,"    "CHR$(133)"    ";:J = HO
210 PRINT@1001 + Z,CHR$(191)CHR$(124):R = A4:S = A4 + 18
220 IFHO>SORHO<RPRINT"CRASH!!!!":PRINT"TIME = "TIME;:GOSUB280
230 IFTIME<10GOTO270
240 ONRND(2)GOTO250,260
250 X = X + .3
260 X = X - .3
270 TIME = TIME + 1:GOTO130
280 FORI = 1TO500:NEXT
290 ONRND(2)GOTO300,310
300 P = - 1:RETURN
310 P = 1:RETURN
320 END
```

Program Listing 2. Formula 80

executes RUN 65000 he can compare the checksum for each program line displayed to the author's checksum value in the magazine listing. When all your line checksums agree with the article, you will know that the listing you entered manually is the same as the author's, or your errors are self-cancelling on the same line, a remote possibility. Error messages would show up quickly when run.

Now you can delete lines 65000-65080 if you like and leave the Checksum program appended to the main program. It will not interfere with execution of the main program. Type run and Enter. ■

Lieutenant Commander Batie, USN, is the program coordinator for the Navy's Fleet Satellite Communications system.

Address	Contents	Meaning
17129	251	Next line
17130	66	at 17147
17131	100	This line
17132	0	Nr 100
17133	132	CLS
17134	58	:
17135	153	DEFINT
17136	65	A
17137	206	–
17138	87	W
17139	58	:
17140	147	REM See
17141	251	' Note
17142	32	SPACE
17143	56	8
17144	48	0
17145	49	1
17146	0	End of line
17147	17	Next line
17148	67	at 17169
17149	110	This line
17150	0	Nr 110
17151	72	H
17152	79	O
17153	213	=
17154	51	3
17155	50	2
17156	58	:
17157	74	J
17158	213	=
17159	72	H
17160	79	O
17161	58	:
17162	147	REM
17163	32	SPACE
17164	49	1
17165	48	0
17166	55	7
17167	49	1
17168	0	End of line

Table 2

```
100 CLS:DEFINTA-W' 801
110 HO = 32:J = HO:REM 1071
120 GOSUB290:GOTO230:REM 768
130 Z = SIN(.9*X)*15*P:REM 1734
140 IFPEEK(15350) = 32HO = HO - 2:REM 1932
150 IFPEEK(15350) = 64HO = HO + 2:REM 1946
160 A4 = A3:A3 = A2:A2 = A1:A1 = Z + 23:REM 2389
170 IFTIME<5A4 = 23:REM 1314
180 PRINTTAB(Z + 23)CHR$(124)CHR$(191);:REM 2004
190 PRINT@768 + HO,CHR$(134)CHR$(143)CHR$(137);:REM 2499
200 Y = 702 + J:PRINT@Y," "CHR$(133)" ";:J = HO:REM 2761
210 PRINT@1001 + Z,CHR$(191)CHR$(124):R = A4:S = A4 + 18:REM 3198
220 IFHO>SORHO<RPRINT"CRASH!!!!":PRINT"TIME = "TIME;:GOSUB280:REM 3633
230 IFTIME<10GOTO270:REM 1281
240 ONRND(2)GOTO250,260:REM 1242
250 X = X + .3:REM 941
260 X = X - .3:REM 697
270 TIME = TIME + 1:GOTO130:REM 1435
280 FORI = 1TO500:NEXT:REM 1020
290 ONRND(2)GOTO300,310:REM 1029
300 P = - 1:RETURN:REM 797
310 P = 1:RETURN:REM 601
320 END:REM 193
65000 A = PEEK(16549)*256 + PEEK(16548): D = 0
65010 CLS: D = D + 1: E = 0: PRINT," LINE","CHECKSUM"
65020 FOR I = 1 TO 10: C = 0: L = PEEK(A + 3)*256 + PEEK(A + 2)
65030 IF L<65000 PRINT,L,: B = PEEK(A + 1)*256 + PEEK(A): ELSE 65070
65040 FOR J = A + 2 TO B - 1: F = PEEK(J): IF F = 147 C = C - 58: GOTO 65060
65050 C = C + F: NEXT J
65060 PRINT C: A = B: E = E + C
65070 NEXT I: PRINT: PRINT,"BLOCK";D,E: PRINT: IF L>64999 END
65080 PRINT,"HIT ENTER TO CONTINUE";: INPUT C: GOTO 65010
```

Program Listing 3. Formula 80 and Checksum

LOAD 80

This algorithm sorts quickly.

Quicksort

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Most data processing applications must sooner or later present data in sequence. As a corollary to Murphy's law, that sequence is not the one that is kept in the data. Thus the need to sort is born. There are a number of algorithms for sorting, some fast and some slowly. Quicksort is the fastest available.

The Quicksort algorithm is simple and, with a little study, easy to understand. An array to be sorted is partitioned into two subarrays. To form the subarrays you choose an element within the array and search up until you locate an element greater than or equal to the chosen element. Then you search down for an element less than or equal to the chosen element. The stopping elements are exchanged, and the scan repeats until the indices cross. The result is two subarrays (partitions). The left contains elements less than or equal to the chosen element; the right contains elements greater than or equal to the chosen element.

In more detail, the algorithm is: Given an array K(0)...K(N) to be sorted, pick an element for use in the partitioning process (P = K(I)). Then scan from K(0) up for an element greater than or equal to P. When you find one, scan from K(N) down for an element less than or equal to P. If the indices have not crossed, exchange the two elements and continue the scan. When the indices cross, the left partition contains all elements less than or equal to P, and the right parti-

The Key Box

Basic Level II
Model I

```
10 CMD"LOAD QSORT3/CMD"
20 CLS:CLEAR 20000
30 DEFUSR0=&HFE5B:DEFINTI-Z:DEFSTRA-H
40 DIM A(999), I(999), B(3)
50 CMD"TIME,00:00:00"
60 FOR K9=199 TO 999 STEP 200
70 X=0: B(0)=RIGHT$(TIME$,9)
80 FOR J=K9-199 TO K9
90 L=RND(7)
100 B=STRING$(12," ")
110 FOR K=0 TO L:MID$(B,12-K,1)=CHR$(64+RND(26)):NEXT K
120 A(J)=B
130 PRINT@128,J;
140 NEXT J
150 I(0)=K9:I(1)=VARPTR(A(0))
160 B(1)=RIGHT$(TIME$,9)
170 X=USR0(VARPTR(I(0)))
180 B(2)=RIGHT$(TIME$,9)
190 FOR J=0 TO K9-1
200 IF A(I(J)).G.A(I(J+1)) THEN PRINT J;I(J);A(I(J));I(J+1);A(I(J+1))
210 NEXT J
220 B(3)=RIGHT$(TIME$,9)
230 LPRINT"SORT OF "K9+1" ELEMENTS"
240 LPRINT"ARRAY BUILD START WAS ";B(0)
250 LPRINT"                END   WAS ";B(1)
260 LPRINT"SORT ENDED AT ------- ";B(2)
270 LPRINT"VERIFY ENDED AT ----- ";B(3)
280 LPRINT
290 LPRINT
300 NEXT K9
310 LPRINT CHR$(12)
320 C="  J          A(J)            I(J)        A(I(J))"
330 D=" ##    (%             %)     ###    (%              %)"
340 LPRINT C
350 LPRINT
360 FOR J=0 TO 19
370 LPRINT USING D;J,A(J),I(J),A(I(J))
380 NEXT J
390 LPRINT CHR$(12)
400 GOTO 400
```

Program Listing 1. SORTTST

tion holds all elements greater than or equal to P.

If you invoke the above process for each resulting partition containing more than one element, the array will be sorted. The bookkeeping is complex but the concept is simple.

How "Intuitive" is Quicksort?

To prove just how "intuitive" Quicksort is relative to other algorithms, try the following experiment. Shuffle a deck of cards and deal four bridge hands. Then sort each hand with a different algorithm. The results will surprise those who advocate the bubble sort! I found that an insertion sort is most natural (probably because the eye scans the entire hand). A warning: Do not assume that ten minutes is enough time.

In non-recursive implementations, an auxiliary stack remembers one partition while another is sub-partitioned. This adds to the already complex bookkeeping.

Limitations

There are two potential problems with Quicksort. If the comparison key is the largest or smallest in the partition, we subdivide to a one element and an (N-1) element pair. If this occurs on every choice of comparison key, our sort degenerates into an order N squared sort, no improvement over a bubble sort! Also, if in this case we stack the smaller partition, our stack requires (N-1) positions. This is not good for a minimum core sort.

The auxiliary stack problem is easy to solve. We can limit our stack to ln(N) by stacking the largest partition and sorting the smaller one. (Not too bad: 4K elements require 12 stack positions.)

The problem of the worst-case performance of the sort is not so easy to solve. There are two ways to attack it. The first method is to choose the partitioning key as the median of a small sample. This also improves the average performance of the sort. The second method is to choose the partitioning key at random. I have used this method in my Quicksort implementation. The Z80 refresh register provides an easy method for obtaining a random number.

The Program Listings are for a TRS-80 Model I with Level II Basic, but you can modify it to run on any Z80 system by changing the compare, set center, exchange and initialization routines.

SORTTST (Program Listing 1) serves as a test of the sort and an example of the arrays and calling sequence for the sort. Line 30 defines the entry point of the sort and types the variables. Line 40 dimensions the alpha array to be sorted (A) and the pointer array (I). Line 70 references the return code variable (X). Line 150 sets the high element index and the address of the string array. Line 170 invokes the sort.

The sort operates indirectly: It provides a sequential index list to the alpha array in the pointer array. I chose this method for two reasons. First, this fits well with the Radio Shack mailing list programs. Second, it does not change the original data sequence.

A warning about the calling sequence! Array variables are moved down when new variables are introduced. For safety, the calling sequence should begin with an assignment to all variables used in it.

```
SORT OF  200  ELEMENTS
ARRAY BUILD START WAS  00:00:01
            END   WAS  00:00:35
SORT ENDED AT -------  00:00:36
VERIFY ENDED AT -----  00:00:39

SORT OF  400  ELEMENTS
ARRAY BUILD START WAS  00:00:52
            END   WAS  00:01:23
SORT ENDED AT -------  00:01:25
VERIFY ENDED AT -----  00:01:32

SORT OF  600  ELEMENTS
ARRAY BUILD START WAS  00:01:45
            END   WAS  00:02:17
SORT ENDED AT -------  00:02:22
VERIFY ENDED AT -----  00:02:32

SORT OF  800  ELEMENTS
ARRAY BUILD START WAS  00:02:44
            END   WAS  00:03:15
SORT ENDED AT -------  00:03:21
VERIFY ENDED AT -----  00:03:34

SORT OF  1000  ELEMENTS
ARRAY BUILD START WAS  00:03:47
            END   WAS  00:06:10
SORT ENDED-AT -------  00:06:32
VERIFY ENDED AT -----  00:06:54

 J        A(J)          I(J)        A(I(J))

 0   (   IAPEVCDQ  )    368   (        AF
 1   (      DGNDF  )    758   (        AK
 2   (     IYDOLQ  )    270   (        AM
 3   (         NS  )    884   (        BB
 4   (      PKRCV  )    757   (        BF
 5   (   NIIOTOGL  )    699   (        BJ
 6   (       NDCZ  )    752   (        BY
 7   (     CHLORU  )    327   (        BZ
 8   (      FGETH  )    992   (        CD
 9   (    SBAMSRT  )    784   (        CM
10   (         PZ  )    618   (        DD
11   (   IFBJEMFI  )    881   (        DO
12   (   HULZHRRN  )    161   (        DF
13   (    IIMECPF  )    701   (        DT
14   (        PZN  )    466   (        EK
15   (       CAGI  )    453   (        FK
16   (        KZX  )    188   (        EP
17   (    IPCBGZJ  )    181   (        EZ
18   (      RPUEG  )    351   (        FG
19   (    PUXAOZP  )    344   (        FF
```

Figure 1

✓See List of Advertisers on Page 455

```
1000 REM CALL QUICKSORT
1010 REM ASSUME A$ AND I ARE
      DIMENSIONED AND THAT
1020 REM N HAS THE INDEX VALUE
      FOR THE LAST
1030 REM ELEMENT IN A$ TO BE
      SORTED
1040 RC = 0: ' USE THE RETURN
      CODE
1050 I(0) = N: I(1) = VARPTR(A$(0)): '
      SET SORT PARMS
1060 RC = USR0 (VARPTR(I(0))): ' CALL
      SORT
```

SORTTST provides a CPU intensive set of data to be sorted. The comparison in the sort terminates on the first unequal character. The data has a minimum of four leading blanks and an average of eight. If viewed as a list of names, the sort is operating on the Smith or Jones section of a phone book.

SORTTST also uses the fact that the sort preserves the original order of the data. As the sample run shows, most time is taken in building the test data.

NEWDOS80 simplifies the steps necessary to invoke the sort. The default memory size is set automatically at IPL to X'FD80', and the sort is loaded by the program itself. The program sets the time to zero.

The benchmark run (Fig. 1) took about seven minutes. Of that time, 23 seconds were used to sort 3000 strings. In no case did even the verification of the sequence match the sort time.

The Sort

The sort (see Program Listing 2) is organized with data areas first, followed by subroutines, and then the sort itself.

Lines 430-540 declare the data areas. Lines 550-2120 are the subroutines. Lines 2130-4570 are the main program.

Lines 2160-2610 edit the values passed to the sort. Lines 2650-2790 initialize the indirect pointer array. Lines 2800-2860 place the initial partition on the stack. The sort begins at line 2920 by unstacking the first partition to split. If the stack is empty, indicated by the value X'FF', the sort is completed and zero is returned to Basic.

Lines 3110-3370 select the partitioning element. This element remains constant throughout the process so the string descriptor is saved.

Lines 3410-3460 scan the partition from left to right until an element greater than or equal to the partitioning element is located. Lines 3500-3540 scan from right to left. These two sections of code are the meat of the sort.

Lines 3600-3620 check whether an exchange is required. Avoiding the exchange when the left and right pointers are the same is simply a time saver.

Lines 3660-3870 perform the exchange of the index array elements. Lines 3880-3910 are, again, time savers.

Lines 3950-4190 determine the smaller of the new partitions and select the routine which will stack the larger one.

Lines 4230-4320 stack the left to J partition if it is not empty, and select the II to right partition to sort. Lines 4360-4450 do the reverse.

Lines 4500-4570 check if the partition selected for sorting is empty and if so, transfers to unstack a partition. Otherwise, the selected partition is sorted.

The program's comments tell the story of its operation. The method of use is easy to understand for those who do not want to explore Assembly language or sorting theory. This program is easy to install and a time saver in conjunction with Radio Shack's original mailing list program. ■

Don Brumm is a systems programmer in operating systems development.

Program Listing 2

```
               00010 ;
               00020 ;THIS SORT IS DESIGNED TO BE CALLED FROM BAS
IC.
               00030 ;
               00040 ;IT SORTS A STRING ARRAY INTO ALPHA SEQUENCE
 WITH
               00050 ;SPECIAL TREATMENT OF UNEQUAL LENGTH STRINGS
. NULL
               00060 ;STRINGS ARE ALLOWED, THEY ARE LOWEST IN SEQ
UENCE.
               00070 ;STRINGS OF UNEQUAL LENGTHS WHICH ARE OTHERW
ISE EQUAL
               00080 ;ARE SEQUENCED WITH THE SHORTER STRING FIRST
.
               00090 ;ARRAY SIZE IS LIMITED TO 4096 ELEMENTS.
               00100 ;
               00110 ;CALLING SEQUENCE: GIVEN AN ARRAY A$(0)-A$(N
)
               00120 ; AN INDEX ARRAY I(0)-I(N), AND N THE NUMBER
 OF ELEMENTS
               00130 ; TO BE SORTED.
               00140 ; I(0)=N: I(1)=VARPTR(A$(0))
               00150 ; RC=USR0(VARPTR(I(0))): REM RC HAS THE SORT
 RETURN CODE
               00160 ; ON A SUCCESSFUL SORT, I(0)-I(N) PROVIDES A
 SEQUENTIAL
               00170 ; INDEX FOR THE ARRAY A$.  I.E.
               00180 ; FOR K=0 TO N: A$(I(K)) WILL ACCESS A$ IN S
EQUENCE
               00190 ;
               00200 ; THE VALUE OF RC IS:
               00210 ;        0   THE SORT WAS SUCCESSFUL
               00220 ;        1 - 6 THE SORT DID NOT TAKE PLACE
               00230 ;        1   I IS NOT AN INTEGER ARRAY
               00240 ;        2   I IS NOT SINGLE DIMENSIONED
               00250 ;        3   I IS DIMENSIONED LESS THAN N
               00260 ;        4   A$ IS NOT A STRING ARRAY
               00270 ;        5   A$ IS MULTI-DIMENSIONED
               00280 ;        6   A$ IS DIMENSIONED LESS THAN N
               00290 ;
               00300 ; A COMMON CAUSE OF CODES 4-6 IS TO INTRODUC
E RC AS A
               00310 ; NEW (NOT PREVIOUSLY ACCESSED) VARIABLE.  B
ASIC, NOT
               00320 ; KNOWING YOU HAVE SAVED THE ADDRESS OF A$(0
), MOVES
               00330 ; THE ARRAY A$ DOWN IN MEMORY TO MAKE ROOM F
OR THE NEW
               00340 ; SCALER VARIABLE RC.  IF THIS HAPPENS, YOU
CAN EITHER
               00350 ; RE-INVOKE THE SORT'S CALLING SEQUENCE OR A
DD AN
               00360 ; ASSIGNMENT OF THE FORM RC=0 PRIOR TO THE C
ALLING
               00370 ; SEQUENCE.
               00380 ;
               00390 ;
               00400 ;
               00410 ;
FD80           00420        ORG     0FD80H  ;FOR 48K SYSTEM
FD80 0000      00430 N9     DEFW    0       ;COUNT OF STRINGS IN
 A$ LESS 1
FD82 0000      00440 II     DEFW    0       ;INDEX I, NORMALLY I
N DE
FD84 0000      00450 J      DEFW    0       ;INDEX J, NORMALLY I
N HL
FD86 0100      00460 LEFT   DEFW    1       ;LEFT LIMIT VALUE
FD88 0000      00470 RIGHT  DEFW    0       ;RIGHT LIMIT VALUE
FD8A FFFF      00480 RSTK   DEFW    0FFFFH  ;RIGHT STACK IX STOP
PER
0018           00490        DEFS    24      ;STACK SPACE
FDA4 FFFF      00500 LSTK   DEFW    0FFFFH  ;LEFT STACK IY STOPP
ER
0018           00510        DEFS    24      ;STACK SPACE
0003           00520 CENTR  DEFS    3       ;SPACE FOR COMP DESC

FDC1 0000      00530 VPTRI  DEFW    0       ;ADDR OF ARRAY I
FDC3 0000      00540 VPTRA  DEFW    0       ;ADDR OF ARRAY A
               00550 ;
               00560 ; SUBROUTINES
               00570 ;
               00580 ; GETNA RETURNS THE ADDRESS OF THE STRING DE
SCRIPTOR
               00590 ;        AT A$(I(HL)).  INPUT IS THE I INDEX
IN HL.
               00600 ;        OUTPUT IS EQUIVILENT TO VARPTR(A$(I(
HL))) AND
               00610 ;        IS RETURNED IN HL.
               00620 ;
               00630 ;
FDC5 D5        00640 GETNA  PUSH    DE      ;SAVE DE
FDC6 29        00650        ADD     HL,HL   ;GET INDEX INTO I
FDC7 ED5BC1FD  00660        LD      DE,(VPTRI)  ; GET ADDRESS OF
 I
FDCB 19        00670        ADD     HL,DE   ;AND I(HL)
FDCC CDF1FD    00680        CALL    GETVAL  ;LOAD CONTENTS INTO
DE
FDCF 62        00690        LD      H,D     ;AND INTO HL
FDD0 6B        00700        LD      L,E
FDD1 29        00710        ADD     HL,HL   ;INDEX*2
FDD2 19        00720        ADD     HL,DE   ;INDEX*3
FDD3 EB        00730        EX      DE,HL   ;INTO DE
FDD4 2AC3FD    00740        LD      HL,(VPTRA) ;GET ARRAY ADDR
FDD7 19        00750        ADD     HL,DE   ;PLUS INDEX
FDD8 D1        00760        POP     DE      ;RESTORE DE
FDD9 C9        00770        RET             ;AND EXIT
               00780 ;
               00790 ; ACHECK CHECKS THE ARRAY DESCRIPTIONS FOR T
YPE
               00800 ;        (PASSED IN A), NUMBER OF DIMENSIONS
(MUST
               00810 ;        BE 1), AND LOADS THE NUMBER OF ELEME
NTS IN
               00820 ;        DE.  ON A GOOD RETURN, B IS SET TO 0
, AND
               00830 ;        HL WILL POINT TO THE ZERO'TH ELEMENT
.
               00840 ;        ON ENTRY, HL POINTS TO THE ARRAY'S Z
ERO'TH
               00850 ;        ELEMENT.  (HL=VARPTR(A(0)))
               00860 ;
FDDA 11F8FF    00870 ACHECK LD      DE,-8   ;BACK UP 8 TO POINT
TO
```

Listing 2 continues

Listing 2 continued

```
          ;                         ARRAY DESCRIPTOR.  (IF SINGLE
          ;                         DIMENSION.)
FDDD 19            ADD     HL,DE
          ;
          ; FORMAT OF THE DESCRIPTOR IS:
          ;  DISPLACEMENT  CONTENTS
          ;       0        TYPE CODE (2=INTEGER, 3=STRING)
          ;       1        2 BYTE NAME
          ;       3        SIZE IN BYTES
          ;       5        NUMBER OF DIMENSIONS
          ;       6        2 BYTE COUNT OF ELEMENTS
          ;       8        FIRST ELEMENT (IF 1 DIMENSION)
          ;
FDDE BE            CP      (HL)     ;CHECK TYPE
FDDF 200A          JR      NZ,ACHK0  ;WRONG - OUT WITH ERROR
FDE1 110500        LD      DE,5     ; POINT TO # DIM
FDE4 19            ADD     HL,DE
FDE5 46            LD      B,(HL)   ;GET IN B
FDE6 1006          DJNZ    ACHK1    ;IF NOT 1 OUT
FDE8 23            INC     HL       ;POINT TO ELE. COUNT
FDE9 1806          JR      GETVAL   ;AND EXIT VIA LOAD OF COUNT
FDEB 0601  ACHK0   LD      B,1      ;SET TYPE BAD
FDED C9            RET
FDEE 0602  ACHK1   LD      B,2      ;SET MULTI-DIM.
FDF0 C9            RET
          ;
          ; GETVAL LOADS THE INTEGER POINTED TO BY HL INTO DE.
          ;        HL, ON EXIT, POINTS TO THE NEXT INTEGER.
          ;
FDF1 5E    GETVAL  LD      E,(HL)   ;GET LOW BYTE
FDF2 23            INC     HL
FDF3 56            LD      D,(HL)   ;GET HIGH BYTE
FDF4 23            INC     HL
FDF5 C9            RET
          ;
          ; STACLR STACKS DE IN LSTK, HL IN RSTK AND
          ; ADJUSTS IX AND IY ACCORDINGLY
          ;
FDF6 DD23  STACLR  INC     IX
FDF8 DD23          INC     IX
FDFA DD7500        LD      (IX),L
FDFD DD7401        LD      (IX+1),H        ;STACK RIGHT
FE00 FD23          INC     IY
FE02 FD23          INC     IY
FE04 FD7300        LD      (IY),E
FE07 FD7201        LD      (IY+1),D        ;AND LEFT
FE0A C9            RET
          ;
          ;COMPARE HL TO DE.  C IS SET IF DE>HL
          ;
FE0B 7C    CHLDE   LD      A,H
FE0C BA            CP      D        ;COMP HIGH BYTES
FE0D C0            RET     NZ       ;UNEQUAL SO RETURN
FE0E 7D            LD      A,L
FE0F BB            CP      E
FE10 C9            RET
          ;
          ;SETCEN CAPTURES THE STRING DESCRIPTOR (POINTED TO BY
          ; HL) OF THE SELECTED COMPARAND FOR THE PARTITION.
          ; THIS ALLOWS US TO EXCHANGE IN THE ARRAY AND STILL
          ; MAINTAIN A FIXED COMPARAND.
          ;
FE11 E5    SETCEN  PUSH    HL       ;SAVE REGS USED
FE12 D5            PUSH    DE
FE13 C5            PUSH    BC
FE14 CDC5FD        CALL    GETNA    ;GET ADDRESS OF DESC.
FE17 11BEFD        LD      DE,CENTR        ;AND ADDR OF SAVE
FE1A 010300        LD      BC,3     ;SET COUNT
FE1D EDB0          LDIR             ;AND SAVE THE DESC.
FE1F C1            POP     BC       ;RESTORE REGS
FE20 D1            POP     DE
FE21 E1            POP     HL
FE22 C9            RET              ;AND RETURN
          ;
          ; CMPCEN COMPARES NAMES(HL) TO THE CENTER NAME
          ; CARRY IS SET IF NAME(HL)<CENTER, ZERO IF =
          ; ALL REGISTERS EXCEPT A ARE PRESERVED
          ;
FE23 E5    CMPCEN  PUSH    HL
FE24 D5            PUSH    DE
FE25 C5            PUSH    BC       ;SAVE REGISTERS
FE26 CDC5FD        CALL    GETNA    ;COMPUTE ADDR OF N(HL)
FE29 46            LD      B,(HL)   ;LOAD LENGTH
FE2A 23            INC     HL
FE2B 5E            LD      E,(HL)
FE2C 23            INC     HL
FE2D 56            LD      D,(HL)   ;AND STRING ADDR
FE2E 3ABEFD        LD      A,(CENTR) ;CENTER LENGTH
FE31 4F            LD      C,A
FE32 2ABFFD        LD      HL,(CENTR+1) ;AND STRING ADDR
FE35 78            LD      A,B      ;COMP LENGTH
FE36 B7            OR      A        ;IS IT NULL
FE37 2003          JR      NZ,COMP0 ;IF NOT CONTINUE
FE39 B9            CP      C        ;MAYBE BOTH NULL
FE3A 181B          JR      COMPX    ;OUT
FE3C 79    COMP0   LD      A,C      ;TRY CENTER
FE3D B7            OR      A        ;FOR NULL
```

Listing 2 Continues

Listing 2 continued

```
FE3E 2003      01880           JR      NZ,COMP1 ;NEITHER IS NULL
FE40 3C        01890           INC     A        ;CY OFF AND Z OFF
FE41 1814      01900           JR      COMPX    ;OUT COMP>CENTER
               01910 ; NEITHER IS NULL - COMPARE FOR SHORTEST LEN
GTH
FE43 C5        01920 COMP1     PUSH    BC       ;SAVE LENGTHS
FE44 79        01930           LD      A,C
FE45 B8        01940           CP      B
FE46 3001      01950           JR      NC,COMP2 ;SHORT IN B
FE48 41        01960           LD      B,C
               01970 ;NOW WE CAN COMPARE THE STRINGS
FE49 1A        01980 COMP2     LD      A,(DE)   ;GET COMP BYTE
FE4A BE        01990           CP      (HL)     ;COMPARE TO CENTER
FE4B 2009      02000           JR      NZ,COMP3 ;NOT EQ SO OUT
FE4D 13        02010           INC     DE
FE4E 23        02020           INC     HL       ;STEP POINTERS
FE4F 10F8      02030           DJNZ    COMP2    ;CONTINUE TO END OF
SHORT
FE51 C1        02040           POP     BC       ;GET LENGTHS BACK
FE52 78        02050           LD      A,B
FE53 B9        02060           CP      C        ;COMP TO CENT
FE54 1801      02070           JR      COMPX
FE56 C1        02080 COMP3     POP     BC
FE57 C1        02090 COMPX     POP     BC
FE58 D1        02100           POP     DE
FE59 E1        02110           POP     HL       ;RESTORE REGS
FE5A C9        02120           RET              ;AND RETURN
               02130 ;
               02140 ; INITIALIZE FOR SORT
               02150 ;
FE5B CD7F0A    02160 START     CALL    0A7FH    ;GET THE ARGUMENT
               02170 ;
               02180 ; FIRST WE EDIT THE PASSED PARAMETERS AS WEL
L AS WE
               02190 ; CAN.  THIS CAN SAVE UNEXPECTED RE-BOOTS AN
D LOCK-
               02200 ; UPS.  IF THE EDIT IS SUCCESSFUL, WE WILL I
NITIALIZE
               02210 ; I(0)-I(N) WITH THE INTEGERS 0-N.  THESE IN
DIRECT
               02220 ; POINTERS INTO A$ ARE WHAT ARE EXCHANGED IN
 THE SORT.
               02230 ;
FE5E 22C1FD    02240           LD      (VPTRI),HL      ;SAVE POINTE
R TO I(0)
FE61 3E02      02250           LD      A,2             ;TARGET TYPE

FE63 CDDAFD    02260           CALL    ACHECK   ;CHECK THYP AND DIM
FE66 78        02270           LD      A,B      ;GET RET
FE67 B7        02280           OR      A        ;CHECK IT
FE68 201B      02290           JR      NZ,ERRET ;IF BAD - OUT
FE6A D5        02300           PUSH    DE       ;SAVE ELEMENT COUNT
FE6B CDF1FD    02310           CALL    GETVAL   ;LOAD N
FE6E ED5380FD  02320           LD      (N9),DE  ;AND SAVE IT
FE72 CDF1FD    02330           CALL    GETVAL   ;GET A$(0) ADDRESS
FE75 ED53C3FD  02340           LD      (VPTRA),DE  ;AND SAVE IT
FE79 2A80FD    02350           LD      HL,(N9)  ;GET N BACK
FE7C D1        02360           POP     DE       ;AND ELEMENT COUNT
FE7D B7        02370           OR      A        ;CLEAR CARRY
FE7E ED52      02380           SBC     HL,DE    ;N-E COUNT
FE80 FA8BFE    02390           JP      M,IISOK  ;I IS OK
FE83 3E03      02400           LD      A,3      ;SET ERROR CODE
               02410 ;
               02420 ; RETURN TO BASIC WITH RETURN CODE IN HL
               02430 ;
FE85 6F        02440 ERRET     LD      L,A      ;SET LOW BYTE
FE86 2600      02450           LD      H,0      ;AND HIGH BYTE
FE88 C39A0A    02460           JP      0A9AH    ;AND RETURN
               02470 ;
               02480 ; CHECK ARRAY A$ DESCRIPTOR
               02490 ;
FE8B 2AC3FD    02500 IISOK     LD      HL,(VPTRA)      ;POINT TO A$
(0)
FE8E 3E03      02510           LD      A,3      ;SET TYPE
FE90 CDDAFD    02520           CALL    ACHECK   ;GO CHECK IT
FE93 78        02530           LD      A,B      ;GET RET CODE
FE94 B7        02540           OR      A        ;CHECK IT
FE95 200A      02550           JR      NZ,ERRA  ;IF BAD - OUT
FE97 2A80FD    02560           LD      HL,(N9)  ;GET N
FE9A ED52      02570           SBC     HL,DE    ;CHECK SIZE OF A$
FE9C FAA5FE    02580           JP      M,FILLI  ;OK - FILL I
FE9F 3E03      02590           LD      A,3      ;SET CODE
FEA1 C603      02600 ERRA      ADD     A,3      ;INDICATE A$ IN ERRO
R
FEA3 18E0      02610           JR      ERRET    ;AND GET OUT
               02620 ;
               02630 ; NOW WE CAN INITIALIZE I(0)-I(N)
               02640 ;
FEA5 19        02650 FILLI     ADD     HL,DE    ;GET COUNT BACK
FEA6 EB        02660           EX      DE,HL    ;AND INTO DE
FEA7 2AC1FD    02670           LD      HL,(VPTRI) ;POINT TO ARRAY
FEAA 19        02680           ADD     HL,DE    ;ADD N
FEAB 19        02690           ADD     HL,DE    ;TWICE FOR LAST ELEM
ENT
FEAC 23        02700           INC     HL       ;POINT TO HIGH BYTE
FEAD 72        02710 FILLI0    LD      (HL),D   ;STORE HIGH
FEAE 2B        02720           DEC     HL       ;POINT TO LOW
FEAF 73        02730           LD      (HL),E   ;AND STORE IT
FEB0 7A        02740           LD      A,D
FEB1 B3        02750           OR      E        ;ARE WE DONE
FEB2 2804      02760           JR      Z,FILLI1        ;YES - DO SO
RT
FEB4 1B        02770           DEC     DE       ;COUNT DOWN
FEB5 2B        02780           DEC     HL       ;POINTER TOO
FEB6 18F5      02790           JR      FILLI0   ;AND DO ANOTHER
FEB8 2A80FD    02800 FILLI1    LD      HL,(N9)  ;GET COUNT
FEBB FD21A4FD  02820           LD      IY,LSTK
FEBF DD218AFD  02830           LD      IX,RSTK         ;SET POINTER
S TO AUX
               02840 ;                                 STACK OF UNS
ORTED PARTS
FEC3 110000    02850           LD      DE,0            ;INITIAL LEF
T MARGIAN
FEC6 CDF6FD    02860           CALL    STACLR          ;STACK INITI
AL VALUES
               02870 ;
               02880 ; BEGIN QUICKSORT.  THIS ALGORITHM IS AN ADA
PTATION
               02890 ; OF THAT FOUND IN "ALGORITHMS + DATA STRUCT
URES =
               02900 ; PROGRAMS" BY NICLAUS WIRTH.
               02910 ;
FEC9 DD7E01    02920 UPSTK     LD      A,(IX+1)        ;GET MSB OF
RIGHT
FECC FEFF      02930           CP      255             ;CHECK FOR S
TOPPER
FECE 200C      02940           JR      NZ,UNSTK0       ;NOT THERE S
O CONTINUE
               02950 ;
               02960 ; THE SORT IS DONE SO RETURN A ZERO
               02970 ;
FED0 210000    02980           LD      HL,0            ;GET A ZERO
FED3 C39A0A    02990           JP      0A9AH           ;DO THE RETU
RN
               03000 ; CONTINUE THE UNSTACKING OF A PARTITION
FED6 67        03010 UNSTK0    LD      H,A
FED7 DD6E00    03020           LD      L,(IX)          ;RIGHT LIMIT
 IN HL
FEDA FD5601    03030           LD      D,(IY+1)
FEDD FD5E00    03040           LD      E,(IY)          ;LEFT LIMIT
IN DE
FEE0 DD2B      03050           DEC     IX
FEE2 DD2B      03060           DEC     IX              ;DEC RIGHT P
OINTER
FEE4 FD2B      03070           DEC     IY
FEE6 FD2B      03080           DEC     IY              ;AND LEFT PO
INTER
FEE8 2288FD    03090           LD      (RIGHT),HL      ;SAVE RIGHT
FEEB ED5386FD  03100           LD      (LEFT),DE       ;AND LEFT
FEEF E5        03110 GETCN     PUSH    HL              ;SAVE RIGHT
ON STACK
               03120 ;
               03130 ; WE PICK A RANDOM KEY AS COMPARAND TO AVOID
 THE
               03140 ; WORSE CASE PERFORMANCE OF THE ALGORITHM.
               03150 ;
FEF0 AF        03160           XOR     A        ;CLEAR A AND CY
FEF1 ED52      03170           SBC     HL,DE    ;GET LEFT-RIGHT
FEF3 BC        03180           CP      H        ;CHECK SPAN OVER 256

FEF4 200E      03190           JR      NZ,GT255 ;IF SO GET RND 0-25
5
FEF6 ED5F      03200           LD      A,R      ;GET RND 0-127
FEF8 063F      03210           LD      B,63     ;SET MASK
FEFA BD        03220 CK00      CP      L        ;IS RND IN SPAN
FEFB 380F      03230           JR      C,AISOK  ;L GREATER
FEFD 280D      03240           JR      Z,AISOK  ;OR EQUAL IS OK
FEFF A0        03250           AND     B        ;TAKE TOP BIT OFF
FF00 CB38      03260           SRL     B        ;HALVE MASK
FF02 18F6      03270           JR      CK00
FF04 ED5F      03280 GT255     LD      A,R      ;GET RND 0-127
FF06 CB45      03290           BIT     0,L      ;IF DIFF IS ODD
FF08 2802      03300           JR      Z,AISOK  ;WE
FF0A F680      03310           OR      128      ;SCALE TO 128-255
FF0C 6F        03320 AISOK     LD      L,A      ;SET RND IN L
FF0D 2600      03330           LD      H,0      ;AND FORCE H TO 0
FF0F 19        03340           ADD     HL,DE    ;AND GET INDEX
FF10 CD11FE    03350           CALL    SETCEN   ;GO GET COMPARAND
               03360 ; LEFT IS IN DE
FF13 E1        03370           POP     HL       ;AND R IN HL
               03380 ;
               03390 ; NARROW THE LEFT PARTITION IN RELATION TO C
ENT
               03400 ;
FF14 EB        03410           EX      DE,HL    ;POSITION L IN HL
FF15 CD23FE    03420 NROWL     CALL    CMPCEN          ;COMPARE NAM
E(LEFT):C
FF18 3003      03430           JR      NC,DORT         ;(LEFT)>C
FF1A 23        03440           INC     HL              ;STEP LEFT I
NDEX
FF1B 18F8      03450           JR      NROWL           ;CONTINUE
FF1D EB        03460 DORT      EX      DE,HL           ;GET RIGHT B
ACK IN HL
               03470 ;
               03480 ; NARROW THE RIGHT PARTITION IN RELATION TO
CENT
               03490 ;
FF1E CD23FE    03500 NROWR     CALL    CMPCEN          ;COMPARE NAM
E(RIGHT):C
FF21 3805      03510           JR      C,DONER         ;(RIGHT)<=C
FF23 2803      03520           JR      Z,DONER
FF25 2B        03530           DEC     HL              ;NARROW RIGH
T
FF26 18F6      03540           JR      NROWR           ;CONTINUE
               03550 ;
               03560 ; EITHER OUT OF SEQUENCE OR AT CENTER.  NOTE
 THAT
               03570 ; OUT OF SEQUENCE ==> LEFT>RIGHT SO WE EXCHA
NGE
               03580 ; LEFT AND RIGHT WHICH FORCES L<C<R.
               03590 ;
FF28 CD0BFE    03600 DONER     CALL    CHLDE    ;CHECK POINTERS
FF2B 2825      03610           JR      Z,LEQR          ;AT CENTER -
 NO EXCH
FF2D 3825      03620           JR      C,LGTR   ;WE HAVE CROSSED OVE
R
               03630 ;
               03640 ;EXCHANGE STRING DESCRIPTORS
               03650 ;
FF2F D5        03660           PUSH    DE       ;SAVE LEFT AND RIGHT
FF30 E5        03670           PUSH    HL
FF31 E5        03680           PUSH    HL       ;AND SAVE RIGHT AGAI
N
FF32 2AC1FD    03690           LD      HL,(VPTRI) ;GET ADDR OF I(0)

FF35 EB        03700           EX      DE,HL    ;POSITION IT FOR SAV
E
FF36 29        03710           ADD     HL,HL    ;INDEX * 2
```

Listing 2 continues

Listing 2 continued

```
FF37 19         03720          ADD    HL,DE     ; + ADDR I(0) = ADDR
 LEFT
FF38 E3         03730          EX     (SP),HL ;SAVE AND GET RIGHT
FF39 29         03740          ADD    HL,HL   ;INDEX * 2
FF3A 19         03750          ADD    HL,DE   ; + ADDR I(0) = ADDR
 RIGHT
FF3B D1         03760          POP    DE      ; RESTORE ADDR LEFT
FF3C 0602       03770          LD     B,2     ;SET COUNT
FF3E 1A         03780 EXCH     LD     A,(DE)  ;GET DE
FF3F 4E         03790          LD     C,(HL)  ;AND HL
FF40 77         03800          LD     (HL),A  ;DE OVER HL
FF41 79         03810          LD     A,C     ;POSITION HL
FF42 12         03820          LD     (DE),A  ;HL OVER DE
FF43 23         03830          INC    HL
FF44 13         03840          INC    DE      ;STEP POINTERS
FF45 10F7       03850          DJNZ   EXCH    ;DO 2 TIMES
FF47 E1         03860          POP    HL
FF48 D1         03870          POP    DE              ;RESTORE HL
AND DE
FF49 13         03880          INC    DE              ;LEFT +1
FF4A 2B         03890          DEC    HL              ;RIGHT -1
FF4B CD0BFE     03900          CALL   CHLDE   ;CHECK POINTERS AGAI
N
FF4E 3804       03910          JR     C,LGTR  ;HL < DE HAVE CROSSE
D
FF50 18C2       03920          JR     NROWL-1         ;DE NOT>HL C
ONTINUE
FF52 13         03930 LEQR     INC    DE      ;STEP LEFT
FF53 2B         03940          DEC    HL      ;AND DECR RIGHT
FF54 ED5382FD   03950 LGTR     LD     (II),DE
FF58 2284FD     03960          LD     (J),HL
                03970 ;
                03980 ; THE WORKING POINTERS HAVE CROSSED OVER EAC
H OTHER
                03990 ; THE CENTER OF THE PARTITION N(LEFT) TO N(R
IGHT) IS
                04000 ; NOW THE MEDIAN VALUE.  (ALL TO THE LEFT AR
E <=
                04010 ; CENTER <= ALL TO THE RIGHT) THIS GIVES 2 N
EW PARTITIONS
                04020 ; II TO RIGHT AND LEFT TO J.  WE WILL SORT T
HE SHORTEST
                04030 ; AND STACK THE LARGEST IF IT IS NOT EMPTY.
 WHEN THE
                04040 ; SHORTEST IS EMPTY, WE WILL UNSTACK A PARTI
TION AND
                04050 ; CONTINUE UNTIL THE STACK IS EMPTY.  THIS C
OMPLETES
                04060 ; THE SORT.
                04070 ;
FF5B E5         04080          PUSH   HL      ;SAVE J
FF5C 2A88FD     04090          LD     HL,(RIGHT)      ;GET RIGHT
FF5F AF         04100          XOR    A       ;CLEAR CARRY
FF60 ED52       04110          SBC    HL,DE           ;MINUS II
FF62 E3         04120          EX     (SP),HL         ;SAVE R-II A
ND GET J
FF63 ED5B86FD   04130          LD     DE,(LEFT)       ;GET LEFT
FF67 AF         04140          XOR    A       ;CLEAR CARRY
FF68 ED52       04150          SBC    HL,DE           ;AND COMPUTE
 J-LEFT
FF6A D1         04160          POP    DE              ;RELOAD R-II

FF6B AF         04170          XOR    A       ;CLEAR CARRY
FF6C ED52       04180          SBC    HL,DE           ;(J-LEFT)-(R
IGHT-II)
FF6E FA89FF     04190          JP     M,ISTAK         ;<0 ==> J,LE
FT SMALLER
                04200 ;
                04210 ;STACK LEFT:J.  IF EQUAL IN SIZE WE STACK LE
FT:J
                04220 ;
FF71 AF         04230          XOR    A       ;CLEAR CARRY
FF72 ED5A       04240          ADC    HL,DE   ;GET FLAGS FOR J-LEF
T
FF74 FA81FF     04250          JP     M,SKPJ  ;IF <0 EMPTY
FF77 2808       04260          JR     Z,SKPJ  ;IF =0 EMPTY
FF79 ED5B86FD   04270          LD     DE,(LEFT)       ;PREPARE TO
STACK L,J
FF7D 19         04280          ADD    HL,DE   ;GET J BACK
FF7E CDF6FD     04290          CALL   STACLR  ;STACK LEFT:J PARTIT
ION
FF81 2A82FD     04300 SKPJ     LD     HL,(II)
FF84 2286FD     04310          LD     (LEFT),HL       ;SORTABLE IS
 II:RIGHT
FF87 1818       04320          JR     TSTLLR          ;CHECK FOR L
EFT<RIGHT
                04330 ;
                04340 ; STACK I:RIGHT PARTITION
                04350 ;
FF89 CB7A       04360 ISTAK    BIT    7,D     ;SIGN OF RIGHT-I
FF8B 200F       04370          JR     NZ,SKPI ;IF SET ==> I>RIGHT
FF8D 7A         04380          LD     A,D
FF8E B3         04390          OR     E       ;NO BITS ==> I=RIGHT

