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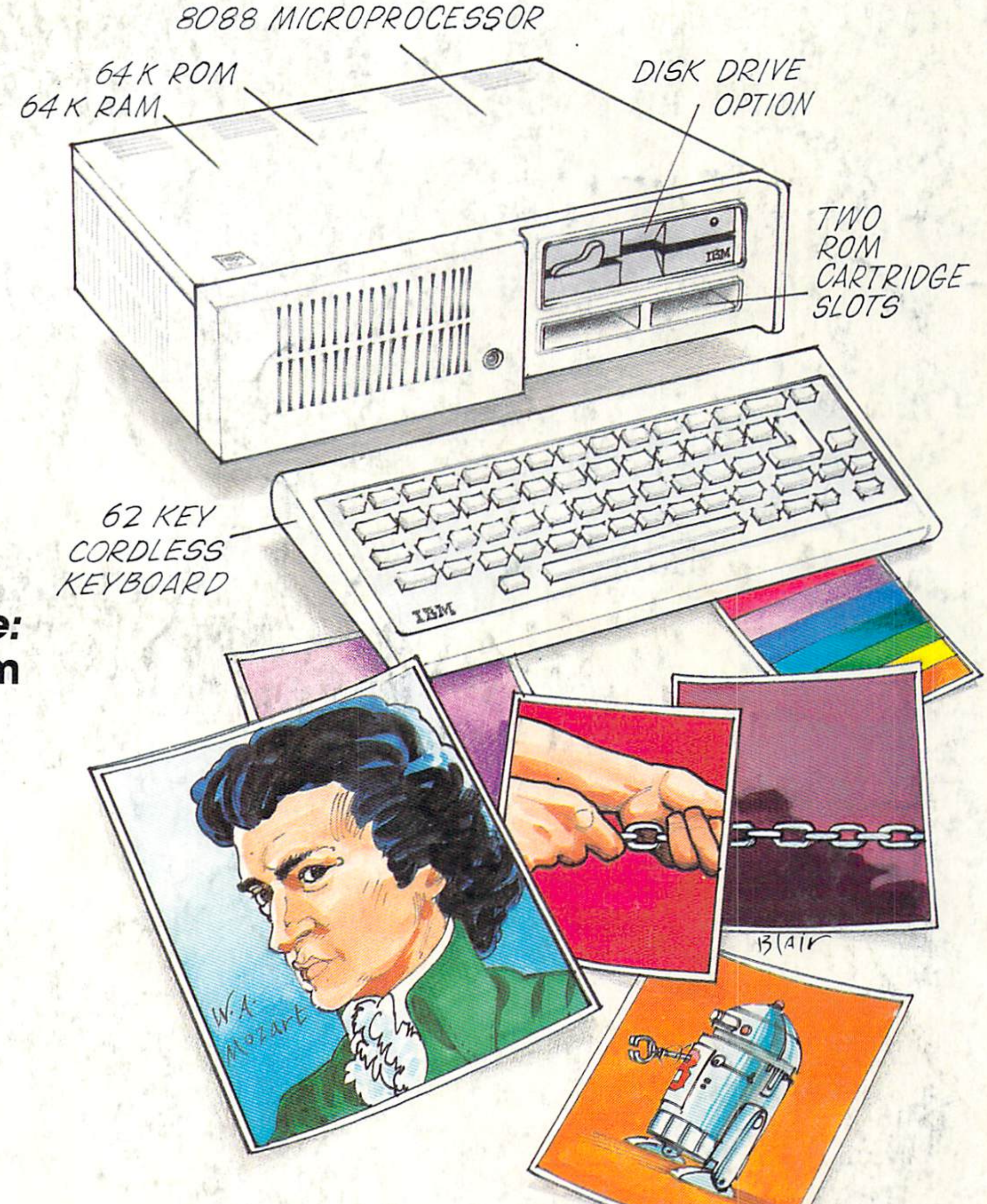
Report On IBM's PCjr



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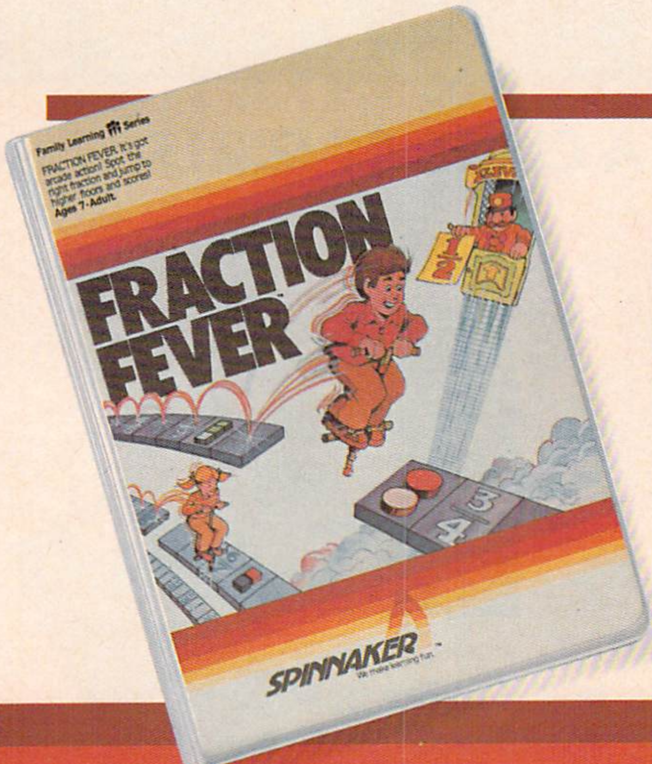
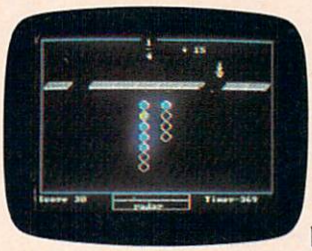
So if you're looking for computer programs that do more than just "babysit" for your kids, read on. You'll find that our Early Learning Programs are not only compatible with **Apple,® Atari,® IBM®** and **Commodore 64™** computers, but also with kids who like to have fun.



FRACTION FEVER™ brings fractions into play. Ages 7 to Adult.



FRACTION FEVER is a fast-paced arcade game that challenges a child's understanding of fractions. As kids race across the screen in search of the assigned fraction, they're actually developing a basic understanding of what a fraction is and of relationships between fractions. They're even discovering that the same fraction may be written in a number of different ways.

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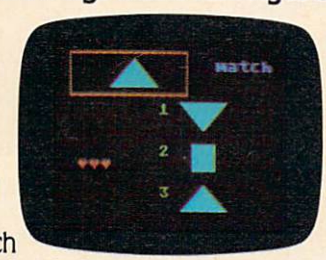
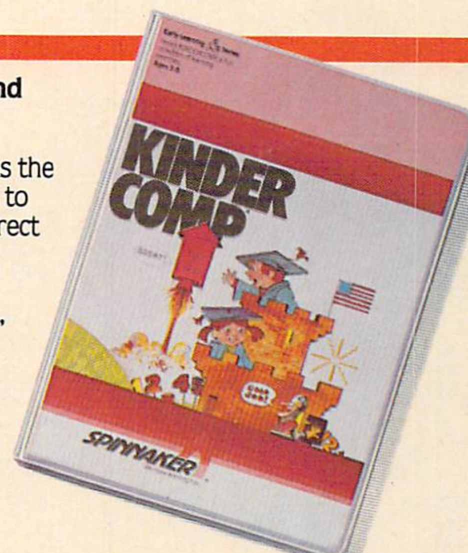
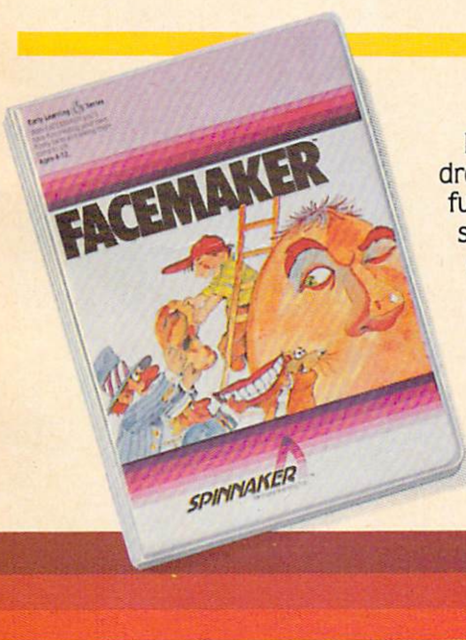


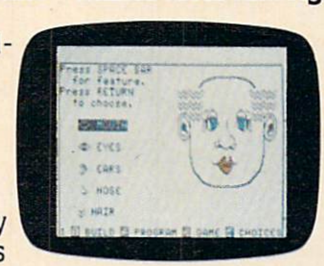
KINDERCOMP is a game that allows very young children to start learning on the computer. It's a collection of learning exercises that ask your children to match shapes and letters, write their names, draw pictures, or fill in missing numbers. And KINDERCOMP will delight kids with colorful rewards, as the screen comes to life when correct answers are given.

As a parent, you can enjoy the fact that your children are having fun while improving their reading readiness and counting skills.





FACEMAKER™ makes faces fun. Ages 4 to 12.



FACEMAKER lets children create their own funny faces on the screen. Once a face is completed, your children will giggle with delight as they make it do all kinds of neat things: wink, smile, wiggle its ears, or whatever their imagination desires.

Plus, FACEMAKER helps children become comfortable with computer fundamentals such as: menus, cursors, the return key, the space bar, simple programs, and graphics. FACEMAKER won't make parents frown because their children will have fun making friends with the computer.

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January 1984 Vol. 6, No. 1

FEATURES

EDUCATION AND RECREATION

REVIEWS

COLUMNS AND DEPARTMENTS

THE JOURNAL

NOTE: See page 199 before typing in programs.

AP Apple **AT** Atari, **P** PET/CBM, **V** VIC-20, **C** Radio Shack Color Computer, **64** Commodore 64, **TS** Timex/Sinclair, **TI** Texas Instruments, **PCjr** IBM PCjr, *All or several of the above.