FF8F 280A       04400          JR     Z,SKPI
FF91 2A88FD     04410          LD     HL,(RIGHT)      ;GET RIGHT
FF94 ED5B82FD   04420          LD     DE,(II)         ;AND II
FF98 CDF6FD     04430          CALL   STACLR          ;STACK PARTI
TION
FF9B 2A84FD     04440 SKPI     LD     HL,(J)          ;GET J
FF9E 2288FD     04450          LD     (RIGHT),HL      ;AS NEW RIGH
T
                04460 ;
                04470 ; PARTITION MAY BE EMPTY.  IN THAT CASE, WE
WORK
                04480 ; OFF THE STACKED PARTITIONS
                04490 ;
FFA1 ED5B86FD   04500 TSTLLR   LD     DE,(LEFT)
FFA5 2A88FD     04510          LD     HL,(RIGHT)
FFA8 AF         04520          XOR    A       ;CLEAR CARRY
FFA9 ED52       04530          SBC    HL,DE
FFAB FAC9FE     04540          JP     M,UNSTK ;EMPTY
FFAE CAC9FE     04550          JP     Z,UNSTK
FFB1 19         04560          ADD    HL,DE   ;GET RIGHT BACK
FFB2 C3EFFE     04570          JP     GETCN   ;GO SORT NEW ONE
0000            04580          END
00000 TOTAL ERRORS
```


See List of Advertisers on Page 455

Protect high memory with this simple patch.

Relocated ULCBAS

Samuel D. Pincus
10 South 671 Ivy Lane
Hinsdale, IL 60521

I purchased my Model I mainly for word processing functions. I installed the lowercase modification for use with the Scripsit package. As time went on I started using lowercase characters in my Basic programs. Now I find that it feels unnatural not using lowercase whenever I code.

To speed up the tape I/O on my 48K system, I recently purchased the TC-8 tape system. I was dismayed to find that their software drivers reside at the top of core. According to Radio Shack I could no longer use the ULCBAS routine for lowercase: "ULCBAS and ULCDVR... move themselves to the top of memory... make sure that your own machine-language programs do not disturb this protected area ... 48K computers, FDDO-FFFF." (This is not true—in a 48K system, it resides at FDF2-FFFF.) How could ULCBAS be sophisticated enough to relocate itself to top of memory but not be able to relocate itself below a protected memory area?

In addition, ULCBAS had a bug in it; to make it work, I must POKE values into memory locations 28829 and 28830 before executing. This means that the program has at least one major flaw.

> *"ULCBAS has at least one major flaw."*

Here's the Problem!

After loading my trusty disassembler, I tried to disassemble ULCBAS. Using the information from Radio Shack in the October 1981 issue of *80 Micro* on load addresses for their programs, I looked for it at 6C00H. No luck; I found the code instead between 7000H and 7269H.

After a brief look at the code, I located the problem. Radio Shack wrote ULCBAS in two pieces. The first piece is a relocator for the main code. It finds the top of memory located at 40B1H, modifies all the jump addresses within the main code, moves this main code to the top of memory and resets the top of memory pointer.

However, they missed one address! This is what the POKEs are for; to make the POKEs work properly, ULCBAS has to reside at the very top of core. All it takes is a simple patch to modify the address Radio Shack missed, and the program is truly relocatable.

To make the patch, use a machine-language monitor. Load ULCBAS and put in the following data starting at 6FF9H: 22 9D 70 E5 2B 18 0B. Then change the data at 7009H-700AH to read 18 EE. Punch out a new System tape for ULCBAS starting at 6FF9H, ending at 7269H with the entry point at 7000H.

The new System tape is truly self-relocating. All you need do is answer the "Memory Size" question with the start of memory address that you want protected from Basic and ULCBAS. Press enter if you do not want to protect any memory. Then load your new System tape and execute as you normally would with / enter. ULCBAS will now relocate itself to the top 525 bytes below your protected memory.■

The Key Box

Basic Level II
Model I
ULCBAS

Use a second cassette recorder to add sound to your programs.

Sound OFF!

Bertram A. Thiel
159 West Main Street
Frostburg, MD 21532

Something is missing from the TRS-80 in the classroom. It lacks both a record of the student's responses, to be checked by the teacher at a later time and an audio output. If you have an expansion interface (or other dual cassette drive interface) and an extra cassette tape deck these missing factors can be realized using the INPUT#- and OUTPUT#- statements.

The programs shown here administer a spelling test in the absence of the teacher. Because the computer cannot print the word to be spelled questions must be audible. The computer synchronizes the word list and records the answers as data on tape. When time permits, the teacher plays the answer tape to make corrections. With proper preparation and structure a computer can save the teacher considerable time.

This is a simplistic use of the computer; expand the concept to include sounds (a lion's roar, a cricket's chirp, or the theme to Beethoven's Fifth) and visual output (animation or other graphics), to create sophisticated learning and testing modules.

Start at the base of the learning pyramid by using the programs described here for a TRS-80 with two cassettes and a dual cassette drive. Conversion to other computer systems and cassette/disk combinations is not difficult.

The Key Box

Two or more CTRs
Dual Cassette Drive Interface

Set-Up

Program Listing 1 allows you to make the audio tape. The program turns the cassette on for four seconds so you can ask for the student's name and then dictate the spelling list, one word at a time. The time delay and the tape deck control are provided by PRINT#-1,"". The statement turns on the tape deck motor, puts out the character string used when you save a

```
10 '    TEACHER'S SET-UP PROGRAM
20 '
30 '     B.THIEL, MARCH 1981
40 '
50 CLS: INPUT"HOW MANY QUESTIONS WILL THERE BE";X
60 CLS
70 PRINT"READY THE CASSETTE TAPE RECORDER SO THAT IT WILL RECORD
 YOUR    VOICE. DO SO BY UNPLUGGING THE 'AUX' PLUG, AND POSITION
 IT SO   THAT THE BUILT-IN CONDENSER MIC WILL PICK UP YOUR VOICE
. PLACE  A BLANK TAPE IN IT AND DEPRESS RECORD AND PLAY KEYS."
80 PRINT:PRINT"WHEN YOU ARE READY TO RECORD, JUST PRESS THE ENTE
R KEY."
90 PRINT:PRINT"START BY ASKING THE STUDENT TO TYPE IN HIS/HER NA
ME."
100 PRINT:PRINT"        DEPRESS  <ENTER>  KEY WHEN READY"
110 A$=INKEY$:IF A$="" GOTO 110
120 PRINT#-1," "
130 FOR L=1 TO X
140 CLS: PRINT"QUESTION NUMBER";L
150 PRINT:PRINT"PRESS  <ENTER>  WHEN READY TO ASK QUESTION"
160 A$=INKEY$:IF A$="" GOTO 160
170 PRINT#-1," "
180 NEXT L
190 CLS:PRINT"QUESTION TAPE IS COMPLETE. PLAY IT BACK TO CHECK R
ECORDING."
```

Program Listing 1

```
10 '    STUDENTS' ANSWER PROGRAM
20 '
30 '    B.THIEL MARCH 1981
40 CLEAR 255
50 DIMA$(50):CLS:PRINTCHR$(23):PRINTTAB(12);"HELLO":PRINT
60 PRINT"GET READY FOR A LITTLE TEST BY  DOING THE FOLLOWING:
          1. PUT THE QUESTION TAPE IN        THE TAPE RECORDER
 THAT HAS      THE LABEL ON IT THAT SAYS               <QUESTION>.
"
70 PRINT:PRINT"WHEN YOU HAVE DONE THAT PUSH MY <ENTER> KEY"
80 E$=INKEY$:IF E$=""80
90 CLS:PRINTCHR$(23)
100 PRINT"   2. NOW MAKE SURE THAT THE            <EAR> PLUG IS NO
T IN THE        <EAR> HOLE IN THE TAPE            RECORDER."
110 PRINT:PRINT"WHEN YOU HAVE DONE THAT PUSH MY <ENTER> KEY"
120 E$=INKEY$:IF E$=""120
130 CLS:PRINTCHR$(23)
140 PRINT:PRINT"     3. NOW PRESS THE PLAY                 BUTTON O
N THE <QUESTION>         TAPE RECORDER."
150 PRINT:PRINT"WHEN YOU HAVE DONE THAT PRESS MY<ENTER> KEY"
160 E$=INKEY$:IF E$=""160
170 CLS:PRINTCHR$(23)
180 PRINT:PRINT"NOW PUT YOUR ANSWER TApE IN THE TAPE RECORDER LA
BELED <ANSWER>"
190 PRINT"THEN PRESS BOTH THE RECORD AND  THE PLAY BUTTONS"
200 PRINT:PRINT"AFTER YOU DO THAT PRESS MY      <ENTER>  KEY"
210 E$=INKEY$:IF E$=""210
220 CLS:PRINTCHR$(23)
230 PRINT:PRINT"MAKE SURE ALL THE PLUGS ARE IN  AND THEN GET REA
DY TO TAKE YOUR TEST."
240 PRINT:PRINT"PRESS MY <ENTER> KEY WHEN YOU   ARE READY."
250 E$=INKEY$:IF E$=""250
260 CLS:PRINTCHR$(23)
270 PRINT#-1," "
280 PRINT"PLEASE TYPE IN YOUR NAME.       WHEN YOU ARE DONE PUSH
 THE      <ENTER> KEY."
290 INPUT N$
300 A$(0)=N$
310 PRINT:PRINT"IF YOU ARE READY TO TAKE THE    TEST, PRESS MY <
ENTER> KEY."
320 E$=INKEY$:IF E$=""320
330 FOR C=1 TO 20
340 PRINT"TYPE IN ANSWER NUMBER";C
350 PRINT#-1," "
360 INPUT A$(C)
370 NEXT C
380 PRINT#-2,A$(0),A$(1),A$(2),A$(3),A$(4),A$(5),A$(6),A$(7),A$(
8),A$(9),A$(10),A$(11),A$(12),A$(13),A$(14),A$(15),A$(16),A$(17)
,A$(18),A$(19),A$(20)
390 CLS:PRINTCHR$(23)
400 PRINT"OKEY, YOUR TEST IS DONE, NOW    REWIND BOTH TAPES AND
GIVE THEM BACK TO THE TEACHER."
410 PRINT:PRINTTAB(12);"THANK YOU"
420 END
```

Program Listing 2

program, sends the data (in this case a single space), and sends the closing string. If the data within the quotes is 255 characters long (the maximum length allowed) the total time is 8.3 seconds. Run a test on your computer to determine your times.

> *"The computer should be an extension of the teacher rather than something separate."*

Since the other two programs are set up for 20 questions, use 20 as your answer to the first input request and follow the program directions. Use a leaderless cassette tape rewound to the very beginning so it is synchronized with the program.

Answer Program

The student answer program (Program Listing 2) gives instructions for tape recorder setup and turns on your question tape. The program gives the student the test, stores answers in the A$ matrix, and records them on the second tape deck as a data string (see line 380). Use a leaderless tape to avoid losing data. In the classroom label the cassette recorders "question machine" and "answer machine" to avoid confusion. Label the two tapes the same way.

Program Listing 3 extracts data from the student's answer tape using the INPUT#-1 statement. Level III or other keyboard abbreviation systems are useful when creating long INPUT#- and PRINT#- statements. I redefined the shifted A key to give "),A$(". Use your own voice in the question tapes. Students enjoy hearing their own teacher on the recorder, and it gives a sense of continuity. The computer should be an extension of the teacher rather than something separate.

Modifications

Modify the programs here to suit your own situation. Consider a more complicated method of controlling the audio deck. Use the following line: FOR X = 1 TO Z:OUT 255,4:NEXT X in place of the PRINT#-1,"" control (line 120 in Listing 1 and line 350 in Listing 2). Use Z as a varying number stored in another matrix, transmitted from the teacher's program to the student's answer program. This varies the time the audio portion is on. Experiment to find out how long the For. . . Next loop is for various values of Z. Use a Step factor so the Z number translates directly to seconds of on-time.■

```
10 '    ANSWER CHECKING PROGRAM
20 '
30 '     B.THIEL  MARCH, 1981
40 CLEAR 255
50 DIM A$(50)
60 PRINT"ANSWER PROGRAM, LOAD STUDENT'S ANSWER TAPE IN TAPE RECO
RDER      AND DEPRESS <PLAY> BUTTON."
70 PRINT"RECHECK PROGRAM IF NECESSARY TO MAKE SURE THE NUMBER OF
 INPUTS  AND THE FOR-NEXT LOOP AGREE WITH THE NUMBER OF QUESTION
S IN THE TEST."
80 PRINT:PRINT"IF READY PRESS THE <ENTER> KEY"
90 E$=INKEY$:IF E$=""90
100 INPUT#-1,A$(0),A$(1),A$(2),A$(3),A$(4),A$(5),A$(6),A$(7),A$(
8),A$(9),A$(10),A$(11),A$(12),A$(13),A$(14),A$(15),A$(16),A$(17)
,A$(18),A$(19),A$(20)
110 PRINT"STUDENT'S NAME: ";A$(0)
120 FOR X=1 TO 20 STEP 2
130 PRINTX;A$(X),
140 PRINTTAB(30);X+1;A$(X+1)
150 NEXT X
160 GOTO 160
```

Program Listing 3

See List of Advertisers on Page 455

Send Tape-Disk into higher memory.

TDRELO

Barry Kornfeld
190 Waverly Place
New York, NY 10014

Being an incurable machine language patcher, I have oft bemoaned the lack of a utility to do a simple save from memory to disk, down in the 5200H range, where so much important software—Scripsit and Visicalc—resides.

I usually use Tape-Disk for dumps but it won't save anything below 5400H (that's where Tape-Disk lives and works). The TRSDOS/NEWDOS 2.1 Dump command is useless; it won't save anything below 7000H and the syntax is next to impossible to type correctly.

NEWDOS 80's Dump command solves all of those problems, but one can't always work in NEWDOS 80, and not everyone owns it.

Superzap is great for little modifications, but tedious for longer patches. Plus, you'll have extra work counting bytes, updating directories and such.

In response to those frustrations I wrote TDRELO to relocate Tape-Disk into higher memory. I can now write patches on Editor/Assembler, load the main program and the patch into memory and save the whole thing as one big file—with the disk operating system counting all of the bytes and updating the directory.

Program Listing 1. Machine-language program to relocate Tape-Disk

```
                   00100 ; LISTING # 1
                   00200 ; TDRELO:  A PROGRAM TO RELOCATE TAPEDISK
                   00300 ;   BY BARRY KORNFELD
                   00400 ;
                   00500 ;********************************************
*
                   00600 ;
00B2               00700 NEWADR  EQU 0B2H
                   00800 ;
                   00900 ; NEWADR = THE MSB OF THE RELOCATION ADDRESS
                   01000 ;   (THE LSB IS ALWAYS 00)
                   01100 ;AS GIVEN ABOVE THE NEW START ADDRESS WILL B
E 0B200H
                   01200 ;   CHANGE THIS EQU BEFORE ASSEMBLY TO RELOC
ATE AT
                   01300 ;      THE ADDRESS OF YOUR CHOICE.
                   01400 ;OR BY USING A MONITOR TO EDIT MEMORY LOCATI
ON 5404H
                   01500 ;     MINIMUM MSB = 55H, MAXIMUM = 0FDH
                   01600 ;
                   01700 ;********************************************
*
```

Program Listing 1 Continues

Only 70 Bytes

TDRELO is a scant 70 bytes that can be quickly assembled with EDTASM or via a Basic POKE program.

If you are using EDTASM:

- Type the source code, assemble and save as a disk file.
- Exit to DOS and LOAD TAPEDISK/CMD.
- RUN TDRELO.
- When the Tape-Disk prompt comes up on the screen enter:

F filespec/CMD:0 B200 B3F1 B200

Locating Tape-Disk at B200H is adequate for all my needs (so far) and works for both 32K and 48K systems. But you can relocate Tape-Disk elsewhere by simply changing line 700 to:

NEWADR EQU 0NNH

and readjusting the save addresses. Enter a new start address: NN00; a new end address: NN00 + 01F1H; and a new execution address: NN00.

NN equals the starting location "page." For example 0E0H relocates Tape-Disk to E000H. The response to the Tape-Disk prompt is:

F filespec/CMD:0 E000 E1F1 E000

NB: NN should not be less than 55 or more than FD.

The Basic Version

If you feel more comfortable in Basic, try this POKE program:

- Go into Basic with your memory size at 28670.
- Type and execute the program.
- CMD"S" or reboot to get back to DOS.
- Run Tape-Disk and answer the Tape-Disk prompt with:

F TDRELO/CMD:0 7000 7045 7000

- Exit Tape-Disk with the E command or hit the reset button.
- Follow the last two steps in the EDTASM instructions.

To relocate Tape-Disk elsewhere with the Basic program follow the relocation directions given after the EDTASM instructions. Note, however, that NN in the Basic program is the data item in line 60 entered in decimal. Disk Basic doesn't seem to like &H DATA items.

Also note that NN should be between 84 (54H) and 253 (0FDH), but cannot be 111 (6FH) or 112 (70H). ■

The Key Box

Disk Basic
32K RAM

```
                01800 ;
                01900 ;CALCULATE NEW ADDRESS, OFFSET, AND RELOCATE
 THE CODE
                02000 ;
5400            02100           ORG 5400H
5400 31FC41     02200 START     LD SP,41FCH         ;SET STACK
5403 3EB2       02300           LD A,NEWADR         ;MSB OF NEW ADDRESS
5405 D652       02400           SUB 52H             ;CALCULATE OFFSET
5407 67         02500           LD H,A              ;FULL OFFSET IN HL
5408 2E00       02600           LD L,00
540A E5         02700           PUSH HL             ;SAVE IT
540B 110052     02800           LD DE,5200H         ;ORIG. TAPEDISK STAR
T ADDRESS
540E 19         02900           ADD HL,DE           ;NEW START ADDRESS I
N HL
540F E5         03000           PUSH HL             ;SAVE IT
5410 EB         03100           EX DE,HL            ;SWAP TO SETUP LDIR
5411 01F201     03200           LD BC,01F2H         ;# OF BYTES IN TAPED
ISK
5414 EDB0       03300           LDIR                ;RELOCATE TAPEDISK!!
!
                03400 ;
                03500 ;*******************************************
***********
                03600 ;
                03700 ;CORRECT FOR CALLS AND JPS
                03800 ;
5416 E1         03900           POP HL              ;GET NEW START ADDR.

5417 D1         04000           POP DE              ;GET OFFSET
5418 01D001     04100           LD BC,1D0H          ;# OF BYTES TO CHECK

541B C5         04200           PUSH BC             ;AND SAVE THEM ALL F
OR
541C D5         04300           PUSH DE             ;   SECOND PASS
541D E5         04400           PUSH HL
541E 3E52       04500           LD A,52H            ;CORRECT 5200H PAGE
5420 CD3754     04600           CALL RAISER         ;   DO IT!
5423 E1         04700           POP HL              ;GET NEW START ADDRE
SS
5424 D1         04800           POP DE              ;  AND OFFSET
5425 C1         04900           POP BC              ;  AND # OF BYTES
5426 D5         05000           PUSH DE             ;RESAVE OFFSET
5427 3E53       05100           LD A,53H            ;CORRECT 5300H PAGE
5429 CD3754     05200           CALL RAISER         ;  DO IT!
                05300 ;
                05400 ;*******************************************

                05500 ;
                05600 ;RESTORE 52H AT ORIGINAL MEM LOCATION 527EH
                05700 ;
542C D1         05800           POP DE              ;GET OFFSET
542D 217E52     05900           LD HL,527EH         ;ORIG MEM LOC TO BE
RESTORED
5430 19         06000           ADD HL,DE           ;NEW MEM LOCATION
5431 3E52       06100           LD A,52H            ;PUT IT IN
5433 77         06200           LD (HL),A
5434 C30052     06300           JP 5200H            ;JUMP TO TAPEDISK
                06400 ;
                06500 ;USE TAPEDISK 'F' COMMAND TO SAVE RELOCATED
TAPEDISK
                06600 ;END ADDRESS = START ADDRESS + 01F1H
                06700 ;EXECUTION ADDRESS = START ADDRESS
                06800 ;FOR 'NEWADR EQU 0B2H' AS GIVEN IN LINE 0080
0
                06900 ;    THE TAPEDISK COMMAND WOULD BE:
                07000 ;?F FILESPEC/CMD:0 B200 B3F1 B200
                07100 ;
                07200 ;*******************************************
*********
                07300 ;
                07400 ;SUBROUTINE TO CORRECT FOR NON-RELOCATABLE C
ALLS & JPS
                07500 ;
5437 EDA1       07600 RAISER    CPI                 ;IS IT 52H OR 53H
5439 2803       07700           JR Z,RAISIT         ;YES? GO!
543B E0         07800           RET PO              ;DONE? RETURN
543C 18F9       07900           JR RAISER           ;ELSE TRY NEXT BYTE
543E F5         08000 RAISIT    PUSH AF             ;SAVE BYTE
543F 82         08100           ADD A,D             ;ADD MSB OF OFFSET T
O MSB OF ADDR
5440 2B         08200           DEC HL              ;GET MEM LOCATION TO
 BE CORRECTED
5441 77         08300           LD (HL),A           ;PUT IN CORRECTED BY
TE
5442 23         08400           INC HL              ;RESTORE HL
5443 F1         08500           POP AF              ;GET BYTE
5444 18F1       08600           JR RAISER           ;TRY NEXT BYTE
5400            08700           END START
00000 TOTAL ERRORS
```

```
4 REM * LISTING # 2
5 REM * TDRELO: BASIC POKE PROGRAM
6 REM * BY BARRY KORNFELD
10 FOR X=&H7000 TO &H7045
20 READ Y
30 POKE X,Y
40 NEXT
50 DATA 49,252,65,62
55 REM * THE FOLLOWING DATA ITEM '178' = 0B2h
56 REM * CHANGE TO RELOCATE TAPEDISK ELSWHERE.
60 DATA 178
70 DATA 214,82,103,46,0,229,17,0,82,25,229,235,1,242,1,237
80 DATA 176,225,209,1,208,1,197,213,229,62,82,205,55,112
90 DATA 225,209,193,213,62,83,205,55,112,209,33,126,82,25
100 DATA 62,82,119,195,0,82,237,161,40,3,224,24,249,245,130,43
110 DATA 119,35,241,24,241
```

Program Listing 2. TDRELO, the Basic version

Hit a bull's-eye with this polynomial factoring program.

Algebraic Archery

Michael A. Duffin
1507 East Avenue
Berwyn, IL 60402

It has always disturbed me that the computer is useless for algebraic applications. My Level II TRS-80 can add, subtract, multiply, divide and determine certain trigonometric identities; when it comes to factoring a simple polynomial the computer knows zip.

The program in Listing 1 presents a student with a polynomial to factor. It gives five chances to answer correctly. If the student fails, the program tells the correct answer and shows how to determine it.

Polynomial Lingo

A variable is a character representing a number or a group of numbers (X, Y or A, for example). A term is a combination of variables and numbers. Terms are separated by plus or minus signs. An example of the type of polynomial factored by this program is X↑2 + 7X + 10.

> ***The Key Box***
>
> **Basic Level II**
> **Model I or II**
> **16K RAM**

A	Random Number
B	Random Number
X	The sum of A and B
Y	Product of A and B
A$	One possible answer to the problem
B$	Alternate answer to problem
C$	User's answer
SA$	Sign in front of X (+ or −)
SB$	Sign in front of Y (+ or −)
Z$	Problem presented by computer

Table 1. Algebra Variables

To factor, you must find two polynomials which when multiplied together equal the polynomial given. The answer to the problem above is (X + 5) (X + 2).

To check the answer, multiply (X + 5) times (X + 2). Do this by multiplying X times (X + 2) and 5 times (X + 2), and add the results. The following details the steps:

```
(X + 5) (X + 2)      =
X(X + 2) + 5(X + 2)  =
X↑2 + 2X + 5X + 10   =
X↑2 + 7X + 10
```

Now that we see how factoring works are there any tricks to make programming it any easier? Look at the problem and answer again.

```
Problem    X↑2 + 7X + 10
Answer     (X + 5) (X + 2)
```

The middle number in the problem (here, 7) is always the sum of the numbers in the answer (5 + 2 = 7). The coefficient of the third term (here, 10) is always the product of these numbers (5 * 2 = 10).

The Program

My program selects two random numbers, A and B. It determines their sum (the variable X) and their product (the variable Y). Then it uses these two numbers to present the problem (Z$). The person running the program has to determine the factors.

The 10 program variables are described in Table 1. The subroutine between lines 1000 and 1030 determines the random numbers in the problem and the sign used with each number. The subroutine also builds the problem and stores it in the variable Z$.

STR$ places the numeric values X and Y within the string. If the STR$ instruction is not used, a Type Mismatch (TM) error occurs. Thus, this line takes the characters "X↑2 + ", the value of the number X, the characters "X +" and the value of the number Y (the product of A and B) and puts them together (concatenates them). If A is 3 and B is 2, X↑2 + 5X + 6 appears on the screen when Z$ is printed (see line 120).

The subroutine at lines 2000–2020 sets the strings B$ and A$ to the acceptable answers. In our example the values of these variables would be (X + 3) (X + 2) or (X + 2) (X + 3).

The user must place a blank before the numeric part of each answer because the STR$ instruction reserves a position for the sign of the number.

The routine between lines 4000 and 4060 informs the student of the possible correct answers and tells how that answer was derived.

The subroutine in lines 3000–3020 gives the student time to read the answer and study it if necessary. Line 3010 loops to itself until a key is pressed. The INKEY$ instruction in this line allows input from the keyboard while the program is running.

Although this program teaches a person to factor rudimentary polynomial equations, it suffers the same ailment as many mathematical applications: It is boring.

Archery Game

I assigned my data processing class to develop a game or educational application on the TRS-80. The hardest thing about this assignment is generating an idea. One of my students came up with the program in Listing 2, Archery Game.

The player fires an arrow at a target. Up to 20 individuals may play; a player with over 200 points wins. The amount of points scored is determined by the level of play.

Look at the variables listed in Table 2. They are grouped according to their functions.

Line 19 sets up the initial values to start the graphics. Lines 20 and 40–90 explain how the game works. Line 100 sets up the maximum number of elements for the array with the DIM instruction. This line also initializes some variables used in the program.

The maximum number of players is ob-

". . . when it comes to factoring a simple polynomial the computer knows zip."

tained by the Input instruction in line 110 (variable N). Lines 120–140 ask for each player's name and store it in the array A$ indexed by the variable I.

An array is a storage area. It contains multiple elements (pieces of data or groups of numbers) identified by one variable name and a subscript or index. We could choose different variables for each player's name, such as NAME1, NAME2, NAME3, NAME4. By specifying A$(I) and changing the value of I we can store all the names and refer to only one variable (A$). In our case, we identify a person's name and score with the same index number. Thus, S(1) is the score of the person whose name is A$(1).

The For...Next loop starting at line 160 and ending at line 312 contains the body of the program. The variable QQ points to the array elements of the current player. Look at line 300 to determine what this really means.

```
300 S(QQ) = S(QQ) + B:PRINT "TOTAL SCORE FOR
"A$(4)" = "S(4)
```

In this line a player's score is incremented by the value of B. For the fourth player this line would read:

```
300 S(4) = S(4) + B:PRINT "TOTAL SCORE FOR "A$(4)"
= "S(4)
```

Only the fourth player's score is incremented and only his or her name is printed.

At line 181 of the For...Next loop we enter two subroutines. GOSUB 22 prints the target, the bow and the arrow; GOSUB 501 moves the arrow.

The remainder of this For...Next loop is arranged sequentially. Line 165 prints 30 blanks at the top of the screen. This erases the line previously starting at screen position zero. Line 170 identifies the player whose turn it is and asks what type of throw is wanted (1, 2 or 3). Line 180 makes sure 1, 2 or 3 was entered and line 181 goes to the subroutines to construct the graphics.

The routine in lines 190–280 determines the number of points scored. The player who enters number 1 has only a 50-50 chance of getting any score. This player stands a better chance of getting a bullseye, however. The player who enters number 2 has a 99 percent chance of getting some score and the player who enters number 3 has a 95 percent chance of scoring.

Line 300 increments the player's score. Line 310 checks to see if we have a winner and line 320 starts the routine over for the next player.

Once the For...Next loop is complete lines 320 and 325 increment the round number and print it. Then lines 330 and 335 determine if we have a winner. If there is no winner yet, the For...Next loop starts again. If we have a winner final messages print.

Algebraic Archery

In the first part of this article I talked about a program to factor simple polynomial equations. In the second part a number of players were able to try their luck at hitting a target with a bow and arrow. As different as these programs are, they suffer from a similar problem. After a short time they become very dull. Next I combined the two games.

First, I renumbered the Algebra game starting with line 600 and incrementing it by 100 with Radio Shack's RENUM package. I stored the renumbered program on tape using the CSAVE command.

I restored my system to its original status (power off-power on). I then loaded the Archery program into the system using the CLOAD command.

To store two programs in the machine at once, CLOAD the first program and then enter the following instructions:

```
PRINT PEEK (16633),PEEK(16634)
```

The resulting values on my machine for the Archery game were 168 and 78. Subtract 20 from the first value and enter the following POKE instructions.

```
POKE 16548,166    :POKE 16549,78
```

W, Q, O, X, Y, Z	Used in the POKE instructions and the For . . . Next loops that graphically display the Target, Bow and Arrow and the Arrow's movement
A$	An array containing the names of up to 20 players
S	An array containing each player's score
I, QQ	Indices used in the above arrays
B	Score received by a player in a particular round
M	Switch set when a player has scored over 200 points (M = 1)
T	Type of shot (1, 2 or 3)
U	Shorthand for the expression RND(100)/100
P1, P2, P3, P4	Predetermined values depending on the value of T selected. These are used with the random number U to determine the score of the player
R	The round being played

Table 2. Archery Variables

✓ See List of Advertisers on Page 455

"... this program ... suffers the same ailment as many mathematical applications: It is boring."

The POKE instructions change the starting address where the second program is loaded. If the value from PEEK(16633) is less than two, subtract one from the second value and add 256 to the first.

Now CLOAD the second program. Restore the pointers to their original locations with the following instructions:

```
POKE 16548,233   :POKE 16549,66
```

The archery program existed at lines 10–511 and the Algebra program existed between lines 600 and 3200. The programs in my machine were still independent of one another.

Final Product

A player is required to factor a polynomial. If the answer is correct, an arrow fires at a target. The number of points scored is determined by the number of tries it takes to factor the problem correctly. Up to 20 individuals may play; the first player to score over 200 points wins.

A few program modifications make the contest more interesting. During the first round each player gets only one chance to answer the problem correctly. Thus, a player receives zero or 50 points. During subsequent rounds, the player with the highest number of points receives only one chance to factor the problem correctly. All other players receive up to five chances to answer the problem.

I made modifications to the games to make them work in this manner. Lines 40–70 in Archery-Algebra direct you to the new instructions for this game.

Notice that line 70 is only a REM instruction. When I modify programs I find it beneficial to put in dummy lines. When modifying programs unfamiliar to you, avoid a UL (Undefined Line) error by replacing deleted lines with a REM. The dummy REM statement allows you to insert lines of code at the start of a GOSUB or GOTO routine which were not identified when the GOTO or GOSUB statement was written.

The next group of instructions modified appears between lines 164 and 180. Line 164 sends us to a subroutine starting at line 4000. This routine erases only the top half of the screen. Thus, it is unnecessary to redraw the target and the bow each time. The PRINT@ writes an entire line of blanks. The POKE instruction would have required POKEing each screen position.

```
2 REM*************************************************************
4 REM*
6 REM*      ALGEBRA---------------FACTORING SIMPLE POLYNOMIALS
7 REM*
8 REM*  BY MICHAEL A. DUFFIN
9 REM*
10 REM*              MORTON COLLEGE---------CICERO,ILL.
12 REM*
14 REM*************************************************************
90 CLS:CLEAR 100:D=1
100 PRINT "FACTOR THE FOLLOWING PROBLEM"
110 GOSUB 1000
120 PRINT Z$
130 GOSUB 2000
140 INPUT "WHAT IS THE ANSWER ";C$
142 IF D>=5 THEN GOTO 4000
150 IF C$=A$ OR C$=B$ THEN PRINT "THATS RIGHT !!":GOSUB 3000:GOT
O 10: ELSE PRINT "TRY AGAIN ":D=D+1:GOTO 140
1000 A=RND(5)+1:B=RND(5)+1
1002 IF RND(2)=1 THEN A=-A:SA$="-" ELSE SA$="+"
1004 IF RND(2)=1 THEN B=-B:SB$="-" ELSE SB$="+"
1010 X=A+B:Y=A*B
1020 Z$="X[2 + "+STR$(X)+"X + "+STR$(Y)
1030 RETURN
2000 B$="(X"+SA$+STR$(ABS(A))+")(X"+SB$+STR$(ABS(B))+")"
2010 A$="(X"+SB$+STR$(ABS(B))+")(X"+SA$+STR$(ABS(A))+")"
2020 RETURN
3000 PRINT "PRESS ANY KEY TO CONTINUE. "
3010 IF INKEY$="" THEN GOTO 3010
3020 RETURN
4000 CLS:PRINT "THE FACTORS OF "Z$
4010 PRINT "ARE EITHER "B$" OR "A$
4020 PRINT "AS YOU CAN SEE"
4030 PRINT "THE SUM OF "STR$(A)" AND "STR$(B)" IS "STR$(X)
4040 PRINT "AND THE PRODUCT OF "STR$(A)" AND "STR$(B)" IS "STR$(
Y)
4050 GOSUB 3000
4060 GOTO 10
```

Program Listing 1

Circle 75 on Reader Service card.→

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Trsdos 1.3, Ldos 5.1, Newdos 2.0, Dosplus 3.3, 3.4

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Apple II	CP/M (Z-80 softcard)
Other Z-80	CP/M based systems (8" drives)

Pascal Features

A complete Jensen and Wirth Standard Pascal
Produces compact efficient code that executes 10-20 times faster than interpreted BASIC
Can compile large programs (4000 lines +)
Fast one pass compiler
Simple commands for compiling and running programs
Supports separate compilation of procedures and functions
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Full heap support including NEW and DISPOSE procedures that perform true heap allocation
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Pascal Reference Manual
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Cross reference index for documentation package

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Pseudocode (Pcode) for compactness
Allows large programs in small memory space (8500 line + programs can execute in 48k)
Native code for speed
Optional code generator produces Z80 instructions
Z80 code can be mixed with Pcode

Extensions

OTHERWISE clause on case statements
Identifiers may contain '$' and '—' characters
Automatic type conversion in arithmetic expressions and assignment statements
Constants may be expressed in decimal or hexadecimal
Characters within strings may be specified by ascii code.
Allows non-printable characters in strings.
Type transfer operator to override type matching
ESCAPE allows exit from anywhere in a procedure
LOCATION function returns the address of a variable
SIZE function returns the amount of memory for a variable

Full Screen Text Editor

Included with Pascal
No limit on file size (except disk capacity)

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Pcode optimizer
Reduces the size of a program by 25-30%
Increases execution speed
Z80 native code generator
Produces relocatable, reentrant native code for the Z80
Native code executes 3-5 times faster than Pcode.
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Links separately compiled routines · Supports procedure and function libraries · Can create command files

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"The programs in my machine were still independent of one another."

Line 172 sets T equal to six during the first round. Each player has only one chance to answer a problem during the first round. Line 175 performs a similar function. The player with the high score is allowed only one chance to answer a problem.

Line 180 sends us to the Algebra program, now a subroutine of the Archery program. The major differences in the Algebra subroutine exist between lines 1020 and 1390. Note the relationship between the variables T and D. The Algebra subroutine uses D as the number of tries it takes a player to answer the math problem correctly. The original Archery program used T to determine the score of the player. Since D now determines the score, lines 600 and 1390 set them equal to one another so the same value is used for both parts of the program.

There is an exception to this rule. Lines 172 and 175 set the value of T to six when a player gets only one try to answer the problem. If the player answers the problem correctly, we must make sure he or she receives the correct score. Line 1380 resets D to one.

Line 1020 in the Algebra subroutine clears the third line of the screen of the previous incorrect answer. Lines 1100–1300 check the answer. If it is correct we exit the subroutine. If the answer is incorrect and D is less than five, the player is given another chance. If the player fails to answer within five tries, the correct answer is given and we exit the subroutine.

Lines 190–280 no longer use the variables P1–P4 of the original Archery game. Probabilities are no longer a factor. The player who answers correctly on the first try receives 50 points. If it takes two tries the player receives 40 points, and so on.

That covers the differences in the three games. This might make algebra more interesting to 6th and 7th graders. If anyone uses this program or a modification of it in a grammar school or high school environment, I would like to hear about it. ■

Michael Duffin is employed full time by International Harvester as a Technical Assistant at their Broadview location. He is employed part time as a data processing instructor at Morton College and Northeastern Illinois University.

Program Listing 2

```
3 CLS
10 REM ARCHERY GAME
19 X=15360:Y=15360:Z=16173
20 PRINT@ 0, "GAME OF ARCHERY":PRINT:RANDOM
21 GOTO 40
22 POKE 16000,188:FOR W=16001 TO 16012:POKE W,140:NEXT W:POKE 16
013,188
23 POKE 16064,191:POKE 16067,131:POKE 16074,131:POKE 16075,191:P
OKE 16077,191:FOR V=16068 TO 16073:POKE V,179:NEXT V:POKE 16066,
191
24 POKE 16128,191:POKE 16130,191:POKE 16132,191:POKE 16134,188:P
OKE 16135,188:POKE 16137,191:POKE 16139,191:POKE 16141,191
25 POKE 16192,191:POKE 16194,191:POKE 16196,143:FOR Q=16197 TO 1
6200:POKE Q,140:NEXT Q:POKE 16201,143:POKE 16203,191:POKE 16205,
191
26 POKE 16256,191:POKE 16257,176:FOR O=16258 TO 16267:POKE O,179
:NEXT O:POKE 16268,176:POKE 16269,191
27 Y=15360
28 POKE Y+692,188:POKE Y+691,176:POKE Y+755,131:POKE Y+754,143:P
OKE Y+753,188:POKE Y+752,176:POKE Y+816,131:POKE Y+815,191:POKEY
+879,131:POKE Y+880,143:POKE Y+881,188:POKE Y+882,176:POKE Y+946
,131:POKE Y+947,143:POKE Y+948,188
29 POKE Y+693,148:POKE Y+757,149:POKE Y+821,149:POKE Y+885,149:P
OKE Y+949,149
30 Z=16173
31 POKE Z,140:POKE Z+1,140:POKE Z+3,140:POKE Z+4,140:POKE Z+5,14
0:POKE Z+6,140:POKE Z+7,140
35 RETURN
40 PRINT "IN THIS GAME, UP TO 20 PLAYERS SHOOT ARROWS AT A TARGE
T."
50 PRINT "WITH 10,20,30,AND 40 POINT ZONES,THE OBJECT IS TO GET
200 POINTS."
60 PRINT "THROW","DESCRIPTION","PROBABLE SCORE"
70 PRINT"1","FAST SPEED SHOT","BULLSEYE OR COMPLETE MISS"
80 PRINT"2","MID SPEED SHOT","10,20,OR 30 POINTS"
90 PRINT"3","SLOW SPEED SHOT","ANYTHING":PRINT
100 DIM A$(20),S(20),W(10):R=0:M=0:S(I)=0:FOR I=1 TO 20
110 INPUT "HOW MANY PLAYERS";N:PRINT
115 CLS
120 FOR I=1 TO N
130 PRINT "NAME OF PLAYER" I:INPUT A$(I)
135  CLS
```

Listing 2 continues

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LOG

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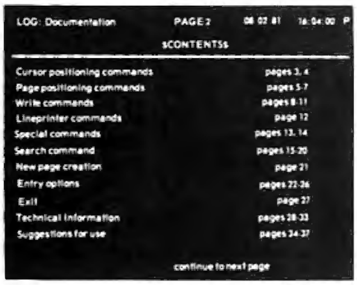

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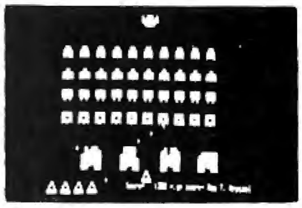

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Listing 2 continued

```
140 NEXT I
150 REM
160 FOR QQ=1 TO N
165 PRINT@ 0,STRING$(30," ");
170 PRINT@ 0, A$(QQ) "'S THROW";:INPUT T
180 IF T<0 OR T>3 THEN PRINT "INPUT 1,2,OR 3":GOTO 170
181 GOSUB 22:GOSUB 501
190 ON T GOTO 200,210,220
200 P1=.65:P2=.55:P3=.50:P4=.50:GOTO 230
210 P1=.99:P2=.77:P3=.43:P4=.01:GOTO 230
220 P1=.95:P2=.75:P3=.45:P4=.05
230 U=RND(100)/100
240 IF U>P1 THEN PRINT"BULLSEYE!! 40 POINTS! "A$(QQ):B=40:GOTO 2
90
250 IF U>P2 THEN PRINT"30-POINT ZONE! "A$(QQ):B=30:GOTO 290
260 IF U>P3 THEN PRINT"20-POINT ZONE! "A$(QQ):B=20:GOTO 290
270 IF U>P4 THEN PRINT"10-POINT ZONE! "A$(QQ);:B=10:GOTO 290
280 PRINT "HA-HA,YOU MISSED THE TARGET!! "A$(QQ):B=0
290 REM
300 S(QQ)=S(QQ)+B:PRINT "TOTAL SCORE FOR "A$(QQ)" = "S(QQ)
310 IF S(QQ)>200 THEN M=M+1:W(M)=1
312  NEXT QQ
320 R=R+1
325 PRINT "ROUND "R
330 IF M=0 THEN GOTO 150
335 IF M=1 THEN GOTO 340
340 PRINT:PRINT "WE HAVE A WINNER!!":PRINT
350 PRINT A$(W(M)) " SCORED " S(W(M)) " POINTS."
360 PRINT:PRINT A$(W(M)) " WANTS YOU TO PAY UP NOW!":END
500 GOSUB 21
501 POKE Z,32:POKE Z+1,32:POKE Z+3,32:POKE Z+4,32:POKE Z+5,32:PO
KE Z+6,32:POKE Z+7,32
502 POKE Z-7,140:POKE Z-6,140:POKE Z-5,140:POKE Z-4,140:POKE Z-3
,140:POKE Z-2,140:POKE Z-1,140
503 POKE Z-7,32:POKE Z-6,32:POKE Z-5,32:POKE Z-4,32:POKE Z-3,32:
POKE Z-2,32:POKE Z-1,32
504 POKE Z-15,140:POKE Z-14,140:POKEZ-13,140:POKE Z-12,140:POKE
Z-11,140:POKE Z-10,140:POKE Z-9,140:POKE Z-8,140
505 POKE Z-15,32:POKE Z-14,32:POKE Z-13,32:POKE Z-12,32:POKE Z-1
1,32:POKE Z-10,32:POKE Z-9,32:POKE Z-8,32
506 POKE Z-23,140:POKE Z-22,140:POKE Z-21,140:POKE Z-20,140:POKE
 Z-19,140:POKE Z-18,140:POKE Z-17,140:POKE Z-16,140
507 POKE Z-23,32:POKE Z-22,32:POKE Z-21,32:POKE Z-20,32:POKE Z-1
9,32:POKE Z-18,32:POKE Z-17,32:POKE Z-16,32
508 POKE Z-31,140:POKE Z-30,140:POKE Z-29,140:POKE Z-28,140:POKE
 Z-27,140:POKE Z-26,140:POKE Z-25,140:POKE Z-24,140
509 POKE Z-31,32:POKE Z-30,32:POKE Z-29,32:POKE Z-28,32:POKE Z-2
7,32:POKE Z-26,32:POKE Z-25,32:POKE Z-24,32
510 POKE Z,140:POKE Z+1,140:POKE Z+3,140:POKE Z+4,140:POKE Z+5,1
40:POKE Z+6,140:POKE Z+7,140
511 RETURN
```

Program Listing 3

```
3 CLS
5 CLEAR 1000
6 JJ$="
    "
10 REM ARCHERY GAME
19 X=15360:Y=15360:Z=16173
20 PRINT@ 0, "GAME OF ARCHERY":PRINT:RANDOM
21 GOTO 40
22 POKE 16000,188:FOR W=16001 TO 16012:POKE W,140:NEXT W:POKE 16
013,188
23 POKE 16064,191:POKE 16067,131:POKE 16074,131:POKE 16075,191:P
OKE 16077,191:FOR V=16068 TO 16073:POKE V,179:NEXT V:POKE 16066,
191
24 POKE 16128,191:POKE 16130,191:POKE 16132,191:POKE 16134,188:P
OKE 16135,188:POKE 16137,191:POKE 16139,191:POKE 16141,191
25 POKE 16192,191:POKE 16194,191:POKE 16196,143:FOR Q=16197 TO 1
6200:POKE Q,140:NEXT Q:POKE 16201,143:POKE 16203,191:POKE 16205,
191
26 POKE 16256,191:POKE 16257,176:FOR O=16258 TO 16267:POKE O,179
:NEXT O:POKE 16268,176:POKE 16269,191
27 Y=15360
28 POKE Y+692,188:POKE Y+691,176:POKE Y+755,131:POKE Y+754,143:P
OKE Y+753,188:POKE Y+752,176:POKE Y+816,131:POKE Y+815,191:POKEY
+879,131:POKE Y+880,143:POKE Y+881,188:POKE Y+882,176:POKE Y+946
,131:POKE Y+947,143:POKE Y+948,188
29 POKE Y+693,148:POKE Y+757,149:POKE Y+821,149:POKE Y+885,149:P
OKE Y+949,149
30 Z=16173
```

Listing 3 continues

Listing 3 continued

```
31 POKE Z,140:POKE Z+1,140:POKE Z+3,140:POKE Z+4,140:POKE Z+5,14
0:POKE Z+6,140:POKE Z+7,140
35 RETURN
40 INPUT "DO YOU NEED INSTRUCTIONS ";II$
50 IF II$="NO" THEN GOTO 70
60 GOSUB 5000
70 REM
100 DIM A$(20),S(20),W(10):R=1:M=0:S(I)=0:FOR I=1 TO 20
110 INPUT "HOW MANY PLAYERS";N:PRINT
115 CLS
120 FOR I=1 TO N
130 PRINT "NAME OF PLAYER" I:INPUT A$(I)
140 NEXT I
145 GOSUB 22
150 REM
160 FOR QQ=1 TO N
164 GOSUB 4000
170 PRINT@ 0, A$(QQ) "'S PROBLEM"
172 IF R=1 THEN T=6:GOTO 180
175 IF S(QQ)=HS THEN T=6 ELSE T=1
180 GOSUB 600
181 GOSUB 501
190 ON T GOTO 230,240,250,260,270
200 GOTO 280
230 PRINT "BULLSEYE !! "A$(QQ):B=50:GOTO 290
240 PRINT "40-POINT ZONE! "A$(QQ):B=40:GOTO 290
250 PRINT"30-POINT ZONE! "A$(QQ):B=30:GOTO 290
260 PRINT"20-POINT ZONE! "A$(QQ):B=20:GOTO 290
270 PRINT"10-POINT ZONE! "A$(QQ):B=10:GOTO 290
280 PRINT "TOO BAD "A$(QQ)" YOU MISSED.":B=0
290 REM
300 S(QQ)=S(QQ)+B:PRINT "TOTAL SCORE FOR "A$(QQ)" = "S(QQ)
305 IF HS<S(QQ) THEN HS=S(QQ)
308 PRINT "HIGH SCORE = "HS
310 IF S(QQ)>200 THEN M=M+1:W(M)=1:WW=S(QQ)
311 GOSUB 2300:IF N=QQ THEN R=R+1
312  NEXT QQ
330 IF M=0 THEN GOTO 150
335 IF M=1 THEN GOTO 340
340 PRINT:PRINT "WE HAVE A WINNER!!":PRINT
350 PRINT A$(W(M)) " SCORED " WW " POINTS."
360 PRINT:PRINT A$(W(M)) " WANTS YOU TO PAY UP NOW!":END
501 POKE Z,32:POKE Z+1,32:POKE Z+3,32:POKE Z+4,32:POKE Z+5,32:PO
KE Z+6,32:POKE Z+7,32
502 POKE Z-7,140:POKE Z-6,140:POKE Z-5,140:POKE Z-4,140:POKE Z-3
,140:POKE Z-2,140:POKE Z-1,140
503 POKE Z-7,32:POKE Z-6,32:POKE Z-5,32:POKE Z-4,32:POKE Z-3,32:
POKE Z-2,32:POKE Z-1,32
504 POKE Z-15,140:POKE Z-14,140:POKEZ-13,140:POKE Z-12,140:POKE
Z-11,140:POKE Z-10,140:POKE Z-9,140:POKE Z-8,140
505 POKE Z-15,32:POKE Z-14,32:POKE Z-13,32:POKE Z-12,32:POKE Z-1
1,32:POKE Z-10,32:POKE Z-9,32:POKE Z-8,32
506 POKE Z-23,140:POKE Z-22,140:POKE Z-21,140:POKE Z-20,140:POKE
 Z-19,140:POKE Z-18,140:POKE Z-17,140:POKE Z-16,140
507 POKE Z-23,32:POKE Z-22,32:POKE Z-21,32:POKE Z-20,32:POKE Z-1
9,32:POKE Z-18,32:POKE Z-17,32:POKE Z-16,32
508 POKE Z-31,140:POKE Z-30,140:POKE Z-29,140:POKE Z-28,140:POKE
 Z-27,140:POKE Z-26,140:POKE Z-25,140:POKE Z-24,140
509 POKE Z-31,32:POKE Z-30,32:POKE Z-29,32:POKE Z-28,32:POKE Z-2
7,32:POKE Z-26,32:POKE Z-25,32:POKE Z-24,32
510 POKE Z,140:POKE Z+1,140:POKE Z+3,140:POKE Z+4,140:POKE Z+5,1
40:POKE Z+6,140:POKE Z+7,140
511 REM
520 RETURN
600 D=T
700 PRINT@ 64, "FACTOR THE FOLLOWING PROBLEM"
800 GOSUB 1400
900 PRINT Z$
1000 GOSUB 2000
1010 REM
1020 PRINT@  192,JJ$;
1100 PRINT@ 192, "WHAT IS THE ANSWER ";:INPUT C$
1110 IF C$=A$ OR C$=B$ THEN PRINT "THAT'S RIGHT !!!":GOTO 1380
1300 IF D<5 THEN D=D+1:PRINT "TRY "D:GOTO 1010
1310 GOSUB 2600
1320 GOTO 1390
1380 IF D=6 THEN D=1
1390 T=D
1399 RETURN
1400 A=RND(5)+1:B=RND(5)+1
1500 IF RND(2)=1 THEN A=-A:SA$="-" ELSE SA$="+"
1600 IF RND(2)=1 THEN B=-B:SB$="-" ELSE SB$="+"
1700 X=A+B:Y=A*B
1800 Z$="X[2 + "+STR$(X)+"X + "+STR$(Y)
1900 RETURN
2000 B$="(X"+SA$+STR$(ABS(A))+")(X"+SB$+STR$(ABS(B))+")"
```

Listing 3 continues

✓ See List of Advertisers on Page 455

Listing 3 continued

```
2100 A$="(X"+SB$+STR$(ABS(B))+")(X"+SA$+STR$(ABS(A))+")"
2200 RETURN
2300 PRINT "PRESS ANY KEY TO CONTINUE"
2400 IF INKEY$="" THEN GOTO 2400
2500 RETURN
2600 GOSUB 4000:PRINT@ 0, "THE FACTORS OF "Z$
2700 PRINT "ARE EITHER "B$" OR "A$
2800 PRINT "AS YOU CAN SEE"
2900 PRINT "THE SUM OF "STR$(A)" AND "STR$(B)" IS "STR$(X)
3000 PRINT "AND THE PRODUCT OF "STR$(A)" AND "STR$(B)" IS "STR$(
Y)
3120 D=6
3200 RETURN
4000 PRINT@ 0,JJ$:PRINT@ 64,JJ$:PRINT@ 128,JJ$:PRINT@ 192,JJ$
4010 PRINT @256,JJ$:PRINT@ 320,JJ$:PRINT@ 384,JJ$
4200 RETURN
5000 PRINT "IN THIS GAME UP TO TWENTY PLAYERS GET TO"
5010 PRINT "FACTOR POLYNOMIALS."
5020 PRINT
5030 PRINT "DOESN'T THAT SOUND EXCITING ?"
5040 PRINT
5050 PRINT "A CORRECT ANSWER TO A PROBLEM WILL CAUSE AN ARROW"
5060 PRINT "TO BE SHOT AT A BULLSEYE."
5070 PRINT
5080 PRINT "A PLAYER WILL RECIEVE FROM 10 TO 50 POINTS FOR"
5090 PRINT "A SHOT. THE AMOUNT OF POINTS IS DEPENDENT ON"
5100 PRINT " THE NUMBER OF TRIES NEEDED TO ANSWER THE PROBLEM."
5110 PRINT
5120 GOSUB 2300
5125 CLS
5130 PRINT "THE WINNER OF THE GAME IS THE FIRST PLAYER TO GET"
5140 PRINT "200 POINTS."
5150 PRINT
5160 PRINT "DURING THE FIRST ROUND EACH PLAYER GETS ONLY ONE TUR
N."
5170 PRINT "DURING THE FOLLOWING ROUNDS EACH PLAYER GETS 5"
5180 PRINT "TRIES TO ANSWER THE PROBLEM CORRECTLY EXCEPT "
5190 PRINT "FOR THE PLAYER WITH  THE MOST POINTS."
5200 PRINT
5210 PRINT "THE PLAYER WITH THE LARGEST NUMBER OF POINTS"
5220 PRINT "GETS ONLY ONE CHANCE TO ANSWER THE PROBLEM"
5230 PRINT "CORRECTLY"
5240 GOSUB 2300
5250 CLS
5260 PRINT "ANSWERS TO THE PROBLEMS MUST BE IN THE FOLLOWING FOR
MAT: "
5270 PRINT
5280 PRINT
5290 PRINT "                (X+ 3)(X- 4)"
5300 PRINT
5310 PRINT "THAT IS A SPACE MUST BE PLACED AFTER EACH '+'"
5320 PRINT "    OR '-' SIGN .
5330 GOSUB2300
5900 RETURN
```

✓See List of Advertisers on Page 455

GENERAL

LOAD 80

Keep track of your books.

Homebrew Librarian

Larry R. Hamilton
306 Torrent Court
Rochester, MI 48063

As a member of several book clubs for many years, I have accumulated a large collection of professional books. Most books from my college studies are also part of my library. The value of these books along with the difficulty of their replacement prompted me to write a program to keep track of them. Program Listing 1 is written for my TRS-80 Level II 16K cassette system attached to an Epson MX-80 printer.

The program stores the value of my books and enough data to assist me in replacing them if necessary. This program provides for data storage on cassette tape and a printed listing of my book inventory which I store in a safe deposit box for insurance purposes.

Program Routines

The file consists of nine data fields necessary to assist in replacing any given book. A description of each field, the program variable used to store that field, and a suggested maximum length of each field is shown in Table 1.

Variable Name	Use
A$(x)	Book Author
D(x)	Date of Book Purchase
H1$	Heading for Listing
H2$	Heading for Listing
I$(x)	International Standard Book Number
J	Index Used in Loops
K	Index Used In Loops
K$	Book Number Input Variable
L	Line Number Counter for Listing
L$(x)	Library of Congress Catalog Number
M$	Search Argument
N	Loop Control—Maximum Books in Memory
N$(x)	Book Number
P	Page Number for Listing
P1	Switch for Additional Files During Listing
P$(x)	Book Publisher and Date
Q	Menu Input
S	Total Book Value Counter
SS	Total Book Value—For Listing
S$(x)	Book Subject
TT	Book Counter—For Listing
T	Book Counter
T$(x)	Book Title
V(x)	Book Value
X$	Search Argument
Z$	Menu Control

Table 1

The program does not edit each field for the suggested maximum length. The more characters you use, however, the faster you will use up your free string space.

Line 40 clears 7000 bytes of memory string space, enough for at least fifty books (the limit set by the dimension statement in line 50). You can store 100 or 150 books in 32K and 48K systems. Be sure to change the value of N in line 70.

Table 2 lists all variables. If you do not want the ISBN or Library of Congress Catalog Number in your file you can build more than fifty records at one time in memory. Experiment to determine

The Key Box

Basic Level II
Model I
16K RAM
Printer required

how many fit in your machine.

A functional diagram of the program routines is shown in Fig. 1. The numbers above each box are entered from the main menu to direct the program. The numbers below each box are the line numbers used in each routine.

Lines 1240-1350 display data on the screen. This subroutine is used in most of the functions. Line 1350 re-directs all functions back to the main menu.

The key to the Book Inventory file is the Book Number field, used while adding or changing records. Code the Book Number value as you like. You could use a sequential number, an alphanumeric code to distinguish hardback books from paperbacks, a coding system to identify location by room, shelf and position, or a combination of all these examples. Since the number is a string variable, it does not have to be numeric. Because I am not interested in locations or special codes to indicate the type of book, I number my books sequentially. The file building routine in lines 210-390 allows you to add records after a file is read into memory from tape. Line 190 searches the file in memory and sets the index equal to the next available position less than 50. The search is based on the first Book Value (V$) equal to zero and is the first available index used. Each book must have some value or the program assumes no book record for that particular index.

Search the book records in memory by Book Number (lines 400-470), by Book Title (lines 480-560), and by Book Subject (lines 570-650).

When searching by Book Number, the number must match one in memory exactly or a prompt will return you to the main menu.

The other two search routines do not require the entire title or subject. Each routine compares the title or subject in memory to the leftmost characters entered. After the first record to meet the criteria is displayed, the program prompts for another search argument. If you press Enter the program uses the previous argument to search through the remainder of the file for another match. You can page through the entire file in memory by repeatedly pressing Enter and having all books meeting the search criteria displayed. For example, enter DATA once as a subject search argument and the program displays all books having the four characters DATA in their subject data field as you repeatedly press Enter.

Lines 660-780 provide an input

Field Name	Program Variable Name	Suggested Maximum Length
1. Book Number	N$	5
2. Title	T$	40
3. Author	A$	20
4. Subject	S$	30
5. Publisher & Date	P$	30
6. Intl. Standard Book No.	I$	13
7. Library Congress Cat. No.	L$	7
8. Date Purchased (MMDDYY)	D	6
9. Book Value (Approx.)	V	5
Total Maximum Length		156

Table 2

Program Listing 1

```
9""10 REM * BOOK INVENTORY PROGRAM -  REVISION EFF. DATE 7/16/81 *
20 REM *  WRITTEN BY -  L. R. HAMILTON    306 TORRENT COURT    *
30 REM *                                  ROCHESTER/MI 48063   *
40 CLEAR 7000
50 DIM N$(50),T$(50),A$(50),S$(50),P$(50),I$(50),L$(50),D(50),V(
50)
60 H1$="BOOK INVENTORY LISTING      ":H2$="        PAGE NUMBER "

70 TT=0:S8=0:L=0:P=0:N=50
80 CLS: PRINTTAB(10);"* *  BOOK  INVENTORY  PROGRAM  * *": PRINT

90 PRINTTAB(20);  "* *  M E N U   * *": PRINT
100 PRINT "TO BUILD FILE IN MEMORY       TYPE 1"
110 PRINT "TO SEARCH FOR BOOK NUMBER     TYPE 2"
120 PRINT "TO SEARCH FOR TITLE           TYPE 3"
130 PRINT "TO SEARCH FOR SUBJECT         TYPE 4"
140 PRINT "TO READ FILE INTO MEMORY      TYPE 5"
150 PRINT "TO VALUE BOOK INVENTORY       TYPE 6"
160 PRINT "TO WRITE FILE TO TAPE         TYPE 7"
170 PRINT "TO CHANGE A RECORD IN MEMORY TYPE 8"
180 PRINT "TO LIST FILE ON PRINTER       TYPE 9"
190 INPUT Q: IF (Q < 1) OR (Q > 9) THEN GOTO 80
200 ON Q GOTO 210,400,480,570,660,790,890,990,1360: END
210 FOR K=1 TO N: IF V(K) <> 0 NEXT K ELSE GOTO 220
220 FOR J=K TO N
230 CLS:  PRINT "TO END FILE BUILD, ENTER ( END)"
240 PRINT "LAST NUMBER WAS "; N$(J-1),"INDEX";J
250 INPUT "ENTER BOOK NUMBER "; K$: IF K$="END" THEN GOTO 380
260 N$(J)=K$
270 INPUT "ENTER TITLE OF BOOK (NO COMMAS )....."; T$(J)
280 INPUT "ENTER AUTHOR (NO COMMAS)............."; A$(J)
290 INPUT "ENTER SUBJECT........................"; S$(J)
300 INPUT "ENTER PUBLISHER & DATE .............."; P$(J)
310 INPUT "ENTER ISBN NUMBER...................."; I$(J)
320 INPUT "ENTER LC CATLG NUMBER................"; L$(J)
330 INPUT "ENTER DATE ACQUIRED (MMDDYY)........."; D(J)
340 INPUT "ENTER APPROX VALUE/COST.............."; V(J)
350 INPUT "CORRECT? Y/N"; Z$: IF Z$="N" GOTO 230
360 PRINT "RECORD < ";N$(J);" > WILL BE BUILT  ";: FOR I=1TO200:
NEXTI
370 NEXT J
380 N$(J)="END"
390 PRINT,"<FILE BUILD ENDED....>": GOTO 1350
400 CLS
410 INPUT "ENTER BOOK NUMBER SEARCH ARGUMENT (END TO STOP)"; M$
420 IF M$= "END"  GOTO 1350
430 FOR J=1 TO N
440 IF N$(J) = "END" PRINT "<END OF FILE...>": GOTO 1350
450 IF M$ <> N$(J) NEXT J
460 GOSUB 1240
470 GOTO 410
480 K=1: CLS
490 INPUT "ENTER TITLE SEARCH ARGUMENT (END TO STOP)"; M$
500 IF M$="END" GOTO 1350
510 FOR J= K TO N
520 X$=LEFT$(T$(J),LEN(M$))
530 IF N$(J) = "END" PRINT "<END OF FILE...>": GOTO 1350
540 IF M$ <> X$ NEXT J ELSE GOSUB 1240
550 K=J+1: IF K>N K=N
560 GOTO 490
570 K=1: CLS
580 INPUT "ENTER SUBJECT SEARCH ARGUMENT (END TO STOP)"; M$
590 IF M$="END" GOTO 1350
600 FOR J= K TO N
610 X$=LEFT$(S$(J),LEN(M$))
620 IF N$(J) = "END" PRINT "<END OF FILE...>": GOTO 1350
630 IF M$<>X$ NEXT J ELSE GOSUB 1240
640 K=J+1: IF K>N K=N
650 GOTO 580
660 CLS:REM * READ FILE INTO MEMORY *
670 INPUT "PRESS ENTER WHEN INPUT TAPE IS READY. ";Z$
680 FOR J=1 TO N
690 INPUT #-1,N$(J),T$(J),A$(J),S$(J),P$(J),I$(J),L$(J),D(J),V(J
)
700 IF J=N THEN N$(J)="END"
710 GOSUB 1240
720 IF V(J) = 0 GOTO 750
730 IF N$(J)= "END" THEN GOTO 750
740 NEXT J
750 PRINT@896,"FREE STRING SPACE = "FRE(Z$);
760 PRINT "FILE IS LOADED IN MEMORY...."
770 IF P1=1 PRINT"PRINTING CONTINUES...": GOTO 1400
780 GOTO 1350
790 CLS: T=0: S=0
800 FOR J = 1 TO N
810 IF V(J)=0 GOTO 850
820 IF N$(J) = "END" GOTO 860
830 T=T+1: S=S+V(J)
840 GOSUB 1240
850 NEXT J
860 PRINT "TOTAL BOOKS ON FILE  =  "; T: PRINT
870 PRINT "TOTAL VALUE OF BOOKS = $"; S: PRINT
880 GOTO 1350
890 REM * RECORD DATA ON CASSETTE *
900 CLS: INPUT"PREPARE CASSETTE FOR RECORDING.  WHEN READY, PRES
S ENTER.";Z$
910 FOR J= 1 TO N
920 IF V(J)= 0 THEN N$(J)="END"
930 CLS: PRINT "COPYING.... BOOK NUMBER ";N$(J);
940 PRINT #-1,N$(J),T$(J),A$(J),S$(J),P$(J),I$(J),L$(J),D(J),V(J
)
950 GOSUB 1240: PRINT "RECORD COPIED...";
960  FOR I = 1 TO 250: NEXT I
970 IF N$(J)="END"   PRINT "FILE COPIED TO TAPE": GOTO 1350
980 NEXT J
990 CLS: REM * CHANGE RECORD IN MEMORY *
1000 INPUT "ENTER BOOK NUMBER TO BE CHANGED. (END TO STOP) ";K$
1010 IF K$="END" GOTO 1350
1020 FOR J=1 TO N: IF N$(J)=K$ GOTO 1050
1030 IF N$(J)="END":PRINT"<BOOK NUMBER NOT FOUND. END OF FILE..>
":GOTO 1000
1040 NEXT J
1050 GOSUB 1240
1060 PRINT@650, "TO CHANGE :             BOOK NUMBER.ENTER B"
1070 PRINT "TITLE.....ENTER T","AUTHOR......ENTER A"
1080 PRINT "SUBJECT...ENTER S","PUBLISHER...ENTER P"
1090 PRINT "ISBN......ENTER I","LC CATLG....ENTER L"
1100 PRINT "DATE......ENTER D","VALUE.......ENTER V";
1110 INPUT Z$
1120 IF Z$="B" INPUT"ENTER NEW BOOK NUMBER ";N$(J)
1130 IF Z$="T" INPUT"ENTER NEW TITLE ";T$(J)
1140 IF Z$="A" INPUT"ENTER NEW AUTHOR";A$(J)
1150 IF Z$="S" INPUT"ENTER NEW SUBJECT";S$(J)
1160 IF Z$="P" INPUT"ENTER NEW PUBLISHER";P$(J)
1170 IF Z$="I" INPUT"ENTER NEW ISBN";I$(J)
```

Listing continues

Listing continued

```
1180 IF Z$="L" INPUT"ENTER NEW LC CATLG NO.";L$(J)
1190 IF Z$="D" INPUT"ENTER NEW DATE";D(J)
1200 IF Z$="V" INPUT"ENTER NEW VALUE";V(J)
1210 GOSUB 1240
1220 INPUT "CORRECT? Y/N";Z$: IF Z$="N" THEN GOTO 1050ELSE GOTO
1230
1230 INPUT "MORE CHANGES? Y/N";Z$: IF Z$="Y" THEN GOTO 1050ELSE
GOTO 1000
1240 CLS:
1250 PRINT "BOOK NUMBER      ";N$(J)
1260 PRINT "TITLE            ";T$(J)
1270 PRINT "AUTHOR           ";A$(J)
1280 PRINT "SUBJECT          ";S$(J)
1290 PRINT "PUBLISHER        ";P$(J)
1300 PRINT "ISBN NUMBER      ";I$(J)
1310 PRINT "LC CATLG NUMBER  ";L$(J)
1320 PRINT "DATE ACQUIRED    ";D(J)
1330 PRINT "APPROX. VALUE    ";V(J)
1340 PRINT: PRINT: RETURN
1350 INPUT "TO SEE MAIN MENU, PRESS ENTER.."; Z$: GOTO 80
1360 REM * PRINT LISTING *
1370 INPUT " IS PRINTER READY? Y/N";Z$:IF Z$="N" GOTO 1350
1380 LPRINT CHR$(143);CHR$(141)
1390 GOSUB 1530
1400 FOR J=1TO N
1410 IF N$(J)="END": GOSUB 1600: LPRINT"TOTAL BOOKS = ";TT;TAB(2
5)"TOTAL VALUE = ";SS;TAB(50)"AVERAGE VALUE = ";SS/TT
1420 IF N$(J)="END": LPRINT:  LPRINT"END OF REPORT ":GOTO 1350
1430 LPRINT "BOOK NO. ";N$(J);TAB(60)"TITLE:  ";T$(J)
1440 LPRINT "AUTHOR:  ";A$(J);TAB(60)"SUBJECT:  ";S$(J)
1450 LPRINT "PUBLISHER: ";P$(J);TAB(60)"ISBN: ";I$(J)
1460 LPRINT "LC CATLG:  ";L$(J);TAB(30)"DATE PURCH: ";D(J);TAB(6
0)"APPROX. VALUE:  ";V(J)
1470 LPRINT
1480 L=L+5
1490 TT=TT+1: SS=SS+V(J)
1500 IF L>55 GOSUB 1530
1510 NEXT J
1520 GOTO 1350
1530 REM * HEADING SUBROUTINE *
1540 L=0:P=P+1
1550 IF P>1:LPRINT CHR$(140)
1560 LPRINT TAB(40);H1$;H2$;P
1570 LPRINT
1580 L=L+3
1590 RETURN
1600 REM * ADDITIONAL FILE ROUTINE *
1610 INPUT"DO YOU HAVE ANOTHER TAPE OF DATA TO PRINT? Y/N";Z$
1620 IF Z$="Y" P1=1: GOTO 660
1630 RETURN
```

routine to read a file into memory from cassette tape. If this routine finds a Book Value equal to zero or a Book Number equal to End the routine ends. After the file is loaded into memory, the program displays the amount of free string space. As each record reads into memory it is displayed on the screen (line 710).

The routine to record the Book Inventory on cassette tape is found in lines 890–980. This routine displays each book record on the screen as it is written to tape. When a Book Number equals End the routine ends.

A simple routine to total the value of all books in memory is in lines 790–880. The total value is also computed when the file is printed.

To change any data for a book in memory, selection eight of the main menu sends the program to line 990. If you enter a valid Book Number you will be prompted to enter a code for the field to be changed. After the changed data field value is displayed you will be asked if it is correct. If so, you can enter another Book Number to be changed or return to the main menu.

The printing routine in lines 1360–1630 uses some control characters unique to my Epson MX-80 printer. Change these codes in lines 1380 and1550 for use with your printer. CHR$(143) condenses the printing to 132 characters per line. CHR$(141) is the line feed and CHR$(140) is the top-of-form code.

The program prints 55 lines per page, allowing eleven books on each page. Lines 1600–1630 allow additional data tapes to be read into memory while the listing is printed, necessary since only 50 books fit in memory at one time. This feature uses the input routine in lines 660–780 and branches back to line 1400 in the printing routine. ■

Mr. Hamilton is a Systems Manager for an automative supply company in Michigan. He is certified by the Institute for the Certification of Computer Professionals.

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These five programs give high-precision answers.

Find a Number's Roots

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I wrote these five Basic programs for the TRS-80 but they apply to any Basic machine. Three of these programs find any roots, and two extract square roots.

Most Basic exponentiation (↑) and square root (SQR) functions only give about six places of accuracy. The methods in this article give higher precision answers, some accurate to 15 decimal places after only a few iterations.

These methods include a 3500 year old technique, continued fractions, binomial expansions, repeated halving, and recursion based on an algebraic identity.

Compare the accuracy, number of iterations used, and computation time of the methods to see which works best for your range of values.

The Key Box

Basic Level II
Model I
16K RAM

The Newton-Raphson Method

An averaging method for square roots appeared in ancient Mesopotamia before 1500 B.C. Those folks successively approximated $\sqrt{A}$ by the sequence $x_1, x_2, \ldots$ where $x_{i+1} = \frac{1}{2}(x_i + A/x_i)$ and x_1 was a first guess at $\sqrt{A}$. This is a special case of the Newton-Raphson method which uses the general formula $x_{i+1} = x_i - f(x_i)/f'(x_i)$. In this formula if $x = \sqrt{A}$ is the desired square root, let $f(x) = x^2 - A$; then $f'(x) = 2x$. The Newton-Raphson formula reduces to the ancient Mesopotamian formula.

Program Listing 1 uses the Newton-Raphson formula with $f(x) = x^M - A$ to find the Mth root of A. Line 80 requests the first guess x_1; the recursion formula appears in line 120. The loop in lines 100 through 140 generates $x_2, x_3, \ldots, x_{11}$. The value x_{11} is a good approximation to $\sqrt[M]{A}$ unless an exceptionally poor choice is made for x_1. Experiment with this by holding A and M fixed and running the program twice using different starting values for the first guess x_1, INPUT of line 90.

To determine how well x_{11} approximates $\sqrt[M]{A}$ add the following two lines to the program:

```
500 PRINT: Y = 1: FOR J = 1 TO M: Y
 = Y*X: NEXT J
510 PRINT Y
```

A Binomial Expansion

In contrast, the user does not enter a first guess or initial value in the Binomial procedure.

The series

$$1 + (1/M)(x/1!) + (1/M)(1/M - 1)(x^2/2!) + (1(M)(1(M - 1)(1/M - 2(x^3/3!) + \ldots$$

obtained by expanding $(1 + x)^{1/M}$ using the binomial expansion, is convergent for x between −1 and 1 inclusive.

Program Listing 2 uses this expansion to determine $\sqrt[M]{A}$. The loop in lines 80 and 90 finds the smallest integer L such that L^M is greater than A. The program lets $x = (A/L^M) - 1$. Then $A = L^M(1 + x)$ or, more suitable to our purpose, $\sqrt[M]{A} = L(1 + x)^{1/M}$. Because the x value is between −1 and 0, our expansion for $(1 + x)^{1/M}$ is valid and converges.

Lines 110 through 160 carry out the series expansion. S denotes the sum of the first I terms and appears in line 130. The Ith term is in line 150, where it is called T. Fifty iterations are used since this convergence is usually slow.

Binary Chopping

Repeated halving begins with an interval known to contain $\sqrt[M]{A}$. This interval (0 to A if A > 1 otherwise 0 to 1) is halved and one-half discarded. The remaining half-interval is halved, one-half discarded, and so on until further halving is insignificant. This proceeds quite rapidly for $0 < A < 1$, but much halving is done if $A > 1$.

If the Mth power of the interval's midpoint is less than A discard the left (smaller) half-interval; the midpoint is too small to be $\sqrt[M]{A}$. For Mth power greater than A discard the right (larger) half-interval.

Line 70 of Program Listing 3 determines the initial interval containing $\sqrt[M]{A}$. Line 100 accomplishes the halving and the logic of line 120 discards half-intervals. Line 90 uses 60 iterations; use only 10 or 15 iterations for small values of A. If many values do not change you used unnecessary iterations.

Recursion Based on an Algebraic Identity

This method and the continued fraction method that follows determine square roots with the same algebraic identity. If T is any real number and if $x^2 = A$ then $x^2 - T^2 = A - T^2$. Factoring, we have $(x - T)(x + T) = A - T^2$, and $x = T + (A - T^2)/(x + T)$. This is our desired identity.

For recursive use with $x_1, x_2, \ldots$ approximating $\sqrt{A}$ replace the identity with $x_{i+1} = T + (A -$

$T^2)/(x_1 + T)$, with x_1 being T. If you choose T such that T^2 is close to A, you obtain good approximations for $\sqrt{A}$ rapidly.

Program Listing 4 implements the recursive relationship with the algebraic identity in line 90. The twenty-five iterations in lines 70 through 100 are usually more than enough to approximate $\sqrt{A}$ very accurately if your choice for T is good. For example, if A = 0.0012345 only fifteen iterations are needed if T is chosen to be .03. If T = .1 fifty-T = 1, 57 iterations are required. The 25 value in line 70 must change to 75 to allow this.

Continued Fractions

This technique repeatedly uses the identity $x = T + (A - T^2)/(T + x)$. Replace the x on the right side of this identity by the entire right side. Thus, $x = T + (A - T^2)/(T + T + (A - T^2)/(T + x))$. Continue to replace the right hand x value by $T + (A - T^2)/(T + x)$. The resulting expression, after an infinite number of replacements for x, is called a continued fraction.

In general, if $x = b_0 + a_1/(b_1 + a_2/(b_2 + a_3/(b_3 + \ldots)$ is a continued fraction, then x is approximated by $A_i/B_i = (b_iA_{i-1} + a_iA_{i-2})/(b_iB_{i-2})$ for $i = 1,2,\ldots$ with $A_{-1} = 1, A_0 = b_0, B_{-1} = 0$, and $B_0 = 1$. If

$$\lim_{i \to \infty} A_i/B_i$$

exists (as it does with our particular continued fraction), the infinite continued fraction converges to x.

```
0 '*** NEWTON-RAPHSON METHOD FOR FINDING ROOTS ***
10 CLS
20 DEFDBL A,X,Y
30 DEFINT I,J,M
40 INPUT "WHAT ROOT DO YOU WANT,
    ENTER 2 FOR SQUARE ROOT ,3 FOR CUBE ROOT ,ETC. ";M
50 PRINT "ENTER THE NUMBER YOU WANT THE ";M;"-TH ROOT OF ";
60   INPUT A
70 'YOU CAN ENTER 1 FOR THE INPUT IN LINE 90 IF YOU WISH.
    OTHER CHOICES MIGHT BE BETTER THOUGH.
80 PRINT "ENTER A NUMBER WITH POWER ";M;" CLOSE TO ";A;
90   INPUT X
100 FOR I=1 TO 10
110    Y=1:FOR J=1 TO M-1:Y=Y*X:NEXT J
120    X=((M-1)*X+A/Y)/M
130    PRINT X;
140 NEXT I
```

Program Listing 1

```
0 '*** A BINOMIAL EXPANSION METHOD TO FIND M-TH ROOTS ***
10 CLS
20 DEFDBL A,S,T,X
30 DEFINT I,J,L,M
40 INPUT "ENTER 2 FOR SQUARE ROOT,3 FOR CUBE ROOT,ETC. ";M
50 PRINT"ENTER THE NUMBER YOU WANT THE ";M;"-TH ROOT OF ";
60    INPUT A
70 L=1
80 L1=1:FOR J=1 TO M:L1=L1*L:NEXT J
90    IF A>=L1 THEN L=L+1:GOTO 80
100 X=A/L1-1
110 I=1:T=X/M:S=1
120 FOR K=1 TO 50
130    S=S+T
140    PRINT L*S;
150    I=I+1:T=T*X*(1/M-(I-1))/I
160 NEXT K
```

Program Listing 2

```
0 '*** REPEATED HALVING OR BINARY CHOPPING FOR ROOTS ***
10 CLS
20 DEFDBL A,D,X,Y
30 DEFINT J,M
40 INPUT"ENTER 2 FOR SQUARE ROOT,3 FOR CUBE ROOT,ETC. ";M
50 PRINT "ENTER THE NUMBER YOU WANT THE ";M;"-TH ROOT OF";
60    INPUT A
70 IF A>1 THEN D=A ELSE D=1
80 X=D
90 FOR K=1 TO 60
100    X=X/2
110    Y=1:FOR J=1 TO M:Y=Y*D:NEXT J
120    IF Y<A THEN D=D+X ELSE D=D-X
130 PRINTD;:NEXT K
```

Program Listing 3

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Program Listing 5 evaluates the A_i terms in line 80 and the B_i terms in line 90. Two prior values, initialized in line 60 and updated in line 110, determine each of the values A_i and B_i.

Program Listing 6 combines the previous five programs. Lines 31 through 34 print a menu with the five methods for choices.■

David R. Cecil is chairman of the Department of Mathematics at Texas A & I.

```
0 '*** USING AN ALGEBRAIC IDENTITY TO FIND SQUARE ROOTS ***
10 CLS
20 DEFDBL A,T,X
30 INPUT "ENTER THE NUMBER WHOSE SQUARE ROOT YOU WANT ";A
40 PRINT "ENTER A NUMBER WHOSE SQUARE IS CLOSE TO ";A;
50    INPUT T
60 X=T
70 FOR K=1 TO 25
80    PRINT X;
90    X=T+(A-T*T)/(X+T)
100 NEXT K
```

Program Listing 4

```
0 '*** CONTINUED FRACTION METHOD FOR SQUARE ROOTS ***
10 CLS
20 DEFDBL A,B,T
30 INPUT "ENTER THE NUMBER WHOSE SQUARE ROOT YOU WANT ";A
40 PRINT "ENTER A NUMBER WHOSE SQUARE IS CLOSE TO ";A;
50    INPUT T
60 A1=T:A2=1:B1=1:B2=0
70 FOR K=1 TO 25
80    A0=2*T*A1+(A-T*T)*A2
90    B0=2*T*B1+(A-T*T)*B2
100   PRINT A0/B0;
110   A2=A1:A1=A0:B2=B1:B1=B0
120 NEXT K
```

Program Listing 5

```
0 '*** A COMBINED PROGRAM FOR ROOTS ***
10 CLS
20 DEFDBL A,B,D,S,T,X,Y
30 DEFINT I,J,L,M
31 PRINT"SELECT THE METHOD YOU WANT TO USE TO FIND THE ROOT"
32 PRINT"1. NEWTON-RAPHSON ","2.BINOMIAL SERIES "
33 PRINT"3.INTERVAL-HALVING ","4.ALGEBRAIC IDENTITY "
34 PRINT,"5.CONTINUED FRACTION "
35    INPUT K1:IF K1>3 THEN 320
40 INPUT "WHAT ROOT DO YOU WANT,
      ENTER 2 FOR SQUARE ROOT ,3 FOR CUBE ROOT ,ETC. ";M
50 PRINT "ENTER THE NUMBER YOU WANT THE ";M;"-TH ROOT OF ";
60    INPUT A
70 ON K1 GOTO 80,150,250
80 PRINT "ENTER A NUMBER WITH POWER ";M;" CLOSE TO ";A;
90    INPUT X
100 FOR I=1 TO 10
110    Y=1:FOR J=1 TO M-1:Y=Y*X:NEXT J
120    X=((M-1)*X+A/Y)/M
130    PRINT X;
140 NEXT I:END
150 L=1
160 L1=1:FOR J=1 TO M:L1=L1*L:NEXT J
170 IF A>=L1 THEN L=L+1:GOTO 160
180 X=A/L1-1
190 I=1:T=X/M:S=1
200 FOR K=1 TO 50
210    S=S+T
220    PRINT L*S;
230    I=I+1:T=T*X*(1/M-(I-1))/I
240 NEXT K:END
250 IF A>1 THEN D=A ELSE D=1
260 X=D
270 FOR K=1 TO 60
280    X=X/2
290    Y=1:FOR J=1 TO M:Y=Y*D:NEXT J
300    IF Y<A THEN D=D+X ELSE D=D-X
310 PRINTD;:NEXT K:END
320 INPUT "ENTER THE NUMBER WHOSE SQUARE ROOT YOU WANT ";A
330 PRINT "ENTER A NUMBER WHOSE SQUARE IS CLOSE TO ";A;
340 INPUT T
350 IF K1=5 THEN 410
360 X=T
370 FOR K=1 TO 25
380    PRINT X;
390    X=T+(A-T*T)/(X+T)
400 NEXT K:END
410 A1=T:A2=1:B1=1:B2=0
420 FOR K=1 TO 25
430    A0=2*T*A1+(A-T*T)*A2
440    B0=2*T*B1+(A-T*T)*B2
450    PRINT A0/B0;
460    A2=A1:A1=A0:B2=B1:B1=B0
470 NEXT K:END
```

Program Listing 6

SYSTEM loads that crash explained.

Things Still Crawl in the Level II ROM

Gregg E. Marshall
P.O. Box 3282
Walnut Creek, CA 94598

Recently, while loading a machine language tape with the System command my TRS-80 displayed a "C" in the upper right corner of the video display, and the tape stopped. I tried the load again, but still had no luck.

I usually record any program twice, with different file names. But when I tried to load the second copy, my TRS-80 couldn't find it. Since the Radio Shack manuals didn't give any explanation of these problems, I decided to "PEEK" around in the Level II ROMs and find out what was going on.

I was interested in what was happening at the byte level since Radio Shack's *Technical Reference Manual* offers a good description of the hardware and operation at the bit level. By searching the ROMs for calls to the read-a-byte subroutine at 0235H, I found the System command processing nearby in locations 02A9H to 032AH. By disassembling and analyzing the code, I not only discovered an explanation of my loading problems, but two potentially serious bugs!

The Key Box

Basic Level II
Model I
4K RAM
Cassette

Machine-Code Tape Format

Figure 1 shows an overview of the machine language tape format as a sequence of bytes that can be divided into four record types: the leader and sync byte, a file name, the data records, and the end of file/starting address.

The leader and sync byte record consists of 255 bytes of zeros, followed by a single byte containing the value A5H. When the tape is started, the TRS-80 moves an eight-bit wide window across the data bits read from the tape until it finds the value A5H. Normally, the tape is started before or during the leader, so it skips the zero bytes until it reads the A5H.

If, however, the tape is started in the middle of a file, it is possible for some of the data to be mistaken for a sync byte. That data might be an AND A,L instruction; or an LD A, (BC) followed by an LD, D, B; or any number of combinations of instructions that result in an A5H data bit pattern.

A more secure mechanism for synchronizing the tape would be to identify the leader by finding several bytes of zeros followed by the A5H sync byte. This mechanism is not foolproof, but the probability of a program or data matching the desired pattern is significantly lower.

Following the leader and sync byte record is a file name record. This record consists of a file name ID byte (55H), followed by a six character file name. If the file name is shorter than six characters, it must be padded, usually with spaces. Unlike the data records, no checksum is recorded.

Next on the tape are one or more data records. The number of records depends on the size of the program being saved. Each data record contains a maximum of 256 data bytes. Therefore, if the machine language program were 1000 bytes long, at least four data records are required. However, you can use more than four. In fact, the records need not even be in order since they each contain the starting address for storing the data.

A data record consists of an ID byte (3CH), a byte containing the number of data bytes in the record (0 implies 256 data bytes), two bytes containing the starting address of the data (least significant byte first), the data bytes themselves, and finally a single checksum byte. Note that a single file can contain data for several areas of memory.

> *"There are few limitations on file names—the only illegal characters are the colon and the cursor control. . ."*

The checksum for data records is a simple running sum of the data bytes and the data starting address, but not the ID byte or byte count.

If, during loading, the checksum calculated by the TRS-80 doesn't match the recorded checksum, a C is displayed in place of the left asterisk normally displayed as part of a tape loading signal. However, the loading doesn't halt until the end-of-file record is detected.

This can be good or bad, depending on what causes the checksum error and what data are affected. If a part of a text string is bad, the program may run sucessfully. If, however, the byte count is bad, the loading may become out of step with the data, causing the tape to read continously.

After it reads each data record, a loading tape toggles the right asterisk, alternating between * and space; this results in the familiar flashing asterisk.

Finally, each file contains an end-of-file record. This consists of an ID byte (78H) and two bytes containing the starting address of the machine language program (again, least significant byte first). This address is used if the slash is typed without a numeric value. A numeric value overrides the recorded starting address. Like the file name, it records no checksum byte.

System Command Processing

To understand the inner workings of the System command, I dump the ROM memory between 02A9H and 032AH, disassembling it by hand.

With help from Wes Thielke's article in February 1981's *80 Microcomputing*, I translate that information into Assembly. The result is a commented Assembly listing.

Since Radio Shack copyrights its machine language, I cannot publish that listing here, but Fig. 2 is a detailed flowchart of the System command processor in the order in which it appears in memory. This flowchart and the discussion that follows should allow anyone to create his own commented listing.

The System command processor divides into four major sections: prompting and command decoding (02B2H to 02CCH), file name search (02CEH to 02E5H), file loading (02E7H to 0312H and 02A9H to 02AFH), and execute a machine language program (031DH to 0329H).

Upon entering the command processing code, the TRS-80 calls a subroutine located in RAM. This moves the TRS-80 from Basic to TRSDOS. I plan to use it to transfer control to a ROM monitor I am attaching to my TRS-80.

During power-up, TRS-80s without disks initialize the RAM subroutine to a return-from-subroutine instruction. This nullifies the subroutine. If the RAM subroutine returns, the TRS-80 initializes the stack pointer, outputs a *? prompt, and uses Basic's line input subroutine to input the command. Using Basic's line input allows the user to type left arrow and shift left arrow to erase the last character or the entire line, respectively. You can terminate input by either Enter or Break, with Break returning you to Basic. Typing Enter causes a syntax error and returns to Basic.

There are only two System commands: Execute and Load. If the command line starts with a slash, the TRS-80 assumes it to be a Start Execution command. Otherwise the TRS-80 interprets the command line to be the file name of the machine language program you want loaded.

There are few limitations on file names—the only illegal characters are the colon and the cursor control characters.

You can store several machine language programs on a single tape and search for the desired file.

Starting the cassette, the TRS-80 finds the sync record. It then inputs until it finds a file name ID byte.

The file name characters you type are matched with those read from the tape until: 1) two characters do not match; 2) all the characters in the command line are matched; or 3) six characters have been matched.

In the first case, the TRS-80 looks for another sync record and tries again. Otherwise, it considers the file data loaded into memory.

During file loading, the TRS-80 displays two asterisks in the upper right corner of the video display. It turns the right asterisk on, then off, after it reads each data block. It replaces the left asterisk with a C any time a data record checksum occurs.

After the TRS-80 reads one block but before it reads either a data ID byte or an end-of-file ID byte, it ignores any characters.

The end-of-file ID byte is assumed to be followed by a two-byte starting address. When you are loading more than one machine language program, the last file loaded determines the starting address.

In all cases, after the TRS-80 loads the file, it stops the tape and restarts the System command.