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EDITOR'S NOTES

As many of you will be aware, IBM has finally unveiled the long discussed PCjr. The unit (we described it in a recent GAZETTE editorial as "restrained as breakthroughs go") leaves something to be desired. A keyboard for one. Nonetheless, it is, after all, an IBM, and not to be taken lightly.

Atari and Coleco must have breathed collective sighs of relief, because both promptly raised January 1 pricing of their personal computer systems. Texas Instruments (too little, too late) is, for the first time in the history of their home computer division, selling every computer dealers can get their hands on, as fast as they can get their hands on them. Unfortunately, since TI doesn't make TIs any more, this phenomenon will soon be over. It's a bargain at $49.95!

We are pleased to report that there are teeth to TI's promises of continued support. They do plan to continue to market support software; establish a user service hotline; and, most importantly, will continue to service and repair their computers. At least they're withdrawing with class and appropriate concern for their customers.

Back to IBM's highly successful PCjr. It will be quite successful. First, it's defined a market niche that aims it rather directly at Apple and Atari, slightly above Coleco, and several hundreds of dollars above Commodore. It will compete quite well against the well-established Apple software library, and IBM's marketing strength is certainly ahead of the struggling Atari. The fact that Atari and Commodore have superior sound and graphics capabilities may go unnoticed by many in the marketplace. Coleco's packaging strategy is still an unknown, and since we've been unable to get our hands on a Coleco, we'll have to be more restrained in our bold predictions.

In recent editorials, we've commented that frequently the most inexpensive thing in a computer system is the computer. Happily this isn't the case with the PCjr. There are many, many "optional" accessories one can add without getting close to the price of the entry-level $689 computer. Among these are joysticks (a maximum of two) at $40 each; an adapter cable so you can hook up a cassette drive for $30; an extended Microsoft BASIC cartridge for $75; and so on. Get the picture?

In spite of the inevitable muttering and groaning by members of the personal computer industry press, the IBM PCjr will make a definitive mark on 1984 and the home computer industry. For one thing, IBM's entry will attract buyers that have been reluctant to join the home computer revolution. IBM's credibility, support, and service will greatly enhance their ability to more aggressively promote the use of computers in educational settings. And the installed year-end base of IBM PC's (estimated at approaching 500,000) will surely provide a ready-made customer base for home users of the PCjr. IBM has very wisely paid full attention to the necessity of compatibility.

Where does this leave us? Well, given the above comments, not surprisingly we're introducing a third magazine in the COMPUTE! Publications, Inc., family. COMPUTE!'s PC & PCjr Magazine will premier with a March issue. It will contain the same kind of useful applications information, tutorials, and programming assistance that are currently provided by COMPUTE! and COMPUTE!'s GAZETTE for Commodore. Concurrently, we're adding the PC and PCjr to COMPUTE!'s more intermediate and advanced editorial coverage.

In this issue, you'll find a factual overview of the new PCjr by Editor Tom Halfhill. Tom will become the editor of our new PC & PCjr magazine. If you own or use an IBM PC, or purchase a PCjr whenever they're really available, we're actively recruiting columnists and writers for our IBM support. Address your queries and submissions to Tom Halfhill, COMPUTE!'s PC & PCjr Magazine, Post Office Box 5406, Greensboro, NC 27403. If you have an IBM PC- or PCjr-related book proposal, we'd certainly be interested in seeing that as well. Send your queries or proposals to Stephen Levy, Book Division Editor, at the same post office box.

Robert Lock

Editor In Chief

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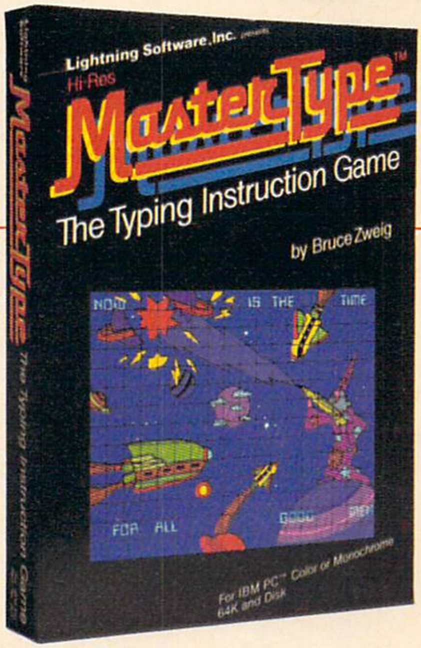

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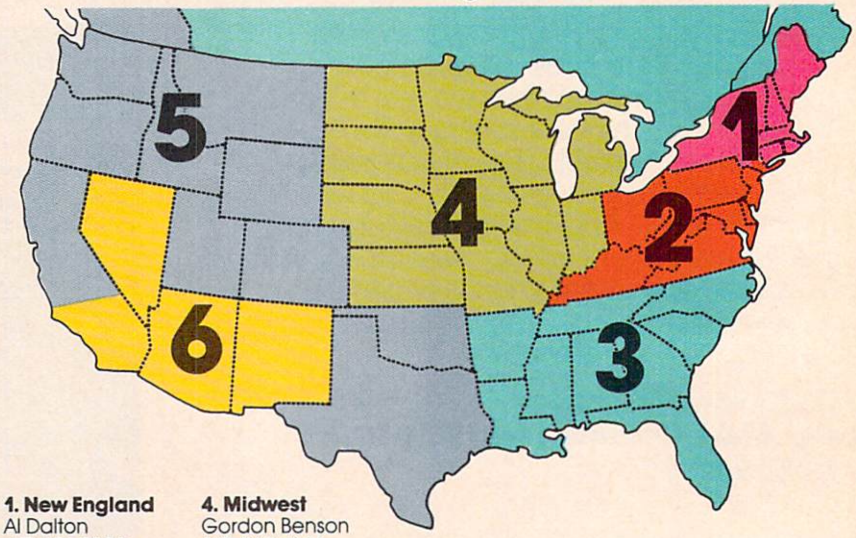

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READERS' FEEDBACK

The Editors and Readers of COMPUTE!

Computing With Kerosene

Our local computer columnist recently wrote that kerosene heaters and home computers don't mix. He stated that one by-product of kerosene combustion is a conductive film that gets on everything, including computer chips. He concluded that kerosene heaters and computers should not be in the same house. Any comment?

Charles Ranney

An interesting point. In general, burning fuels and sensitive electronics don't, in fact, mix well. Although we have no firsthand experience with the combination you've cited, we have seen what happened to a phone connection box installed right next to a gas heater—lots of corroded wires.

It probably has something to do with the proximity of the heater and how often the heater is used. The situation can't be as serious as the columnist implies, however. Most modern televisions contain electronics of roughly equal sensitivity to a computer. If the stoves damaged TVs, we surely would have heard about it by now, considering the hundreds of thousands of such heaters currently in use.

Nevertheless, it probably wouldn't be a bad idea to use an electrostatic air cleaner just to be on the safe side.

Program Line Addresses For VIC And 64

John B. Swetland's letter (COMPUTE!, July 1983) and his program for locating program lines on the Timex/Sinclair prompted me to share a similar program with VIC and 64 users. This program also provides the starting and ending addresses for any program line, but gives the total program length rather than the length through the particular program line. (Actually, the program length will be two bytes low, since the program ignores two of the three zero-bytes which end the program.) The indicated addresses are provided in decimal and hexadecimal which facilitates the location of internal program POKEs and the use of a monitor.

To prepare the program, type it in exactly as shown, insuring that there is a space between the first set of quotation marks and the word "line" in line 63986. RUN the program, then enter, in direct mode, POKE SA+9,25 (ignore the "illegal quantity" error message produced by running the unfinished program). This POKE puts a special "end of program" marker in line 63986; line 63989 looks for this marker, and when it finds it, ends the program run. Finally, SAVE the program using the program name "line locater".

To use the program, append it to the program that is to be examined as follows:

1. LOAD the program that is to be examined.

2. Enter in the direct mode: POKE43,PEEK(45)-2:POKE44,PEEK(46)

3. LOAD "line locater", device number (1 for tape, 8 for disk).

4. Enter in the direct mode: POKE43,1:POKE44,8

Finally, type in direct mode RUN 63987.

James J. McQueeney III

```
63986 STOP:REM " LINE LOCATER"
63987 PR$="Ø123456789ABCDEF"
63988 PA=PEEK(43)+256*PEEK(44): SA=PA: IN
      PUT"LINE NUMBER"; LI
63989 PL=PEEK(SA):PS=PEEK(SA+9):IF PS=25
      {SPACE}THEN 63996
6399Ø PH=PEEK(SA+1):LN=PEEK(SA+2)+256*PEE
      K(SA+3):PN=PL-1+256*PH
63991 IF LN=LI THEN 63993
63992 SA=PN+1:GOTO 63989
63993 PI=SA:GOSUB 63997:SA$=PY$:PI=PN:GOS
      UB 63997:PN$=PY$
63994 PRINT"BEGINS AT";SA;"($";SA$;"),"
63995 PRINT"ENDS AT";PN;"($";PN$;")":SA=P
      N+1:GOTO 63989
63996 PE=SA-PA:PRINT"PROGRAM IS";PE;"BYTE
      S LONG":END
63997 PY$="":FOR N=3 TO Ø STEP-1
63998 PZ=INT(PI/(16↑N)):PX$=MID$(PR$,PZ+1
      ,1):PY$=PY$+PX$
63999 PI=PI-PZ*(16↑N):NEXT N:RETURN
```

An Easier Load For Atari Binary Files

In the September Readers' Feedback column, Forrest Meiere offers a very useful routine that allows BASIC programmers to load binary files from BASIC on the Atari.

As long as we're making illegal jumps into the operating system, here is a much simpler routine that does the same thing.

```
OPEN #1,4,0,"D:PROGRAM.OBJ"
X=USR(5576)
```

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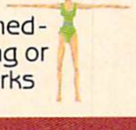

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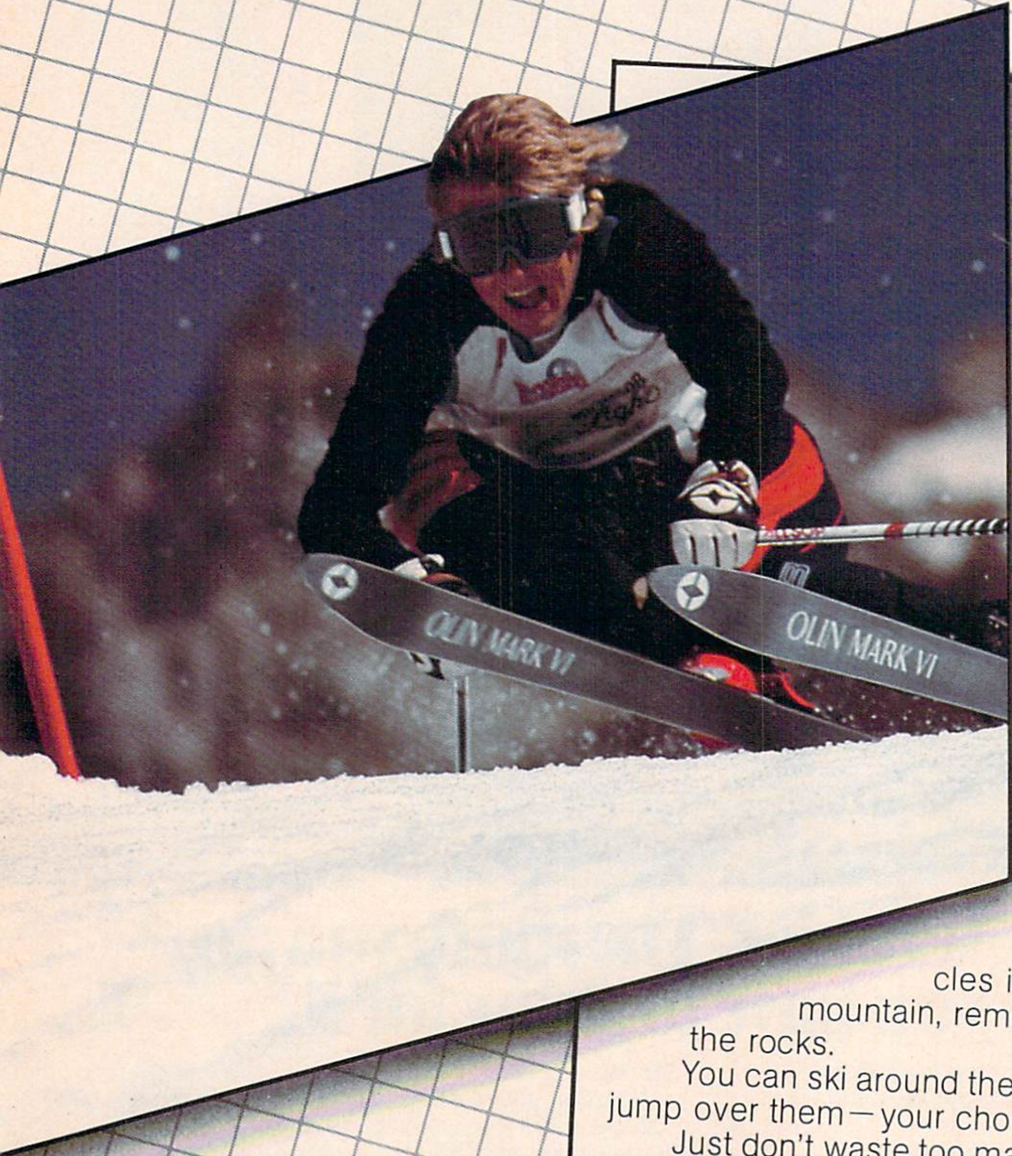
Racing



It's cold on top of the mountain. But the view is great and the people are pulling for you.

So you pull on your gloves, adjust your goggles, check your bindings, take a deep breath and you're off.

Now the clock is running, so you'd better concentrate on your technique. Get as close to the gates as you can, but not too close—contact with a slalom pole will cost you precious penalty seconds. Turn too sharply and you'll come to a stop.

And slalom poles aren't the only obstacles in your path. This is a mountain, remember, so look out for the rocks.

You can ski around them. Or jump over them—your choice.

Just don't waste too many tenths of a second trying to make up your mind!

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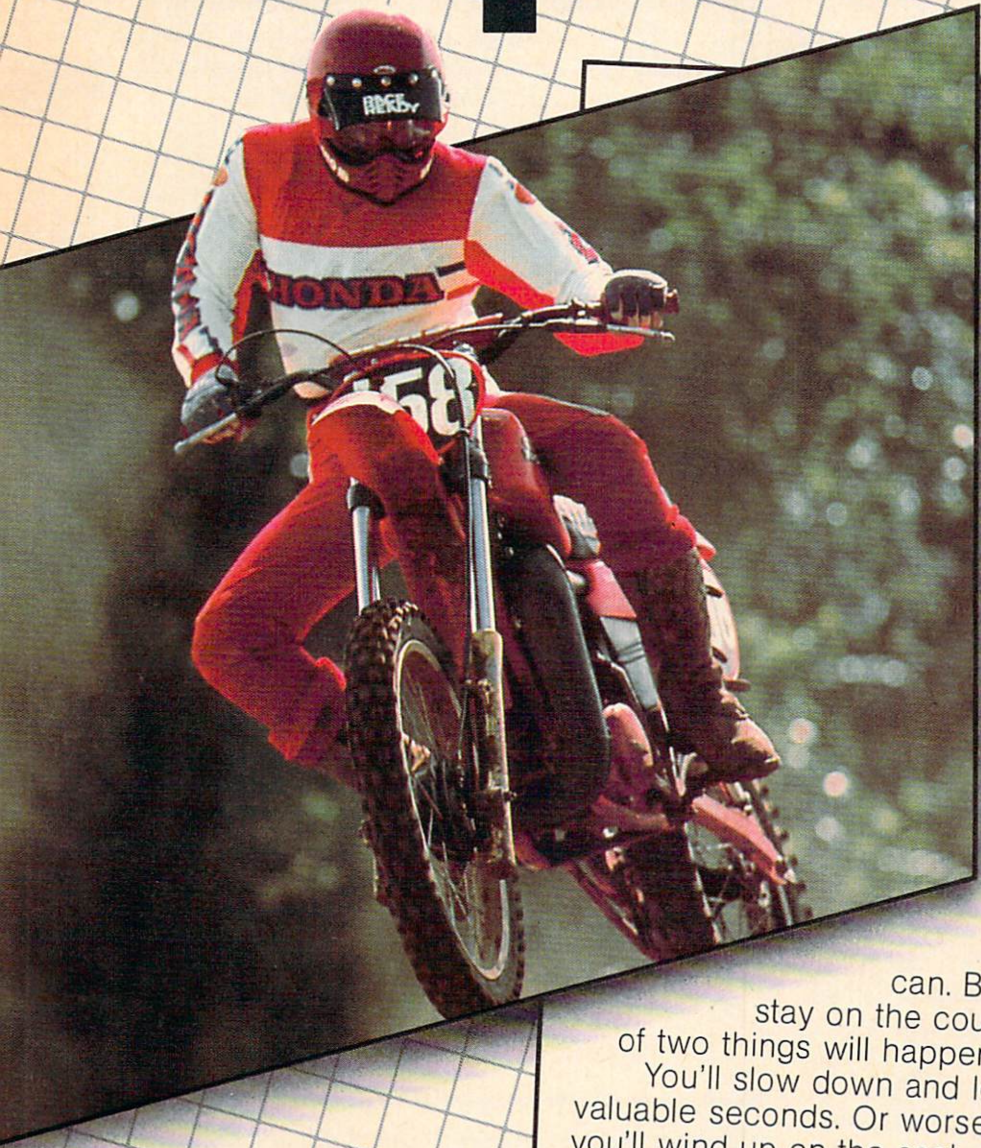

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Stay ahead if you can. But whatever you do, stay on the course. If you don't, one of two things will happen.

You'll slow down and lose valuable seconds. Or worse, you'll wind up on the seat of your pants.

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PROGRAM.OBJ is of course any valid filename that can be loaded with the L function from Atari DOS II. This is particularly useful when using either the Datasoft BASIC Compiler or the Monarch ABC Compiler, since neither allows you to load and run other programs.

For readers who use the Axlon RAMdisk, the appropriate location to jump to is X=USR(6060). If the Monarch ABC Compiler has been used without the relocating loader, you may then jump back into the calling program with the M command and address $2600. This information first appeared on the Atari SIG on CompuServe.

Michael H. Reichmann

We've tried this useful technique, and it works well. Because the DOS routine does not have the PLA that USR requires, you will get an ERROR 9. Just ignore it, or use TRAP to make BASIC ignore the error for you.

TI Cartridge Loading Problems

I'm wondering if any readers have had problems using TI cartridges with the TI-99/4A. I've had no problem loading them the first several times, but after ten or so uses of the same cartridge, loading becomes increasingly difficult. I've had problems with the keyboard locking up and with broken screen display patterns. It often takes me ten or more tries to load and run something successfully. Have any of your readers experienced such problems and, if so, have any solutions been found?

Charles J. Smith

We have many TI cartridges here at COMPUTE! *and, even after prolonged use, haven't had any of the problems you mention. One possible cause is dirty contacts on the cartridge. To prevent this, you should occasionally clean the contacts. On the back of the cartridge (where the cartridge is fitted into the slot), manually depress the spring-loaded section, and you'll see an edge with about 18 contact strips. Use a cotton swab moistened with either contact cleaner fluid or rubbing alcohol. Rub the contacts gently with the swab, allow them a few seconds to dry, and your cartridge will be ready to use.*

If this doesn't help with your loading problems, we suggest you try the suspect cartridge in another TI computer and, if there's still a problem, contact your dealer. If any readers have had this same problem and found a solution, we'd like to hear from you. On the other hand, if you're using a kerosene heater, all bets are off.