```
                          REVISED FILENAME SEARCH FOR TRS-80          1

0000                          TITLE   'REVISED FILENAME SEARCH FOR TRS-80'
0000                          ORG     0000H              ; SET THIS TO APPROPRIATE MEMORY ADDRESS
                      ;
                      ; Revised filename search for loading machine language programs
                      ; via the 'SYSTEM' command in Level II Basic.  Replaces the code
                      ; from 02CEH to 02E6H.  To be useful, the code between 0285H and
                      ; 02CDH should also be relocated and a jump to the revised code
                      ; placed starting at location 41E2H.
                      ; Gregg E. Marshall     2/15/80
                      ;

0000 CD 93 02         MCLOAD: CALL    0293H              ; START THE CASSETTE AND FIND THE SYNC BYTE
0003 CD 35 02         SFNAME: CALL    0235H              ; A := BYTE READ FROM CASSETTE
0006 FE 55                    CP      55H                ; IF BYTE <> START OF FILENAME
0008 20 F9                    JR      NZ,SFNAME          ;       THEN KEEP LOOKING FOR START
000A 06 06                    LD      B,06               ;       ELSE B := MAX FILENAME LENGTH
000C E5                       PUSH    HL                 ;*           SAVE DESIRED FILENAME POINTER
                                                         ;            IN THE EVENT OF NO MATCH
000D 7E               SLOOP:  LD      A,(HL)             ; A := NEXT CHARACTER IN DESIRED FILENAME
000E B7                       OR      A                  ; IF END OF DESIRED FILENAME
000F 28 09                    JR      Z,MATCH            ;*      THEN MATCH IS SUCESSFUL
0011 CD 35 02                 CALL    0235H              ;       ELSE A := NEXT CHARACTER IN
                                                         ;                 RECORDED FILENAME
0014 BE                       CP      (HL)               ; IF RECORDED CHARACTER <> COMMAND STRING
0015 23                       INC     HL                 ;    CHARACTER
0016 20 06                    JR      NZ,NOMTCH          ;       THEN FIND NEXT FILENAME
0018 10 F3                    DJNZ    SLOOP              ;       ELIF NOT 6 CHARACTERS COMPARED
                                                         ;               THEN CHECK NEXT CHARACTER
001A E1               MATCH:  POP     HL                 ;*              ELSE SUCESSFUL MATCH
                                                         ;                    (ADJUST STACK)
001B C3 E7 02                 JP      02E7H              ; AND READ THE FILE'S DATA
                      ; NO MATCH -- SO START OVER
001E E1               NOMTCH: POP     HL                 ;* RESTORE POINTER TO DESIRED FILENAME
001F 18 DF                    JR      MCLOAD             ;* AND FIND NEXT SYNC/START OF FILNAME
                                                         ;* COMBINATION
0021                          END
```

Program Listing. Assembly Program Listing of Revised File Name Search

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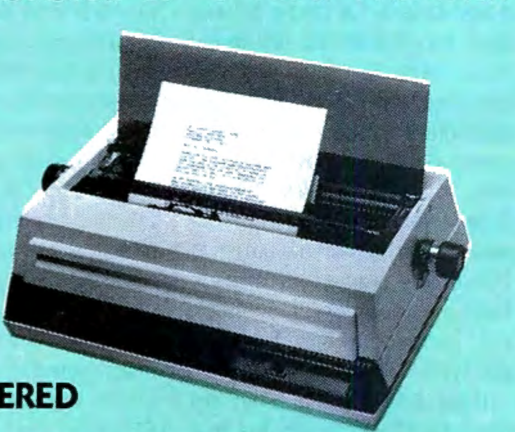

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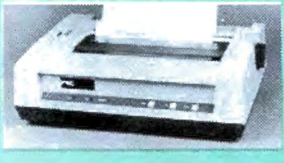

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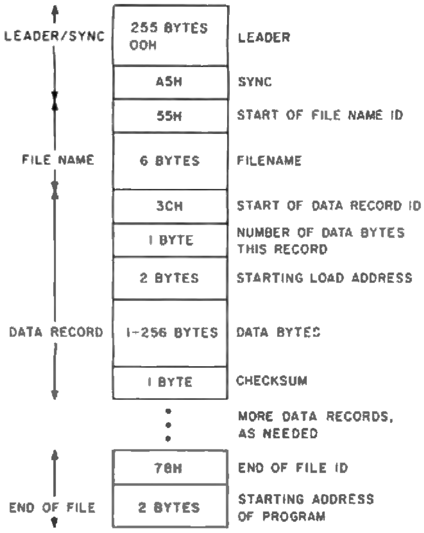
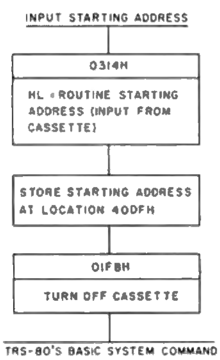


Fig. 1. Machine language tape format

It is also possible to build a file that loads on top of the System command's RAM subroutine, takes control of the TRS-80 (possibly to load a "protected" program), then returns control to the TRS-80's normal System command processing.



Bugs in System Command

Have you ever tried to load the second or third machine language program on a tape only to have it float into Never-never land? Eventually, you reach the end of the cassette without loading the program.

The problem is a result of the way the TRS-80 searches for a file name. When you type a file name, the TRS-80 activates its cassette and finds the sync byte. It reads the tape, character by character, until it finds the start of the file name ID byte. It compares the file name you type with the recorded file name until one of three conditions is met: 1) If you type a file name of less than six characters, as many characters as you type are matched with corresponding characters in the recorded file name. (Thus, EDTASM and ED both load Radio Shack's Editor/Assembler.) 2) Six characters of both file names match. 3) One of the characters it reads from the tape does not match the corresponding character you type.

If conditions one and two are met, the TRS-80 loads the machine language program that follows.

Condition three is an unsuccessful match. This is where the TRS-80 can get confused. Instead of going back and finding a new leader and a new sync byte, the TRS-80 continues to read characters until it finds another file name ID character.

This strategy, in itself, is very dangerous, since it is likely the TRS-80 will use a data byte as the start of file name. Even worse, the TRS-80 might lose sync completely. Then, any combination of data that results in a byte equal to 55H will be misinterpreted.

Even in the unlikely event that the TRS-80 does find another real file name, it does not reset its pointer to the file name you typed. Therefore, what the 80 matches depends on how well the last file name(s) it reads from the cassette resembles the desired file name.

Eventually, it can match all the characters in the desired file name, resulting in its loading the wrong file. Assuming the first bug doesn't "byte" you, it is possible to exploit this "feature" to load the second copy of the same file by preceding the file name with an extra unmatchable character. For example, to load the second copy of EDTASM, you can type XED.

Program Listing shows a revised version of the file name search. This version only adds nine bytes of code but fixes the second bug and decreases the probabilities of the first. To use this version, relocate the code for the locations 02B5H-02CDH to come immediately before the code listed. (I generally put the code in the highest part of memory after protecting it from Basic.) When the TRS-80 loads this code into memory, change the memory locations starting at 41E2H to jump to the revised System command processor.

This revised version is the same as Radio Shack's except I add code to save and restore the pointer to your file name before and after each attempt at matching. It also improves the chances of finding a second file

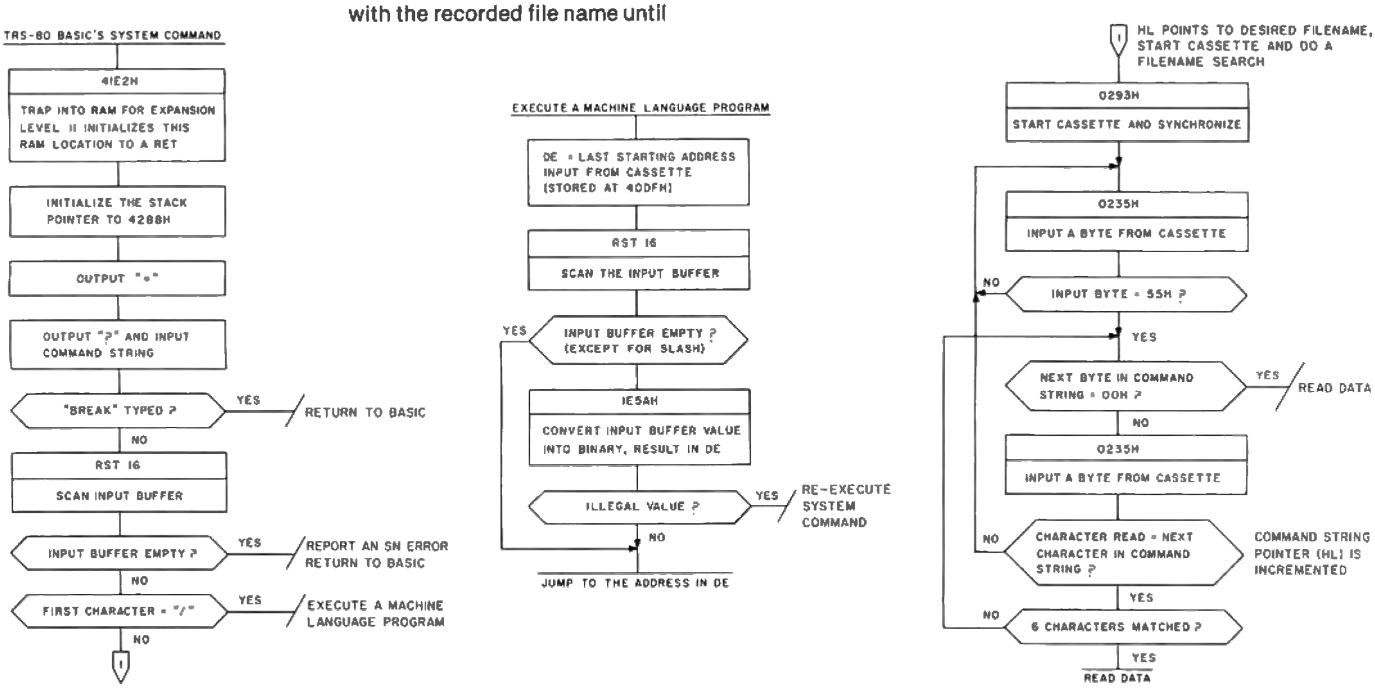


Fig. 2. Flowchart of TRS-80's System Command

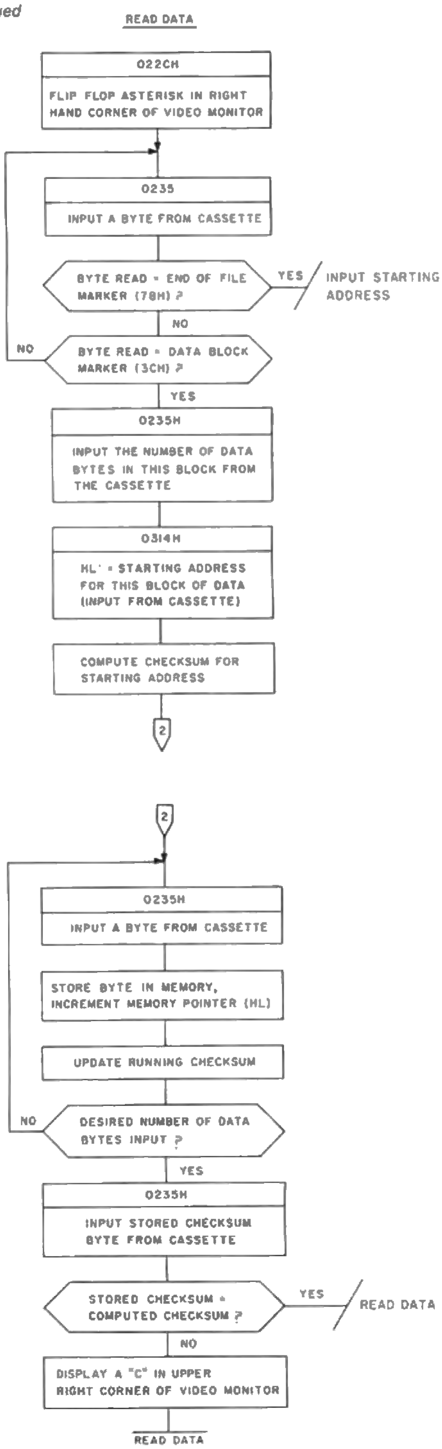
name ID byte by jumping back to the synchronization routine whenever an unsuccessful match occurs. The lines in the listing with an asterisk before the comment indicate the revised code.

This version is not an absolute answer to the first bug, since it only searches for the sequence: one byte of zeros, sync ID byte, file name ID byte. While it is still possible for a machine language program to contain those three bytes—00H, A5H, 55H—I haven't run into one.

Conclusion

In general, the TRS-80's ROM software works as specified. Though it's been said, "If a piece of software is bug free, it is obsolete," the Level II ROMs are hardly obsolete. It's safe to assume they contain several bugs. Always approach a piece of software with a bit of justified caution. ■

Figure 2 continued



GAME

LOAD 80

Destroy the crafty K'taabas.

Invader

Jeffrey Fisher
414 W. 41st Street
Sand Springs, OK 74063

Earth is being threatened by the K'taaba, beings capable of existing beyond three dimensions. When in these higher dimensions, they are invisible to us. To attack they must regress to three dimensions, becoming visible. They remain three dimensional until either you or they are destroyed.

"To attack they must regress to three dimensions..."

You are in the cockpit of a fighter ship. When a K'taaba appears, target him at the approximate center of the screen using the arrow keys. Pressing two keys together results in diagonal movement.

Press the space bar to fire your laser. Hold the space bar down for a machine gun effect. You must hit the ship with the tip of at least one of your two laser beams to destroy it.

Due to the small target area, it is sometimes difficult to tell if firing the lasers will destroy the ship. To help I incorporated small graphics blocks that track the ship's position by its horizontal and vertical com-

The Key Box

Basic Level II
Model I
4K RAM

```
10 REM      **** INVADER! ****
            BY JEFF FISHER
            JANUARY 3RD, 1982
20 CLEAR300:DEFINTD,F,H,J,K,O,P,T,V,X,Y:CLS:PRINTCHR$(23);:S$(1)
=CHR$(156)+CHR$(140)+CHR$(172):S$(2)=CHR$(191)+CHR$(140)+CHR$(19
1):S$(3)=CHR$(141)+CHR$(188)+CHR$(142):PRINT@448,"INVADER!":PRIN
T"BY JEFF FISHER"
30 A$=INKEY$:IFA$=" "THEN110ELSEIFK<150THENK=K+1:GOTO30
40 CLS:PRINT"EARTH IS IN DESPERATE TROUBLE!!!!!":PRINT:PRINT"YOU
 HAVE BEEN CHOSEN TO SAVE EARTH FROM THE K'TAABA RACE!":PRINT:PR
INT"   THE K'TAABA HAVE THE CAPACITY TO TRAVERSE HIGHER DIMENSIO
NS":PRINT"AND ARE ATTACKING!  TO BE FAIR, THEY ALWAYS REGRESS"
50 PRINT"TO THREE DIMENSIONS TO ATTACK.  AT THIS TIME, THEY BECO
ME":PRINT"VISIBLE AND YOU MUST DESTROY THEM.":PRINT:PRINT"   WHE
N THE INVADERS ATTACK, YOU LOSE FUEL SINCE YOU MUST":PRINT"REPLE
NISH YOUR SHIELDS AS THEY ARE WEAKENED BY ENEMY FIRE."
60 PRINT"   IN DESTROYING ENEMY CRAFT, YOU SCORE POINTS ACCORDIN
G TO":PRINT"THE TYPE OF VESSEL.":GOSUB320:CLS:PRINT"VESSEL","POI
NT","DESTRUCTIVE":PRINT"TYPE","VALUE","CAPACITY":FORK=1TO3:PRINT
S$(K),K*10,K*50:PRINT:NEXT
70 PRINT"   THE VESSEL TYPE IS WHAT THE SHIP LOOKS LIKE.  THE":P
RINT"POINT VALUE IS THE NUMBER OF POINTS YOUR SCORE IS INCREASED
 FOR":PRINT"DESTROYING THAT TYPE OF SHIP.  THE DESTRUCTIVE CAPAC
ITY IS THE"
80 PRINT"MAXIMUM AMOUNT OF FUEL THAT YOU CAN LOSE WHEN THAT SHIP
 FIRES":PRINT"UPON YOU.":GOSUB320:PRINT"   MANEUVER THE OFFENDIN
G SHIPS TO THE APPROXIMATE CENTER":PRINT"OF THE SCREEN USING THE
 ARROW (";:FORK=91TO93:PRINTCHR$(K);",";:NEXT
90 PRINTCHR$(K);") KEYS.  THE DIRECTION":PRINT"OF THE KEYS INDIC
ATE THE DIRECTION OF MOTION OF THE SHIP.":PRINT"DIAGONAL MOVEMEN
T IS ACCOMPLISHED BY PRESSING PERPENDICULAR":PRINT"KEYS."
100 PRINT:PRINT"TO DESTROY AN ENEMY SHIP, YOU MUST HIT IT WITH T
HE TIP OF YOUR":PRINT"LASER.":PRINT:PRINT"TO FIRE, PRESS THE SPA
CE BAR.":PRINT"REMEMBER---THE K'TAABA NEVER MISS!":PRINT:PRINT"G
OOD LUCK.....":GOSUB320
110 CLS:PRINT@448,CHR$(23);"TRANSFERRING COMMAND":FORK=1TO8:L$=L
$+CHR$(27)+CHR$(186):LE$=LE$+CHR$(27)+" ":R$=R$+CHR$(27)+CHR$(24
)+CHR$(24)+CHR$(181):RE$=RE$+CHR$(27)+CHR$(24)+CHR$(24)+" ":NEXT

120 FORK=1TO14:S$=S$+CHR$(26)+CHR$(24)+CHR$(191):SE$=SE$+CHR$(26
)+CHR$(24)+" ":NEXT
130 CLS:PRINTCHR$(23);:FORJ=1TO10:PRINT@458,"* PREPARE FOR BATTL
E *";:FORK=1TO25:NEXT:PRINT@458,STRING$(22," ");:NEXT:F=1000:T=0

140 CLS:GOSUB260:V=RND(3):X=RND(61):Y=RND(14):P=Y*64+X:GOSUB340
150 PE=PEEK(14400):X=X+RND(3)-2:Y=Y+RND(3)-2:IFPEAND8ANDY>1THENY
=Y-1
160 IFPEAND16ANDY<14THENY=Y+1
170 IFPEAND32ANDX>1THENX=X-1
180 IFPEAND64ANDX<61THENX=X+1
190 IFX<1THENX=1ELSEIFX>61THENX=61
200 IFY<1THENY=1ELSEIFY>14THENY=14
210 P=Y*64+X:GOSUB340:IFRND(20)=1THEND=(957-P)/64:PRINT@P+2,LEFT
$(S$,D*3);:PRINT@P+2,LEFT$(SE$,D*3);:F=F-RND(50*V)/(D+1):GOSUB26
0
220 IFPEAND128THENPRINT@983,L$;:PRINT@1001,R$;:PRINT@983,LE$;:PR
INT@1001,RE$;:PRINT@P,S$(V);:F=F-10:GOSUB260:IFP>475ANDP<481THEN
GOSUB250:GOTO140
230 IFF<=0THEN280
240 GOTO150
250 FORJ=1TO10:PRINT@P,"   ";:PRINT@P,CHR$(128+RND(63))+CHR$(128
+RND(63))+CHR$(128+RND(63));:FORK=1TO5:NEXTK,J:T=T+V*10:GOSUB260
:RETURN
260  IFF<0THENF=0
270 PRINT@960,STRING$(63," ");:PRINT@960,"FUEL :";F;:PRINT@980,"
SCORE :";T;:PRINT@1005,"TOP SCORE :";H;:RETURN
280 FORJ=1TO5:PRINTCHR$(23);:FORK=1TO15:NEXT:PRINTCHR$(28);:NEXT
:M=M+1:PRINT"MISSION";M;"OVER":GOSUB300:PRINT"CARE TO PLAY AGAIN
 (Y/N)?"
290 A$=INKEY$:IFA$="Y"THEN130ELSEIFA$<>"N"THEN290ELSEPRINT"THANK
S FOR PLAYING!":END
300 IFT>HTHENPRINTSTRING$(25,"*"):PRINT"CONGRATULATIONS!  YOU HA
VE":PRINT"POSTED A NEW HIGH SCORE!":PRINTSTRING$(25,"*"):H=T:GOS
UB260:PRINT@320,;
310 RETURN
320 PRINT:PRINTTAB(13)CHR$(191);"PRESS THE SPACE BAR TO CONTINUE
";CHR$(191);
330 PE=PEEK(14400):IFPE<>128THEN330ELSECLS:RETURN
340 PRINT@O,"   ";:PRINT@XO+1," ";:PRINT@YO," ";:PRINT@P,S$(V);:
IFX>27ANDX<33THENPRINT@X+1,CHR$(191);ELSEPRINT@X+1,CHR$(131);
350 YB=Y*64:IFY=7THENPRINT@YB,CHR$(191);ELSEPRINT@YB,CHR$(140);
360 XO=X:O=P:YO=YB:RETURN
```

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ponents. When the K'taaban vessel is in target range both sighting blocks will grow larger.

The K'taaba return fire occasionally. Their weapons shoot downward. Although they never miss you can limit their effectiveness by keeping the attacker near the top of the screen. The higher the ship, the greater its distance and the less damage its weapons can cause.

The status of your ship is indicated by fuel reserves. If you are fired at, it takes a certain amount of fuel to replenish your shields. The amount of reserve fuel lost due to an attack depends on the distance between you and the attacker and on the type of the ship attacking. The ones that can do more damage are worth more points when you shoot them down.

Each ship's point value and potential maximum damage is explained during the program's instructions. Firing your lasers also uses fuel. The consumption rate is 10 fuel units for each shot, 1,000 units of fuel are allocated for each mission allowing for a maximum of 100 shots.

Invader has 3,000 points as a perfect score, assuming that the enemy causes little, if any, damage, all the ships you encounter are worth 30 points, and your lasers always find their target.

Pressing the space bar while the game's title is displayed bypasses the instructions on the screen.

A$—Used with the INKEY$ command in lines 30 and 290 to wait for user input
L$—Graphic characters for left laser
LE$—Used to erase left laser
R$—Graphic characters for right laser
RE$—Erases right laser
S$—K'taaban ship's laser graphic string
SE$—Erases K'taaban's laser
S$(*n*)—String array used to contain enemy ships (*n* is equal to 1, 2 or 3)

Table 1. String Variables

D—Distance of the enemy vessel from bottom of the screen; used to assess damage to player's ship
F—Amount of fuel remaining; initialized to 1000 before each mission
H—Highest score achieved during current game session
J,K—Used as control variables in For...Next loops; K is also used to escape the GOTO loop in line 30
O—Enemy's previous position; erases ship prior to moving its position
P—K'taaban ship's current position
T—Tally; player's current score
V—Vessel type on screen
X—Current horizontal position of enemy ship
XO—Previous horizontal position of enemy ship
Y—Current vertical position of enemy vessel
YB—Used to print vertical sighting block on screen
YO—Previous vertical sighting block's position

Table 2. Numeric Variables

Modifications for the 4K Owner

The program requires about 3,650 bytes of memory. Leaving out lines 10, 40-100, and 320-330 (which are primarily instructions) drops the requirement to roughly 2,050 bytes.■

Jeff Fisher is a computer science/engineering major at the University of Illinois in Urbana-Champaign. His hobbies include amateur radio.

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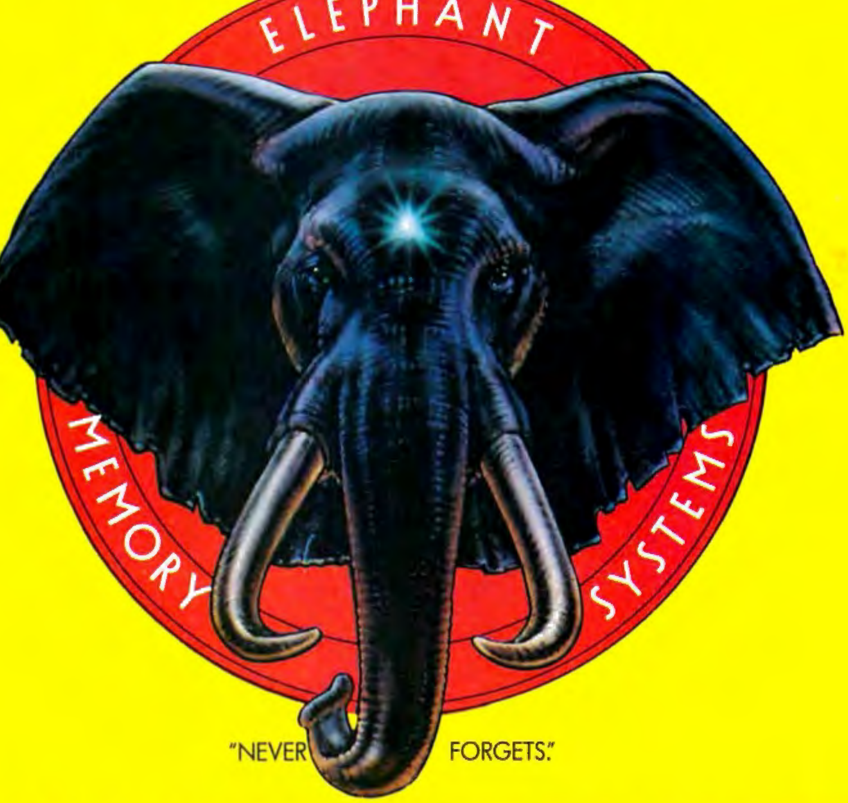

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Merge a mailing list with a standardized letter.

Scripsit Makes It Easy

Peter C. Bennett
7139 Scott Road
Homer, NY 13077

At last! My first big mass mailing job: 700 "hand-typed" personalized campaign letters (complete with envelopes) for a neighbor running for the county legislature.

My 48K TRS-80 Model I is blinking its friendly Scripsit cursor at me and its dual disk drives and Daisy Wheel II printer are ready. Now what?

Name Your Price

If you can afford a $20,000 dedicated word processing system touted as the latest in office automation, your problem is solved practically before you've identified it. For that money you can expect a machine that will automatically merge your standardized letter with a separate file of names and addresses, replace the name of the recipient in the salutation (and wherever it appears in the body of the letter) and, just as automatically, print the letters and envelopes. All you have to do is sign and fold them, stamp the envelopes and march off to your local post office.

Or, for a much smaller cash outlay—in the area of $7,500—you can use the Model II's ability to merge files created under Scripsit 2.0 and Profile II.

But what if you have a *much* smaller amount of cash? Enter the Model I/III with Scripsit 1.0 alone. For less than $5,000 you can provide yourself with a TRS-80 Model III, two disk drives and the letter-quality Daisy Wheel II printer. That combination will do nearly everything the larger, more expensive computers can do. It will, however, be somewhat slower, since a great deal of manual file and block manipulation is required.

How can we get Scripsit 1.0 to merge a campaign letter with a mailing list of recipients? The workflow depends on the creation of two master files, the address file and the standard letter file. A temporary print file holds the letter (with an envelope printing routine chained to it) with each name and address record merged using Scripsit's Insert Block command. The trick is to make sure I send only one letter to each potential recipient. More on how that is accomplished later.

Creating the Address File

Each name and address record will be designated Block A in the list so it may be moved around at will during the merge process. You can name the block any alphabetic character, but I use A because it is conveniently close to the letter Q on the keyboard, which, with @ (the control key) produces the command Scripsit needs to recognize the various block functions it has available.

Start, then, with a name and address format to be called Block A within another block (let's call it Q).

Hold control, type Q, release control and again strike Q, thus naming the block. Now repeat the process, but name the new block A. To prompt for this first address line type name and leave enough blank spaces for the longest name on your list. Press enter.

You will most likely label the next line address. Again leave enough blank space on the line to allow entry of the longest street address on your list.

Since all the letters on my political mailing list are going to one election district, the next line of the address block will be the same for all addressees. Thus I type Cortland, NY 13045. By holding control and typing Q and the down arrow (i.e. block end) twice I now have an address format that I can use 700 times to create the 700 Block "A"s I will need to run the manual merge routine. Be sure to end each address block with a control block end enter command sequence since the insert of Block Q does not move a block end signal with it.

Figure 1 shows the Block Q format and the first three addresses on a fictional political mailing list. The underline symbol (_) indicates forced line ends (created by pressing enter) while the left ([) and right (]) brackets show Scripsit's block beginning and block ending symbols.

After the name and address file is complete I delete the Block Q format since later I will use Block Q to manipulate the letter/envelope combination in building a print file. Save the mailing list under its own unique file name.

Creating the Letter

Start with a full format line, even though most of the instructions are already default values. This confirms the instructions when you call the file for review on your screen.

Then, since my candidate does not have a preprinted letterhead I use the C=Y format command to center his name, address and telephone number at the top of the letter. Two spaces down I use the FR=Y format command to set the date line flush with the right margin. Don't forget to countermand those two commands with C=N and FR=N before you type the body of your letter or the printed output will come as a surprise!

Two spaces down again I insert a comment line using the greater than and asterisk symbols to keep the line from printing. It reminds me >*INSERT BLOCK "A" ON NEXT LINE.

I skip another line and I am ready to start the letter with the salutation "Dear M   " leaving plenty of space to type in r., rs., or s. and the recipient's last name.

After typing the body of the letter and the usual closing, end the page with a page end marker, control V, which is indicated on the sample letter/envelope (Fig. 2) by the backwards slash or virgule.

The Envelope

The format line will take into consideration the short page represented by the envelope as well as the different left margins for the printer-produced return address and the recipient's name and address. Again a comment line reminding where to insert Block A is helpful during the creation of the temporary print file. Don't forget to type a Page End marker so you have a chance to change paper and envelope in the printer between letters.

With the completion of the letter/envelope file designate the entire file Block Q so you have the opportunity to create a fresh document for each name on the mailing list.

Figure 2 shows what the combination looks like when printed using the P,I command to show all of the invisible print format instructions.

Putting It Together

Load the name and address file. Then load and chain the letter/envelope file using the L,C command. This appends Block Q to the end of the address file so there is quick access to both the top and bottom of the combined file using the shift, up arrow and shift, down arrow keystrokes.

Now go to the end of the file. Insert Block Q by holding control and pressing S (Insert), Q (Block), and—after releasing control—Q (the name of the block). Using the down arrow, space a few lines to the first >*INSERT BLOCK "A" ON NEXT LINE prompt and insert the first name and address block. Space down again to the salutation and, after setting a Tab at the space after "Dear M..." (using the Break, TS, Enter routine), type the rest of the recipient's title and last name. Jump to the end of the document again (using shift, down arrow) and insert Block A where prompted.

To assure sending only one letter to each recipient simply jump to the top of the file where the name and address blocks are and delete the used Block A by holding control, pressing D (Delete) and answering the prompt "DELETE OR UNMARK BLOCK (D OR U)?." with a D.

The next name and address is now in position to be inserted into a new Block Q at the end of the file by repeating the whole process. Although the procedure may seem complicated as each step is described in detail, by the time you have repeated it several times the keystrokes become almost second nature and the process surprisingly fast and accurate.

Warning: If the number of recipients is large it doesn't take many letters to fill up the computer's available memory. A one-page letter/envelope combination resident in memory with a 100-name mailing list will only allow about 10 Block Qs before a 48K machine returns the No More Room error message. The solution to the problem is two-fold: Break the name and address file down into several smaller files, and when you run out of memory save the existing file under a new name such as TEMPFILE. After you have printed the current letters and envelopes, reload TEMPFILE, delete all of the completed documents below your original Block Q letter/envelope combination and start the whole process over. Thus you have preserved the correct mailing list and, with each deleted Block A, have opened up more memory space for new Block Q documents.

Printing the letters and envelopes is simple once you have cleaned up the file. First save the current file as suggested above. Then remove the top part of the file (names and addresses down through the end of the Block Q blank letter/envelope) leaving only the properly addressed letters in memory. Issue a P,P command to the printer so it will stop between each document to allow insertion of the next letterhead or envelope.

By the way, my candidate won. He thinks it was because of the mass mailing I prepared. ■

```
>PL=66 LM=12 RM=72 TM=1 BM=58 LS=1 PF=2 J=N C=N H=2_
>* NOTE: this is the letter format._
>C=Y_
John Q. Candidate_
2136 Disk Drive_
Cortland, NY  13045_

_

>C=N FR=Y_
October 30, 1981_
>FR=N_

_
_

>* INSERT BLOCK "A" ON NEXT LINE_

_
_

Dear M                              $
     The body of the letter goes here - - - - - - - - - - -
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
- - - - - - - - - - - - - - - - - - - - - - - - - - - - -._

_
                              Sincerely,_

_
_
_
                              John Q. Candidate_
\
>PL=23 LM=4 RM=90 TM=2 BM=23 J=N C=N FR=N VC=N H=N_
>* NOTE: this is the envelope format._
John Q. Candidate_
2136 Disk Drive_
Cortland, NY  13045_
>*NOTE: change LM=25 for short envelopes_
>LM=40_