More "Extra Instructions"

Joel Shepherd's article "Extra Instructions" for the 6502 (COMPUTE!, October 1983) presents a fascinating peek into the mysterious workings of microprocessors. I wonder, though, if the limited usefulness of these instructions would warrant the trouble of expanding our assemblers to include them. For instance, since the decrement/compare instruction (DCMP) ties up the accumulator, it would be of limited value in real applications. Likewise, how often does a real program need to load the accumulator and the X register simultaneously from a single memory location? Now, if you could load *immediate* data to both registers with one command, that *would* be handy.

After a few minutes at the keyboard, I discovered that Mr. Shepherd has revealed only the tip of the iceberg. In fact, most of the "unofficial" opcodes do something. Here are a few that would be really useful:

Opcode			"Mnemonic"		
ab	xx	:	LAX	#$dd	(.a=data) (.x=data)
cb	xx	:	SBX	#$dd	(.x=.x−data) (*without* carry)
8b	xx	:	NAX	#$dd	(.a=.a and .x and data)

There are many more. The most bizarre extra "instruction" I found was:

```
bb xx xx : ZSP $aaaa,y  (sp=sp and $aaaa,y)
                        (.a=sp and $aaaa,y)
                        (.x=sp and $aaaa,y)
```

That's right, the contents of the stack pointer are anded with indexed absolute memory and the result placed in the accumulator, the .x register *and* the stack pointer (ZSP is Zap Stack Pointer). Talk about limited usefulness!

One more point: If assembler modification is contemplated, three-letter mnemonics should be used, since such programs often take advantage of the fact that all standard 6502 mnemonics have three letters only.

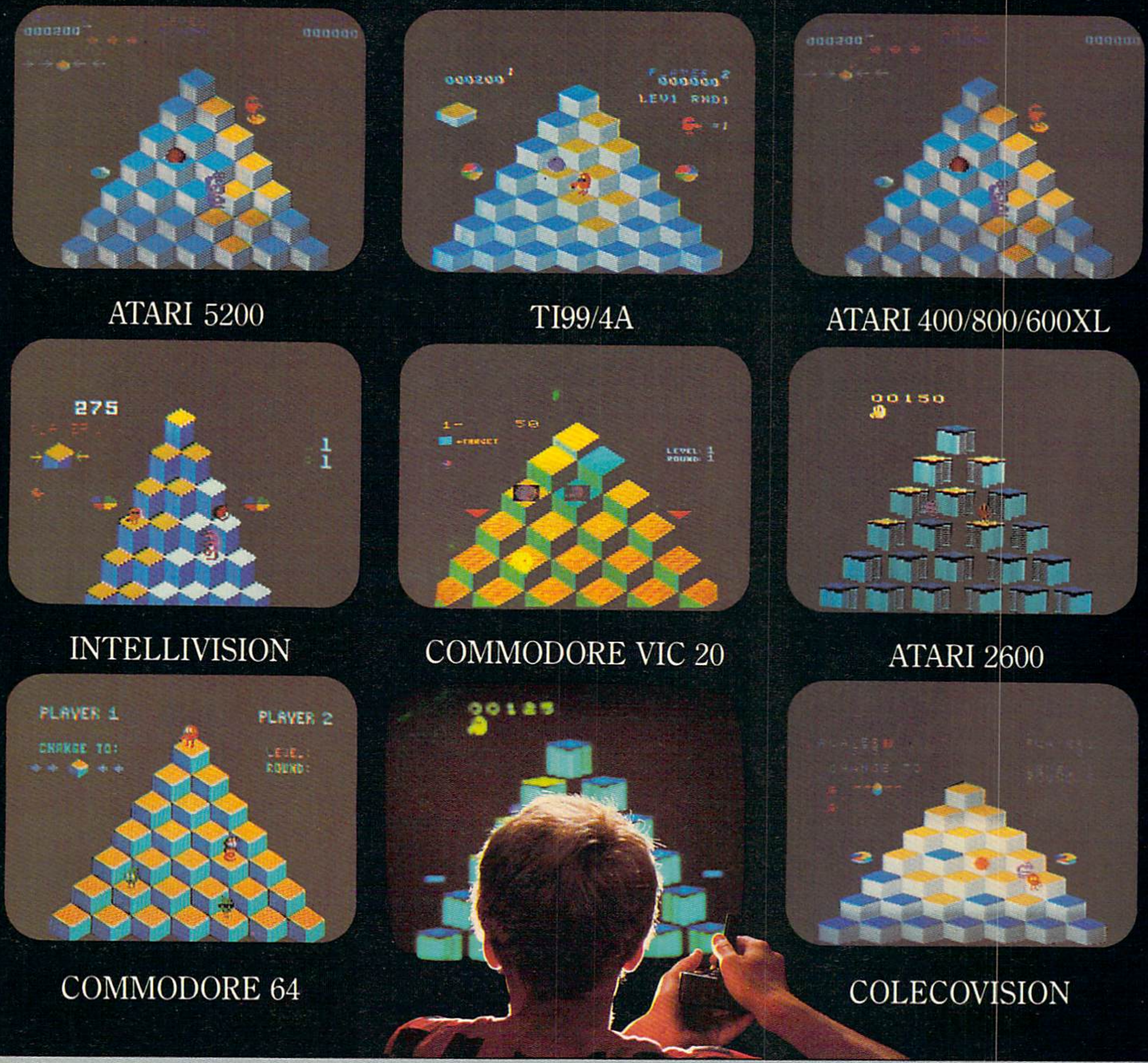
Once again my thanks to Mr. Shepherd for a very stimulating article.

Henry Gibbons

"Extra Instructions" And 6502 Design

Joel Shepherd's article "Extra Instructions" (COMPUTE!, October 1983) was fascinating. Some of these instructions appear quite useful. It must be remembered, however, that the published instruction set for a microprocessor constitutes, in a sense, a "contract" between the maker and the user.

The "extra" opcodes are not guaranteed across design revisions of a chip from one manufacturer, or among separate designs of what appear to be the same chip from different manufacturers. A good example is redesign for less silicon area. The less area, the more chips per wafer and—all else being equal—the more chips per dollar of processing. The redesign might change a microprocessor using a "state machine" architecture—a programmed logic array and register design to a microcoded design—essentially



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a little computer inside the computer. The new chip might meet all published specifications yet be radically different inside. The "extra" instructions might also do something completely different—or nothing at all.

Similar caveats apply to the electrical aspects of microprocessors. Often very interesting things go on internally and in between the defined places on the timing diagrams. The early TI 9900 chips are an example of this. Bitter system designers can even relate mechanical horror stories, like manufacturers deciding to "slightly" move a few pins around on their microprocessor.

With respect to the 6502, it would be interesting to see how many owners of the various home computers with 6502s can use these instructions. My Atari can at least execute the ANDX and thus likely can execute the others.

Brian Converse

64K And Bank Memory For The VIC-20

Recently, I have seen 64K expansion cartridges for the VIC-20. They use something called "bank memory." Since the VIC is expandable only to 32K, how do you get 64K? And what is bank memory?

Robert Bleich

The 6502 microprocessor (the "brain" of Commodore, Atari, and other computers) can access only 64K of memory at one time. Of this total, various amounts are used up by the VIC's operating system in ROM, and by peripheral chips, including the VIC (video) chip. There is a maximum of 32K of space left for user memory (RAM) in a VIC. Some RAM expanders get around this by letting you swap out pieces of your user memory. For example, one 8K block could be replaced by any of four other 8K blocks, giving you 32K of memory in one 8K space. You just bank-select *which of the blocks of memory you want to move into the actual address space.*

Bank selection varies among RAM expanders in several ways: in the size of the blocks, the number of bank-selected blocks, and where the switchable blocks will reside. For example, a 64K device might give you 32K of memory the usual way, then let you switch to an alternative 32K block all at once. On the other hand, it may be configured as eight 4K blocks, two 16K blocks, four 8K blocks, etc. One other thing: You can only take advantage of the 64K from your own programs, as commercial software can hardly be expected to figure out how your cartridge is bank-selected.

Atari Color Explosion

Here's a program that demonstrates all 256 colors on the Atari. It uses GRAPHICS 9 and a lot of display list interrupts.

Thomas Brandner

```
10 GRAPHICS 9
20 FOR A=0 TO 79:COLOR INT(A/5)
30 PLOT A,4:DRAWTO A,191:NEXT A
40 FOR A=1536 TO 1562:READ B:POKE A,
   B:NEXT A:D=PEEK(560)+256*PEEK(561
   )
50 FOR A=0 TO 14:READ B:POKE D+B,143
   :NEXT A
60 POKE 1616,0:POKE 512,0:POKE 513,6
   :POKE 54286,192
70 GOTO 70
80 DATA 72,173,80,6,24,105,16,141,80
   ,6,141,10,212,141,26,208,201,240,
   208,5,169,0,141,80,6,104,64
90 DATA 17,29,41,53,65,77,89,104,116
   ,128,140,152,164,176,188
```

Try this. It's pretty impressive.

Serial Or Parallel?

What is a serial or parallel printer? How can I tell if my printer is one of these or both?

Rajeev Rohtegi

A printer must receive and send data to and from the computer and therefore requires an interface *(a connection which makes two things able to communicate). Most printers have either a serial or parallel interface built-in.*

A serial printer has a single channel and receives one bit at a time—in a series*—from the computer. A parallel printer has a multichannel connection and receives one byte, or eight bits, at a time.*

Parallel printers are faster, easier to use with a variety of software, and can be more expensive. Serial printers often require the user to manipulate certain functions (baud rate, word size, parity, etc.) for compatibility with different software.

There is no simple way of telling which kind you have, but your manual should certainly make it clear.

What Is An RGB Plug?

I have a Commodore 64 and a Data Grade Panasonic Color Monitor (CT-1-300D). The monitor has a video/audio RCA input and an eight-pin female RGB input, which the manual says is for computer applications. The RCA input works fine with the 64, but what is the RGB plug and how do I use it? I've written to Commodore and Panasonic, but to no avail. Can you help?

John G. Laing

The basic principle of black and white television is that a "gun" sprays a controlled stream of electrons across a specially treated screen. When the electrons hit there are light spots, and where no electrons fall the screen remains dark. The arrangement of light and dark patterns forms the image on the screen.

Color televisions are more complicated. Instead of just one electron gun, these TVs have three—one each for red, green, and blue (hence RGB) signals. Instead of

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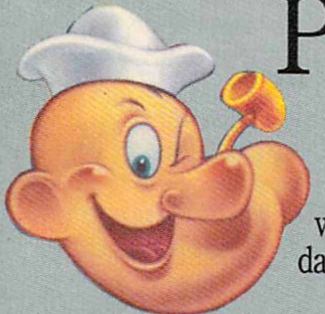

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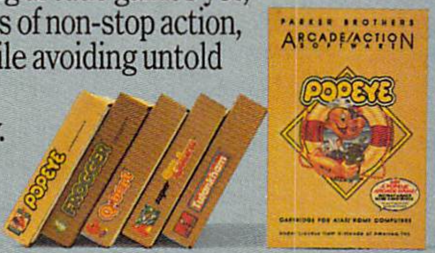


combining into light and dark patterns, the three colors mix to form various hues to produce the multicolor screen image. In a television, and in most inexpensive color monitors, there is only one input signal for all three colors, and the TV or monitor must separate the parts for each gun. More sophisticated (and usually more expensive) RGB monitors allow you to have direct control over each gun. As a result, the picture on such a monitor can be much sharper and more detailed.

Unfortunately, separate red, green, and blue signals are more difficult to produce. So, few home computers have an RGB video output. The VIC-II chip in the Commodore 64, for example, produces only a combined chrominance signal, not three separate signals. Special interfaces are available for some RGB monitors to provide RGB signals from a combined chroma signal, but we're not aware of one for the 64. One other problem—RGB has not yet been standardized. Thus, the plug from a computer might not match the input to an RGB-capable monitor.

Multicolor Players From BASIC On The Atari 400

I own an Atari 400 with 16K. Is there any way to achieve multicolor players from BASIC? Was it described in an earlier COMPUTE! issue?

Gary Resheff

With machine language, you can dynamically change a player's color while the screen is being drawn, but this is exorbitant in terms of the processing time needed. There is a better way, discussed in COMPUTE!'s First Book of Atari Graphics *("The Priority Registers"), in which you can overlay two players to share two colors, as well as have a third color formed by overlapping pixels. This technique was used for a multicolor airplane in the Atari version of the "Air Defense" game (*COMPUTE!*, April 1983).*

VICmodem 1600 And 1650 Differences

What is the difference between the VIC 1600 Modem (VICmodem for VIC/64) and the new 1650 modem? Do they have 40-column screens? If not, do you need a 40-column screen? If so, how do you get one (hardware or software)? I'm eventually going to trade in my VIC for a 64. Are these modems and their software compatible with both the VIC and 64?

Matt Schmidt

The VICmodem (1600) was the first modem that Commodore offered for the VIC and the 64. Because it plugs into the user port, it can be used with both the 64 and the VIC.

The 1650 modem is the new offering available from Commodore for about $100. Because the 1650 is designed to plug into the expansion port, it will only be usable with the 64. The 1650 is an auto dial/auto answer modem that comes packaged with a tape cassette containing the necessary software support, and one free hour on CompuServe.

The format of your screen (40 columns) is not controlled by the modem, and you do not need any special screen software to use either of the modems. It should also be noted that the tele-terminal software available for the 1600 modem is not compatible with the new 1650 modem.

Pascal On The Atari

I know that you can use Pascal on the Apple with only one disk drive. I have an Atari 800 with one disk drive; I heard that you need two disk drives to run Pascal on the Atari. Is it possible to run Pascal on the Atari with only one disk drive?

Tim McWain

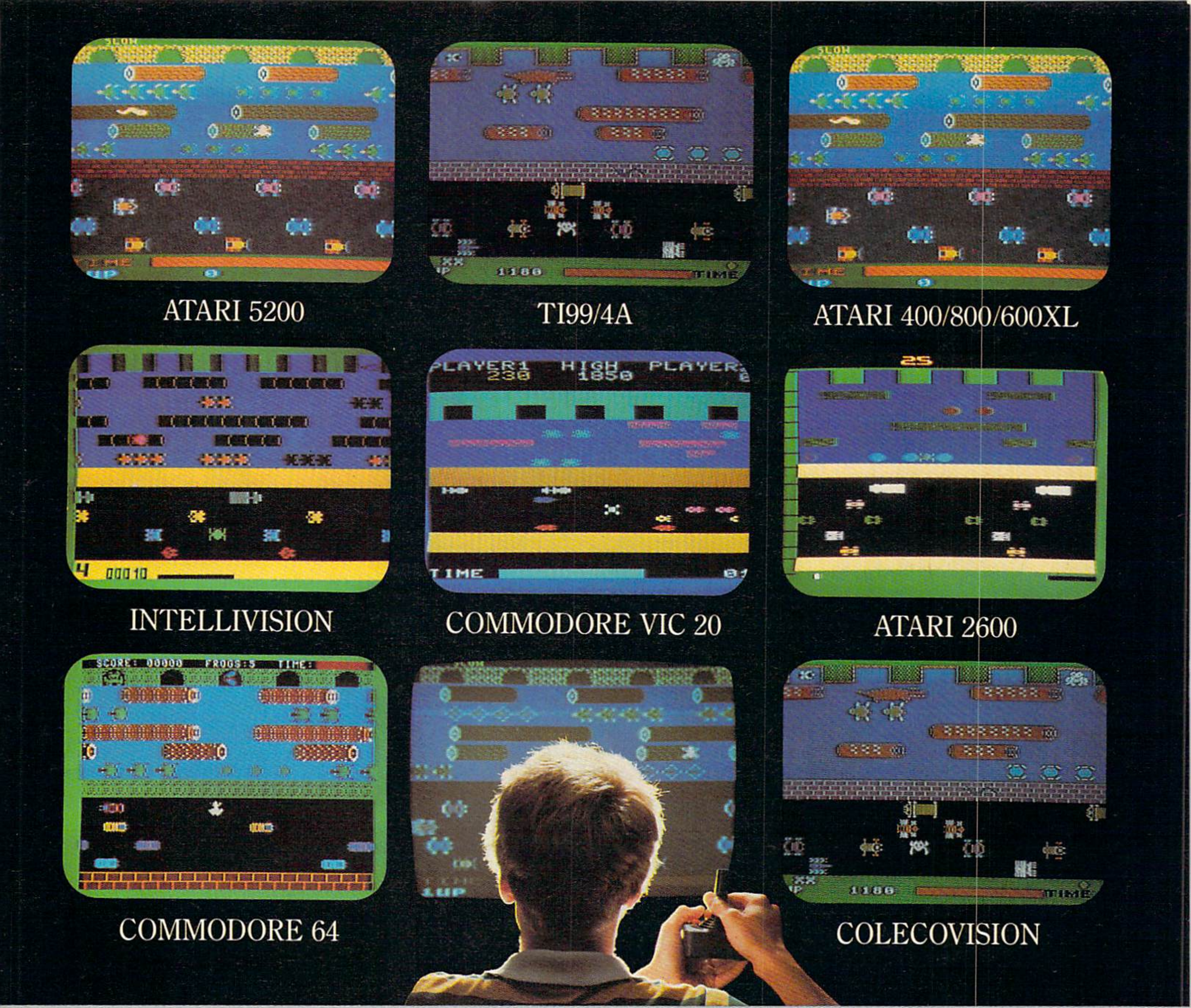
Pascal for the Atari was originally developed for use with the 815 dual-drive, double-density disk system, as it requires large amounts of disk storage for the compiler and compiler work space. Pascal's future looked grim after the 815 was cancelled, but an enterprising programmer managed to modify Pascal so it would go between two drives, with the equivalent of half of an 815 disk on each drive. Both drives need to be accessed during compilation. The Atari and Apple products are not versions of the same product, but Apple Pascal has more disk space to work with per drive (140K versus 90K).

You may be interested in other language alternatives for the Atari. The most Pascal-like is Action from Optimized Systems Software. It only requires 16K and can work with cassette. Other languages include Forth and C, with versions available from several companies including the Atari Program Exchange. PILOT is available from Atari, Inc., and an Atari Logo is forthcoming.

Electronic Typewriters As Printers

I would like to add to the comments made in COMPUTE! (November) about using typewriters as printers. While I have serious doubts about the suitability of a mechanical electric typewriter with solenoids placed over the keys, I know from experience that modern electronic typewriters are perfectly acceptable for use as printers. Electronic typewriters are themselves computers of sorts. The keyboard (input device) is constantly scanned; when a key is pressed, a signal is sent to the logic board (CPU). A typing program, in ROM, enables the printer (output device) to make the desired impression on paper.

Interfaces for electronic typewriters connect between the keyboard and the logic board, al-



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lowing the computer, rather than the typewriter keyboard, to be the source of input; the interface handles handshaking. Most interfaces have a selectable baud rate, line feed enable/disable, form feed, and other useful features. Parallel and serial interfaces are available. Normal typewriter functions are not affected.

All major typewriter manufacturers offer interfaces for their high-end electronic typewriters, but these machines will likely be too expensive for many home users. However, typewriters such as the Olympia Electronic Compact, Swintec 1146CM, Adler Satellite II, Royal Alpha 2001, and the Olivetti Praxis series are available (and already interfaced) for under $1000. Some of these machines might even be available at discount stores. If you already own the electronic typewriter, let the *dealer* install the interface to keep your warranty or maintenance contract active (your maintenance contract rate may rise slightly with the addition of the interface).