_
_
_

>* INSERT BLOCK "A" ON THE NEXT LINE_
\
```

Figure 2

```
TQ>[A>name                                  _
address                                  _
Cortland, NY  13045                      _
]]_                                      _
[A>Mr. & Mrs. Albert D. Voter
36 Anylane Drive                         _
Cortland, NY  13045                      _
]                                        _
[A>Mrs. Jacob Askher
222 City Court                           _
Cortland, NY  13045                      _
]_                                       _
[A>Ms. Holly Woodstar
5230 Glitter Road                        _
Cortland, NY  13045                      _
]_                                       _
```

Figure 1

✓See List of Advertisers on Page 455

Tandy CC unchained

Move to sell CC outside chain overplayed

When the Tandy Corporation announced in July that for the first time in its history it would market a computer outside its company stores, the computer press spent a considerable amount of ink on the move, treating it as an admission by the Fort Worth firm it could no longer hold its share of the home computer market by distributing its Color Computer exclusively through its Radio Shack outlets. Much of that ink was misspent, according to one Tandy executive.

"It's been way overplayed [by the press]," said Tandy's vice president for retail computer marketing Ron Stegall.

He added the new distribution scheme is "absolutely a test . . . a non-controlled distribution experiment to see what kind of business is out there."

The move, he said, is not an attempt to establish an alternative distribution network. "An alternative distribution system doesn't make much sense when you own the distribution chain you've got out there," he declared.

Clive Smith, an analyst with the Yankee Group in Cambridge, MA, sees Tandy's move as "market research to see how its machine will do against other machines on the same shelf, rather than an attempt to build an alternative or complementary distribution network."

"I would be surprised if it were expanded to substantial proportions," he added. "At this point, Tandy doesn't expect it to develop into a significant portion of its business."

But Aaron C. Goldberg, research manager at International Data Corp. in Framingham, MA, attached more importance to Tandy's decision: "It's a very significant decision. It shows Tandy becoming a more aggressive competitor, going into these independent stores to build a market share."

Although Smith doubted the Color Computer would make a strong showing in the experiment because it's "overpriced and has other problems," Goldberg reserved judgement on the outcome of the test: "Any time you have a system priced very attractively, has a wealth of software, and is broadly supported by the market place, you can't make a snap judgement that this tryout distribution channel will be a failure."

The new distribution channel will involve 60 independent distributors of RCA products, who reach some 2,000 retailers. Stegall explained Tandy has existing business contacts with the distributors because of a tv antenna plant purchased from RCA by Tandy.

With 2,000 new retailers and Tandy's existing network, the Color Computer will have more than 8,000 outlets in the United States. However, that's less than the number of retailers hawking the home computer of one of Tandy's chief competitors, Texas Instruments. After announcing a $100 rebate scheme on its 16K 99/4A, TI's retailers zoomed from 6,000 to 9,000 in one week.

There is a significant difference, though, in Tandy's new retailers and its competition's: size. The competition has gone after large, general merchandising firms—K-Mart, Montgomery Ward, J.C. Penney, Woolco, and Sears—while Tandy's distributors will be selling to smaller shops. "As a general rule," Stegall said, "the distributor network is servicing your small video store that is handling the RCA line. Your big discount houses and department stores don't buy from distributors. They buy directly from manufacturers."

But there is at least one distributor who feels it can elbow Tandy's home computer onto the shelves of a mass merchandising chain. Southco of Atlanta, GA, told *Electronic News* it has supplied regional K-Marts in the past and sees the stores as a potential customer for the TDP-100—the version of the Color Computer the distributors will be peddling.

The model is a "totally different-looking machine" on the outside, Stegall said, but it is "similar" to the Color Computer on the inside. He added all Color Computer software and peripherals will work with the TDP-100.

"The main difference is it's going out in a white box," said Smith of the Yankee Group. "They're not developing an alternative machine." He maintained the color change is a significant one: "It will improve the consumer desirability of the machine quite considerably."

He explained: "Tandy has had a commitment for a long time now to what it calls Mercedes silver, what other people call battleship gray. They went the other way with the Model 16 because their market research showed them executives would not have a battleship gray machine on their desk. Part of the market research they're conducting now is to see whether they should change the color of the lower end of the line as well."

Soon after Tandy announced the distribution move, industry observers claimed Radio Shack was forcing competition between its entrenched stores and its neophytes.

Tandy's Stegall maintained the new stores "will never bump heads with our existing company-owned dealer network," but one competitor contends Tandy's test will be a Pandora's Box for the firm.

Said Kit Spencer, Commodore's vice president for marketing: "I think it will be difficult for Tandy to be successful with independent channels because they will always have a conflict of interest with their internal channels.

"How are you going to give the outside people the same terms as their internal people, who have always had price control of their own brand? The independents will be upset because they won't feel they're getting as good terms

TANDY*continued*

as the Tandy people, while the Tandy outlets themselves won't be happy because they have to compete with more people on the outside.

"I think it shows some uncertainty about where Tandy is going in the marketplace."

But the national accounts manager for Commodore's Consumer Products Division, David Harris, found no uncertainty in Tandy's move. He told *Electronic News*: "It was a logical move for Tandy to make. They are acknowledging the market is bigger than that which they can take advantage of through their stores."

"Buyer's preference is becoming a very important issue here," said Texas Instruments' Consumer Group Manager William Turner. "Retailers over the last three or four years have been working very hard at making a lasting franchise with a given consumer to get him to feel comfortable with buying all his products in a given channel or a given store. As such, I think Radio Shack is finding their market somewhat limited by working only through its channel of distribution."

"They're acknowledging they don't want to lose [their] market share," Commodore's Harris added.

That market share would mean substantial revenues for Tandy. Analysts estimate the market to be $500 million to $800 million this year, $2 billion next year and $3 billion by 1985. But according to some analysts, Tandy will need more than a new distribution scheme to maintain their slice of the market. It will need price cuts.

Both Smith of the Yankee Group and Robert Lyon, a portfolio manager at the Fred Alger Company, an investment and brokerage firm in New York City, maintained the Color Computer is overpriced in today's home computer market. Lyon observed: "I think they have to cut the price of the Color Computer. I think they have to bring the price down substantially."

"Radio Shack has enjoyed an opportunity to get a premium price for their product compared to the competition's by having only one product on the shelf in Radio Shack stores," Turner of Texas Instruments said. "When Radio Shack goes into the marketplace, they're going to have to be more competitive in price. Every other product on the market has more functionality for a price equal to or lower than Radio Shack's."

Tandy's President John Roach has approached Herculean task of competing in red hot home computer market by letting the Color Computer break out of the Tandy distribution chain.

By the end of 1983, he predicted, any home computer maker who wants to remain competitive will have to retail his product between $175 to $200.

"This is a razor business," he contended. "You sell your razors cheap and you maximize your sale of razor blades. Razor blades in this business are software in cartridge format—not disk or cassette format—with an expansion capability for skilled users as they grow."

Because it controlled its distribution chain, Tandy, to some extent, could remain aloof from price wars. But as *80 Micro* went to press, there were signs Tandy would unsheath its broadsword and storm into the pricing fray. By the end of August, the *Electronic News* was quoting unnamed sources close to Tandy as saying a CC price cut was "imminent."

Those price cuts, in the minds of some analysts, were signaled by the outside distribution scheme, since the corporation could not control discounting by independent sellers.

According to *Electronic News*, the cost of making the CC ("well under $200") is not as low as the cost of making the VIC ($80 to $90), but it does leave room for discounting. How much room, though, was questioned by Smith of the Yankee Group: "Tandy is not going to the dealers. They're going to the distributors, which means there's a lot less leeway for the computer to be discounted."

That prospect doesn't seem to be worrying the retailers served by RCA's independent Boston-area distributor, Eastco of Westwood, MA. Audio Division General Manager Joseph Cunningham said the retailers he's talked to about carrying the TDP-100 were "very enthusiastic" about the prospect.

Stegall argued consumers will be looking at more than prices when shopping for a home computer. They'll also be looking for expandability. "The Color Computer has legitimate expandability at a reasonable price," he said. "The cost to expand the machines that underprice our machine is considerably more than the cost to expand ours."

But portfolio manager Lyons insists that without price cuts, Tandy's outside distributors will find very few takers for the white CC: "They're not going to put this on the shelf when Toys R Us is selling the Atari machine for $250 and a Commodore for less. How's it going to sell?"

That's a good question in the face of dizzying price moves by Tandy's competitors:

- Texas Instruments—which is aiming to be top dog in the home computer market by the end of the year—has effectively reduced the price of its 99/4A to $199 by offering a $100 rebate with the purchase of that model.
- Commodore is offering a new game machine—the Max, listing at $179—and offering dealers a $25-$40 price break on the VIC if they pass the break on to consumers.
- Atari, the *Electronic News* speculated, may, in the face of those moves, release its new model 600 at a lower than originally planned price.

Add to that an impending invasion by a bevy of low-priced European and Japanese computers (including a Color Computer clone produced by Dragon Ltd. of Swansea, Wales, UK) and you've got what amounts to a pricing holocaust.

With that kind of price war looming over the market, a question some observers are asking is, is Tandy's experiment too little, too late? "Radio Shack has a strong marketing capacity," Turner responded. "They have knowledgeable, good marketing people. My suspicions are they will make the appropriate marketing reaction." ■

End of the Tandy hot line

Customers debate end of toll-free service

Midwestern software entrepreneur and programmer Bob Snapp became the standard bearer for the Tandy Corporation in CompuServe's Software Author's Special Interest Group during a flurry of exchanges spurred by Radio Shack's dropping of its toll-free customer service lines June 1.

"The reason for dropping the 800 number was quite simple and sensible," Snapp wrote on the CompuServe SIG's bulletin board. "The availability of the toll-free call prompted thousands of calls that never should have been made. Faced with the choice of looking in the book and calling a toll-free number, many folks opted for the latter. As a result, folks who REALLY needed help had to be put on hold for 45 minutes on the average. The bottom line was that they were providing BAD customer service through lack of availability. Each time they added more lines and staff, the calls just increased. This change will filter most of the 'junk' calls, so they can provide better service to those who really need it."

In a telephone interview with *80 Micro*, Ted Rosenberg, the customer relations manager at Tandy, echoed Snapp's view: "We found, quite to our surprise, simply adding more WATS lines wasn't really doing anything. In fact, it made things worse.

"We used to get letters saying I've been on this queue waiting to get through to you guys for 20 minutes, half an hour, an hour and a half—you name the number. We had almost 65 WATS lines and it wasn't doing diddley."

But business consultant George Berman disagreed with Radio Shack's rationale for ending the service. "You either give service or you don't," he wrote in a bulletin board message. "If your view of the customer is punitive, then you deny him service...Tandy forgot who exists for whom."

He went on to say in another message: "It seems to me Bob Snapp's report indicates a punitive approach to customers that is exactly the opposite of what the conceptually intimidating PC industry needs at this point.

Then Berman offered this tongue-in-cheek alternative to total abolition of Tandy's hot line:

"Let the dumb customers listen to Muzak for an hour. Offer a toll number for any customer who wants to pay for it. Use a red phone. Give this line immediate priority. If the questions are still dumb, charge a fee. Tell them to call toll-free with dumb questions. But keep the 800 line open to the dummies—they're your customers!"

If the Fort Worth powers didn't like that suggestion, Berman had another one:

"Tandy sets up a committee to determine the quality of each incoming request. If it's a sort of excusable ignorance, let him pay the toll charge. If it's a real [bleep] question, invoice him $10 and explain why he really shouldn't own a computer if he can't think his way out of a paper bag. And when it's a true bug or it stumps the experts for more than 15 minutes, send him a check for $10 and a certificate suitable for Framingham...."

The Snapp-Berman debate stirred Roy Green to enjoin: "I have to agree with Bob. I know too many people who would call the 800 number to get a clue to Rakka-Tu or Pyramid!"

Green's comment prompted a parting shot from Tony Camas:

"I think that Tandy should realize that by selling computers through Radio Shack stores, they're going to sell some machines to people who probably shouldn't have bought them. These people need a good deal of handholding and if Radio Shack is a responsible retailer, they should provide it or risk being badmouthed by these gullible folks.

"In fact, I'll bet that the proper analysis would reveal that the 'dumb' questions come from a continually refreshed phalanx of new owners who need initial support—and now don't have it as part of their purchase. I know I often bother a tech service group for about three weeks after I buy a computer/time share/data bank service simply because it ain't all in the manual.

"My approach to clients is that there are dumb answers, but no dumb question."

Snapp replied to Berman's broadsides: "Many new users need a certain amount of handholding. Tandy wants them to get it. That's why they established the relatively new position of CSR at each RSCC. Most folks could get the answers to their simple questions from the (simple-minded) CSR via a local phone call. This would take the pressure off the (supposed) tech-heavies in Fort Worth to deal with the more serious problems."

Tandy's Rosenberg added: "If a customer has a problem, his first step should be to go to his computer center. If the man at the computer center doesn't know the answer, then the Radio Shack guy will call us, so its on our nickel."

"Now," he continued, "people who have to call Fort Worth get in much faster. The reps don't keep them on the phone. They get the information they need and they're off. It also discourages people who, with all due respect, are too lazy to look into their instruction book. They tie up the phones for someone who has a legitimate problem."

"Has it occurred to you," Berman asked rhetorically, "that the present arrangement favors 'dummies' in Fort Worth over those in Yonkers and proportionately in between?"

"The problem is, having made the 800 number available once, it will do them a great deal of harm now that they are taking it away.

"Now that they have created the monster, it is irresponsible to try and sweep it under the rug." ■

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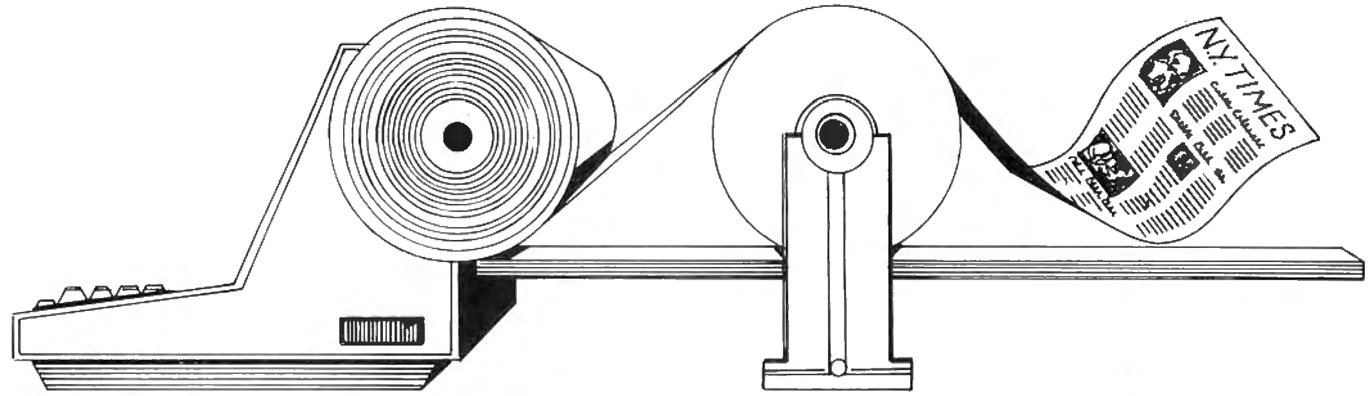

AP experiment ends

Seven e-papers fold after two years on line

BY JOHN P. MELLO JR.
80 MICRO NEWS EDITOR

Without much fanfare, a two-year experiment in videotext journalism involving the Associated Press, 10 newspapers, and CompuServe ended June 30. The final verdict isn't in on the test, but its participants appear to agree on one thing: the market isn't there yet for a profitable electronic newspaper.

"There is a lot more smoke than fire in this area to date even though some day it's going to be a big thing," an executive at one of the participating newspapers observed. "It's obviously some time off because it's very expensive for the consumer as well as the provider."

"We don't think that as the technology is now [an electronic newspaper] is a profitable venture," noted Glenn McCutchen, managing editor for administration, *Atlanta Journal and Constitution*.

Not only is the technology expensive, the CompuServe experimenters found, but the audience for the product is small and specialized.

The *Washington Post's* manager for electronic publishing research and development, Harold Logan, observed: "The reader of the electronic news has to be someone who owns a receiving device. The demographics of those people makes them a specialty audience. They're male. They're upper income. They're white. They're highly paid, college-educated people. I think that defines a pretty specialized audience."

Those publications, he said, should be aimed at computer enthusiasts of any professional area where people are frequently in contact with computers.

"The fact that people weren't beating our doors down to sign up for the service might be interpreted as failure, but we don't see it that way at all," *San Francisco Chronicle* Executive News Editor Kenneth E. Wilson contended. "The market is still a few years away, but what we learned was we could do it and that was really something for us to learn."

When the newspapers began their experiment (*80 Micro*, November 1981, p. 74), most of them said they were participating primarily for the experience of working with videotext and not to turn a profit. But one videotext editor argues money was the primary reason most of the newspapers folded their electronic editions. "What it comes down to is money," Jim Crowley of the *Columbus Dispatch* maintained. "We ain't making it."

In a column on the electronic Dispatch (see "I sweep floors" box), Crowley said his e-paper made $4,000 for CompuServe since July 1, 1980. He explained revenue from an e-paper's interactive features—games, crosswords, and the like—are split 90–10 and for news and information, 80–20. In both instances the lion's share goes to CompuServe, which charges $5 an hour to access its system weekday evenings and all day Saturday and Sunday.

Gordon Phillips, director of promotion and public relations at the *Los Angeles Times*, noted money played a part in his newspaper's decision to cut loose from CompuServe:

"The CompuServe experiment was just that: an experiment. There was some expense involved and we felt we learned about as much from it as we could for the present time. This is a tight economic year and our investments really needed to go into some other areas."

"We are not making money on CompuServe. I can categorically say that," said the *Post's* Logan.

But that isn't deterring the Washington daily from continuing the CompuServe experiment. Logan said the *Post* will continue furnishing the Columbus, OH, information utility the entire text of the newspaper and an electronic product emphasizing the paper's strongest suit: coverage of the federal government.

He noted: "There is a market for electronically delivered news. It may not be as large and robust a market as we suspected two years ago, but if you

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V-TEXT *continued*

look at the research, it is clear to us that there is a market out there."

Asked how long the *Post* will remain on CompuServe, Logan replied: "There's been no deadline set. I suspect we will continue with CompuServe for as long as we feel we're learning something about how to present news in an electronic medium and for as long as CompuServe will have us."

Leonard R. Harris, director of corporate relations for the *New York Times*, said the test "shows there is an interest in retrieval of specific information." However, he added, "It doesn't indicate people will necessarily find videotext or teletext a substitute for a newspaper in its traditional form."

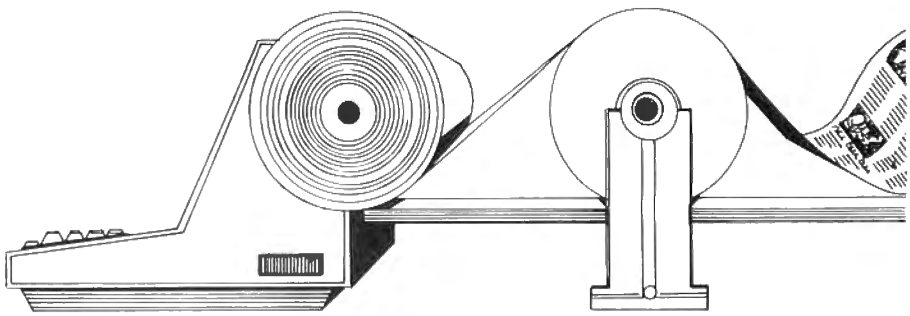
"At this point," he continued, "a newspaper is a far less expensive way to display information of all kinds. If you wanted to read current news, current advertising, and current lifestyle information, it's a great deal cheaper to buy it printed on paper than it is to buy it on a screen."

The *Post's* Logan added: "There are substantial differences between the way people use these things. The example people use all the time is you can't take your computer to the bathroom with you. You can't give the sports section to daddy and the style section to son and the front page to someone else."

In the experiment, the Associated Press was the most-accessed news source, the *New York Times* was second, the *Post* third, and the *Los Angeles Times* fourth.

"If you look at the 12 news entities on the service, those four are by far the best known nationwide," the *Post's* Logan observed. "What's difficult for us to ascertain at this point is whether we're looking at some kind of name-recognition phenomena, or what we're looking at is some reflection of the quality of the product."

Those access figures crosscut some popular ideas about the content of an e-paper since the AP provides hot, breaking news and the *New York Times*, *Post* and *Los Angeles Times* "dumped" their printed editions into the CompuServe system.



Harris of the *New York Times* maintained: "Hot, breaking news is about the least useful thing you can put out in this kind of system. Hot, breaking news is available on radio and tv."

"At this point," *Minneapolis Star and Tribune* editor Steve Poulter argued, "people are willing to adapt themselves to use the national papers—the *New York Times* and *Washington Post*—in electronic form."

"Economically, it's very easy to dump an entire newspaper into a data base," he continued. "You've got the keystrokes captured in your computer; you send it off and it sits there. If you've got a national newspaper with a national audience, you'll probably get someone to read it. In the long run, though, I don't think it's going to make sense from a consumer's point of view."

Logan agreed with Poulter: "We don't think there's a market for the full text of the paper. We think the cost considerations and the way people use the tubes mitigate against that."

"You use your CRT retrospectively, in some respect," Harris added, "to get details you may have missed from other sources."

Rather than dump their dailies into the system, two of the experimenters—Columbus and Minneapolis—slanted their electronic editions toward compuphiles. Crowley, at Columbus, included a batch of the two-way features that enthuse chipsters: interactive crosswords, video games and CB-radio simulation.

"You could get the same news from every one of those papers," Crowley said. "The reason we branched out into CB, games, and computer news was we wanted to be a cut above the other papers."

He explained the Columbus e-paper began its message system and CB features in February. "We wanted to give people an alternative to the regular hee-hee, ha-ha of CB, where you just get a bunch of people with weird handles," he continued, "I'm not running that down, but I'm saying people needed something a little more serious."

"The message system," he noted, "sparked a substantial amount of interest. I got more feedback about the paper than I ever got through electronic mail."

"And," he added, "since you could post messages to other users, I found the message system a good springboard to get people to read the paper." He cited one occasion when he warmed up his readers to a series on computer crime by having them "talk" on the e-paper's CB to a lawyer specializing in that subject.

The CB feature increased interest in Crowley's e-paper, but its draw was small compared to systemwide figures. Since it began, the Columbus CB was accessed 8,000 times and 1,957 messages were posted on it. By comparison, CompuServe's CB-message setup was accessed 100,000 times and 33,000 messages were posted on it.

With the end of the CompuServe test, some of the newspapers have branched into other experiments. The *New York Times* is participating in the CBS Ridgeway, NJ, videotext experiment (see *80 Micro*, April 1982, p. 362) and the *Los Angeles Times* in an Orange County, CA, test involving 300 homes.

While the market may not be there yet for a profitable videotext newspaper, most of the experimenters seemed to share the sentiments of the L.A. *Times'* Phillips: "We feel there is still a great deal of experimentation to be done, a great deal to be learned." ■

I sweep **floors**

BY JIM CROWLEY
CONTRIBUTING EDITOR

(Ed. Note: The following is the opinion of Jim Crowley, operator of the Columbus Dispatch *on CompuServe since July 1, 1980. It does not represent the views of the newspaper. It was written when the electronic* Dispatch *was set to close shop in September. However, the e-paper continued publishing through October.)*

I sweep floors."

That's much easier than trying to explain to most non-computer types what a videotext journalist does.

Most computer types don't give a rat's rear end about it anyway, so I don't even try to tell them.

Most newspaper people don't understand or want to. After all, you can't wrap fish in your terminal and I defy anyone to try and read one on the bus or the toilet.

So why are we here and why did six other newspapers decide to bail out? It's the almighty dollar, but I can tell you, we ain't making it. Since July 1, 1980, we made about $4,000 and that doesn't quite pay our rent.

We are on here until September to gather data about this medium. Period.

We are the victims of the HEEHEE, HUG and KISS of regular CB, turtle speed 300 baud, and general indifference.

Most CIS users think menus are the most exasperating thing since child-proof medicine bottles.

Newspapers, or in CompuServe parlance, NIPs (for Newspaper Information Providers) have lost a computer war by trying to fight with Gutenberg technology.

It makes me sad, personally, and leaves me empty professionally.

The papers that died, including the *New York Times*, didn't get the same press that a newspaper death would get in the real world. I guess that underscores the view that newspapers here are not viewed as real.

Funny. Because we still publish every day. And we update our news hourly. And our production costs are minimal: one newsman a shift.

Show me a real newspaper that can do that and I will eat my modem.

When the *Times* quit, for example, avid readers were greeted by a terse termination announcement. Can you imagine the hubub if the REAL *Times* put out a blank paper other than a few-graph story that just said they were closing down that day?

It would give the D.T.s to bottle-in-the-drawer city editors everywhere!

I have read a ton of stuff adulating the joys of "state-of-the-art" journalism and none of it says that this is a medium and technology without a market. But it is for at least 10 years.

And if I had a nickel for every masters and doctorate paper I have been interviewed for, I could buy CompuServe.

There is one thing that has happened to me in this journey through never-never land that makes it all worthwhile. That is our SIG.

SIG is more CompuServe alphabet soup for Special Interest Group. It is an interactive message system that also has an open channel CB.

When you combine NIP with SIG, it comes out NIPSIG, which sounds like some new oriental strain of herpes.

NIPSIG can be found at CDP 100. There I go again. CDP is Columbus Dispatch Page.

Anyway, if you come from CIS into CDP 100, you see "Request recorded. One moment, please." And in case you miss it the first time, the system does it again once you get there.

Just what you need at $5 an hour, right?

If you survive and stumble into our conference mode, you will find it worth the trek.

Since we started the SIG in February, we have had several conferences. A compulawyer talked about computer crime and a local entrepreneur talked about electronic publishing. Atari, Apple and Tandy came on to answer questions. Handicapped users have gathered to talk about their special needs on this system.

More are planned, but I think what is more important are the people we try to serve. We have a hardcore group of devoted users who make it worthwhile to be on here every night with my cohort, Jim Perine.

To name them would be a bit much. But they know who they are.

So on long, lonely mundane shifts when I would rather throw this terminal out the window, I am refreshed by a chance to talk to folks.

Perhaps that is the true future of this medium. Let's have newspapers that talk to people. I will admit, though, that I refuse to be a wrapper for fish or sit with you on the toilet.

Other than that, I am negotiable.

And until we die in September, I wouldn't trade it for the world.

And to all you videotext experts, CB freaks, and neurotic computer monkeys who wonder what this law student and newsman does for a living: "I sweep floors."

And if you're too narrow-minded to peer into this world, too bad.

I don't do windows. ■

Moursund: Like encyclopedias, micros might end up in the closet collecting dust

Public school education rapped at conference

Home education software more sales pitch by micro firms than threat to school system

By Tom Hager
Contributing Reporter

Public school education is joyless, uncreative, cruel, mean-spirited, and competitive. It teaches children to be cynical about life and makes them intellectually impotent." And it might some day be supplanted by microcomputers.

That's the view of Jeremy Ross, a Radio Shack computing instructor, speaking at a national conference on the use of computers in education drawing 700 teachers, administrators, theorists and computer specialists to the University of Oregon in July. While most attendees were concerned with improving the situation by integrating computers into the classroom, a few, like Ross, foresaw the day when microcomputers would eliminate the classroom entirely.

"The home will become the primary site of education in the future," predicted Ross, who led a special-interest session on home computer-based learning systems. "You'll be able to learn what you want, when you want, at whatever depth you want."

He believes the widespread use of micros for running computer-assisted drills, tests, and learner-interactive educational simulations, word processing, accessing outside data bases and communicating with other students around the country will decentralize schooling, create a new home-based learning environment and encourage a cottage industry in educational software.

The result? With more and better learning taking place in the home, said Ross, "At some point, the current school system will just collapse."

Will your child soon be able to graduate from high school without ever leaving the house? Is computer-assisted home education technologically feasible—or desirable?

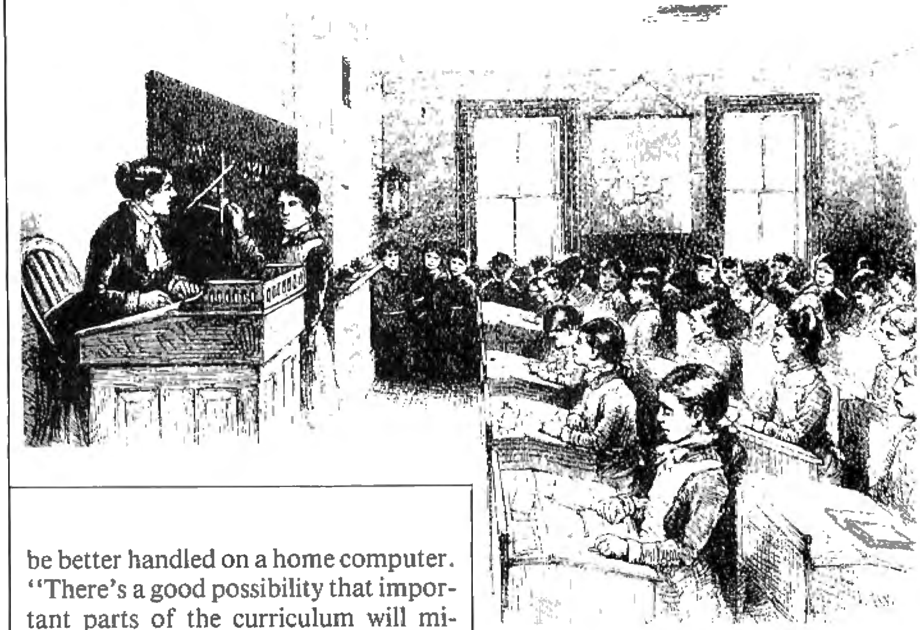
David Moursund thinks not. Moursund, keynote speaker at the conference and editor of *The Computing Teacher*, said educational software that can teach a child an entire course of study is now far too costly for most home computer owners. He sees the idea of computer-based home education more as a selling point for microcomputer companies than a threat to our current school system. Educational applications may soon be ranked with business and entertainment as the three biggest marketing areas for home computers. "But what they're used for after they get there is still a question," Moursund said.

As an analogy, he brings up another learning aid once seen as a revolutionary advance in home education: the encyclopedia. Tens of thousands of expensive sets were—and are being—sold to parents as useful adjuncts to their child's schooling. In the same way, parents may be influenced to buy a micro because it will be "good for the children." But, Moursund said, programs for education may, like encyclopedias, end up gathering dust while the youngsters use the micros to play the latest video game instead.

continued

✓See List of Advertisers on Page 455

EDUCATION*continued*



Conference speaker Alfred Bork agreed micro manufacturers will soon latch on to the sales potential of home education. Bork, director of the Educational Technology Center at the University of California, Irvine, and author of *Learning with Computers*, said this is one way micros will gain the practical appeal necessary if they are to become true mass consumer items. Microcomputers, he noted, will have to be seen as home appliances rather than hobby items before they will become as common as tvs. One way to give them that appeal is to tell parents computers will help their children learn.

Once the machines are in the home, Bork thinks kids will become so fascinated with the technology that they will demand more computers in school. "We tend to think home use will drive school use," he said. "Once you start getting good education at home, kids will start going to school and demanding more quality."

Although Bork sees home computers making schools better, not obsolete, he admitted some kinds of education may be better handled on a home computer. "There's a good possibility that important parts of the curriculum will migrate out of the schools and into the home," he said, especially as publishing companies jump into the home software market—a trend already starting. But Bork cautions that a simple fascination with the increasingly complex hardware available for home use also carries the danger of replacing true learning with technological game-playing.

As micros grow more powerful, though, it may become possible to create learning environments falling somewhere between the schools and the home. Ramon Zamora, director of a National Science Foundation-funded community computer project called ComputerTown, told the conference micros can serve as tools to take education "to the streets." His ideas center on community learning centers where children and adults can learn programming, computer applications and "rent" time on microcomputers. His plan is to help the public—especially that segment unable to buy their own micros—become computer literate. ComputerTowns have already been set up in a number of local libraries, senior citizen's centers, museums and youth clubs around the country.

The centers may help deal with what some observers see as the major problem facing home-computer-based learning: the growing gap between rich and poor.

"People at the poverty level are not going to buy computers," Bork said. That limits the educational advances possible with home computers to those with enough money and technological orientation to invest in the hardware. "That would tend to increase the schism between the haves and have-nots," Moursund maintained.

ComputerTowns, accessible to all economic classes, may be one way to counter this trend. Another is government subsidies targeted at computer education for the poor.

Inequities caused by the cost of microcomputers is only part of the problem. What are the social costs involved if micros disrupt the traditional school system? Moursund stressed that school is more than learning. It is a place where children learn to deal with other children. Removing the child from the schoolroom and teaching him at home may result in faster transmission of facts, but as one conference speaker said, "As interesting as computers are, they can't replace your schoolmates."

And there's another thing home computers will never do: get your child out of the house. Jeremy Ross's proposed home-based educational utopia may be a better way to teach kids some things, but as Moursund argued, "Most parents don't want to have the kids around the house all day. Micros won't help get the children out of their parents' hair." ■

Enter the electronic agora

Network Nation's writers create marketplace of ideas

Whether you're a budding software author or crusty vet of silicon publishing, be prepared for some lively interaction and vital information when you enter the Author's Special Interest Group on the CompuServe Information Service.

The originators of the SIG, Charles Bowen and Stewart Schneider, set it up because there's "no neatly bound directory of writers' markets" for microcomputer programmers and writers.

Market analysis wasn't the sole inspiration for the SIG. The allure and expense of being a member of the network nation also influenced Bowen.

"I talked to a fellow who got a $700 bill from CompuServe," Bowen noted. "$700! Did you have a good time? He said, 'yeah, I guess' I got scared and thought I'd better find a way to make a living on CompuServe or at least let it pay for itself."

"I had just sent off a couple of hundred dollar checks to CompuServe for all the talking I'd been doing," he continued, "so I thought, maybe I should talk to them about starting a service."

Bowen's service offers authors a newsletter, market listings, bulletin board, and electronic conferencing.

Electronic conferencing is potentially the most powerful service his SIG offers authors, Bowen said. "What would take a week of notes to accomplish can be done in an hour of 'talk.' "

The group also has a message system that's turned into a kind of computerized marketplace for ideas, a sort of electronic Agora. Since the group's inception, members have discussed conflict-of-interest problems related to product reviews, the best computer to write software for, computers creating new art forms, and the makeup of computer utopia—The Micropolis.

"The subjects are really up to the members," Bowen told *80 Micro*. "We have 'threads.' You can respond to any message you want. Some threads, some topics, have gone on for

The electronic conference is potentially the most important service this SIG offers authors. What would take a week of notes can be done in an hour.

a month or more."

He explained software publishers—like Bob Snapp of Snapp Software and Paul Grupp of Scott Adams's Business Division—often drop by to comment on messages.

The group's first electronic conference spun off a message system "thread."

"Folks were talking about the problem of piracy," Bowen explained, "and someone said, 'Did you hear about this dumb guy in California who's giving his programs away?' That was discussed about a week, until a fellow logged in and said, 'Well I'm the dumb guy doing that.' "

The "dumb guy" was Andrew Fleugelman, who encourages people to pirate his IBM PC communications software. If they like it, he requests them to make a contribution to him.

Fleugelman told authors' SIG members 70 percent of the people making copies of the program were sending him contributions. Can you say the same thing about programs you've protected in conventional ways? he asked.

"The conversation was very interesting," Bowen noted. "It was scheduled for two hours and it went into a third hour on a Saturday night, which I since learned is not a good night to have conferences. People would rather go out and boogie."

Information in the SIG's market reports is similar to its traditional counterparts—publisher, contact person, address, publisher's needs, what machines he supports, royalty structure, time it takes to evaluate a program, tips for submitting software—but all of it can be electronically massaged. Key-word searches can be performed, allowing a writer to look for all publishers looking for TRS-80 programs or find a specific software firm.

Bowen explained he initially considered writing a "Writer's Market"-style book for the software set, but "because of the delay time in getting out a book, it wouldn't be very useful to people. In the software markets you almost have to be electronic to stay current."

He cited one case where he was informed of a software opportunity through electronic mail on a Saturday and had a market report on the firm on line by Monday. "Even a newsletter couldn't do it quite that fast," he said.

He added his members have found links between soft and hard publishing: "We're finding a great similarity between print and software markets. An awful lot of people, at least at this stage, are doing both. They're finding the best way to market the software is to do it in print fashion with an article—the way it would be done in *80*."

As the operator of a SIG, Bowen got free access to CompuServe, a perquisite that excited him: "I thought, 'Great, now I can talk to my CB buddies all the time and not be charged for it.' But I don't have time to do it. There's a lot more work involved than I realized, but I'm enjoying every minute of it." ■

Tandy chooses LDOS . . .

SOFTWARE

Radio Shack took a giant step forward in product support when it decided to carry LDOS as an alternative disk operating system for its Models I and III computers.

The DOS made by Logical Systems Inc. of Mequon, WI, will be the only one from Radio Shack interfacing with the Fort Worth firm's hard disk drive.

At press time, Radio Shack hadn't officially released LDOS to its stores, so a retail price was not available, although it will probably be close to the current retail price for LDOS ($129).

It is considered one of the most powerful operating systems for the TRS-80. Its features include many absent from Tandy's operating system, TRSDOS: automatic support of double-density and double-sided drives; drive track counts between 35 and 80; support of all drive-motor step-rates (3ms, 6ms, 12ms, etc.); hard drive support; type and size drive mixing (5-inch, 8-inch, hard drive) up to eight drives; compiled JCL; link, route, filter, and set device control support; and complete compatibility of data disks between the Models I and III.

All Microsoft language products for the TRS-80 are supported by LDOS and the DOS is compatible with TRSDOS 1.2 and 2.3.

Ed Juge, Tandy's director of computer merchandising, said in a telephone interview with *80 Micro* Radio Shack decided to add LDOS to its product line because of previous business deals and commitments with Logical Systems. It did not compare LDOS with other operating systems before making its decision, he added.

For new disk drive owners, TRSDOS will still be used as a "first DOS" and as the medium for new program development and distribution.

TERRY KEPNER

. . . while competitor questions choice

SOFTWARE

Before Tandy named LDOS as an alternative operating system for its Models I and III, Fort Worth observers speculated there was more than one entry in the race to become Radio Shack's anointed DOS.

Ed Juge discounted that speculation, but not without raising the eyebrows of one major operating system marketer, Apparat Inc. of Denver, CO. A programmer with the maker of the highly touted NEWDOS80 told *80 Micro*: "Tandy didn't even approach us. They didn't even ask us, which I thought was rather funny."

When asked by *80 Micro* about Tandy's choice of his firm's operating system as an approved alternate, Logical System's Bill Schroeder refused to comment and said all queries would be answered by Tandy.

"We think [LDOS] will be a good product," Juge said. "We don't intend to support it with software. We're putting it out there as a programmer's tool for the programmers who want something more powerful than TRSDOS."

"I really don't think Radio Shack's going to LDOS was based on the technical aspects," the Apparat programmer noted. "I really couldn't see a whole lot of reasons for Tandy going to LDOS. Technically speaking, LDOS can't match NEWDOS as far as we see and as far as the reviewers have seen."

He speculated Radio Shack might have chosen LDOS because it wanted a system that supported a hard disk. NEWDOS80 2.0 does not support one.

But, he interjected, version 3.0, slated for release in early 1983, will support four kinds of hard disks, eight floppy drives, and combinations of the two drive types. He added, "When NEWDOS version three comes out, it's going to be more powerful than even quite a few people around here can understand."

New currency at Tandy is plastic

BUSINESS

It will be tougher than ever resisting the urge to upgrade your system when Tandy begins flashing its latest offering in your face: a Radio Shack credit card.

Tandy has teamed up with Citibank of New York and created a Citiline card for Radio Shack customers who want to drop a bundle of money in a hurry. The card is patterned after others of its kind, but requires an initial minimum purchase of $225. The minimum for subsequent purchases is $100.

The card's repayment schedule is worked out on a 24 percent annual interest rate. According to *InfoWorld*, the higher-than-average bank-card interest rate is a tradeoff for no service charge on card-holding privileges. The newspaper added users with an average balance of $500 would pay less than credit-card users with the same balance who paid a $20 membership fee for the card and 20 percent interest.

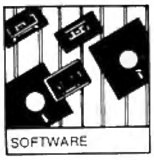
Purchases made with the Citiline card will be analyzed for direct-mail advertising purposes, Tandy said. Citiline credit statements will include advertising stuffers for Tandy products and for financial services offered by Citibank and other institutions.

The credit card service was expected to go into effect this fall.

continued

PULSE TRAIN*continued*

Hardware protects this software



Softbucs with a mind to pirate Simutek products, beware! The Tucson, AZ, firm protects its software with hardware.

"We got the idea from seeing some of the products for Apple computers that plug into the joy port connector to prevent piracy," said Simutek President Mike Gariepy. "We thought it was possible to do that with the cassette port on the TRS-80, and it was."

Simutek first used its software "key"—which is about the size of a 5-pin DIP jack—with its Copyart word-processing program. The program or copies of it will not run unless the key is in the machine's cassette port.

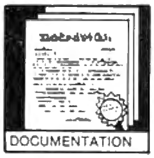
"The software scans the port to make sure our key is plugged in correctly," Gariepy said. "If it's not, the program crashes and goes into Never Never Land."

He explained schools or businesses may buy extra keys from Simutek for multiple uses of a program.

Can the code to the key be broken? "Some friends of ours at a tv station in Tucson broke it," Gariepy said. "It took them two and a half weeks and they're all certified engineers.

"If someone has a knowledge of microelectronics, they could make copies of a particular key," he said. But since the codes are changed from key to key, he added, the copy would work only with copies of the program issued with the original key.

The subject is privacy



How emerging technology affects privacy is the focus of a newsletter published by Washington, DC, attorney Robert Ellis Smith.

He told *80 Micro* he started his newsletter in 1974 to address press-privacy issues. But in a short time, he discovered his subscribers "were concerned more about computer data banks than they were about the press."

Hence evolved *Privacy Journal: An Independent Monthly on Privacy in a Computer Age* with about 2,000 subscribers.

"I have become concerned about the impact of computer technology on individual rights," Smith said. "It threatens them a good deal in a lot of different ways that people haven't looked at."

"I try to advise people how new technology will affect their rights," he continued. "That involves mainly computer data banks and new communications."

Recent stories in Smith's newsletter concerned how computer matching is used to catch people working and collecting welfare, how data banks are used to catch student loan delinquents, and how a ban on credit transactions was used to curb travel to Cuba.

"The newsletter has a point of view," Smith said. "It's pro-privacy. But by and large, I try to be factual in the newsletter because I'm providing an information service to people. And a lot of them don't agree with me."

New publications take aim at lawyers, Sinclairs, CP/M, and kids

Attorneys, Sinclair users, CP/M users, computer market observers, and kids are the targets of some new electronic publications.

Attorneys Computer Report was launched in August and claims to be the first newlsetter about computer use written for lawyers. The report is published every two weeks. It includes information on hardware and software for attorneys: experiences of users with law-firm oriented microwares; and tips for cutting costs, managing a practice, and expanding client services.

The report is available from Professional Publications Inc., P.O. Box 80280, Atlanta, GA, and costs $229 a year.

The maiden issue of a quarterly magazine for Timex-Sinclair users was expected to be released this month. Called *SQ*, the publication will feature programs, reviews, and projects for Timex-Sinclair machines.

Editor Ann Zevnik said in a statement: "*SQ* will be the biggest source of information about Timex-Sinclair machines in the US. It will be written for intelligent users who don't necessarily have any computer background, but who wish to learn."

The new magazine will be published by the Harvard Group, based in Harvard, MA, which also publishes *SYNTAX*, a newsletter for Timex-Sinclair users. Selected computer stores will carry *SQ*. Subscriptions cost $15. A package offer is also available: four issues of *SQ* and 12 of *SYNTAX* for $39.

A six-times-a-year magazine devoted to the CP/M operating system has been launched on Mercer Island, WA. The first issue, released in September, featured a buyer's guide covering more than 50 single source CP/M systems. Other features include abstracts of CP/M related articles, listings of hardware and software products, user groups, and club news. Subscriptions are $16 a year.

A newsletter that promises to be controversial has been announced by Ron Jeffries.

"My newsletter will give you a *personal view of computing*," Jeffries said in a statement. "Each issue will bring you up-to-date information about the fast-changing personal computer field. *The Jeffries Report* will be controversial. The style will be informal, chatty, and fun to read."

Jeffries also claims his publication will avoid the

continued

PULSE TRAIN*continued*

biases of other silicon media:

"Have you noticed that mass-market computer magazines never seem to find anything wrong with the computers they evaluate? Don't get me wrong: Those magazines are produced by good people. But they have a problem: Advertisements placed by computer manufacturers are an important source of their income. Since *The Jeffries Report* carries no advertising, our editorial content is not affected by those factors."

Here are some samples from Jeffries' first effort:

• "[I]t is my opinion that the VIC can't possibly survive in the marketplace surrounded by the $179 MAX machine on one side and the $595 C64 on the other. The much cheaper MAX has far better graphics, and has a 40-column display! And don't forget the new Sinclair Spectrum that will be selling for about $225.

• "In less than a year, IBM has sold close to 250,000 personal computers. That means that IBM has more than half as many personal computers installed as Apple has sold to date. The main reason that the IBM PC has an 'open design' is that IBM carefully studied the Apple, and copied it in many ways. (They even copied some of the mistakes: Those 160K 5-inch disks that were on the early IBM PCs held only slightly more data than Apple disks. IBM has since gone to double-sided 320K disks, but it took them several months to correct the mistake.)"

• "I do have reservations about how well Commodore can compete in the Atari game arena. For one thing, the MAX package is rather unsophisticated. For example, if the consumer changes cartridges without turning the unit off, they run some risk of damaging the cartridge. (The current Atari VCS has the same problem. However, the Atari 400/800 and the new 5200 game do not have the problem.) I do not consider the physical packaging of the MAX to be outstanding. My reaction was that it looked like they had it designed by Radio Shack. (It's even that same shade of battleship gray!)"

And speaking of Radio Shack, it has released its third computer comic, starring—with the permission of Warner Communications' DC Comics division—Superman, Wonder Woman, and Tandy's own dynamic tandem, the TRS-80 Computer Whiz Kids. The 36-page comic, "The ComputerMasters of Metropolis," is available free of charge from Tandy.

Digest in red at Source

When Readers Digest acquired The Source, it might have thought it was buying a piece of the information revolution, but according to the *New York Times*, it appears to have bought a headache.

Despite heavy investment in The Source, the information utility hasn't reached the goals Digest has set for it, the *Times* reported.

It said The Source is at a crossroads and there is speculation in the industry Digest might be disillusioned with the business and seek to sell it. That was denied by The Source's new chief executive, George V. Grune. "We are not looking for a bailout and we are not selling," he told the *Times*.

Digest would not disclose the financial results for the venture, the New York daily said, but an unnamed source estimated the service lost $5 million to $7 million on revenue of $6 million to $8 million in the fiscal year ending July 31. So far, the *Times* said, Digest has sunk $15 million to $20 million into the project.

The newspaper reported The Source's chief competitor, CompuServe, a division of H&R Block, expects to be $5 million to $7 million in the black by the end of its fiscal year, April 30, 1983.

The daily explained CompuServe has an advantage over The Source because the meat of its business doesn't depend on providing consumer information. That business is just an add-on to its commercial time-sharing concern.

The *Times* added Digest has made many improvements since it acquired The Source. It increased its staff to more than 125 from 50, purchased new computer hardware and software to make it easier for subscribers to access the system, and it is building a new computer facility capable of handling up to 250,000 subscribers.

Meanwhile, The Source has launched a new publication for its subscribers, *SOURCEWORLD* Newsletter. The first issue contained notes from subscribers who have found productive uses for the service in their businesses, a profile of the "Subscriber of the Month," tips on how to create a private Source network, and an announcement an advisory panel was being formed to pre-test new services.

The Source also announced PARTICIPATE, "the first computer conferencing service made commercially available to the general public."

In a statement, creator of the service, Chandler Harrison Stevens, noted subscribers have been using PARTICIPATE for—

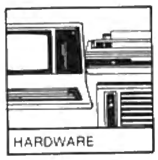
• Project management (to monitor progress and share information despite geographic separation);

• Group authorship (to review new material and direct manuscript changes and consistency);

• Executive decision making (to gather information to support timely decisions and actions); and

• Market research (to survey and poll other Source subscribers).

Even robots sing the blues



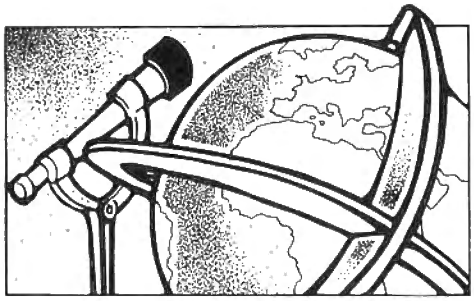
Ritz Miller has found a new use for those obnoxious little robots that overpopulate computer shows. He rented one to picket the San Mateo County Courthouse with a sign protesting: "Divorce Courts Unfair."

According to United Press International, the 4 ½-foot robot with a fishbowl head sang the blues to anyone who would listen: "She got the gold mine. I got the shaft."

Miller used the robot to hand out fliers complaining about the high cost of divorce. Robot rental fees cost him $1,000 a day. ■

COPERNICA MATHEMATICA

by Bruce Douglass



Statistics 101

Statistics are the most misused and misunderstood procedures in applied mathematics. Many people think you can prove anything with statistics, implying that they have nothing to do with reality, while others accept any statistics without question. Neither attitude is correct.

Statistical methods provide a powerful tool for looking at large amounts of data, and for shaping and testing hypotheses. Every statistical measure makes some assumptions that may or may not be true. Therefore, no statistical procedure should be used without thought or consideration. Statistical validity does not come from using double precision, although that can minimize round-off error with large amounts of data.

There are two main categories of statistics: descriptive and inferential. The first describes a collection of data (a data set), while the second infers information about a data set. Descriptive statistical measures include central tendency, range, variability, skewness, and kurtosis. The inferential measures are used to infer from the data whether groups of data are from the same population (their similarity or difference).

Descriptive Statistics

If you have a data set with a number of scores in it, what single representative number can describe the data set? It depends on what you mean by representative. Three measures are in common use:

- Mean—the sum of the scores divided by the number of scores.
- Median—the score that divides the data set into two sets with equal numbers of points in each.
- Mode—the scores that occur with the greatest frequency in the data set.

Although the mean is used most often, the other two measures are easier to appreciate intuitively. The median is the 50th percentile in a group of scores—it is the middle score. The mode is the most frequently occurring score. The mode may not be unique. If all the scores in the data set occur with the same frequency, there is no mode. If there are two modes (that is, two scores occurring most often), the data set is said to be bimodal, or to have a bimodal distribution.

All three methods are used; for different applications, only one may be appropriate. It all depends on the question you're asking of the data.

Computation of these various measures is shown in the Program Listing. This program finds the mean, median, and mode of a data set, either in grouped or ungrouped format. If you choose to group your data, you must enter the number of groups. You may use default limits on your groups (lowest and highest scores), or may input your own. The program will print data on the screen or line printer, plot it on the screen or make a histogram of your grouped data.

A sample run of the program using the data set 1,3,3,5,6,7,8 gives a mean of 4.714286, a mode of 3, and a median of 5.

The mean is the most sensitive measure in that it is affected by all scores. The median is affected the same amount by the presence of a score to the right of the center of the data set regardless of how far the score is to the right. The mode is indifferent to all scores except the one of greatest frequency. The mode, then, is the least sensitive measure of the center or central tendency of a set of data.

The program is fine for many applications, but often it is desirable to group data. This forces data (often from a continuous number system) into little packages (a discrete number system). An example is school grades. When it is time to decide who gets the As and the Bs, the fairly continuous scores are forced into discrete boxes marked A, B, C, D, or F. It would be useful to be able to apply the measures of central tendency to this grouped data as well.

Calculation of the mode is as simple with grouped data as it is with ungrouped. You simply look for the box with the greatest number of scores. The median is somewhat less simple. As it turns out, this can be summarized in the equation below:

MD = LLI + WMI *(N/2 – Cf)/If

where:

MD = median
LLI = lower limit of the median interval
WMI = width of median interval
N = number of scores
Cf = cumulative frequency up to the median interval
If = frequency within the median interval

The lower limit of the median interval and the width of the interval are real numbers. If the cutoff for the Bs is 80 percent right, the LLI would be 80 percent. The width of the median interval is the upper limit of the interval minus the lower limit of the interval. The cumulative frequency is the number of scores that occur before the median interval—the number of scores less than the cutoff for the median interval. It is the number of scores that occur within the median interval (the interval that holds the median).

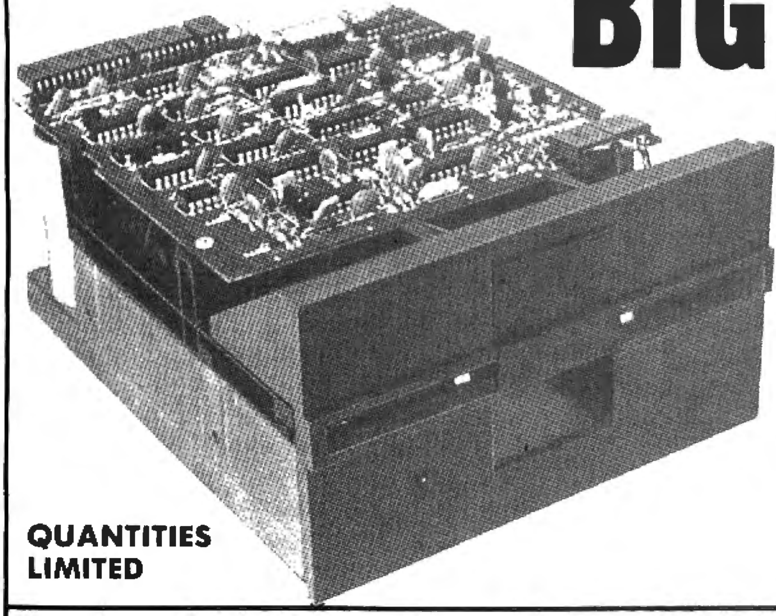
The method for finding the median is only a special case of finding a percentile rank of the scores. This is simple for grouped and ungrouped data. The xth percentile of a data set is that score that divides the data set into two groups with x percent of the scores below the point and (100–x) percent above the point. Thus, the 99th percentile means that 99 percent of the scores fell below the point and 1 percent of the scores fell above the point. The formula for calculating percentiles is:

P(x) = L + W*(x*N–Cf)/If

where:

x = percentile rank desired
L = lower limit of interval containing the percentile score
W = width of interval
N = number of scores
Cf = cumulative frequency up to the interval containing the xth percentile score
If = interval frequency

BIG SAVINGS ON DISK DRIVES



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For example, to find the 60th percentile, if the lower limit of the interval is 30.5, the number of scores is 125, the cumulative frequency up to this interval is 58, the width is 1, and the frequency within this interval is 23, the data point with a percentile rank of 60 would be P(60) = 30.5 + 1*(.60*125–58) /23 = 31.24.

Measures of central tendency give a number that is somehow representative of the data set. It says little, if anything, about the distribution of the data points.

One important aspect of the distribution of the data set is the variability of the data. Variance is a measure of how the scores deviate from the mean. If we merely added the differences of the scores from the mean, $\Sigma(X_i-X_m)$, where X_i is the ith score and X_m is the mean, we would get zero. This is a property of the mean. One measure of how the scores deviate from the mean is provided by the sum of the squares of the deviations, $\Sigma(X_i-X_m)^2$. If we divide this sum by the number of scores minus one (to normalize the sum so that it is independent of the size of the data set), we get the variance.

The standard deviation is the square root of the variance. It is more convenient to rewrite the equation for the variance to be:

$$V = (n*\Sigma X^2 - (\Sigma X)^2)/(n*(n-1))$$

If you are using grouped scores, it would be better to use an alternative formula:

$$V = (\Sigma(f*X^2) - (\Sigma(f*X))^2/n)/(n-1)$$

The frequency of scores within each group is f, and the value used for X_i is the mean of the ith interval. If the data has a normal distribution, 67 percent of the data points will lie between minus one and plus one standard deviation away from the mean.

Another thing we need is a method of turning lists of data into a form more easily understood—a data plot. Histograms, frequency plots, pie charts and X,Y plots are all useful graphs. Since we are concerned only with one-dimensional data here, we will only create the histograms and frequency plots. The program allows you to enter a raw data set grouped as you will. You may then plot it using a histogram or frequency plot, and print out the median, mode and mean.

The program is menu-driven. You

Program Listing