The interfaced electronic typewriter provides the home computer user with two machines in one package: an up-to-date electronic typewriter along with a printer with unsurpassed impression quality. It is an alternative well worth consideration.

J. A. Jaynes

Interfacing The Epson MX-80 With A 64 And 1541 Disk Drive

I'm finding that I write longer programs and have grown out of my present computer capacity and need to either expand my existing system or start over. I can get set up with a Commodore 64 for less money than it would cost me to expand my present system. I would like to buy the computer and disk drive, and retain my Epson MX-80 printer. From what I have been able to determine, the disk drive and printer use the *same* RS-232 interface connection on the computer. It seems that each time I want to use the disk drive I would have to disconnect the printer and then, when I'm through with the disk drive, disconnect it and plug in the printer again. Can you help?

George O'Kelley

There is some confusion here about the serial port used for Commodore disk drives and printers, and the separate RS-232 port which is used to add third-party serial devices such as modems, digitizers, plotters, and RS-232 printers. You can attach both a Commodore printer and a Commodore disk drive by plugging the disk's cable into the computer, and the printer's cable into the disk drive via a second connection. This is known as daisy chaining.

Your MX-80 will not plug directly into the Commodore serial port, because that port is not RS-232 standard serial. In fact, the serial port signals are modeled on those of the IEEE port of the PET/CBM models. If your printer has a built-in RS-232 port, you can attach it to the User Port (modem port) with the Commodore RS-232 cartridge. This cartridge performs voltage conversions (the lines coming out of the User Port are at the computer's level—0–5 volts, whereas most serial printers and modems need voltage levels from −12 to +12 volts). If your MX-80 has a Centronics parallel port, there are interfaces available which plug into the disk drive and convert the data from the Commodore serial port into parallel format for your printer. There are some interfaces which convert the User Port into a software-driven parallel port, but this function is separate from the use of the User Port as an RS-232 port.

What Are Sprites?

I recently bought an Atari 800 and I am wondering if it has sprites, and if so, how many.

Paul Mercurio

A sprite is a movable display object. Its shape is different from a character or graphics pixel, due to its independence from other screen activity. A true sprite can pass over any background text or graphics without disturbing the background. It is also usually faster and easier to program than a bitmapped (high-resolution) shape. Machines with sprites usually include features such as collision-checking (have one or more sprites touched each other?) and variable height and width for the sprites.

The Atari 800 has four such sprites, called players, *and four tiny two-bit sprites called* missiles *(the missiles can be combined to form a fifth player). They can each be eight bits (dots) wide, and up to 256 lines high. The use of players is not limited to games. They can also form borders, special tall characters, cursors, or even a checkerboard. Other machines that have sprites are the Commodore 64 (with eight 24 × 21 sprites with multicolor capability), and the TI-99/4A (whose sprites can be moved automatically by the computer).*

Our reference to a game by Michael S. Holtzman and Timothy Baldwin in the October 1983 issue was incorrect. It should have been: Michael S. Holtzman and Mark Kershenblatt.

COMPUTE! welcomes questions, comments, or solutions to issues raised in this column. Write to: Readers' Feedback, COMPUTE! Magazine, P.O. Box 5406, Greensboro, NC 27403. COMPUTE! reserves the right to edit or abridge published letters. ©

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The Future Of Synthetic Music

Richard Mansfield, Senior Editor

Something is about to happen to music. Synthetic music, *synthesizers*—those machines which can sound like entire orchestras at the touch of a button—are becoming inexpensive consumer items. Soon, anyone will be able to afford this powerful musical tool: an instrument which can be programmed (you can make technically perfect music even if you're tone deaf or have no rhythmic sense); can sample and hold any sound via a microphone (you could write a concerto for doorbell and dog orchestra); and can create digital "tracks" in RAM memories (you layer sounds as if you were a one-man band and had rented a professional recording studio).

Anyone thinking of buying a piano or organ for their home now has to think twice. A good synthesizer can offer all the sounds of an organ, plus a harpsichord, drums, piano, and even realistic violins and cellos.

Hal Chamberlin, an authority on computerized music, believes that synthesis-on-a-single-chip technology now has made small and affordable what used to cost thousands of dollars and was very large indeed. The revolution in electronics, which made personal computers possible, is now transforming music.

Synthesizer pioneer Robert Moog predicts that—with a Casio synthesizer already selling for under $100—prices are not going to fall much further. Materials will not go down much in cost. Furthermore, he says that synthesizers will never replace an instrument like the guitar. They won't be as transportable. You cannot sing along with a synthesizer quite the same way that you can with a guitar. Most synthesizers have to be plugged into your stereo amplifier and played through your speakers. That would be hard to set up on the beach.

Some portable synthesizers do contain built-in amps and speakers, but there's always the problem of power. Moog doesn't expect electronic keyboards to simply replace traditional instruments in every situation: "Not until there's a technical breakthrough, which, as far as I know, no one currently foresees. Battery power cannot do that much, but they will replace home organs, electric pianos, etc. They simply have more potential."

A video display of waveforms and a computer keyboard accompany New England Digital's Synclavier II.

The Sound Of The Nineties

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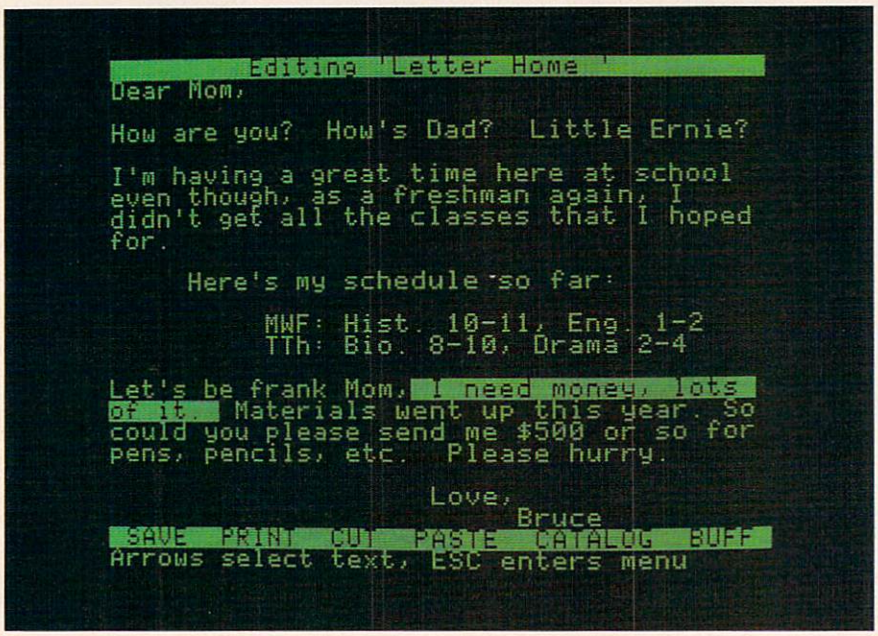

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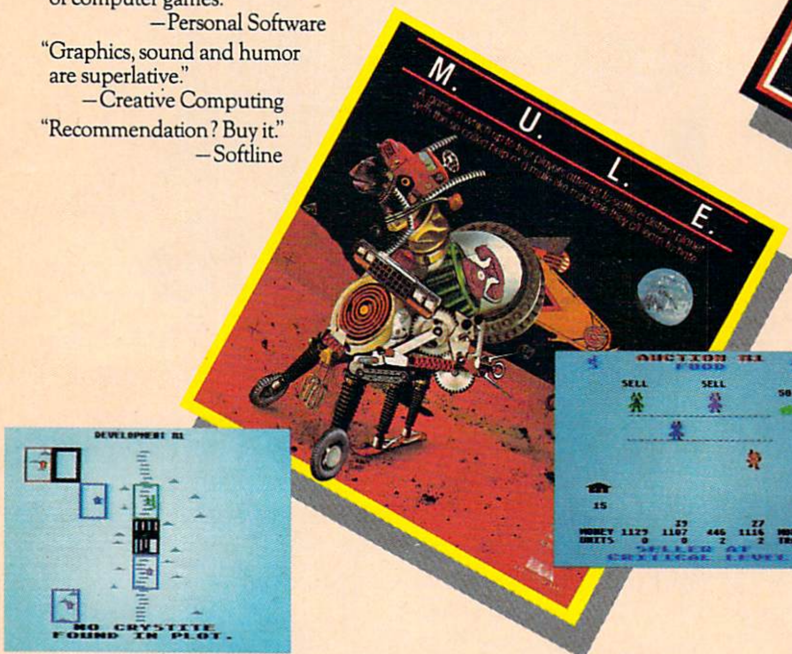

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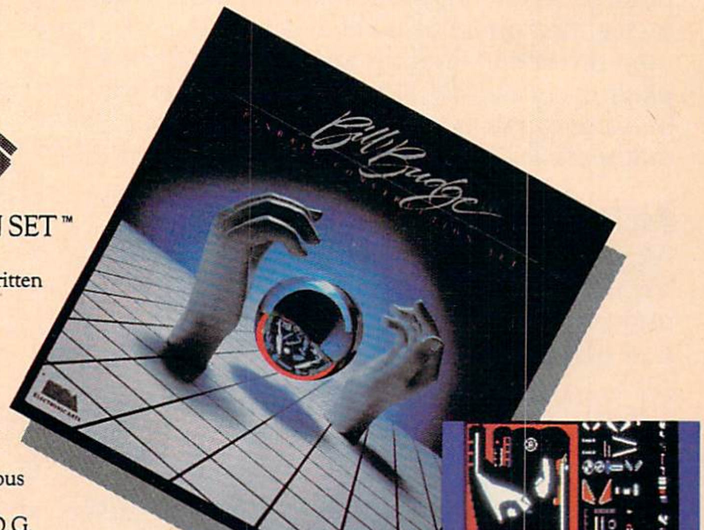

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Home Software for the Commodore 64

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Victims of evolutionary pressure prepare to make music with portable Moog "Liberation" synthesizers.

there will be new "special input devices—maybe a keyboard, an alphanumeric keyboard, special controls. Synthesizers could become so standardized that they all become preset."

Hal Chamberlin looks for keyboards with more freedom, and falling prices for *performance* synthesizers. Synthesizers optimized for performance (as opposed to primarily *programmable* machines) will offer greater expressiveness, a more sensitive response to the player's hands. He's currently working on a keyboard which responds to the velocity with which a key is pressed, the amount of initial pressure, and the secondary pressure deriving from the motion of the fingers—three kinds of sensitivity at once.

Will Alexander is technical manager for Fairlight Instruments, a manufacturer of popular, high-end synthesizers. He sees several important developments over the next few years. For one thing, new technology will make the instruments more complex. They'll have "more memory, smaller packages, more voice generation capability (as in polyphony)." What is now layered sound on an eight-track recorder will be handled in one pass by a synthesizer. And we can probably also expect to hear more synthesizers in video and media applications.

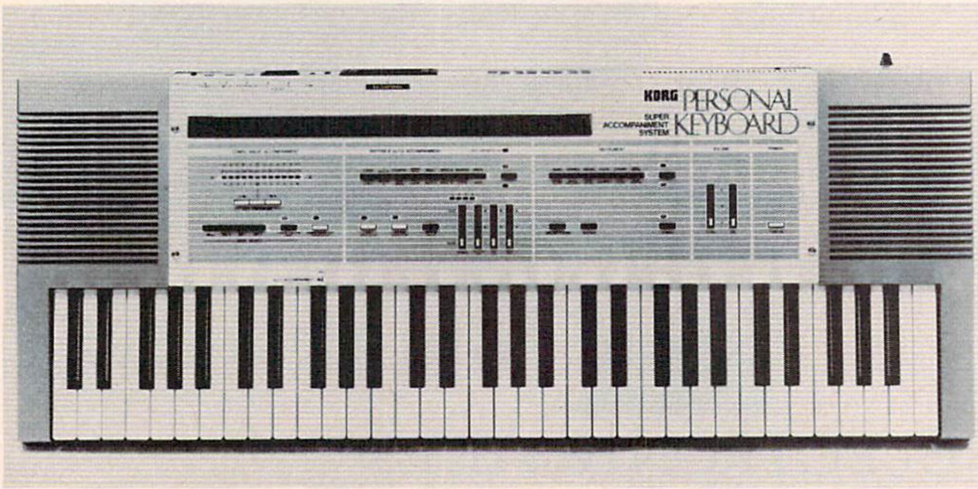
One interesting possibility is direct interfacing to personal computers. That would permit computer-generated graphics that illustrated the music. Alexander also believes that the now common restriction limiting many synthesizers to playing eight notes at once might well expand to 64 voice capability. The computer and its great mathematical capabilities make all this possible.

An Invasion Of Numbers

Although it is at first hard to imagine the music of Vivaldi or The Talking Heads as a collection of numbers and equations, music is very much a part of the current trend toward digitization. And when something goes digital, you can expect to find a computer in there somewhere, keeping the numbers straight. It's a matter of speed, really—if you can sample something fast enough and then assign a number to each sample, you can store it and transmit it with no degradation in quality. Alexander notes that digital has "a transparent sound—it has no characteristics (unlike analog). It only produces what you program it to do."

Perhaps even more important to the creative musician, digitization permits an extraordinary range of sound timbres, rhythms, and harmonies. And while it can take years to learn to effectively play a violin, you can quickly pick up the skills necessary to program an artificial violin. On current analog synthesizers, the string section sounds pretty convincing. On digital synthesizers, you might well be hard-pressed to tell the difference.

Of course, in many areas of modern life, digital is replacing the traditional analog approach. A tiny imitation of a Vivaldi concerto appears as the bumps in the grooves of a typical stereo LP record. The new laser discs contain only numbers. And the laser disc players are dedicated computers which can read those numbers at the rate of 44,000 per second.



Korg's self-contained SAS-20 makes up rhythm, bass, and even chord progressions when you play a melody with one finger.

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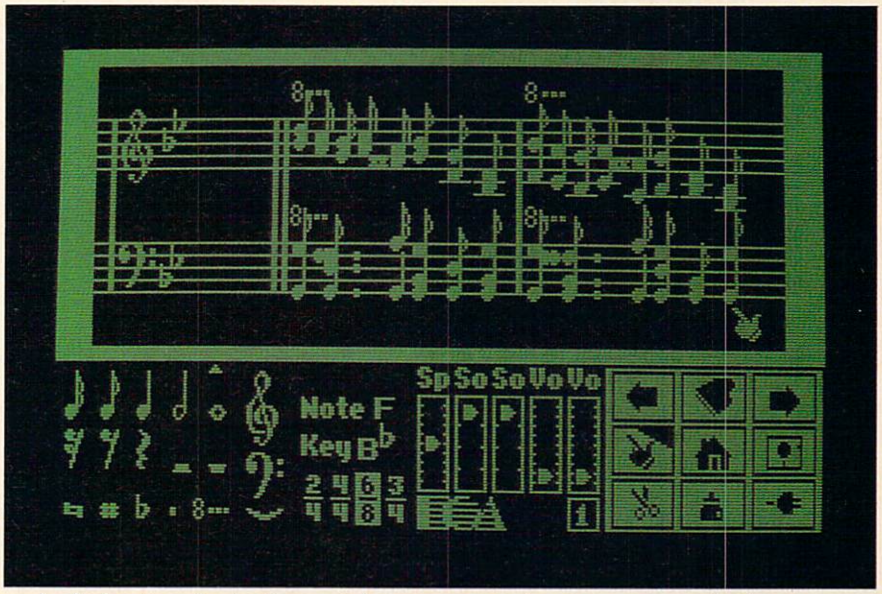
Announcing the first computer music program that actually sounds like music.



LET'S FACE IT. Up till now, music programs for your home computer have all sounded, well, pretty lame. There were the ones that resembled little electronic music boxes, remember? And then there were those that sounded like so many burps.

Enter Music Construction Set.™ It's the first music program that really makes use of the power of that machine you've got. If you're a serious student, this means you'll be able to work with an intricacy and range of sound quality you've never heard before on a computer. And if you know nothing about music, you'll find something even more important. Namely, that this thing is simple enough to be a lot of fun.

Take a good look at this screen because it, you, and a joystick are the whole story here.

That's you at the right end of the staff of notes — the little hand. Move the joystick, and you move the hand. Use it to carry notes up to the staff. Lay in rests, signatures, clefs, then point to the little piano in the lower right and listen, because you'll hear the whole thing played back.

Move those little scales in the middle up and down to vary the music's speed, sound quality, and volume. Use

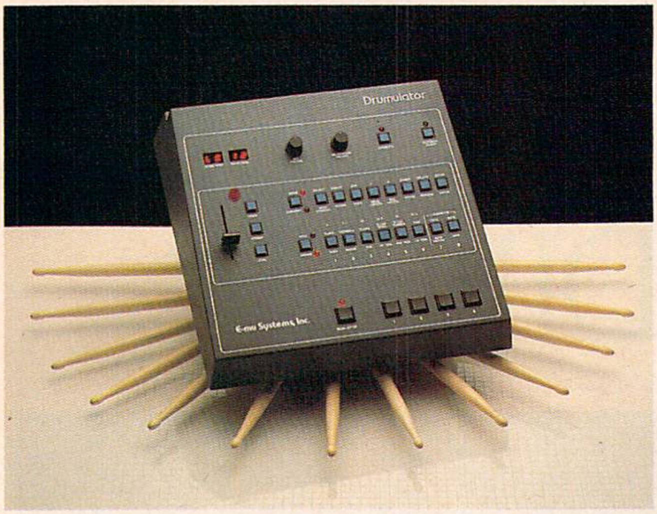
the scissors to cut out whole measures, then use the glue pot to paste them in somewhere else. Got a printer? Great. Print the score out and show it off to your friends.

But what if you're not up to writing your own stuff yet? No problem. There are twelve pieces of music already in here, from rock 'n roll to baroque. They're fun to listen to, and even more fun to change. (Apologies to Mozart.)

The point is, the possibilities are endless. But if you're still skeptical, visit your nearest Electronic Arts dealer and do the one thing guaranteed to send you home with a Music Construction Set in tow.

Boot one up. Point to the piano. And listen.

ELECTRONIC ARTS™



E-MU Systems' Drumulator, containing digitized versions of real drum sounds.

Will Alexander states without equivocation that "digital is the wave of the future in music synthesis." His company's Fairlight synthesizer *is* a computer—it's got BASIC, FORTRAN, a word processor, and a light pen. And soon they're expecting to add the language C. The Fairlight has two microprocessors on the same bus—one for music composition and the other for input/output. He sees the availability and management of memory as a key to future synthesizer designs. At present, the Fairlight implements the concept of virtual memory storage; music can be performed while new music is overlaid in memory.

Most of today's synthesizers are analog. If you want a softer, more woodwind sound on one of these machines, you turn a dial controlling a built-in, filtered waveform until you get close to what you're after. Yamaha has recently introduced a relatively inexpensive digital synthesizer and—like anything digital—it isn't tuned, it's programmed.

Alexander forecasts the death of analog: "Analog has been taken to its limits ... the decisions are made for you." With digital, "the end user specifies the parameters—decisions are made by the user." Using analog, you work with a specific set of predefined harmonies; with digital, you specify the harmonies for the system. This gives the player more responsibility, but also far more freedom. The Fairlight, for example, has no oscillator—the user works directly with the waveform itself.

Playing an analog synthesizer, Alexander says, is like going to a paint store and just buying tubes of colors and supplies. Using a digital synthesizer is far more individual: Like a painter in the 15th century, you work from scratch, making your own paints, creating all your own colors.

Hal Chamberlin agrees, saying that analog synthesis will be dying out over the next several years. The only thing holding back further digital development is the cost and complexity of the technology. He says that the chip technology is already here—it's just a matter of implementation.