```
10 '      *******    FREQ1/BAS    *******
20 '      *             BY              *
30 '      *     BRUCE POWEL DOUGLASS    *
40 '      *     DEPT. OF PHYSIOLOGY     *
50 '      *      USD MEDICAL SCHOOL     *
60 '      *******************************
70 GOTO 140:' INITIALIZATION IS A SUBROUTINE (BELOW)
80 DEFINT I-K,N:F$="BLANK":DIM I,J,A$,L
90 DEF FN ODD(N)=-(INT(N/2)<>N/2):' RETURNS '1' IF ODD
100 DEF FN EVEN(N)=-(INT(N/2)=N/2):' RETURNS '1' IF EVEN
110 U$="%               % = ######.######"
120 '   %---15 SPACES---%   #-12 DIGITS-#
130 RETURN
140 'DISPLAY MENU ROUTINE
150 CLS:PRINT TAB(19);"**** FREQ1/BAS ****"
160 PRINT TAB(25);"OPTIONS:"
170 PRINT"1. ENTER DATA
180 PRINT"2. SAVE DATA TO DISK
190 PRINT"3. LOAD DATA FROM DISK"
200 PRINT"4. ANALYSE DATA"
210 PRINT"5. PRINT/PLOT DATA"
220 PRINT"6. END PROGRAM"
230 PRINT"DATA SET IS ";F$
240 A$=INKEY$:IF A$="" THEN 240 ELSE IA=VAL(A$)
250 ON IA GOTO 280,370,440,530,1650,270
260 GOTO 240
270 END
280 '          KEYBOARD DATA ENTRY
290 CLEAR:GOSUB80:CLS:PRINT TAB(25);"KEYBOARD DATA ENTRY"
300 INPUT"ENTER THE NUMBER OF SCORES";N
310 DIM A(N),B(N),C(N),D(N),G(N)
320 FOR I=1 TO N
330    PRINT"ENTER SCORE ";I;:INPUT A(I)
340 NEXT I
350 INPUT"ENTER NAME OF DATA SET";F$
360 GOTO 140
370 '          SAVE DATA TO DISK
380 OPEN"O",1,F$
390 PRINT#1,N
400 FOR I=1 TO N
410   PRINT#1,A(N);
420 NEXT I
430 GOTO 140
440 '          LOAD DATA FROM DISK
450 CLEAR:GOSUB80:CLS:INPUT"ENTER NAME OF FILE TO LOAD";F$
460 OPEN"I",1,F$
470 INPUT#1,N
480 DIM A(N),B(N),C(N),D(N),G(N)
490 FOR I=1 TO N
500   INPUT#1,A(N)
510 NEXT I
520 GOTO 140
530 '         ANALYSE THAT STUFF!
540 'GROUPED OR UNGROUPED ANALYSIS??
550 CLS:PRINT"1. UNGROUPED, OR 2. GROUPED ANALYSIS"
560 A$=INKEY$:IF A$="" THEN 560 ELSE A=VAL(A$)
570 ON A GOTO 590,1130
580 GOTO 560
590 '           UNGROUPED ANALYSIS
```

Listing continues

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Listing continued

```
600 '  THE MEAN
610 FOR I=1 TO N
620   SUM=SUM+A(I)
630 NEXT I
640 MEAN=SUM/N
650 PRINT USING U$;"UNGROUPED MEAN",MEAN
660 '  THE MEDIAN
670 GOSUB 680:GOTO 800
680 'FIRST, MOVE THE DATA INTO ANOTHER ARRAY
690 PRINT "SORTING ..."
700 FOR I=1 TO N
710   B(I)=A(I)
720 NEXT I
730 'THEN SORT IT INTO ASCENDING ORDER
740 FLAG=0
750 FOR I=1 TO N-1
760   IF B(I)>B(I+1) THEN B=B(I):B(I)=B(I+1):B(I+1)=B:FLAG=1
770 NEXT I
780 IF FLAG=1 THEN 740
790 RETURN
800 'SORT DONE
810 '**  MEDIAN=MIDDLE SCORE IF N IS ODD
820 '**  MEDIAN=AVERAGE OF MIDDLE TWO SCORES IF N IS EVEN
830 ' LEVEL II USERS JUST STICK IN THE DEFINITION FOUND
840 ' IN LINES 90-100 INTO THE MD EQUATION BELOW -
850 ' I JUST DID IT THIS WAY FOR READABILITY
860 MD = FN ODD(N)*B(INT(N/2)+1) + FN EVEN(N)*(B(INT(N/2))+B(INT
(N/2)+1))/2
870 PRINT USING U$;"UNGROUPED MEDIAN",MD
880 'MODE
890 FOR I=1 TO N:C(I)=0
900   FOR J=1 TO N
910     IF A(I)=A(J) THEN C(I)=C(I)+1
920   NEXT J
930 NEXT I:C=0
```

Listing continues

may input the data from keyboard or disk file, and it may be saved to disk as well. Cassette users, merely delete the Open and Close statements and change the PRINT#1 and INPUT#1 statements to PRINT#− and INPUT#−1, respectively.

Correlation and Regression

A correlation is a measure of the relation between two or more variables. It can be thought of as an inferential statistic, but when we are only looking at the relationship between two variables without inferring information, it is essentially descriptive. Karl Pearson created the Pearson r product-moment correlation in the early part of this century, although the idea of a product-moment correlation dates back to an 1846 article by a Frenchman named Bravais.

The standard deviation is denoted with a small sigma (σ). The Pearson r correlation is defined to be:

$$r_{xy} = \sigma_{xy}/S_xS_y$$

or, more conveniently,

$$r_{xy} = \frac{S_{xy}}{S_xS_y}$$

$$= \frac{n\Sigma(X_iY_i) - \Sigma(X_i)\Sigma(Y_i)}{\sqrt{(n\Sigma(X_i)^2 - (\Sigma Xm)^2)\,(n\Sigma(Y_i)^2 - \Sigma(\Sigma Y_i)^2)}}$$

Correlation between two variables can be used to predict behavior; in this sense it is an inferential statistic. Let's consider two variables: X and Y. If you assume a linear relationship exists between X and Y, simple matrix methods are sufficient to determine the coefficients of the equation $Y' = a*X + b$. The prime (') indicates that the resulting Y value is predicted and not a real entry in your data set. The fitting parameters are called a and b, and regression is the method of finding a and b. In the end you have the equation for the best-fit line.

Normally, a method called least squares is used in regression. The idea behind the method is this: A distance is normally thought of as a positive number, regardless of direction. If you have a mile to walk, it doesn't matter if you go north or south—direction and distance are independent values. We would like to minimize the distance between the regression line and the data points (since they will never all lie on

Listing continued

```
940 'NOW FIND THE MAX OCCURRENCE OF A SCORE (THE MODE)
950 FOR I=1 TO N
960   IF C(I)>C THEN C=C(I)
970 NEXT I:L=0
980 FOR I=1 TO N
990   IF C(I)<>C THEN 1040:'        IS IT A MODE?
1000     FOR J=1 TO L:'             IF SO, IS IT ALREADY USED?
1010       IF D(J)=A(I) THEN 1040
1020     NEXT J:'                   IF SO, THEN GO ...
1030     L=L+1:D(L)=A(I):'          IF NOT, THEN INCLUDE IT
1040 NEXT I
1050 'NOW DISPLAY ALL MODES IN DATA
1060 IF L=0 THEN PRINT"NO MODE":GOTO1110
1070 FOR I=1 TO L
1080   MODE=D(I)
1090   PRINT USING U$;"UNGROUPED MODE",MODE
1100 NEXT I
1110 PRINT:PRINT"PRESS <ENTER> TO RETURN TO MENU"
1120 IF INKEY$="" THEN 1120 ELSE 150
1130 '   ******   GROUPED ANALYSIS   ******
1140 CLS:INPUT"ENTER THE NUMBER OF GROUPS";NG
1150 INPUT"USE DEFAULT LIMITS (Y/N)";A$
1160 IF A$="N" THEN INPUT"ENTER UPPER AND LOWER LIMITS FOR GROUP
ING";UP,LOW:GOTO 1190
1170 GOSUB 680:'MOVE INTO B() AND SORT
1180 LOW=B(1):UP=B(N)
1190 SIZE=(UP-LOW)/NG
1200 'NOW GROUP THE DATA
1210 FOR I=1 TO NG
1220 ' L1, U1 ARE THE LOWER & UPPER LIMITS FOR INTERVAL I
1230   L1=LOW+SIZE*(I-1):U1=LOW+SIZE*I
1240   FOR J=1 TO N
1250     IF A(J)=>L1 AND A(J)<U1 THEN G(I)=G(I)+1
1260     IF I=NG AND A(J)=UP THEN G(I)=G(I)+1
1270   NEXT J
1280 NEXT I
1290 'GROUPED MEAN
1300 SUM=0
1310 FOR I=1 TO NG
1320   MIDPNT=LOW+(I-1)*SIZE+SIZE/2
1330   SUM=SUM+G(I)*MIDPNT
1340 NEXT I
1350 MEAN=SUM/N
1360 PRINT USING U$;"GROUPED MEAN",MEAN
1370 'GROUPED MEDIAN
1380 'FIND MEDIAN INTERVAL
1390 CF=0:MI=0
1400 FOR I=1 TO NG
1410   IF CF=>N/2 THEN MI=I:GOTO 1440
1420   CF=CF+G(I):' CUMULATIVE FREQUENCY
1430 NEXT I
1440 MD=LOW+SIZE*(MI-1)+SIZE*((N/2)-CF)/G(MI)
1450 PRINT USING U$;"GROUPED MEDIAN",MD
1460 'GROUPED MODE
1470 L=0:C=0
1480 FOR I=1 TO NG
1490   IF G(I)>C THEN C=G(I)
1500 NEXT I
1510 IF C<2 THEN 1580
1520 FOR I=1 TO NG
1530   IF G(I)<>C THEN 1560:'       IS IT A MODE?
1540     L=L+1:'                    IF SO, THEN INCLUDE IT
1550     D(L)=LOW+SIZE*(I-1)+SIZE/2:' MIDPOINT OF THE INTERVAL
1560 NEXT I
1570 'NOW DISPLAY ALL MODES IN DATA
1580 IF L=0 THEN PRINT"NO MODE":GOTO 1630
1590 FOR I=1 TO L
1600   MODE=D(I)
1610   PRINT USING U$;"GROUPED MODE",MODE
1620 NEXT I
1630 PRINT:PRINT"PRESS <ENTER> TO RETURN TO MENU"
1640 IF INKEY$="" THEN 1640 ELSE 150
1650 'PRINT/PLOT DATA
1660 CLS:PRINT"1. PRINT
2. LPRINT
3. X-Y PLOT
4. HISTOGRAM OF DATA
5. RETURN TO MENU"
1670 A$=INKEY$:IF A$="" THEN 1670 ELSE A=VAL(A$)
1680 ON A GOTO 1700,1770,1850,1960,140
1690 GOTO 1670
1700 'PRINT DATA
1710 J=1
```

Listing continues

the line in real applications).

Since we want to minimize this distance, could we use Σd, where d is (XL–XD), and XL is the point on the line and XD is the data point? No—some distances will be negative, effectively cancelling out those that are positive. We need some way to turn all those distances into positive numbers.

How about d^2? That is why this method is called least squares; it finds the line that minimizes the sum of all the distances squared.

The regression equations must be linear in the fitting parameters, but not necessarily in terms of the variables. Therefore, $Y' = a*e^x$ is linear in a, although not in x, and meets our linearity requirement. However, $Y' = a*X^b + c$ is not linear in the fitting parameters a, b, and c. For the general nonlinear case the problem is far more difficult, and must be solved by iterative methods (such as a gradient method or the Marquardt optimal neighborhood method).

In the simple linear case with two variables X and Y, the regression equation is $Y' = aX + b$. The parameter b can be found using the equation $b = (\Sigma XY - (\Sigma X)\ (\Sigma Y)/N)/(\Sigma X^2 - (\Sigma X)^2/N)$. The other parameter, a, can then be easily found using $a = Y_m - b*X_m$, where Y_m and X_m are the means of Y and X, respectively.

Analysis of variance (ANOVA) is a special case of regression. In a simple ANOVA you have two or more groups of data, and want to know whether they come from the same population. Is there a difference between the two groups? There will almost always be some difference between the means of two groups of experimental data. Even when you purposefully collect data from the same source, some fluctuation is inevitable. So how different is different?

The answer lies in significance tests. No matter how large the difference between two data sets may be, there is always some finite chance that the difference you are observing is due solely to chance, not to some real difference in the data source. In significance testing, you decide on some level of chance at which point you will conclude that the two groups are different. This is normally called alpha (α). In scientific work, α is often chosen to be .10 or .05, meaning that if the probability that the difference observed

Listing continued

```
1720 FOR I=1 TO N
1730   PRINT "SCORE #";I;A(I)
1740   J=J+1
1750   IF J>14 THEN INPUT"CONTINUE";A$:J=1
1760 NEXT I
1770 'LPRINT DATA
1780 J=1
1790 FOR I=1 TO N
1800   LPRINT "SCORE #";I;A(I)
1810   J=J+1
1820   IF J>60 THEN INPUT"CONTINUE";A$:FOR K=1 TO 6:LPRINT" ":NE
XT K:J=1
1830 '  FOR 60 LINES OF TEXT ON A PAGE OF 66 LINES
1840 NEXT I
1850 'X-Y PLOT OF DATA
1860 GOSUB 680:'SORT IT IN B()
1870 LOW=B(1):UP=B(N)
1880 SY=47/(UP-LOW+1):SX=127/N
1890 CLS
1900 FOR I=1 TO N
1910   PX=I*SX
1920   PY=47-B(I)*SY
1930   SET(PX,PY)
1940 NEXT I:PRINT@0,"DONE";
1950 IF INKEY$="" THEN 1950 ELSE 140
1960 'HISTOGRAM OF PRE-GROUPED DATA
1970 IF NG=0 THEN 1670:' MUST BE GROUPED
1980 IF NG>64 THEN 1670:' TOO MANY TO SEE ON SCREEN
1990 UP=C:'MAX NUMBER OF SCORES IN G()
2000 CLS:FOR I=1 TO NG
2010   IF G(I)=0 THEN 2050
2020   FOR J=47 TO 47-G(I) STEP -1
2030     SET(I*2,J)
2040   NEXT J
2050 NEXT I:PRINT@0,"DONE";
2060 IF INKEY$="" THEN 2060 ELSE 140
```

between the groups is due to chance is less than .1 (1 chance in 10) or .05 (1 chance in 20), we assume the data sets are different.

Statistically, the null hypothesis is the theory that there is no difference between the groups; it is denoted H_o. The hypothesis that there is a difference between the groups is called the alternative hypothesis and is denoted H_a. To be more specific, if we let μ_1 be the mean of group 1, μ_2 be the mean of group 2, and so on, the hypotheses may be summarized with:

$$H_o\!: \mu_1 = \mu_2 = \ldots = \mu_m$$
$$H_a\!: \mu_i <> \mu_j \text{ for some i, j}$$

This is a vital approach to inferential statistics. Notice that here, as well as in the regression statistics, no reference is made to cause and effect. Inferential statistics such as ANOVA and regression are concerned only with the correspondence between variables or differences between groups of variables.

ANOVA uses two independent measures of variance to determine whether the experimental groups are different. One, between-groups variance, is the variance of the means between the groups. The other, within-groups variance, represents the variance within each group. If the null hypothesis is true, then these independent measures of variance should be about the same. The decision is made through an F test.

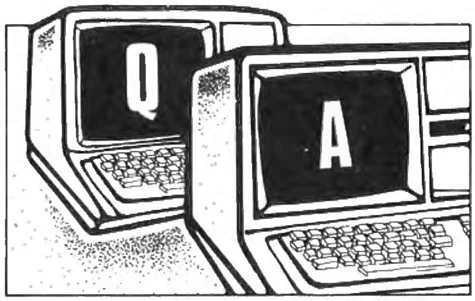
If the groups are different, then you would expect the between variance to be larger than the within variance, right? The between variance is divided by the within variance. If this ratio is significantly greater than one, there is at least one pair of groups different. This F ratio is then looked up in tables with the within and between variance (or calculated with some approximation), and the probability that this ratio could occur by chance is given. If it is less than your previously chosen level of alpha, then you reject the null hypothesis, otherwise you accept the null hypothesis.

Significance tests are used with all sorts of inferential statistics. They can be used to determine whether two or more groups of data are different (for example, the t test and ANOVA), if there is any improvement in a regression by including additional variables, or whether a model describes a set of data.

We'll continue this discussion next month. ■

FEEDBACK LOOP

by Terry Kepner



Problems and Solutions

I can't make backups with my single-drive Model I. The system works fine in all other modes, even passing the RS Stress Test. But, it will only complete some of the Floppy Doctor tests.

Radio Shack recommends I buy a head-cleaning kit. I don't know if this will work since the reference manual doesn't say anything on this. I've cleaned my disk drive's head using a cassette head cleaner, but this didn't help.

Radio Shack charges $30 to clean and align the head. If that doesn't work, it will then cost another $120 to change the head. Should I spend this kind of money when I can buy a non-Radio Shack disk drive for about $260?

A.M.
Egg Harbor, NJ

Unfortunately, you don't mention which Floppy Doctor tests your drive failed. (Please, if you have a question for Feedback Loop, tell me what your system has on it, what modifications it has, what tests you've given it and how it fared on them, and your phone number so I can call you if I have questions.)

The first step is getting a disk-drive head-cleaning kit. Even if it doesn't cure your problem, it does prevent debris buildup on the drive head, which can damage both the head and any disks you put in the drive.

The second step is to have your drive aligned and tested. Spending $30 to have the drive checked is much cheaper than buying a new drive, no matter what the source. (One of my drives began exhibiting the same symptoms you mention; the problem was a loose drive-head alignment screw.)

Finally, if the drive needs the head replaced, the decision on whether to buy a new drive or repair the old one is up to you. I'd buy a new drive and repair the old one later. That way I'd have a two-drive system. If you can't afford both, keep the old unrepaired drive for emergency use.

I've made several unsuccessful attempts to get a mailing list of Model I and III users. I've talked to different Radio Shack Computer Stores, and have even tried the head office in Texas.

My reason for wanting the mailing list is to market a personnel accounting package I've written. I need about 1,000 names and addresses, and I'm willing to pay for them.

H.S.
Dunwoody, GA

You're not the only one who wants a list of TRS-80 owners! Practically every company marketing TRS-80 software would love to get hold of the Tandy mailing list. Tandy regards its list as secret information and won't release any of the names they have.

Your best sources for names are the magazines. Most magazines, this one included, have contracts with agencies to sell sections of their subscription lists at reasonable prices, generally around four to six cents an address in batches of 5,000. For more information, contact Qualified Lists Inc., 20 Maple Avenue, Armonk, NY 10504, (914) 273-3353. They handle all the Wayne Green Inc. mailing lists.

I have a TRS-80 Model II, an Epson MX-80 printer, and Scripsit. I can't get the printer to print in the emphasized mode.

I've sent letters to both Radio Shack and Epson America, and it seems that they can't help me.

H.J.
Skokie, IL

Your main problem is the word processor. The Epson can be made to print in the emphasized mode by sending it the escape code, followed by the code for emphasized printing. While the TRS-80 Model II can easily transmit any code generated by Scripsit, Scripsit itself cannot generate the code required. In Basic, you could use the CHR$(x) command to send the proper codes to the printer via the LPRINT command. Any subsequent information sent to the printer would be printed in the emphasized mode, until the printer is turned off or the escape code is sent again followed by the code to turn off the emphasized mode.

My best suggestion is to boot the Model II into Basic, send the escape code and emphasized print code using LPRINTCHR$(27"E"), then reboot the Model II with Scripsit. You should get the emphasized print mode.

I have a TRS-80 Color Computer. This computer has a facility built in for renumbering, but no merge. Can you persuade one of your readers to produce a merge program? To my knowledge, no one has produced one over here.

E.S.
Largs, Ayshire, Scotland

You chaps overseas are in a rather difficult position. Normally I'd refer you to the ads in the magazine, but trying from America for shipment overseas can be a real bear. Customs messes things up, and packages sent surface mail take months to arrive (if ever). Since most American companies aren't familiar with these procedures, overseas customers end up the losers. This being the case, is there someone who knows of a Scottish or English source we could refer E.S. to? (A Color Computer merge program will be published in *80 Micro* soon.—Eds.)

In September I incorrectly stated that Weather Forecaster in Instant Software's Climate Comp package (#0316RD) can be used on a cassette system. When originally released by Instant Software, the program was cassette based and didn't use data files. But when it was converted to disk, it was rewritten to use the same data files as its sister program, Weather Plot. Because of this it can no longer be used on a cassette-based computer system.

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I've just purchased a used Model I and I'm enjoying it tremendously, except for its infamous RFI problems. Is there any way to reduce the hash this machine generates?

P.S.
Hammond, IN

Just a few months ago I saw a letter from a computer user in the Netherlands who described what he did to eliminate the RFI on his Model I. He built a wire cage, using quarter-inch grid wire to fit around the expansion interface and the keyboard (leaving a gap for the actual keys of the keyboard).

The cage is soldered together, with the top piece soldered only at the back (so he can remove the computer from the cage if he wants). All the cables that leave the cage (power cords and video cable) are wrapped, several times, around ferrite core rings, while each interface cable (printer, disk drives, and so on) passes between two ferrite bars that are bolted together and grounded to the cage. The cage itself is connected to ground. This contraption forms a Farraday cage that grounds out all RFI generated by the computer. The creator of this box says it eliminated all the RFI produced by his computer. If you try this, let me know how well it works.

The Color File Program Pac for the TRS-80 Color Computer is a powerful data-base manager. The only drawback to the program is its inability to format printed output. I tried to read the sorted data tape, but failed. Fort Worth told me that all tape output is in machine-language compacted form and cannot be accessed in Basic. Could you, or a reader, supply a machine-language program (to be POKEd in) that would read the Color File tape output into a Basic program?

R.L.
Davenport, IA

I don't have that particular Program Pac, so I can't help you. Is there anyone out there who can help?

My first problem has to do with a specific commercial program. After the program loads once or twice that area on the tape seems to wear out. The next time I load in that area, the tape loads perfectly until the very end, then beeps and the memory size question appears. I have a Model I, but no amplifier so I listen to the sound with an earphone.

My second problem involves my CRT. Whether it's on or off, plugged in or not, at times it emits a loud cracking noise.

A.R.
Chicago, IL

There are two possible reasons for your CRT problem, one of which is known as Corona discharge. The insulation around your CRT's high voltage lines on the tube itself is allowing a slight voltage leakage. As you use your CRT it builds up a static charge. At intervals, depending on the humidity, this charge is released, much in the same way that lightning discharges the static buildup in storm clouds. This discharge occurs only when the unit is on. It can be dangerous as it indicates the insulation inside the case is breaking down. Take your CRT to a tv repair shop and have a technician determine how serious the problem is.

The other possible answer is that the cracking noise is caused by the expansion and contraction of the plastic case of the CRT as the unit warms up when you turn it on and cools down when you turn it off. This is most pronounced when you have heavy items such as books or hardware on top of the case. The noises can occur quite a while after you've turned the unit off. If you have items on top of your CRT, take them off and see if that stops the noise. If you're not sure, take the unit to the repair center and have a technician check it out.

There are two possible sources of your problems with the commercial tape. The first is your tape recorder. As you use it, a slight magnetic charge builds up on the tape head. This charge acts like a tiny magnetic eraser. It isn't powerful enough to completely erase the signal on the tape, but each time a program is loaded, the charge degrades the signal quality. After several passes the computer "sees" a dirty, unreadable signal, even though it may sound okay to you. The only solution is to use a tape-head demagnetizer on your tape recorder at frequent intervals, once a month for example. If the disappearing program effect only shows up when you use that company's tapes, then this shouldn't be the problem, although regular tape-head cleaning and demagnetizing is still a good idea.

The other possibility is that the tapes used by that company are of poor quality. I know of a software house that once purchased 10,000 cassettes from an overseas source at a very nice price. Unfortunately, the tape material was not as represented in the ads, and microscopic pieces of the magnetic material actually flaked off the mylar tape base as the tape was used. The tape worked just fine when Quality Control tested it, but after the customer used it several times, the program failed to load. They had to throw away the tapes and find another source.

If the company is having the same problem with their tapes, your best solution is to transfer the program to a tape of your own. If you can't do this, contact the company about the defective tape. In any case, check your tape recorder first; that is the most likely trouble spot.

I use a Digital Equipment Corporation Decwriter II (LA-36) on my TRS-80 Model I, Level II, via Electronic System's Serial I/O Board. The problem is with the ASCII character set used by this dot-matrix printer. I would like to convert it to print out Radio Shack's character set, including the graphics blocks. Can this be done by changing the character-generator chips? I am not electronically knowledgeable.

D.M.
La Grange, IL

This question took many phone calls to several different branches of DEC across the country, but the answer is yes, it can be done, but probably not by you. The chief engineer in charge of the LA-36 project lab told me that all you need to do is replace the present character generator chip in the LA-36 with one containing the characters you want.

Unfortunately, neither he nor I know of a source of EPROM chips that already contain the TRS-80 characters. He says the ROM chip used in the LA-36 is a standard chip (although by today's standards it's an old chip design), with many different manufacturers supplying a pin-compatible alternative. To design your own character font requires an intimate knowledge of the working codes used by the LA-36 and the character-generator chip, which is not a job for a novice. He did say that if someone were to come up with a replacement EPROM for the LA-36, there would probably be a good market for it as the number of LA-36 printers in the used market is increasing rapidly.

I asked him about the belt/pulley combination, and he said that changing the number of teeth on the pulley (which also means changing the belt) will affect the speed of the print head as it scans across the paper (and will also change the character spacing), but it isn't necessary if you only want to change the character font. If you want to change to a compressed character font, contact the nearest DEC office for information on their special projects lab, which should be able to help you for a reasonable cost.

Do you know where we can purchase a Scrinput, as they are no longer available from ACR?

E.S.
S. Blue Hill, ME

When writing about companies, please include their full name and address with your letter (the first ACR I found in Florida and sells marine navigation equipment). If you're writing about a program that's no longer available or needs modifications, please tell me what the program does and the computer for which it is designed. (There's no need to describe popular programs such as VisiCalc, Scripsit, Electric Pencil, and the like, but do tell me which machine it's for.)

Scrinput, I eventually discovered, was a Model I machine-language program that took information from the screen and put it into your Basic program. It was originally a product of ACR Consultants in Indiana. John Acres, the manager of ACR, decided to temporarily cease the marketing of Scrinput because of other business commitments. Scrinput Plus will have been released by the time this column appears. It has a new 90-page manual and retails for $49. It is now sold by Electronic Display Technology, 3200 Polaris, Suite 3, Las Vegas, NV 89102, (702) 362-6877.

Normally the Model I power transformers produce a soft ac hum. Occasionally the hum becomes a loud buzz. What is causing this? Is there a potential for damage to the circuitry? What is the cure?

Also, how can I connect one of the stand-alone video monitors to the video socket on the keyboard?

K.S.
Anaheim, CA

The power supply hum is caused by the laminations inside the transformer being vibrated by the 60 Hz power field coming from the electric company. Occasionally, the field will be depleted or increased by the turning on or off of a heavy power motor (such as a refrigerator or air conditioner). This fluctuation causes the laminations inside the transformer to shift slightly, sometimes increasing the distance between the laminations, sometimes decreasing the distance. If the distance increases, the hum gets louder. This is most noticeable on the older units. It is completely harmless. There is no cure other than replacing the unit with a newer one that might not make as much noise.

The answer to your second question can be found in the September 1980 issue of *80 Micro* in Dennis Kitsz's column 80 Applications. If you don't have that issue look on page 97 of Dennis Kitsz's book *The Custom TRS-80*, IJG Computer Services, 1260 W. Foothill Blvd., Upland, CA 91786, (714) 946-5805. It retails for $29.95.

I have several questions. I've heard about a new type of mini-floppy disk drive that is about to be released that will increase the storage capacity of a 5¼-inch floppy to 5 Mb. It's supposed to use some sort of vertical or depth reading and writing rather than the surface method now used. What's the story?

I've also heard about a new dot-matrix printer due out early next year that's supposed to have a 20-by-25 print head, operate at 160 cps, and cost under $700. Heard anything about it?

There is a company called Irwin International that makes a Model 510, 10-megabyte, hard-disk drive that uses a plug-in tape cartridge about the size of an audio cassette for back-up. It's supposed to take eight minutes to back up 10 megabytes. The lack of cheap, reliable hard drive backups has been a major drawback, so why haven't we seen or heard about these drives? Is anyone working on an interface for the TRS-80? I'm surprised this drive wasn't on the market long ago!

On page 228 of the TRS-80 Model III reference manual, there's a page of special effects the Model III user is supposed to be able to get by using the shift, down arrow, and another letter. With my computer (purchased March 1981) none of these work. I tried them at the local computer center and they didn't work there either. They telephoned Tandy who told them it would be fixed in early 1982, and I could get a cheap fix at that time. Still, the newer machines don't seem to use them either. Do you know what the story is on these functions?

When I turn up the brightness on the Model III monitor I get strange lines across the screen, sloping downhill to the left. They are close together at the top of the display and about an inch apart at the bottom. What are these lines and what can be done to eliminate them?

Last, but not least, my latest version of Scripsit (version 3.2) for TRSDOS 1.3 does wierd things. Mostly, it works fine, but if I try to load a file that isn't on the current data disk, Scripsit crashes. Tandy's customer service tells me that this isn't supposed to happen and that something is wrong with my copy of Scripsit. I've tried two other copies (not my backups) and they all did the same thing. A friend's Model III, about the same age as mine, does the same thing, but the very same copy of Scripsit runs just fine in a newer computer. If that's not enough, the TRSDOS 1.2 version of Scripsit runs just fine! Any ideas?

R.T.
Denver, NC

I can't answer your first two questions. Several years ago *Electronics* magazine had a brief article on the possibility of depth-reading disks. The article concluded that while it was possible, technology had not yet reached the point of making it economically feasible. That is the last I've heard of the technique until you mentioned it. Does anyone else have an answer?

The reason you haven't seen or heard about the Irwin hard drives is that they haven't been on the market very long. They were introduced to Original Equipment Manufacturers (OEMs) in November 1981, and the controller board for the drives was released in April 1982. The marketing representative told me that there are several companies working on an adapter for TRS-80s.

Irwin International, 2000 Green Road, Ann Arbor, MI 48105, (313) 663-3600, actually has three hard-disk drives, the 510, the 516, and the 416. The 510 is a 10-megabyte (formatted) hard-disk drive that uses 3M DC-100 tape cartridges for backup (it takes about eight minutes, as you mentioned in your letter). The 516 is a 13.2 Mb (formatted) version of the 510. The 416 is a 516 without the tape cartridge backup. The 510 costs $2,750, the 516 costs $2,990, and the 416 costs $1,900. The controllers for the drives are purchased separately and cost $975 for the 500 series, and $695 for the 400 series. There are host adapters for the S-100-bus computers that cost $400. So, if you buy a 516 with controller, it'll cost you $3,965 plus shipping. And you'll have to build your own host computer adapter, since none of the companies involved in developing adapters for TRS-80s have finished yet.

I called the local Tandy Computer Center and talked with the technician about your special effects problem. The shift, down arrow combination is supposed to be a substitute for Radio Shack's missing control key. Pressing and holding the shift, down arrow keys while pressing an alphabetic key results in the numerical sequence number of that key being returned to the keyboard driver.

Shift, down arrow A returns the value 1; shift, down arrow B returns 2, and so forth. Since the keyboard driver echoes your keystrokes to the video, these values are sent to the video. And since the video interprets any values below 32 as control codes, funny things can happen rather than the expected functions.

Control M is a line feed, the cursor just moves down one line, and control W converts the screen to 32-characters-per-line mode. To get most of these special functions to work, they must be accessed from a program using the INKEY$ routine. The technician also told me that while there was a problem in early production with the ROM C, it has been fixed, and you can get a new ROM C installed for $20.

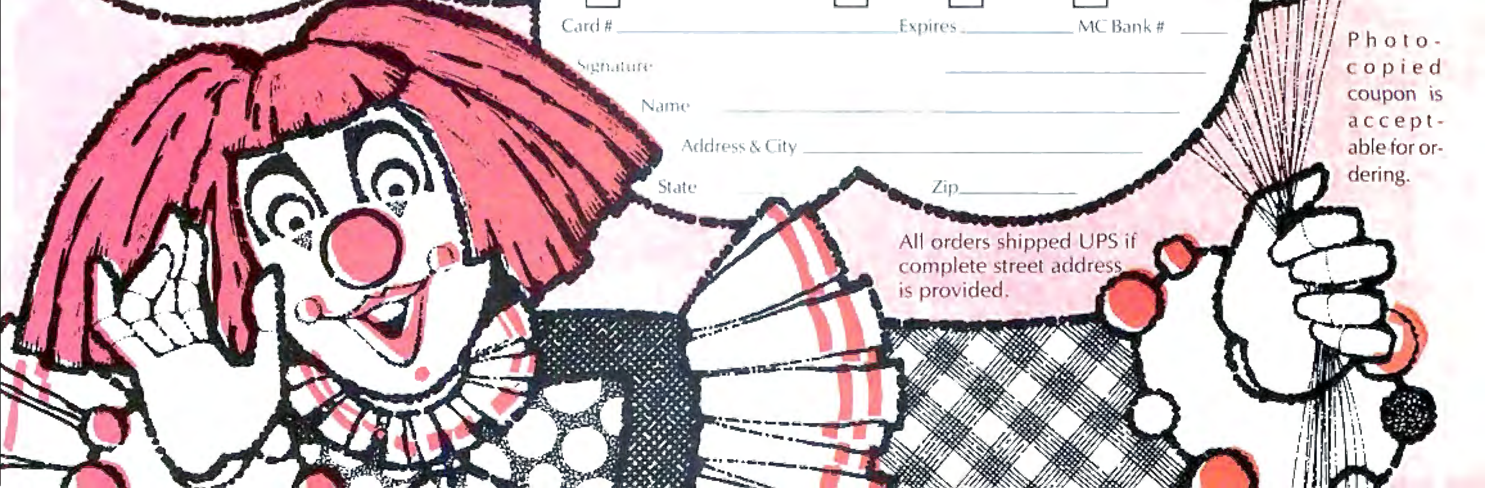
The next problem is video idiosyncracy. The lines you describe are created by the video circuitry in the computer. They are present on Model I, II, III, and 16 computers. The only way to get rid of them is to turn the brightness down until the lines just barely disappear, then adjust the contrast control for the best clarity.

Your Scripsit problem sounds like a problem with your DOS, not Scripsit. Since several different copies of the program are involved, and several different computers, problems with the program or problems with the hardware should be eliminated.

In March of 1981, TRSDOS 1.3 was released. It had a few bugs. Because you bought your computer in March, you probably have a flawed TRSDOS 1.3. If, when you boot up your DOS, you see a release date earlier than June 1981, DOS needs to be updated. Updated copies of TRSDOS 1.3 are available at your local computer store. If the problem isn't with your DOS, I'm stumped. ■

Send any questions or problems dealing with any area of TRS-80 microcomputers to Feedback Loop, 80 Micro, *80 Pine Street, Peterborough, NH 03458.*

✓117



FUN HOUSE ADVENTURE

by Richard Ramella

Got your boots and flashlight? Got your wits about you?

This may seem like an ordinary fun house, but there are labyrinths and excitement ahead. Wait here in the darkness as I tap three times on this panel and twist the raven's wooden head. Ah, it worked, the panel opened. Now for some adventure.

The program listings ahead will run on the Color Computer and on the Model I, Level II computer.

SERIAL

Well, this isn't too dangerous unless you get close to the screen; it's a serial.

Movie serials aren't made these days, though they are shown on television now and then.

A movie serial is an adventure story told in 10–15 chapters, each running about 20 minutes. The idea is to show a chapter each week so people come back to see what happens. There is a lot of fighting, though no one ever seems to get hurt. At the end of each chapter the heroine or hero

The Key Box

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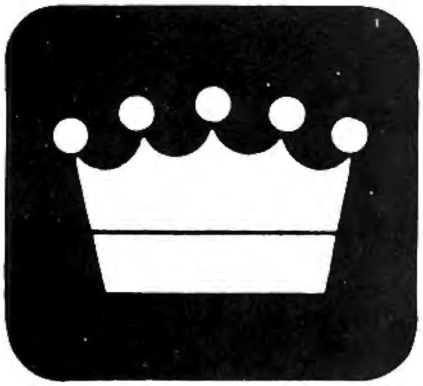
Serial

```
100 REM * SATURDAY SERIAL *
110 CLS
120 DATA THORDAL,DR. WISE,BRET,SUSAN,THE STENTORIAN
130 DATA HESTER HEX,THE RED BOMB,CAPTAIN BLAIR,JOHNNY
140 DATA VERA VALIANT,EARS MALONE,MASCOT MUGGS
150 DATA EARTH ORBIT,HEADQUARTERS,PLANET Q,SIMOLEA,RANDOM RANCH
160 DATA GROTTO OF GREED,DISTANT CITY,CLOUD REFUGE
170 DATA THE NEWSPAPER OFFICE,THE HOSPITAL,MOUNT VESUVIUS
180 DATA DINKEYVILLE,PRISON OF PRIDE,PERDITION PLAN
190 DATA TOM'S RANCH,POISON CITY,ACCIDENT
200 DATA FORMULA,STOLEN X-RAY,MISSING MICROCODE,PLANS
210 DATA POPGUN,MASK,JET GLIDER,INVISIBILITY BOOTS
220 DATA FREEZE MACHINE,PASSWORD,CAMERA,PASSPORT
230 CLEAR 300
250 DIM A$(41)
260 H=12
270 J=29
280 FOR X=1 TO 41
290 READ A$(X)
300 NEXT X
310 PRINT A$(RND(H));" AND THE ";A$(RND(J)+H)
320 PRINT
330 PRINT "A SERIAL IN LIMITLESS CHAPTERS"
340 FOR X=1 TO 1000
350 NEXT X
360 N=1
370 CLS
380 PRINT
390 PRINT "CHAPTER";N
400 FOR T=1 TO 500
410 NEXT T
420 PRINT
430 L=RND(7)+3
440 FOR G=1 TO L
450 B=RND(5)
460 ON B GOSUB 540,630,770,920,1000
470 S=RND(5)
480 IF S=5 THEN PRINT "THERE IS A BIG FIGHT"
490 FOR T=1 TO 1000
500 NEXT T
510 NEXT G
520 N=N+1
530 GOTO 370
540 PRINT A$(RND(H));" ";
550 R=RND(5)
560 IF R=1 THEN PRINT "GOES TO ";
570 IF R=2 THEN PRINT "SEES ";
580 IF R=3 THEN PRINT "PLOTS AGAINST ";
590 IF R=4 THEN PRINT "BATTLES ";
600 IF R=5 THEN PRINT "EXPOSES THE PLOT OF ";
610 PRINT A$(RND(H)+H)
620 RETURN
630 PRINT A$(RND(H));" ";
640 R=RND(5)
650 IF R=1 THEN PRINT "HAS A SECRET MOTIVE: ";
660 IF R=2 THEN PRINT "DISAPPEARS, CLAIMING NO ONE IS ";
670 IF R=3 THEN PRINT "SAYS ";A$(RND(12));" USED TO BE ";
680 IF R=4 THEN PRINT "TAKES THE OATH OF ";
690 IF R=5 THEN PRINT "IS SILENT ABOUT ";
700 R=RND(5)
710 IF R=1 THEN PRINT "A CIRCUS CLOWN"
720 IF R=2 THEN PRINT "CONNIVING"
730 IF R=3 THEN PRINT "A TRAITOR"
```

Listing continues



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change no. of characters per inch
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- Specifically written for the MX-80 but will work with any printer that accepts CHR$ codes for control.
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3) Binder #2 will include THE SOURCE CODE for SUPER UTILITY PLUS.
Yes...the SOURCE CODE to this MAJOR program will be available to 500 programmers. This is FULLY commented by the author, Kim Watt, and is a machine language programmer's dream come true! After reading this, your machine language programming skill should increase tremendously. All of Kim's knowledge in ONE book! All at your disposal and for YOUR use.*

4) The license to USE Kim Watt's sub-routines... will be granted to those 500 registered owners! These 500 ONLY will be able to apply all of Kim's magic to THEIR programs. No royalty fee necessary. In other words, IMPROVE YOUR PROGRAMS! Take Kim's ideas and expand on them! Never has anything EVER been done like this before. These 500 ONLY have the right to use our sub-routines. This information is NOT being put in the public domain. We are allowing these 500 to use our routines by buying our special package. All copy-rights and trademarks are retained by Breeze/QSD, Inc.

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6) This is a very important step that we are taking, and only a select group can appreciate the value in a package like this. This is NOT for the general mass market. It is a college education in machine language written by a recognized expert. It IS SU+ in /CMD file form. It is a license to use Kim Watt's subroutines. It is an opportunity to vastly improve your product. It is a collector's item, also. Limited, Indeed. Last, but not least, it is expensive. On the surface only, however, as this product will make you an expert programmer if that is what you want. You can literally write a DOS from studying the code! It will also make you a member of an elite group that has access to Kim's knowledge and can USE that knowledge to YOUR benefit.

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Listing continued

```
740 IF R=4 THEN PRINT "THE ";A$(J)
750 IF R=5 THEN PRINT "A MUD WRESTLER"
760 RETURN
770 PRINT A$(RND(H)+12);" ";
780 R=RND(5)
790 IF R=1 THEN PRINT "IS THE HIDING PLACE OF ";
800 IF R=2 THEN PRINT "WILL BLOW UP IF ";A$(RND(12));" FINDS ";
810 IF R=3 THEN PRINT "ALL ALONG HOUSED ";
820 IF R=4 THEN PRINT "IS A SECRET PASSAGE TO ";
830 IF R=5 THEN PRINT "WILL SLIDE INTO THE SEA SOON": RETURN
840 PRINT "THE ";
850 R=RND(5)
860 IF R=1 THEN PRINT "CONTROL PANEL"
870 IF R=2 THEN PRINT "CURTAIN OF DOOM"
880 IF R=3 THEN PRINT "OMNERIAN RUBY"
890 IF R=4 THEN PRINT "LASER LIGHT"
900 IF R=5 THEN PRINT "PIT OF NO RETURN"
910 RETURN
920 PRINT A$(RND(H));" AND ";A$(RND(H));" ";
930 R=RND(5)
940 IF R=1 THEN PRINT "FIGHT"
950 IF R=2 THEN PRINT "DIVIDE SOME ";A$(RND(J)+H)
960 IF R=3 THEN PRINT "VISIT AN OLD FRIEND: ";A$(RND(H))
970 IF R=4 THEN PRINT "PLAN TO ATTACK AT DAWN"
980 IF R=5 THEN PRINT "JOIN FORCES AGAINST ";A$(RND(H)+H)
990 RETURN
1000 PRINT A$(RND(H));" ";
1010 R=RND(5)
1020 IF R=1 THEN PRINT "STEALS ";
1030 IF R=2 THEN PRINT "RECOVERS ";
1040 IF R=3 THEN PRINT "USES ";
1050 IF R=4 THEN PRINT "DROPS ";
1060 IF R=5 THEN PRINT "FORGETS ";
1070 PRINT "THE ";A$(RND(H)+J)
1080 RETURN
1090 END
```

Subterra

```
100 REM * SUBTERRA * BY RICHARD RAMELLA
110 CLS
120 DATA NORTH,SOUTH,EAST,WEST,KEY,NOTE - I AM NOT ALWAYS EMPTY
130 DATA DESERT,HOME,LOCATION,DO YOU WALK INTO WALLS A LOT?
140 DATA WALL,CAVE ENTRANCE,TUNNEL OF MICA,CRAWL SPACE,VESTIBULE
 OF EVIL
150 DATA TRIANGLE TUNNEL,ENDLESS PASSAGE,GROTTO OF GRIEF,DRAGON,
WELL
160 DATA FOUR CORNERS,TROLL WAY,ROCK TUNNEL,THREE CORNERS,ECHO C
AVERN
170 DATA RIVER,THREE DOORWAYS,SULPHUR LANE,WATERY ELBOW,DARKLING
 WAY
180 DATA COBWEBBED HALLWAY,CIRCLE CHAMBER,WHITE WATER,RIVER ROCK
,ABYSMAL WATERFALL
190 DATA SACRIFICIAL ALTAR,SHORT HALL,SNAKES,POISON FUMES,GIANT
TIGER
200 DATA IT'S ENDLESS SO GO BACK NORTH BEFORE IT'S TOO LATE
210 DATA IT'S A DINNER INVITATION YOU JUST CAN'T REFUSE. THE END
...
220 DATA HER FIERY BREATH DRIVES YOU BACK,A DOORWAY,RIVER BANK
230 DATA LIMBO JAUNT,CAVE-IN NOW BLOCKS ENTRANCE,A ROUND PORTAL
240 CLEAR 500
250 DIM A$(48)
260 FOR B=1 TO 48
270 READ A$(B)
280 NEXT B
290 L=12: N=7: W=7: S=8: E=13
300 GOSUB 1740
310 IF X$="N" OR X$="W" THEN PRINT "LOST... NEVER HEARD OF AGAIN
.": END
320 IF X$="S" THEN PRINT "WENT HOME AND DIDN'T EVEN TRY.": END
330 IF X$="E" GOTO 340
340 L=13: N=11: W=13: S=14: E=13
350 GOSUB 1740
360 IF X$="N" THEN PRINT A$(10): GOTO 340
370 IF X$="W" THEN PRINT A$(47): GOTO 340
380 IF X$="S" GOTO 400
390 IF X$="E" GOTO 470
400 L=15: N=14: W=11: S=11: E=16
410 Z=RND(2)
420 IF Z=2 GOSUB 1850
430 GOSUB 1740
440 IF X$="W" OR X$="S" THEN PRINT A$(10): GOTO 400
450 IF X$="N" GOTO 340
460 IF X$="E" GOTO 570
470 L=18: W=13: S=22: E=20
```

Listing continues

is left in danger. You must return the following week to see how this danger is avoided.

The Fun House theater is showing a serial today. I don't know the name because it has a different name every time it runs, and it has an endless number of chapters. All I know is that there's going to be lots of hard-hitting action. Let's hope the good folks win.

SUBTERRA

A long and perilous journey into the underground is at hand. We round a curve and come to a mysterious opening in a cliff. There's a small sign on which is scrawled this verse:

Enter not, lest you not return.
But if for an idol of gold you yearn,
Come in and wander through the gloom,
And, seeking riches, find your doom.

We're not going to let that scare us, are we? No sir!

Look, I've got to tie my shoelaces, so you go on in without me. I'll tell you what I know about this adventure, however.

At every location you'll be told what lies to the north, south, west and east. You travel by pressing N, S, W and E to go in each direction.

You're looking for a golden idol. If you find it, I claim half because we're in this together even though I'm sca...I mean,

FUN HOUSE

not quite ready to go into the strange cave.

Watch out; You can fall victim to various traps. To reach the idol you need a magic direction and a key. And when you find the idol you have to find your way back. I sure hope the entrance doesn't cave in while you're in there!

Subterra is tough, so tough you may wonder if there's really a way out; but you wouldn't be interested if it weren't difficult.

However, if you get stuck, I'll rescue you. Send me a nickel and a stamped, self-addressed envelope, and I'll send you a genuine, crudely-drawn map of Subterra. That's this month's Nickel Bargain Bin offer. Since it costs me a nickel to make the map, I'm not in this for profit. I just wonder how many of you will get lost.

Read this carefully: For a map of Subterra, write to me: Richard Ramella, 1493 Mountain View Ave., Chico, CA 95926. Include a stamped envelope with your name and full address on it. Without the nickel and the stamped, addressed envelope, I can't afford to write back.

Hmm, the holidays are coming up, aren't they? I'll try to have the Fun House looking festive by next month. ■

Listing continued

```
480 IF H=2 THEN N=14 ELSE N=19
490 GOSUB 1740
500 IF X$="N" AND H<>2 THEN Z=RND(2)
510 IF X$="N" AND H=2 THEN PRINT "YOU EXIT TO SUNLIGHT. THE IDOL
 IS YOURS": END
520 IF Z=1 THEN PRINT A$(42): END
530 IF Z=2 THEN PRINT A$(43): Z=0: GOTO 470
540 IF X$="W" GOTO 340
550 IF X$="S" GOTO 570
560 IF X$="E" GOTO 720
570 L=21: N=22: W=16: S=17: E=23
580 GOSUB 1740
590 IF X$="N" GOTO 470
600 IF X$="W" GOTO 400
610 IF X$="E" GOTO 1040
620 IF X$="S" GOTO 630
630 P=2
640 L=17: W=11: S=17: E=11
650 GOSUB 1740
660 IF P=2 AND X$="N" THEN PRINT "YOU LEAVE ";A$(17): P=0: GOTO
570
670 IF X$="S" THEN P=P+2
680 IF X$="N" THEN P=P-2
690 IF P=10 GOSUB 1850
700 PRINT "DISTANCE INTO ";A$(17);":";P;"MILES"
710 GOTO 640
720 L=20: N=11: W=11: S=11: E=11
730 Z=RND(5)
740 IF Z=3 THEN PRINT "TRAPPED FOREVER IN THE ";A$(20): END
750 Z=0
760 GOSUB 1740
770 IF X$="N" OR X$="S" GOTO 730
780 IF X$="W" GOTO 470
790 IF X$="E" GOTO 950
800 N=11: W=11: S=25: E=11
810 IF Z=1 THEN L=38
820 IF Z=2 THEN L=39
830 IF Z=3 THEN L=40: E=37
840 M=RND(2)
850 IF M=1 THEN PRINT "YOU FIND A CHEST CONTANING A ";
860 IF M<>1 GOTO 900
870 M=RND(2)
880 IF M=1 THEN PRINT A$(5) ELSE PRINT A$(6)
890 IF M=1 THEN K=1
900 GOSUB 1740
910 IF X$="N" OR X$="W" GOTO 900
920 IF X$="E" AND Z=3 GOTO 1280
930 IF X$="E" GOTO 900
940 IF X$="S" GOTO 950
950 L=25: N=27: W=20: S=28: E=44
960 GOSUB 1740
970 IF X$="W" GOTO 720
980 IF X$="S" GOTO 1040
990 IF X$="E" AND K<>1 THEN PRINT "NO ";A$(5): GOTO 950
1000 IF X$="E" AND K=1 THEN PRINT A$(5);" DOESN'T WORK.": GOTO 9
50
1010 INPUT "WHICH DOOR - 1, 2 OR 3";Z
1020 IF Z<>1 AND Z<>2 AND Z<>3 GOTO 1010
1030 GOTO 800
1040 L=45: N=28: W=23: S=11: E=26
1050 GOSUB 1740
1060 IF X$="N" GOTO 950
1070 IF X$="W" GOTO 570
1080 IF X$="S" THEN PRINT "HURT YOUR HEAD?": GOTO 1040
1090 L=29: N=26: W=26: S=46: E=11
1100 GOSUB 1740
1110 IF X$="N" GOTO 1230
1120 IF X$="W" GOTO 1040
1130 IF X$="E" THEN PRINT "OOPS, ANOTHER WALL EH?": GOTO 1090
1140 L=46: N=29: W=11: S=46: E=11
1150 PRINT "DISTANCE IN:";P;"MILES"
1160 GOSUB 1740
1170 IF X$="S" THEN P=P+2
1180 IF X$="N" THEN P=P-2
1190 IF P<2 THEN PRINT "YOU'RE OUT": GOTO 1090
1200 IF P=10 THEN PRINT A$(41)
1210 IF P=12 THEN PRINT "TOO LATE. LOST IN THE DARK. THAT'S ALL"
: END
1220 GOTO 1140
1230 L=34: N=33: W=44: S=26: E=31
1240 GOSUB 1740
1250 IF X$="W" GOTO 950
1260 IF X$="S" GOTO 1090
1270 IF X$="E" GOTO 1430
1280 L=36: N=35: W=40: S=33: E=11
1290 GOSUB 1740
1300 IF X$="W" THEN Z=3: GOTO 800
1310 IF X$="S" GOTO 1230
1320 IF X$="E" THEN PRINT "ANOTHER BRUISE": GOTO 1280
1330 IF X$="N" THEN PRINT "YOU KNOW WHAT AN ";A$(35);" IS AND ST
```

Listing continues

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Listing continued

```
ILL WANT TO GO?"
1340 INPUT "ANSWER YES OR NO";X$
1350 IF X$<>"YES" AND X$<>"NO" GOTO 1340
1360 IF X$="NO" GOTO 1280
1370 PRINT
1380 PRINT "NOW YOU FALL FOREVER ";: GOTO 1420
1390 PRINT "AND EVER ";
1400 FOR T=1 TO 200
1410 NEXT T
1420 GOTO 1390
1430 L=31: N=11: W=34: S=11: E=48
1440 PRINT "YOU STAND AT ";A$(48)
1450 IF K<>1 THEN PRINT "NO ";A$(5);" TO ENTER": GOTO 1230
1460 IF K=1 THEN PRINT "YOUR ";A$(5)" WORKS!"
1470 GOSUB 1740
1480 PRINT "YOU NOW ENTER THE ";A$(32)
1490 FOR T=1 TO 1000
1500 NEXT T
1510 PRINT "DO YOU RECALL THE MAGIC DIRECTION?"
1520 PRINT "IF YOU DON'T KNOW, GUESS QUICKLY."
1530 PRINT "THE MASSIVE LIMESTONE CEILING WILL START TO LOWER...
"
1540 PRINT "PRESS ANY KEY IF YOU KNOW."
1550 PRINT
1560 FOR T=1 TO 1000
1570 NEXT T
1580 FOR M=10 TO 1 STEP -1
1590 PRINT M;"SECONDS TO GO"
1600 C$=INKEY$
1610 IF C$<>"" GOTO 1650
1620 FOR T=1 TO 200
1630 NEXT T
1640 NEXT M
1650 INPUT "THE MAGIC DIRECTION";C$
1660 IF C$=K$ GOTO 1680
1670 PRINT "BAD GUESSING. A CRUSHING DEFEAT, EH?": END
1680 PRINT "YOU FOUND THE GOLDEN IDOL IN TIME."
1690 PRINT "YOUR WORRIES ARE OVER..."
1700 PRINT "EXCEPT YOU HAVE TO FIND YOUR WAY OUT."
1710 PRINT "YOU EXIT THE ";A$(32);" WITH TREASURE IN HAND."
1720 H=2
1730 GOTO 1230
1740 PRINT A$(9);": ";A$(L)
1750 PRINT A$(1);": ";A$(N)
1760 PRINT A$(4);": ";A$(W)
1770 PRINT A$(2);": ";A$(S)
1780 PRINT A$(3);": ";A$(E)
1790 PRINT
1800 FRINT "DIRECTION - (N-W-S-E)";
1810 INPUT X$
1820 IF X$<>"N" AND X$<>"W" AND X$<>"S" AND X$<>"E" GOTO 1800
1830 PRINT STRING$(32,"-")
1840 RETURN
1850 IF K$<>"" THEN RETURN
1860 Z=RND(4)
1870 K$=A$(Z)
1880 Z=0
1890 PRINT "A WALL OPENS. A MESSAGE SCROLL APPEARS:"
1900 PRINT "'REMEMBER THE MAGIC DIRECTION: ";K$;"'"
1910 RETURN
1920 END
```

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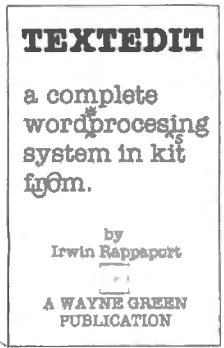

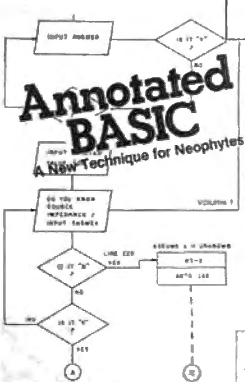

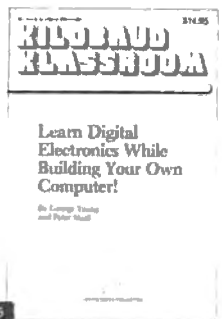

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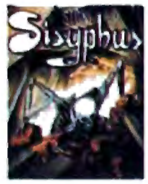

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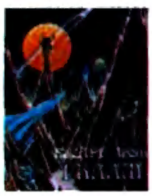

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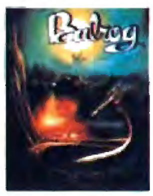

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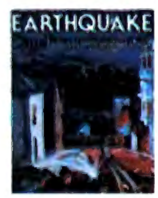

EARTHQUAKE - San Francisco 1906

The title says it all! You're in the middle of one of the most violent earthquakes of modern times — and your survival hinges on wits alone! EARTHQUAKE — SAN FRANCISCO 1906 features one of the most powerful data bases available for a game of this type. Hours of exciting fun guaranteed!

TRS-80 16K TAPE $19.95
TRS-80 32K DISK $20.95

Skill Level: Moderate.

DEATH PLANET: The Dog Star Adventure

The evil General Doom and his Roche soldiers are gearing up for a galactic onslaught — will you be able to rescue the kidnapped princess and save the royal treasury in time? An adventure from Lance Micklus, author of STAR FLITE.

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The MACES & MAGIC Series continues! Magical beings and strange creatures populate this mystical realm. Equip your warrior with the necessary accouterments, then plunge into the awesome world of MORTON'S FORK!

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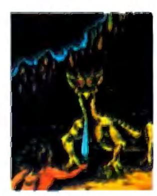
TRS-80 48K DISK (Mod 3) $29.95

Skill Level: Moderate.



HIDDEN VALLEY

Sure, you're an exalted, courageous, robust warrior — but can even your sturdy constitution save you from the terrors of HIDDEN VALLEY? This dungeon-type program features 99 separate levels of play. This is the second entry in the new DEMON VENTURE Series.

TRS-80 16K TAPE $19.95
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Skill Level: Moderate

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First in the new DEMON VENTURE Series, REIGN OF THE RED DRAGON features dungeon-esque excitement laced with real time graphics. Brace yourself for the incredible!

TRS-80 48K DISK $24.95

Skill Level: Moderate.

SKILL LEVEL KEY

BEGINNER
Excellent introductory adventure for younger players. Minimal problem-solving skills required.

MODERATE
Moderate problem-solving skills required.

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Advanced problem-solving skills required.

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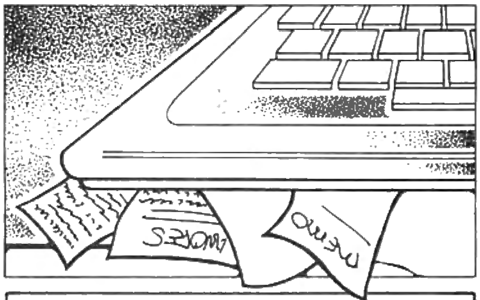
NOTES FROM BENEATH the KEYBOARD

by Paul Wiener



Farewell to a friend, TRS-80s at work, and 2nd-hand software

A superb programmer and good phone-friend died unexpectedly this year. I first became acquainted with U.S. Air Force Captain (soon to have been Major) David Forbes when I was editor-in-chief of Instant Software. David wrote the editor/assembler component of Instant Software's Assem/Zsim package, perhaps the best Model I Assembly-language development system I've ever seen.

More recently, David was at work on a Pascal implementation, a Basic compiler, and a word processor, all for the TRS-80. David had some unusual health problems, and seemed to have had them licked. Suddenly, late last April, he suffered an apparent heart attack and left the body he'd inhabited for 39 years.

David leaves behind a wife and two daughters, who I am sure miss him very much. He will also be missed by those of us who use his software and were looking forward to more of it. I'm certain that whatever plane of existence David now occupies, he is using the talents that made him such a fine programmer for the benefit of his fellow travelers.

Counting Apples, et al.

I have occasionally heard rumors of marketing surveys that indicate Apples and other micros are outselling TRS-80s—and that there may already be more Apples than Radio Shacks out there.

I have also heard counterrumors saying that those marketing studies include computer store sales only, not Radio Shack stores. These counterrumors claim that if Radio Shack's sales figures were included in the count, TRS-80 numbers would exceed its competition's.

I don't know what the real scoop is. I know a few local businesses using TRS-80s for their data processing, but haven't noticed any here using Apples, Ataris, Vics, or whatever.

The Indian Head Resort, in Franconia Notch, NH, has been using a TRS-80 to keep track of its liquor inventory since the first days of the Model I disk system.

I stumbled across a couple of TRS-80 installations in Keene, NH. One of those businesses, Audio Lab, has had a number of hardware difficulties which has hampered efforts to computerize its inventory. The great Dennis Kitsz himself helped make Audio Lab's printer operable. There are still a few little problems to solve before Audio Lab can fully use its TRS-80.

I discovered a more successful and comprehensive TRS-80 installation in Keene when I went to Stevens Datsun to trade cars. I found three TRS-80s on the premises—two Model IIs and a Pocket Computer (the old model). The owner, "Fordy" Stevens, uses the Pocket Computer to do calculations involving financing and the like, so he can quickly answer customers' questions without consulting tables. Actually, I didn't think the Pocket Computer's response was all that quick, but I'm sure it beats using a calculator.

One of the Model IIs handles standard accounting functions. The second Model II is in the parts department and is used mainly for inventory. Fordy is a skilled programmer and has written almost all his company's software, though he has purchased one or two of Radio Shack's packages.

Not long ago I visited the Jaffrey Municipal Airport to inquire about flying lessons. I was surprised to find a Model III on a desk in the airport office. The staff didn't have much time to discuss its uses with me, but it evidently handles normal small-business data processing, such as accounts receivable. The pilots also have some aviation programs for it, but not very many.

The system includes two 80-track, double-sided disk drives (about 1.5 megs of on-line bulk storage), and a modem. Most of their custom programming is done by an out-of-state programmer via the phone link. One of these days, I'll bring my copy of the FS1 Flight Simulator to the airport and see what the flight instructors think of it.

More Local Observations

All Software, a home computer software store in Merrimack, NH, sells programs for TRS-80 Models I and III, Ataris, Apples, and IBM Personal Computers. Though All Software doesn't sell computers, they have Apples and an IBM on the premises so that customers can try before they buy. At this writing, they don't yet have a TRS-80, but hope to get one.

All Software has a policy which intrigues and disturbs me a little. They take used games in trade. You can trade in an old game program, on its original magnetic medium and with the original documentation and packaging, in exchange for a discount on any new software package. All Software then offers the old program for resale at a reduced price.

What disturbs me is the possibility of customers copying a program before trading it in. I think the management of All Software would be protecting programmers, software publishers, and itself, if it required customers to sign a statement declaring that no copy of the traded software had been retained.

I think such a declaration would cover All Software if a publisher ever screamed copyright infringement. Also, it might help the publisher obtain compensation if a case ever went to court. Software copyright infringers have proven very difficult to prosecute. But if a false no-backup declaration had been signed, the perpetrator would also be guilty of fraud or misrepresentation. ■

✓See List of Advertisers on Page 455

CALENDAR

November

1–3 Online Inc., Weston, CT. **Online '82: Conference for users of data bases** Atlanta Hilton.

3–5 IEEE Computer Society, Silver Spring, MD. **Foundations of Computer Science** Chicago, IL.

4–5 IEEE Computer Society, Silver Spring, MD. **Annual Workshop on Computing to Aid the Handicapped** Charlottesville, VA.

7–9 New York State Association for Educational Data Systems, Ardsley, NY. **17th Annual Conference of the NYSAEDS** Americana Hotel, Albany, NY.

8–10 IEEE Computer Society, Silver Spring, MD. **16th Asilomar Conference on Circuits, Systems and Computers** Pacific Grove, CA.

8–12 Virginia Polytechnic Institute and State University, Blacksburg, VA. **Workshop on Personal Microcomputer Interfacing and Scientific Instrumentation Automation** Virginia Tech Campus.

8–12 IEEE Computer Society, Silver Spring, MD. **COMPSAC '82** Palmer House, Chicago, IL.

9–10 Saginaw Valley Chapter of Data Processing Management Association, University Park, MI. **Ninth Great Lakes Computer Expo '82** Civic Center, Saginaw, MI.

11–12 University of South Alabama, College of Education, Mobile, AL. **Microcomputers in Education** Biloxi, MS.

11–14 National Computer Shows, Chestnut Hill, MA. **The Fourth Annual Northeast Computer Show and Office Equipment Exposition** Hynes Auditorium, Boston, MA.

15–17 Virginia Polytechnic Institute and State University, Blacksburg, VA. **Workshop on Microcomputer Interfacing, Design, and Programming Using the Z80/8085/8080** Virginia Tech Campus.

16–18 IEEE Computer Society, Silver Spring, MD. **1982 Test Conference** Philadelphia, PA.

18–21 National Computer Shows, Chestnut Hill, MA. **Applefest** San Francisco Civic Center and Brooks Hall.

December

6–8 IEEE Computer Society, Silver Spring, MD. **Winter Simulation Conference** Holiday Inn at the Embarcadero, San Diego, CA.

6–8 IEEE Computer Society, Silver Spring, MD. **VLSI & Microcomputers: Today and Tomorrow (TENCON '82)** Hong Kong.

6–10 IEEE Computer Society, Silver Spring, MD. **Tutorial Week West '82** San Diego, CA.

7–9 IEEE Computer Society, Silver Spring, MD. **1982 Real Time Systems Symposium** Los Angeles, CA.

10 IEEE Computer Society, Silver Spring, MD. **Computer Networking** Gaithersburg, MD.

9–12 National Computer Shows, Chestnut Hill, MA. **The Second Annual Southeast Computer Show and Office Equipment Exposition** Atlanta Civic Center.

22 Motorola Inc., Phoenix, AZ. **Seminar on 8-bit MPUs** Sheraton-Lexington Motor Inn, Lexington, MA.

January

17–20 IEEE Computer Society, Silver Spring, MD. **Optical Storage of Digital Data** Lake Tahoe, CA.

Coming Next Month

December will bring a potpourri of interesting articles. William Kaczor is a lobsterman in Maine. After having trouble finding his lobster pots, he decided to let his TRS-80 keep track of them. What he came up with is an interesting grid-mapping technique.

Ever wanted to type a letter without lifting a finger? What if you were unable to lift a finger? Mike Rigsby has built a mod to turn the TRS-80 into a voice-actuated typewriter.

What do Basic, Fortran, Cobol, Pascal, and APL have or not have in common? Author Nicholas has written a piece that will answer that question.

How about a light pen for the Color Computer? December will have the details. Merry Christmas. ■

PROOF NOTES

Continued from page 12

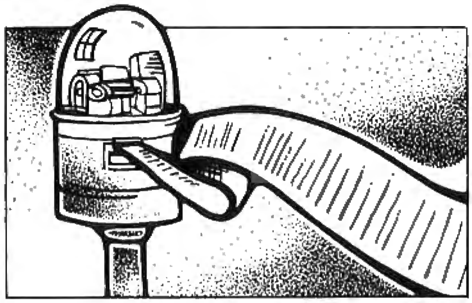
On the following pages, you'll read about a genius of the last century, a quest to build a mechanical computer. Tom Hager will take you on a tour through the halls of academe to see how today's scientists are using microcomputers to discover tomorrow's truths. James Larsen of Nike Inc. presents a detailed explanation of research being done by one of the world's largest sporting goods manufacturers—with a micro at the forefront.

Medicine, which is strongly tied to science, finds itself under our microscope as we look at how micros are being used by the medical community in America and in Britain. Our Maine connection, Wynne Keller, writes about a TRS-80 in the lab in a rural down-east hospital.

And since the Color Computer is rapidly evolving into the star of the TRS-80 clan, John Fowler offers you rainbow computerists a program to aid in your star gazing. ■

MONEY DOS

by J.M. Keynes



Platinum and risk capital

Whew! I need a double scotch. As I write this, it is 6 p.m. on Monday, August 3. The September issue just hit the streets. MONEY DOS discussed commodity trading and presented a system of trading that has been successful for 10 years.

When I wrote the column, I thought perhaps 50–100 people would be interested enough in commodities to call for the free booklet I offered. I thought computer nuts were basically a conservative lot, few of whom would have interest in such a risky undertaking. Give old J.M. a C– in perspicacity.

Last weekend over 800 of you called the toll-free MONEY DOS hotline, and today the phone rang off the wall with requests for more information on commodities. Before you become the "killee" rather than the "killer" in your quest for riches, pay close attention to these words of wisdom.

To trade the System effectively requires a minimum of $10,000 of *genuine risk capital*. I define risk capital as the amount of money you could throw in the ocean and not change your long-term financial security. The System has averaged over 50-percent net profit for 10 consecutive years, but it doesn't win every month. Your bankroll must be large enough to withstand the loss of some battles. Remember, if you're in doubt, *stay out!* The primary reason that nine out of ten new businesses fail is that they are undercapitalized.

If you are determined to try the System with real money (I suggested you try it for six months with *Monopoly* money), here are several dos and don'ts.

- Trade with a discount broker. There are several reliable firms that give a 50–70 percent discount from what you would pay Merrill-Lynch, Dean Witter, or E.F. Hutton. Make sure whoever you trade with is a clearing member of at least one of the major exchanges.
- Put up Treasury bills in lieu of cash for margin money. Why not earn 12 percent on your funds?
- Do not tell the broker about the System. Just say, "I make my own decisions." Give him your orders (before the market opens) exactly as the System dictates, and go fishing. Resist the urge to call several times each day for quotes.
- Never second guess the System. If you do, you no longer have a system.

Also, there was one mistake in the program listings. One of the gnomes of Peterborough managed to place the last few lines of the data-base program at the end of the main program.

As this is written there is a commodity trade available that, if you make it, is quite a deal. Today gold for delivery in April closed at $381.80 per ounce while April platinum closed at $314.10 per ounce. Historically, platinum has almost always sold for more than gold. When gold hit $885 per ounce in 1980, platinum was at $1,025 per ounce. A few years before then, when gold was $100, platinum sold for $125–$150.

I expect this spread to return to normal in the coming months. Today I bought April platinum for $310.50 per ounce and concurrently, sold April gold at $381.50 per ounce. I expect platinum to reach parity with gold, and perhaps go to a $50-per-ounce premium—no matter which way the markets go.

When you read this, check the prices of the spread and see if platinum hasn't gained on gold. The opportunity may still be there. Each spread involves buying two platinum contracts for each gold contract sold (platinum contracts are 50 ounces and gold 100 ounces). The profit potential per spread is about $12,000. I will risk no more than $1,500. I like those odds.

Last month I predicted an awesome bull market. I suggest you reread past MONEY DOS articles on covered option writing and convertible securities. Both strategies are more conservative than owning common stock, and in many cases, more profitable.

Next month I'll deal with some advanced strategies in the options market, some that require only a modest bankroll.

I give my comments on stocks, options, and commodities on the MONEY DOS hotline, 800-327-3389 or in Florida (305) 665-3389. It operates from 9 a.m. Saturday to 7:30 a.m. Monday (EST). ■

LYNN'S A/R SYSTEM

12 Intergraded Account Receivable Programs
Tested In Service For Over 3 Years

User's Comments: • menu driven • increased cash flow • saved over 50 hours a month in secretarial hours • almost completely eliminated billing errors • phone supported-ask for Ron.

LYNN'S A/R SYSTEM WILL

- print invoices
- tell you your a/r total, number of invoices outstanding, average per invoice
- tell you at any time how many invoices an individual account has open, the total amount owed, the average per invoice, the invoice date, and then invoice amount
- total sales on account for a given month, number of invoices sent, average sale per invoice
- how much an account purchased during month, how many invoices were sent, average invoice for month
- tell you what percent of sales an account is to total sales by month
- tell you what percent of a/r an account is
- print mailing labels for your accounts
- print statements at any time you want them (either individual or all accounts)
- print alphabetical hardcopy of accounts and account numbers
- print all items sold for month
- alphabetical sort of items sold by month
- this set of programs can be custom modified by you or us
- AND MUCH MORE!!

AGING REPORT FOR LYNN'S A/R SYSTEM

Aging Report 01/31/82 Page 1

Account	Current	30-60 Days	60-90 Days	90+ Days	Total
ABC Inc.	$ 249.00	$ 65.20	$ 00.00	$ 00.00	$ 314.20
Old Co. Inc.	00.00	84.40	165.20	00.00	249.60
New Co. Inc.	97.75	00.00	00.00	00.00	97.75
Deadbeat Inc.	00.00	00.00	00.00	345.00	345.00
Totals	$346.75	$ 149.60	165.20	345.00	$ 1,006.55

Aging reports can be compiled on a daily, weekly or monthly bases.

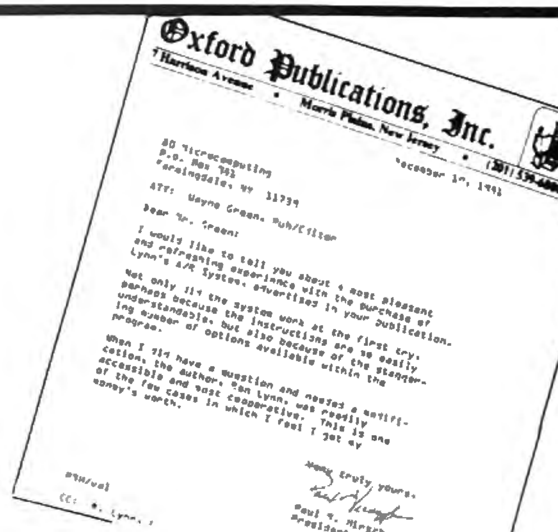
LYNN'S CHECKBOOK LEDGER SYSTEM

•Phone Supported Ask For Ron•

• saves hours of posting to general ledger • almost completely eliminates mathematical errors • menu driven • 200 expense fields • will handle 1,000 checks a month • will print checks with option to enter handwritten checks • will do reconciliation statement with hardcopy • will print hardcopy of field totals both by month, year to date and end of year • automatic account numbering • automatic field entry • will print hardcopy of checkbook register • debit and credit memo entry • alphabetical hardcopy of accounts payable and account numbers (machine language sort, very fast) • AND MUCH MORE! •

DATA BASE MANAGER BY WELLS

perfect tool for storing and maintaining mailing list, inventories, menus, collection records, article references, important dates, client records • all functions menu driven • easy to interface to word processors and communication programs • sort in ascending or descending order (fast machine language sort) • compact storage with minimum overhead • go from data base to visicalc and return • sort and select visicalc lines!! • interface to Radio Shack's "advanced statistical package".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ATT: Wayne Green, Pub/Editor

Dear Mr. Green:

I would like to tell you about a most pleasant and refreshing experience with the purchase of Lynn's A/R System, advertised in your publication.

Not only did the system work at the first try, perhaps because the instructions are so easily understandable, but also because of the staggering number of options available within the program.

When I did have a question and needed a clarification, the author, Ron Lynn, was readily accessible and most cooperative. This is one of the few cases in which I feel I got my money's worth.

Very truly yours,

President

LYNN'S

Account Receivable System	$49.95
Account Receivable Aging Report	$20.00
Checkbook Ledger System	$69.95
Well's Data Base Manager	$39.95

Add $2.00 Freight and Handling.

Illinois Residents Add 6% Sales Tax

Send $10.00 Per System
For Printouts and Documentation.
Credit Given on Order

Equipment Needed: 48K Model I or III, Lineprinter, 2 Disk Drives.

The above programs will work on TRSDOS 1.2 and 1.3 for the Model III. NEWDOS, NEWDOS80, NEWDOS80 V2.0, LDOS and MULTIDOS for the Model I and III.

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✓See List of Advertisers on Page 455

MEDICAL OPINION

by Philip R. Mills, M.D.

Medical word processing nuts and bolts

Word processing is essential in most medical practices. It can make a mediocre secretary good and a good secretary great.

Unfortunately, most word-processing articles discuss *only* software. Of course software is important, but in a medical practice, the hardware, particularly the printer, is equally important.

Like a stereo, there are two ways to purchase word processors: either as separate components (computer plus printer plus software) or as a complete system (Wang, Lanier, and so on). The system word processor's major advantage is convenience in packaging and training. Its major drawback is its expense, decreased versatility, and little room for customization. Software updates are few and hardware updates are slow in coming and expensive. At this writing, system software dictionaries and grammar checkers, if available, are clearly inferior to state-of-the-art micro programs available.

A special case of the system word processor is the memory typewriter. It has excellent secretarial acceptance since it looks like a typewriter. Our clinic has an IBM Memory typewriter. It has been a disappointment, however. Every secretary we send to IBM for training costs nearly $300. Service has been good. (It better be—breakdowns have been distressingly frequent and service contracts are expensive.)

The printout from memory is *slow*: there is no continuous feed for printing of rough drafts. Editing is *very slow*. It is often faster for our secretary to retype a one or two-page document and then edit it with the memory feature. Since using the Model I with its video editing, our secretary now prefers the computer to the memory typewriter.

The big advantage of the component word-processing system is the far lower cost and the customization it provides for the medical clinic. The cornerstone of the component system is the computer itself. Serious business use precludes the inexpensive color game-type computers, since the keyboard and video are inferior for secretarial use. Even the Apple II requires a keyboard enhancer, video card, and, in my opinion, a Z80 card with CP/M. This becomes expensive.

My first choice of a word-processing computer is the Model II. Its present reduced price makes it very competitive. It has an 80-character-per-line screen, reverse video, a 4.0 MHz clock, and a keyboard that includes a command key. It also has good word-processing software available for TRSDOS 2.0a as well as CP/M.

If you purchase the Model II, an external disk drive is a necessity for backups. While Tandy has used reasonably good disk drives for the computer itself, they skimped on the external drives and used cheap, inferior units. Nearly everyone recommends non-Radio Shack external disk drives.

Another good choice of computer is the LNW. It has a command key, 80-character-per-line video with reverse video, and 4.0+ MHz clock speed. It has Model I compatibility, as well as CP/M compatibility.

The Model III is also a reasonable choice. It lacks a command key, but other keys can be substituted. When modified by Holmes Engineering, MTI, and others, it comes with reliable speedups, 80-character-per-line video, and other enhancements. Radio Shack is also releasing an 80-character-per-line enhancement for this computer.

What about the Model I? That is what our clinic uses. An inexpensive high-resolution green phosphorous screen, Holmes Engineering speedup, memory, and expansion interface greatly improve its performance. We are awaiting the 80-character-per-line enhancement. Even so, it serves our word-processing needs, though not elegantly.

That brings us to printers. At this point we should acknowledge that a word-processing system will not eliminate a good correcting electronic typewriter. Our secretaries use Selectric typewriters for small jobs such as typing cards or filling out questionnaire forms. To use a word processor for jobs such as these is like using a bulldozer to hoe a garden.

Since a typewriter is needed anyway, some clinics have purchased a device that sits on top of the typewriter keys and "types" with finger-like projections. Originally these units were developed to test and burn in new typewriters at the factory. PMC has been marketing one such unit for under $500.

The greatest weakness is the slow print speed (usually around 100 wpm). Most units of this type use an RS-232C connection, so a faster dot-matrix printer could be connected to the serial output. The dot-matrix printer could be used for billing, while the "typewriter" can be used for professional letters and reports. This arrangement would not be satisfactory for most businesses, however.

A far better solution is the Radio Shack Daisy Wheel II. The print is very high quality; the printer also has the advantage of Radio Shack's service and availability. It is very easy to feed single sheets by hand, and there is even an automatic single-sheet feeder (but what a cost). The quieting cover is a helpful option.

It does have drawbacks, however. Early printers are different than later printers. If your clinic purchases the Daisy Wheel II, make certain it has a current serial number. Ribbons are available only from Radio Shack. Print fonts are available only from Radio Shack and are $30 each. Proportional font-style selection is very limited (they all look the same to me). There is also a more serious flaw with the inability to underline blanks.

Our clinic has a NEC 5530 Spinwriter. It is faster than the Diablo or daisy-wheel type printers (55 cps versus 45 cps). Thimble fonts can be obtained for $10–$15. It is slightly more expensive than the Daisy Wheel II, but it is more reliable and a real workhorse. We are very happy with it. In fact, our only complaint is its inability to prepare mimeographic stencils.

If I were purchasing a new printer today, I would buy the C.Itoh. It is a best buy. The mechanics are so precise that overstriking even three times fails to produce a significantly darker print, since it is hitting the same identical spot on the page with each strike. No other printer that I have seen can duplicate this kind of print-strike accuracy.

Medical clinics must have a Selectric-quality printer for business letters and reports. Correspondence quality is useful for billing and rough drafts where speed is essential. I used to believe that dot matrix could never produce Selectric quality print, but technology is rapidly changing my ideas.

Anadex is trying to break open the high-quality, dot-matrix market for the microcomputer. The WP6000 will be fast (reportedly 300-plus characters per second) and able to produce Selectric-quality print. If it turns out to be as good as the prerelease publicity, it will be an exciting printer.

Epson is also "expecting," and second-hand sources have shown me the actual print at 80 characters per second. It is impressive; it looks typeset.

Our clinic also has a dot-matrix printer, the MX-100. This Epson is a good printer in many respects, but for the clinic it is too slow for speedy billing and it is not Selectric-quality print.

Proportional Printing

Proportional printing can make documents look superb. It can dramatically improve the appearance of the in-house handouts designed for patient education. One of the problems with patient education is compliance. But often this poor compliance is merely due to our patients forgetting our instructions. Standard instruction sheets on back care or diet, printed up nicely with proportional print, can make a patient want to read them. I believe patients will read these instructions more readily than a hard-to-read, poorly formatted sheet of instructions.

But obtaining proportional printing is a problem. None of Radio Shack's word-processing programs have very sophisticated print possibilities. (They keep telling me improvements are coming, but right now they aren't here). Most so-called proportional-print software for the TRS-80 has spacing that is wider on the left part of the line, instead of equal apportioning throughout the line.

While I was giving a talk to the New England Medical Computer Club, I mentioned my frustration with the limitations of Scripsit and the continued delays in Radio Shack's production of SuperScripsit. I was tired of WordStar's slowness on the Model I as well as its marginal usefulness with the video restrictions of this computer. My secretary was frightened of the WordStar's complexity and didn't want to learn it.

Several physicians mentioned their satisfaction with Chuck Tesler's program, Newscript (Prosoft, Box 560, North Hollywood, CA 91603-0560, (213) 764-3131), and mentioned their understanding that Tandy's Super-

Scripsit was being held up because it is abysmally slow.

Newscript

Skeptically, I obtained a manual from Prosoft and studied it. It was outstanding, and so I got the program. I have used many word-processing programs, but this is the finest I have seen on the Model I/III. It isn't necessary to review it in depth since it has received excellent reviews, but some of its features are particularly valuable in a clinic setting.

It is the only program supporting true proportional print. (WordStar, incidentally, supports only a pseudo-proportional print. Magic Wand also supports pseudo-proportional print. While it has commands for true proportional, the print is poorly spaced, and is not fully implemented. Two years ago I attempted to improve the source code without success.)

The author of Newscript understands the needs of medical clinics. His father was an anesthesiologist. His brother is a physician. He intended to be a physician until he discovered computers! The new manual, which is very complete, even contains suggestions for use in a clinic.

The program, older than Scripsit and based on IBM's Script, is very user friendly. Mailing lists can be created and used to provide the basis for form letters. More importantly for the clinic, boilerplating is possible. This boilerplate can *significantly* reduce secretarial time.

The Electric Webster spelling checker from Cornucopia Software is fully compatible and selectable from the menu. We originally purchased the earlier Microproof, but the Electric Webster is vastly superior. It is now completely accurate, expandable for medical words, and the speed has increased. The browse feature is less helpful for our secretary (she is a good speller), but is a real time saver and convenience when I write.

Newscript also supports JF Consulting's Inkslinger from the menu. This can be useful in preparing clever titles for patient-education handouts on the Epson MX printers and Okidata's Microline series. Although I have not yet tried it, it can even make large print for overhead masters.

For those who are Dvorak keyboard enthusiasts (see *80 Micro*, December 1980), there is full support (even a Dvorak typing tutor and keyboard labels that won't interfere with the Qwerty labels).

For owners of LNW computers, or 80-character-per-line enhanced screens, there is full support as well.

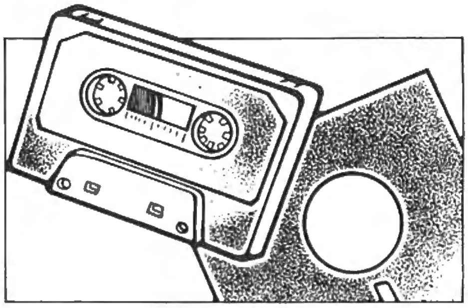
Newscript has a very important modification for your one-handed patients. It was first suggested by a handicapped Newscript user, Walt Crede. This modification makes it quite simple to type manuscripts with only one hand. (Most word-processing programs are difficult to do with one hand because of the way the control key functions.)

Next month we'll look at a printer peripheral, the spooler. I was going to include it with this article, but it should be discussed with accounting, since this is where it shines. Until then... ■

✓See List of Advertisers on Page 455

RELOAD 80

by Art Huston



Load 80 goes color

We have big Load 80 news this month—COLOR!!! Due to reader enthusiasm, the major Color Computer listings from each month's *80 Micro* will be available on cassettes. The Model I/III Load 80 will continue monthly on tape and disk.

Color Load 80 will start with the December 1982 issue. It will contain the best Color Computer programs from *80 Micro*'s 1982 issues. This cassette will sell for only $14.97 plus postage.

Subsequent Color Load 80s will be issued every three months for $9.97 plus postage. The first will be available with the March 1983 issue of *80 Micro*, and will include Color Computer programs from January, February and March.

Load 80 Gripes

We are proud of the high-quality customer service we provide. Sometimes the correspondence is frustrating. One person complained that the EDTASM source code files on the June/July 1982 Load 80 tape would not work on his machine. His local Radio Shack store advised him to buy their Series 1 Editor/Assembler, upgrade to 48K, and add a second disk drive. Many dollars later the EDTASM files would still not work.

The three EDTASM source code files on the June/July tape were SMPLZAP1, SMPLZAP2 and SMPLZAP3. These were three parts of one disk zapper which the author split to prevent the source code from overflowing the memory of a 32K machine. The accompanying article ("Stepwise Refinement," page 232) contained a Table (page 234) which clearly stated the steps necessary to assemble each part separately before dumping the object code to disk as one unit. The person obviously did not read Table 1.

What is the moral of all this? Each article serves as the documentation for each Load 80 program. Read each article carefully. Also read the Key Box. It tells which systems the program will run properly on. If you still have problems, call me at (603) 924-9471 ext. 233.

Finally, if you write, describe your exact system. I must know if you have a Model I, III, or Color Computer, how much RAM, and how many disk drives. If you have non-standard equipment let me know. Describe, as completely as possible, the symptoms of the program failure.

August Zaps

Many people had trouble converting August 1982 Load 80 programs to run on disk. Table 1 lists which programs will run after implementing the changes described in remark statements, and which will not run at all.

The disk documentation incorrectly listed Kalah/SRC as being in Basic; it is an Assembly-language program requiring an editor/assembler. The first program on side B was listed on the disk documentation as LUCK13. The correct file name is LUCKY13.

If you modify a Load 80 program to run on a different system, drop a short note to "80 Input" so others can benefit too. ■

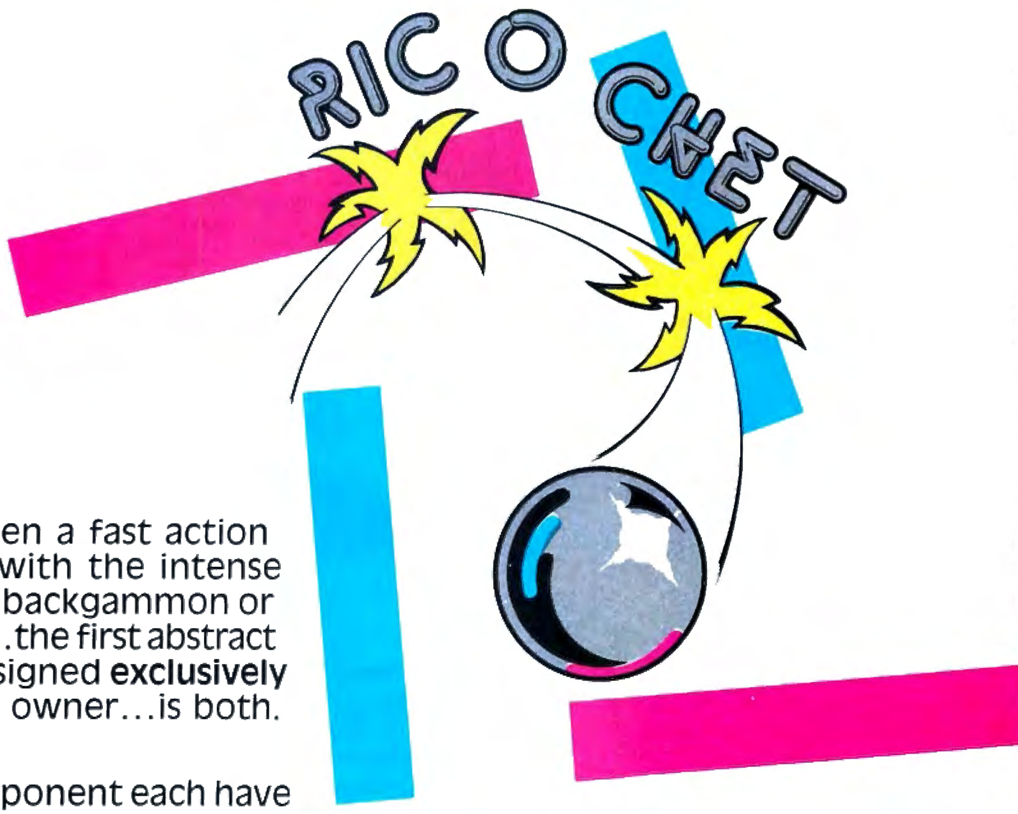
Program Name	Disk Status
CUBE80	Works unchanged, but requires 32K
KALAH/SRC	Must be assembled
SLOTMACH	Will not work with disk
CRAM	Works with changes in lines 960, 970
RAMMER	Works with changes in line 100
TREK1	Works unchanged, but not on Model III
TREK2	Works unchanged, but not on Model III
SUBCHOP2	Works with changes in lines 60, 65
THRUASTR	Works with changes in line 15

Table 1

Program	Title	Page	Comments
1	COPYRGHT/BAS	—	None
2	MEDHIST/BAS	90	None
3	REGRESS/BAS	96	None
4	HEATSTRS/BAS	148	None
5	EINSTEIN/BAS	222	None
6	DRAWPOKR/BAS	246	None
7	BABYCASS/BAS	282	None
8	KWIKMAZE/BAS	318	None
9	PIXLPRNT/BAS	364	None
10	GENEALGY/BAS	398	None
11	ANCESTRY/BAS	398	None
12	FAMILY/BAS	398	None
13	TRON/SRC	406	Needs EDTASM
14	QUIKSORT/SRC	414	Needs EDTASM
15	BKINVTRY/BAS	436	None
16	KTAABA/BAS	450	None

November Load 80 Directory

It's Here! The Computer Strategy Game with Bounce!



For:
Apple
Atari
TRS-80

Have you ever seen a fast action game combined with the intense strategy of chess, backgammon or Othello? Ricochet...the first abstract strategy game designed **exclusively** for the computer owner...is both. And loads of fun!

You and your opponent each have six opposing blocks to maneuver and two launchers to fire. Your shots ricochet off the blocks, changing their position with every hit, while earning you points on the way to their targets. The longer your shot ricochets, the more points you get.

You don't have to play alone, either. Play against any of four different computer opponents, (each a different personality), or another human. Five game variants to choose from—each requires a different strategy.

Ricochet is truly competitive...if you want it to be. A "smart clock" lets you put more pressure on your opponent by forcing him to play faster than you. But you've got to win two out of three (or three out of five) games to claim victory.

Your computer rates you after each match, so you can compare your mastery of the game with that of other players. In the long run, you're trying to rack up points for your personal Ricochet Rating.

Get Ricochet now at your local dealer for your Atari, Apple or TRS-80. Suggested retail price: $19.95.

Another Mind Toy From EPYX

EPYX COMPUTER GAMES THINKERS PLAY

*APPLE, ATARI and TRS-80 are trademarks of Apple Computer, Inc., Atari, Inc. and Tandy Corp., respectively.

P.O. Box 4247, Mountain View, CA 94040.

28

Keep X-rays Away

A leaded screen shield protects video display terminal or computer terminal users from the X-rays emitted by these screens.

The I-Protect leaded acrylic screen shield is a 3 mm thick piece of transparent acrylic plastic impregnated with enough lead to stop any X-rays from reaching your body.

This product affixes to the front of the monitor screen with four velcro tabs. Anti-glare devices can be attached to the front of the I-Protect screen shield.

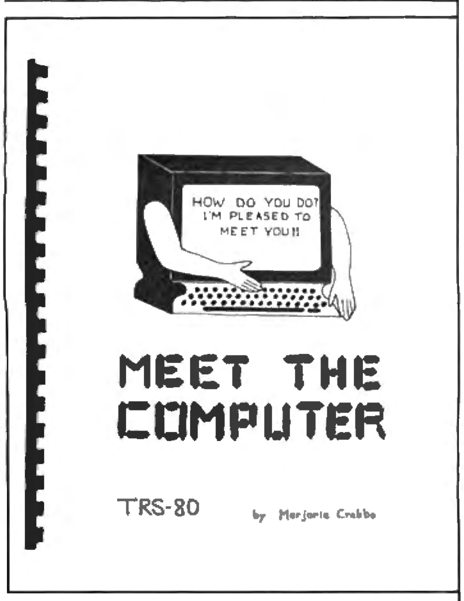
I-Protect is available in two sizes, 8 by 10 inches ($49.95) and 10 by 12 inches ($59.95), to fit most monitors. For more information contact LSI Systems, 132 W. 24th St., New York, NY 10011, 800-221-7070.

Reader Service ✓579

Meet the Computer

Meet the Computer helps young children learn simple programming for a TRS-80 home computer.

The 77-page text, written by Marjorie Crabbe, features easy-to-understand language and clear-cut instructions children can follow with a minimum of supervision. By the time the child completes the suggested activities sections, he should be capable of writing simple programs on his own.



Meet the Computer by Marjorie Crabbe

Significant concepts are set off in bold boxes at the bottom of pages to simplify learning. Important ideas are repeated throughout the publication, and illustrations supplement the text and add visual interest.

A seven-page glossary with concise definitions and a cross-referenced index provide additional teaching aids for the child. The plastic binding permits the book to lie flat when opened to any page.

Priced at $9.95, the book is available from Crabbe Associates, 212 W. Graham Ave., Lombard, IL 60148.

Reader Service ✓577

The MTI Business Computer

Business Computer

Microcomputer Technology Inc. (MTI) is offering a new personal computer line designed especially for business use. The new line, known as the MTI MOD III PLUS B series, begins with a 48K memory and double-density dual-drive system. In addition, the Business line features 4MHz operation for rapid processing, an RS-232 interface for communication applications, and an anti-glare screen and cooling unit. MTI will include a complete accounting package with each business computer for prices from $2,495.

As an added enhancement for those looking for word processing capability, arrangements have been made with ProSoft to allow buyers of the MTI business computers to receive Newscript at a substantial discount. With Newscript, the computers have complete word processing capability.

For more information, contact Microcomputer Technology Inc., 3304 West MacArthur Blvd., Santa Ana, CA 92704, (714) 979-9923.

Reader Service ✓593

VisiCalc Surrogate

Aton International Inc. has announced two programs, Basic Surrogate and VisiCalc Surrogate, for use with their JobStream CP/M 2.2 operating system. These programs provide the interfaces which allow Radio Shack Basic and Radio Shack VisiCalc to operate in the JobStream CP/M environment on the Models II and 16. This creates a less expensive alternative for TRSDOS users who wish to upgrade to CP/M and improve performance without buying new applications packages.

VisiCalc Surrogate ($99) allows access to the VisiCalc program (not generally available in the CP/M environment). VisiCalc Surrogate also offers an additional 4K to 12K bytes of memory space over what is available under TRSDOS. Basic Surrogate ($99) increases

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CHECK THESE GREAT BUYS ON OTHER PRODUCTS:

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Epson MX-80 ft	575.00	DC Hayes Smart Modem	259.00	Novation D Cat Modem	199.00	Head Cleaning Kit 5¼"	14.95
Epson MX-100	750.00	DC Hayes Micro Model II	339.00	Percom Doubler II	169.00	Disk & Other Mysteries Book	19.95
MX-80 Ribbons	12.50	OKIDATA Microline 80	359.00	Percom Data Separator	29.95	Basic & Other Mysteries Book	27.50
MX-100 Ribbons	30.00	OKIDATA Microline 82A	529.00	Paper 9½ x 11 (Fanfold)	29.95	NEC Ribbons (Min. 6)	5.95
Epson Graphtrax	75.00	OKIDATA Microline 83A	799.00	Paper 14⅞ x 11 (Green Bar)	34.95	Printer Cable	25.00
C.ITOH F-10 40 cps	1,695.00	OKIDATA Tractor	75.00	Verbatim 5¼" Diskettes	26.90	LDOS Operating Sys.	129.00
Tractor	200.00	Lexicon Modem	125.00	Maxell 5¼" Diskettes	39.00	DOSPLUS Operating Sys.	149.00
				Nashua 8" Diskettes	42.95		

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See List of Advertisers on Page 455

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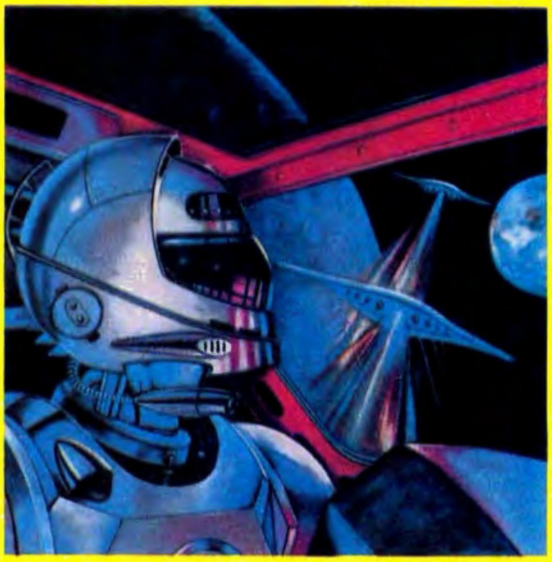

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36

program storage space 2K bytes over TRSDOS.

For more information contact Aton International Inc., 260 Brooklyn Ave., San Jose, CA 95128.

Reader Service ✓567

Hard Disk for the Model III

The JHD-III is a hard-disk system for use with the Model III. It utilizes a 5¼-inch Winchester drive with either 5 or 10 megabytes of storage. An LDOS driver allows the storage to be divided into individual logical units.

The system comes with the controller, host adapter, hard disk drive, all cables, LDOS driver disk, and an operator's manual.

Priced at $1,895 for the 5-megabyte system and $2,095 for the 10-megabyte system, JHD-III is available from J&M Systems, Ltd., 137 Utah NE, Albuquerque, NM 87108, (505) 265-5072.

Reader Service ✓559

Color Computer Index

Color Computer Index indexes articles, programs, letters, reviews and news releases from seven magazines including *68 Micro Journal, 80 Micro, 80 U.S. Journal, Byte, Color Computer News, The Rainbow* and *TRS-80 Microcomputer News.*

The two magazines wholly dedicated to the Color Computer are completely indexed, but only materials on the Color Computer are selected from the other magazines. This index, published on a quarterly basis, is available for $16 per year. A separate index covering 1980–81 is also available for $5.

Color Computer Catalog is a companion publication available two times a year for $20 per year. It lists software, hardware, books and other accessories for your Color Computer.

For more information contact Robert T. Divett, 3705 Mary Ellen NE, Albuquerque, NM 87111, (505) 298-7164.

Reader Service ✓564

Investor's Computer Handbook

The Investor's Computer Handbook helps you manage investments better with the use of your personal computer. It requires no previous microcomputer or investment experience.

The first section of the book provides information on choosing the microcomputer system best suited for your particular investment applications, including information on hardware, software, peripherals and a list of required and recommended components.

The remainder of the text explains how the system can be used for investment applications. The programs and principles—primarily in terms of the stock market—transfer easily to other dynamic markets and portfolios, such as commodity futures and options, bonds and treasury bills. The four general types of investment programs are explained: portfolio management and trading; portfolio maintenance; research filing and retrieval; and chart generation and analysis. Included are four demonstration programs in Microsoft Basic, one for each type of investment application with a step-by-step analysis of each module. Several case histories of actual investors, their systems and how they use them are also presented in this book.

Priced at $10.95, it is available from Hayden Book Company Inc., 50 Essex St., Rochelle Park, NJ 07662, 800-631-0856.

Reader Service ✓576

DOSPLUS II

DOSPLUS II for the Model II features complete device independence and a high level of user friendliness coupled with a speed increase of 5–10 times over TRSDOS. More reliable disk I/O is present even though the system stores more data on each disk than TRSDOS.

A full line of support software, at no extra charge, includes a terminal/host package and full disk editing/repair programs. The system uses Microsoft Basic.

This product is available in a standard floppy-disk version and versions for most popular Model II hard-disk subsystems. Priced at $249.95, it is available from Micro-Systems Software Inc., 4301-18 Oak Circle, Boca Raton, FL 33431, (305) 983-3390.

Reader Service ✓575

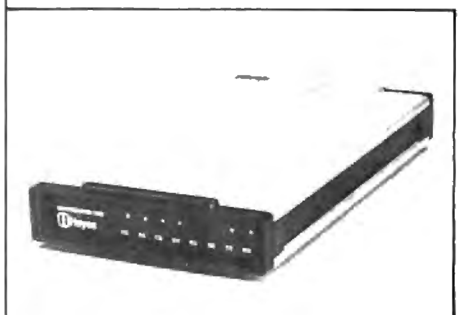
Football Compu-Stat

Football Compu-Stat analyzes the performance of teams in the National Football League. Compu-Stat provides information on won-loss records and margin of victory both in "on field" and point-spread performance.

Displays are presented in graphic or printed form. Breakdowns of performance are further classified by division, by conference and by interconference opponents. Statistical data is available and comparable on a team versus team basis. All box-score statistics are considered.

This product runs on a Model III with one disk drive. It is available on disk complete with manual for $150 and can be updated by the user or by statistical disk ($25/week). For more information contact Interactive Sports Systems, 1022 Harmony St., P.O. Box 15952, New Orleans, LA 70175, (504) 895-1481.

Reader Service ✓553



The Smartmodem 1200

High Speed Modem

The Hayes Stack Smartmodem 1200 is a Bell 212A compatible modem that lets RS-232C compatible computers or terminals communicate over telephone lines at 1200 bps.

This product is actually two modems in one: It operates at either 0–300 bps or 1200 bps. Smartmodem features auto-answer and auto-dial and can be controlled by any programming language. It executes user commands and responds with either decimal digit or English word result codes. Indicator lights on the modem's front panel allow a visual check of operational status.

Priced at $699, the modem is available from Hayes Microcomputer Products, 5835 Peachtree Corners East, Norcross, GA 30092, (404) 449-8791.

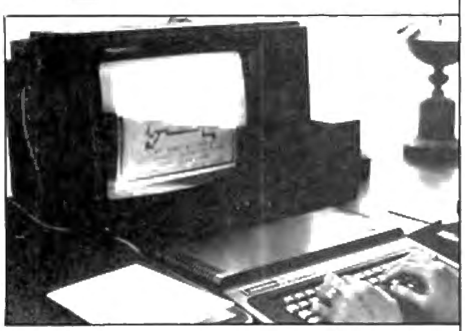
Reader Service ✓563

CP/M File Indexer

Synopsis automatically creates, updates, searches and displays an index containing the file names, disk ID, and four lines of information about any CP/M file. When the four lines of information (e.g., date, writer, addressee, subject) are included as nonprinting comments in a document file, Synopsis automatically reads the information into its index. Information describing nondocument files, such as those created by spreadsheet and data-base programs, is easily entered into the index directly. Synopsis treats the file names, disk ID, and each comment line as a separate field and lets you search the index by any part of a field or combination of field.

This product requires 48K RAM, CP/M or MP/M, and either WordStar, Spellbinder, SuperWriter, Magic Wand, or a similar text editor. Priced at $125, it is available from Digital Marketing Corp., 2670 Cherry Lane, Walnut Creek, CA 94596, (415) 938-2880.

Reader Service ✓552



Color Computer Auto Run

Auto Run

Auto Run is a utility program for the Color Computer that lets your machine-language or Basic programs start automatically. It creates a machine-language loader program and stores it on tape. Following the loader you store your program. Your program can now be started by entering the CLOADM Basic command.

The Auto Run graphics editor lets you design and create a graphics title screen that will display as your program loads. An audio feature enables you to record a musical or vocal introduction to your program.

This product requires a 16K Color Computer with Extended Color Basic and sells for $14.95. For more information contact Sugar Software, 2153 Leah Lane, Reynoldsburg, OH 43068, (614) 861-0565.

Reader Service ✓585

"The Auto Run graphics editor lets you design and create a graphics title screen that will display as your program loads."

Bowling League Secretary

A time-saving bowling league secretarial system called LEAGUEBOWL-24 is now available for the TRS-80 Model III.

An extensive editing feature gives the secretary complete control of the data. Provisions are included for forfeits, blinds, partial absences, snapout errors, postponements, team ties, individual ties, substitute bowlers, name changes, drops, ineligibles, messages, display of secretary's lane, and lane assignments anywhere in a 98-lane house.

Handicapping is selectable and accurate at 21 games or whenever the secretary desires. Printed output does not need special forms and uses any printer that gives an ASCII program listing. Designed for the non-computer-oriented secretary, the program handles handicap team, sum of individual handicap, scratch, mixed, men's, and women's leagues per ABC rules. It accepts 3, 4, or 7-point scoring systems.

This product runs on a 48K Model III and sells for $145 for the dual disk drive version and $160 for the single drive version.

For more information contact Briley Software, P.O. Box 2913, Livermore, CA 94550, (415) 455-9139.

Reader Service ✓554

Software for Real Estate Professionals

Investor III, a program developed by real estate professionals for real estate professionals, performs the detailed, comprehensive financial analysis necessary to evaluate a potential real estate investment.

Based on the user's assumptions, this program provides projections of key evaluation criteria for each of up to 20 years, including: annual depreciation shelter, either straight line or accelerated; cash flow benefits, both before and after taxes; future property values; loan balances at the end of each year; net equity build-up; capital gain and recapture taxes; net proceeds from resale; and more.

Investor III's output is formatted to print on standard letter-size paper ready for distribution to clients or inclusion in the user's investment package.

This product runs on the Models I, II, III and 16 and is available for $595. For more information contact Good Software Corp., 12900 Preston Road, Dallas, TX 75230, (214) 387-2327.

Reader Service ✓555

Model II Marriage

MERGIT-GLII turns Radio Shack's Model II Scripsit 2.0 and their single-disk general ledger system (cat. no. 26-5401) into a flexible report writing package.

MERGIT-GLII creates a merge file formatted to Scripsit requirements and limitations. It allows user selection of accounts to be included in the merge file by general ledger classification or account range. It also allows expense accounts to be chosen by category. It automatically creates variable code names and formats variable amounts based on the user's chart of accounts for current month and year to date account balances.

Priced at $89.95, MERGIT-GLII is available from Independent Software, P.O. Box 3126, Federal Way, WA 98003, (206) 941-6022.

Reader Service ✓556

Municipal Billing System

The Municipal Billing System, MBS, from Foy Inc. handles the billing of water, electricity, sewer, garbage, and other utilities for municipal governments. Designed for the Model II, it is available in versions to handle from 2,000 to 30,000 customers.

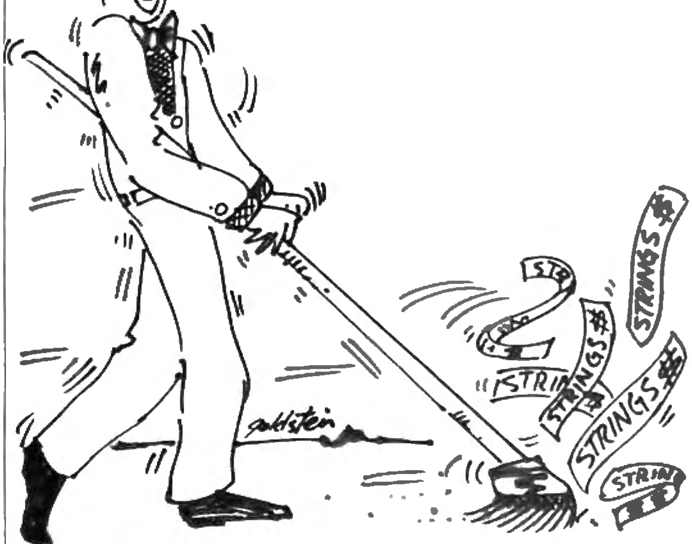
MBS is currently in use by the cities of Farmersville, Murphy, and Van Horn in Texas; Avenal, CA; and Crystal Springs, MS. These cities use MBS to generate a meter-reading list, print a high/low audit of unusual usages, print an account status report, calculate and print postcard bills ready for mailing, generate a daily cash receipts listing, and print a delinquent account report. MBS handles a wide range of rate structures, making it suitable for virtually all cities with populations between 1,000 and 50,000.

For additional information contact

DOES STRING COMPRESSION HAVE YOU TIED UP IN KNOTS?

LET TRASHMAN CLEAN UP THE MESS!

TRASHMAN is a machine language utility for the TRS-80 Models I and III. It was written by Glenn Tesler, the author of FASTER, and can reduce BASIC's string compression time by 95% (see table below).



WHAT'S STRING COMPRESSION?

When a BASIC program changes a string (words, names, descriptions), it moves it to a new place in memory, and leaves a hole in the old place. Eventually, all available memory gets used up and BASIC has to push the strings together to free up some space. This takes time. Lots of time. The computer stops running for seconds or minutes, and you may even think it's "crashed". The keyboard won't work, and until all the strings have been collected, you just have to sit and wait. Then things run for a while, until string compression is needed again. And again.

If you're using your computer for business, that wastes your money. If you're using it personally, it wastes your time.

WHAT'S THE SOLUTION?

As soon as you start using TRASHMAN, those delays almost disappear. It uses less than 600 bytes of memory, plus 2 bytes for each active string. It works with other machine language programs and with all major operating systems. It's easy to use, comes with complete instructions, and can be copied to your own disks.

WHAT'S THE CATCH?

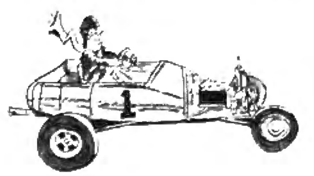
If a BASIC program uses only a few strings, very little time is wasted in string compression, and TRASHMAN won't be helpful. But, if hundreds of strings, including large string arrays, are used, TRASHMAN is just what you need.

# STRINGS	SECONDS DELAY NORMAL	SECONDS DELAY TRASHMAN	PERCENT IMPROVEMENT
250	11.8	0.7	94
500	45.8	1.6	96.5
1000	179.6	3.5	98
2000	713.2	7.8	98.9

Ask your software dealer for TRASHMAN, or order directly on our toll-free number. The price is just $39.95 (plus sales tax in California).

(All timings done on TRS-80 Model I. Model III 15% faster, but pct. improvements identical. Listing of timing program available on request.)

AMAZING PROGRAM SPEEDS UP BASIC



Your time is valuable, so why waste it on slow-running BASIC programs? PROSOFT's "FASTER" will analyze those programs *while they run*, then show you a simple change (usually one new line) that can reduce run-times by up to 50%.

Accounting systems, financial models, engineering and scientific programs all run faster; so do games. Large, complex programs improve the most, and "FASTER" is easy to use.

THIS ISN'T A COMPILER! Your BASIC programs remain readable and can be changed later on. While your programs run, "FASTER" counts how often each "variable" is used, then shows you the correct sequence for these variables. Afterwards, the computer finds them sooner, so your programs run faster.

Does it really work? Yes! *Personal Computing* said so in their May, 1981 issue (p. 116); we've received many letters from customers who've gotten 20-50% improvements; and we will make you this offer:

Order "FASTER" now. Try it on your bread-and-butter programs. If you don't get an overall run-time reduction of at least 20%, return it within 30 days for a prompt and cheerful refund.

"FASTER runs on TRS-80 Models I and III, 16–48K, tape or disk

$29.95

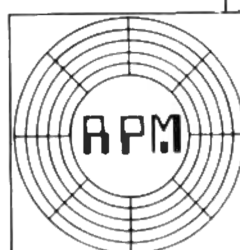
QUICK COMPRESS

Small (276 bytes), fast (processes 800 lines in under 3 seconds) utility removes blanks and remarks from your BASIC programs. Produces smaller, faster programs, and doesn't alter the original logic.

16-48K Model I or III, tape or disk. **$19.95**

SPECIAL FASTER + QUICK Compress: **$39.95**

ERRATIC DISK DRIVES



RPM measures the rotational speed and variation of your disk drives, and reveals a common cause of unexplained errors. Simple one-key operation, runs under any DOS, interchangeable between Models I and III. Shows current and average speeds, plus fluctuation history. Recovers from severe errors. Documentation explains how to adjust drives. Use RPM monthly for best results. 32-48K Model I or III disk: **$24.95**

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Foy Inc., 100 McKinney St., Farmersville, TX 75031, (214) 782-7282.
Reader Service ✓557

PocketCalc I

PocketCalc I is a spreadsheet program for the Sharp PC 1211, Radio Shack PC-1 and Casio FX-702P computers.

The program makes available three rows of up to 13 columns each. Each row may be added, subtracted, multiplied or divided by another row or by a single number. Features include commands for: clearing rows to zero; duplicating the value of one cell into other cells; finding the sum, cumulative value and average value of a row; and saving the results on cassette.

Because the memory of these pocket computers is limited (about 1.5K bytes), the calculations and numerical results are printed sequentially. This printed log becomes a review of the problem solution and enables replication of the numerical solution with new data.

Priced at $30, this spreadsheet is available from PocketInfo Corp., P.O. Box 152, Beaverton, OR 97075, (503) 649-8145.
Reader Service ✓560

Dollar Sense

Dollar Sense is a budget management aid for home use. It is not a checkbook balancer, but an electronic worksheet used in preparing and sticking to a new budget.

Income records allow the user to enter a description field, the amount, and the date expected. Expenses include all of the above, plus a planned date payment and the actual date paid. Once the budgeting information has been entered, the file is sorted by date and displayed, with a current balance always in view.

This product runs on a Model I or III and is available for $12.95 on cassette from KENSOFT, 2102-50th St., Kenosha, WI 53140, (414) 654-2722.
Reader Service ✓574.

Sea Dragon

Sea Dragon, a real-time machine-language simulation, challenges the player to successfully maneuver a submarine past underwater mountains and through labyrinthian passages while avoiding webs of rising, explosive mines. Additional dangers include depth charges dropped from battleships, laser cannons, enemy attack bases and falling stalactites.

This game features a horizontally scrolling seascape that extends the equivalent length of more than two dozen screens placed end-to-end. There are a full range of features and options, including multiple skill levels, high score save, joystick compatibility, and one or two-player capability.

The disk version of this product features Adventure International's exclusive Duo Loader, loading on either Model I or III systems with 32K of memory. This version sells for $24.95. The cassette version for the Models I and III sells for $19.95. For more information contact Adventure International, P.O. Box 3435, Longwood, FL 32750, (305) 862-6917.
Reader Service ✓570

Copyart II

The Copyart II word processor for 48K, one disk-drive Model I and III computers supports underlining, boldfacing, double strike, justification, headers-footers, and offers graphics, math, sorting and mailmerge capabilities.

You can insert graphics within text and do calculations within the text. The sort function allows you to sort up to 650 names, indices, mail lists, and so on, in seven seconds or less. The mailmerge utility and mail list programs allow you to merge up to 2000 names and addresses with a Copyart form letter. The mail list can be sorted by name, state, zip code, city or special code.

Priced at $149.95, Copyart II is available from Simutek Computer Products Inc., 4897 E. Speedway Blvd., Tucson, AZ 85712, (602) 323-9391.
Reader Service ✓566

The Comrex CR-1 ComRiter

ComRiter

The ComRiter daisy-wheel printer is especially designed for word processing. Its bidirectional carriage increases throughput. Print speed is 17 cps. It features one-touch, dust-free interchangeable daisy wheels with a wide range of available fonts.

The ComRiter is available with three separate interfaces built in: Qume Sprint 3 ($1,099), RS-232C serial ($1,199), and Centronics-style parallel ($1,115). For more information contact Comrex International Inc., 3701 Skypark Drive, Suite 120, Torrance, CA 90505, (213) 373-0280.
Reader Service ✓584

Port Doubler

The wYe interface doubles the extensions available at an existing port of your computer, eliminating connecting and disconnecting cables. This saves time and prevents possible damage to connectors and cables. Signal direction is easily changed with a light touch of the selector button.

This product is available for $99 for the Models I or III and for $189 for the Models II or 16. For more information contact Lords Systems Design, 11421 81st Ave. NE, Kirkland, WA 98033, (206) 823-8849.
Reader Service ✓561

Basic Aid

Basic Aid, a utility program for the Color Computer, reduces the number of keystrokes necessary to enter a program. It features automatic line numbering and single key entry of most Basic commands. The user may redefine any or all keys to his own commands.

Basic Aid's Merge command allows merging of Basic routines stored on cassette with the program in memory. Since Basic Aid renumbers the routine being merged, you can build tape libraries of Basic routines without regard to line number. The Move Line command allows you to move and renumber any program line. It automatically changes GOTOs and GOSUBs which reference the section moved.

This product comes in a ROM cartridge and includes a keyboard overlay. Priced at $35.95, it is available from Eigen Systems, Box 10234, Austin, TX 78766, (512) 837-4665.

Reader Service ✓569

6809 Disassembler/Assembler

DISASM allows disassembling and assembling of machine-language programs for the Color Computer. Especially designed for the inexperienced Assembly-language programmer, DISASM uses only easy-to-learn commands and takes data in decimal rather than hex format. The disassembler gives the memory location, instructions, machine code, and branch locations in decimal for ease in tracing program steps. Learn how the Color Computer works by disassembling the Basic and extended ROMs. Use the assembler to write USR subroutines or complete machine-language programs.

DISASM is available on cassette for $19.95 and on EPROM for $49.95. For more information contact Dynamic Electronics Inc., P.O. Box 896, Hartselle, AL 35640, (205) 773-2758.

Reader Service ✓590

Words for the Wise

Words for the Wise is a complete spelling tutor system for elementary school students. It features five spelling activities: missing letters, scrambled words, match the letters, alphabetizing, and hangman. Students are rewarded and corrected through animated graphics and sound.

An additional feature of this product is the unlimited flexibility in choosing words to be studied. The teacher prepares and stores word lists on disk or tape ahead of time. The package comes with a program to prepare or update these word lists. In addition, TYC Software supplies a prerecorded list of 1000 specially selected spelling words for grades 1–6. These words are a representative sample of words used throughout the country in these grades.

The disk version of this program for use on a two-disk Model III sells for $34.95. The Model I or III cassette version sells for $24.95. For more information contact TYC Software, 40 Stuyvesant Manor, Geneseo, NY 14454, (716) 243-3005.

Reader Service ✓578

COCO Drawer

COCO Drawer is a joystick-driven graphics editor for quick and easy pictures on the Color Computer.

The joystick selects and controls over 40 commands on two menus to draw lines, rectangles, circles, dots, and paint

✓ See List of Advertisers on Page 455

with Extended Basic's resolutions and colors. Other commands are merge, change colors, copy, store, restore, and many more.

COCO Drawer comes with two complete character sets for typing messages on pictures. Also included are outlines of Texas and Australia digitized with this program.

COCO Drawer is available for $19.95 from Greathouse and Company, P.O. Box 27051, Rancho Bernardo, CA 92127. Extended Basic and 32K are required.

Reader Service ✓588

The Last One

The Last One

Using simple English terms in menu form, The Last One helps the user design original programs for home, office or hobby without knowing complex computer language. The program's display shows the items that can be chosen to construct the order of an original program. After the program design (or flowchart) is completed, The Last One writes the Basic computer code required to make the program work.

Priced at $600 for Model II and III versions, it is available from Southwest Microcomputer Systems, 16885 West Bernardo Drive, Suite 220, San Diego, CA 92127, 800-854-2099.

Reader Service ✓583

Financial Management System

Plus Accounting Software is a financial management system consisting of individual software packages for general ledger, accounts receivable, accounts payable, fixed assets, payroll, plus the versatile Easytrak, an all-purpose tracking system to monitor sales activity.

All Plus packages are menu-driven for easy operation. Prompts and built-in disciplines aid training and improve accuracy. Complete, easy-to-follow documentation provides detailed information on installation, start-up, operations guide including screen and sample report explanations, glossary, and a basic accounting theory refresher.

This product is available in 5¼ and 8-inch disks for the Models I and II. All packages are available as stand-alone, or can automatically post to general ledger. For more information, contact Tom Turkot, vice president, marketing, Plus Computer Technology Inc., 6900 N. Austin Ave., Chicago, IL 60640, (312) 647-0988, 1-800-323-4240.

Reader Service ✓589

Footmath

Footmath allows mathematical manipulation of feet, inches, and fractions of inches in their written form without converting them to decimal form. Designed for use by architects and contractors, this program prompts for input of dimensional data in the same format as shown on blueprints. The computer interprets the English measure, performs the calculations, and then provides output in the same foot, inch, and fraction format as the input.

The output may be displayed on the screen or listed on an 80-column line printer. The user may also store the output on disk and recall it later and make changes if needed.

Footmath runs on the Models I and III and sells for $99.95. For more information contact Cheever Microwave, P.O. Box 3834, Wake Village, TX 75501, (214) 832-4211.

Reader Service ✓568

Astro-Blast

Astro-Blast is a space shoot-em-up game for the Color Computer featuring high-resolution graphics, color and sound effects.

Wave after wave of alien attackers challenge your joystick and fire-button skills. Move quickly before your fuel runs low. Three selectable skill levels coupled with automatic game acceleration provide a challenge for novice and professional alike.

Software Affair's Orchestra-90

This machine-language program is available on 16K cassette for $24.95 and 32K disk for $29.95. For more information contact Mark Data Products, 23802 Barquilla, Mission Viejo, CA 92691.

Reader Service ✓580

Stereo Music Synthesis

The Orchestra-90 Special Composer's Edition, a software/hardware product, synthesizes stereo music in four-part harmony using any combination of violin, trumpet, organ, oboe, clarinet and percussion effects.

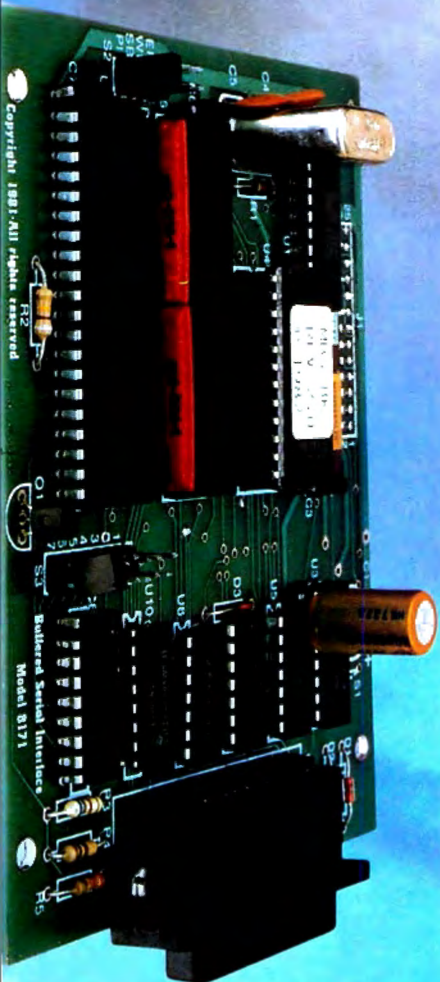
This product includes the tape or disk version plus sample music, instruction manual, and fully assembled and tested PC board which plugs into the 50-pin connector on the Model III. The high-level stereo output may be connected to the aux/tape/tuner inputs of any stereo amplifier.

The system is available from Software Affair, 858 Rubis Drive, Sunnyvale, CA 94087, (408) 295-9195, for $149.95.

Reader Service ✓586

An incorrect price was quoted for Textedit (Wayne Green Books), featured in the Oct. 1982 "New Products" section. The book alone costs $9.97, and the disk alone $19.97.

HOW TO USE YOUR EPSON WITHOUT WASTING COMPUTER TIME:



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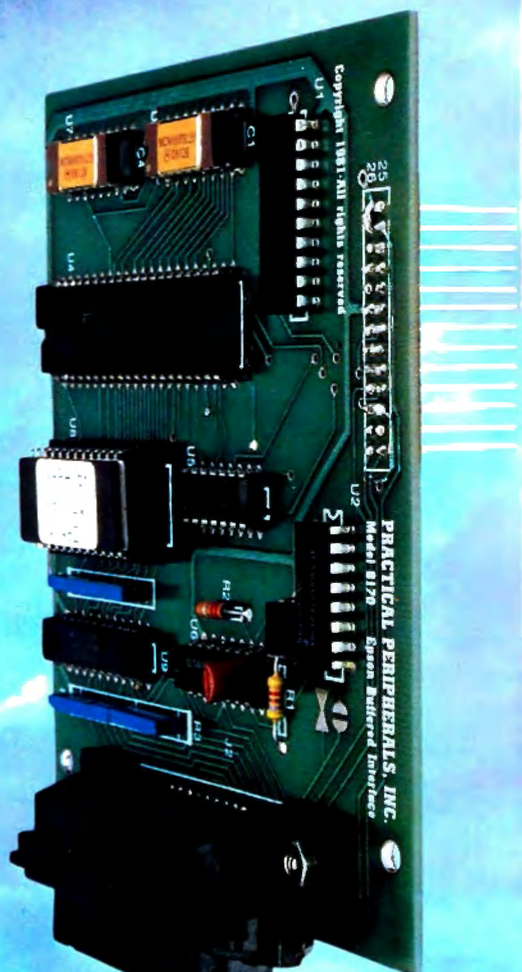

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