Tom Rhea, director of marketing for Moog Music, Inc., finds digital inevitable, but in its infancy. "Digital technology as it appears in musical instruments is not at a mature stage. What technology can do is known. What people need and want is the problem. There's a lot of hoopla over digital. It's another buzzword. For a while it was *polyphonic*, then *programmable*, now it's *digital*. But in ten or fifteen years we'll have digital everything. It's the music of the future."

Analog versus digital "should be a non-issue to a musician. The musician is concerned with 'What does the sound do? How can I manipulate it?' Nobody asks of a piano 'How are you constructed?' They just play and respond subjectively."

Paul Turino, an engineer in the product development division of Unicord, distributors of Korg machines, expects that the coming digital equipment will open many doors for musicians. "We'll see a greater utilization of microprocessor-based units. Presently, a synthesizer such as the Fairlight can record any sound imaginable and process it—as a result of sampling principles. In the future, synthesizers will be able to store more features and handle ten times the amount of routines that they handle now."

Dog Symphonies

You hear Fido howling at the moon. It's a haunting, pleasant sound. You quietly turn on your tape recorder and save the sound. The next morning, you plug the recorder into your synthesizer and *sample* the sounds. A computer inside the synthesizer makes a very accurate, high-resolution analysis of the noise. After that, you can play the howls in any key, add vibrato, decay, echo—whatever you want, to manipulate the sounds into new "instruments." Then layer your invented instruments, harmonize them, bring

A Commodore 64 interfaced to a pair of Prophets from Sequential Circuits.

* Popular Computing, November, 1982

† Apple Softalk, April, 1982

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one to the front as the melody, and you've created a dog orchestra.

Do you like Linda Ronstadt's voice? Sample it from the radio. Drive it through a singing speech synthesizer and you've got the services of a robot songstress at your command. Sampling is the hottest topic in synthesis today and it, too, is an offshoot of the digital revolution brought about by computerization.

You can pull a birdsong from the sky as easily as you could snap a picture of a bluebird in a tree. Sampling is a technique that digitizes a whole sound, says Moog, and any sound imaginable can be used. Fairlight's Alexander also feels that sampling is an extremely important technique, especially in the way it simplifies things for the musician.

It's not necessary to write a computer program to generate and manipulate a waveform. Just offer a sound to the machine and the computer figures out the equations for you, synthesizes the waveforms, and suddenly Linda or Fido is waiting inside the instrument. You can concentrate on writing a song for them because, as Alexander points out, with sampling there are no mathematics for the user to bother with.

To The Limits Of Your Talents

Tom Rhea sounds a cautionary note. Though synthetic music has great promise, he wonders if it will be abused. Playing the violin well "involves neuromuscular skills, technique, hours of time. With a synthesizer we just press buttons. Because we can do this, is this what we *should* be doing? Electronic instruments are dangerous—you can do so much for so little. With synthesizers it's easy, easy, easy to play badly. Everyone can play, sure, but can they play it well?"

Of course, this argument was raised by painters when the camera was invented. Eventually, photography became an alternative art form.

The computerization of music will—like any technology—have its drawbacks. But most people will welcome the exhilarating possibilities offered by these new, powerful music machines. There's something to be said for an instrument which lets you go quickly to the limits of your talents without having to spend years studying before finding out just how good you might be.

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Robots That Roll, Crawl, And Bounce

Fred D'Ignazio, Associate Editor

The World Headquarters For Robots

Where is the world headquarters for robots? Is it in Japan, England, the Soviet Union? Probably not. It's probably right here in the United States at the Robotics Institute. The institute is part of Carnegie-Mellon University, in Pittsburgh, Pennsylvania.

The Robotics Institute was established in 1979. Eighty scientists and engineers and over 60 students work on the institute's multimillion-dollar projects to invent new, advanced computers and robots. The institute's 17 corporate sponsors watch the research closely. They are hoping the scientists and students will invent robots and computers that their companies can use in their business.

A Robot That Crawls

All the robots at the institute are exciting, but the most interesting robots are the ones that move. There are three types of mobile robots: a wheeled robot named Rover, a six-legged robot that crawls, and a couple of bouncing robot pogo sticks.

The crawling robot is one of the first six-legged robots (or *hexapods*) in the world. Earlier hexapods were built in Japan and in the U.S. And there is even an octopod (an eight-legged robot), built by scientists in the Soviet Union.

In order to walk, the earlier hexapod robots divided up their six legs into two tripods of three legs each. To take a step they would raise three legs. To keep from falling they would keep three legs on the ground (in the shape of a triangle—or tripod). In this way, the hexapod could move, but it didn't need to maintain its balance since it always had three legs on the ground.

The institute's hexapod robot can walk using the tripod method. But it is capable of using other methods as well. Its inventor, Ivan Sutherland, studied the motion of several animals, including four-legged horses and six-legged insects. He programmed the robot to use some of the same patterns that real animals use.

Each of the six legs on the robot has its own microcomputer to control the leg. The computers communicate with each other and with a central supervisor computer to make sure the robot accomplishes its main objective: crawling. Without the computers working together, the robots' six legs would become jerky and spastic. Instead of walking it might begin doing deep knee bends or keel over.

A human can ride Sutherland's hexapod. Even though the robot has lots of little computers to help it walk, a human can do some important things to help the robot get where it's going. The rider can adjust the *attitude*, or tilt, of the robot so it won't tip over on hillsides or rocks. He can adjust the robot's clearance so that the robot doesn't scrape its tummy on sharp stones, tree branches, and other objects it passes over. And he can help the robot decide where to place its feet. This is especially important when the robot is walking near a hole, next to a cliff, or beside a puddle.

However, the most important reason to have a human ride on the robot is not to help it walk. It's to use the robot as an intelligent, legged jeep or land rover—to get somewhere that no wheeled vehicle could reach.

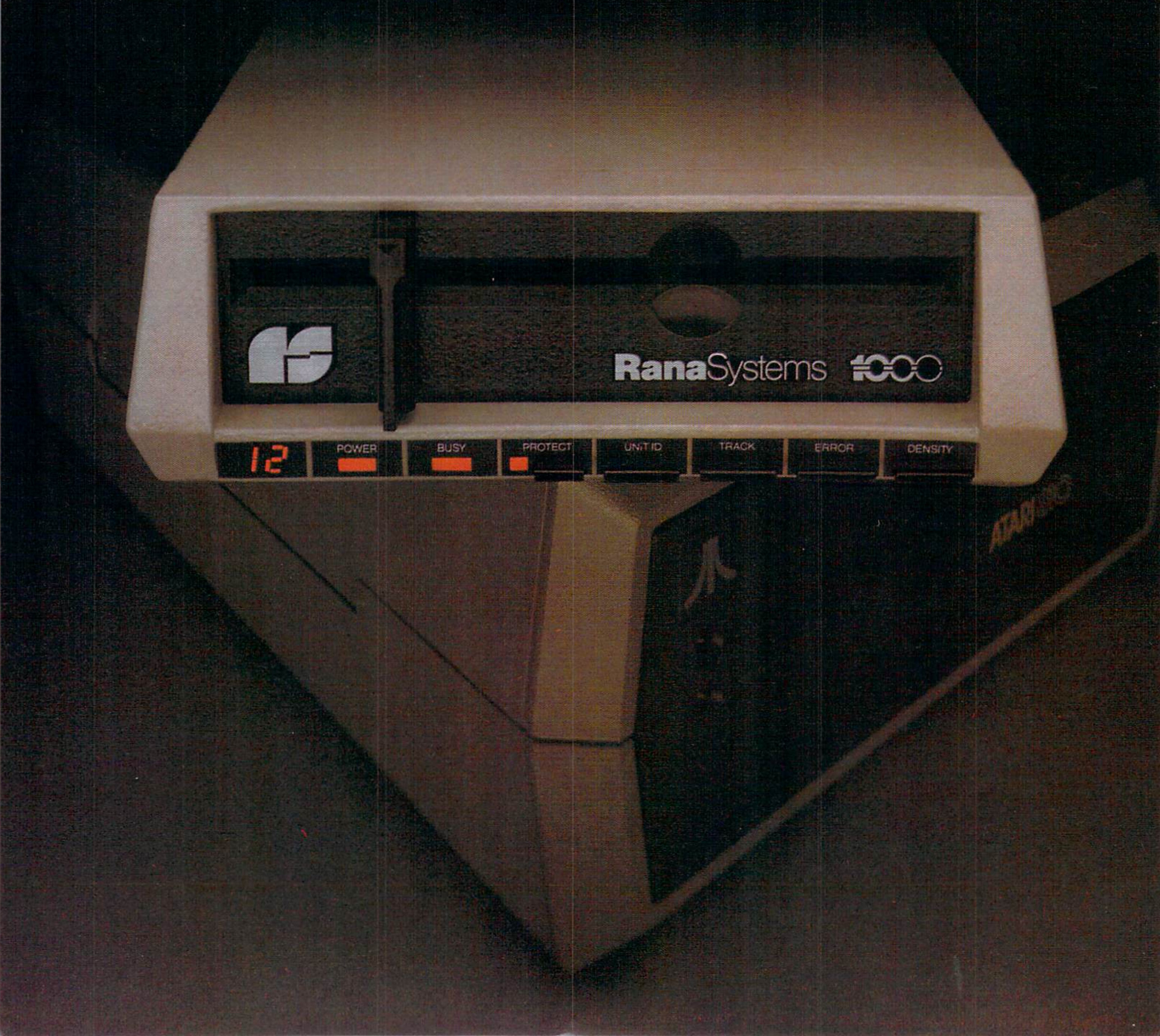
But don't expect to get there fast. Sutherland's hexapod travels at only two miles per hour.

A Robot That Bounces

Perhaps the strangest robot at the institute is Marc Raibert's bouncing pogo stick. The robot has no arms or head, only a body and a leg—*one leg*. The leg keeps its balance and moves forward by hopping, just like a kangaroo.

Raibert built the robot (or *monopod*) to help him study how creatures balance themselves. The

We just made owning an Atari computer a lot more logical.



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A New Age Of Discovery

Someday, maybe 10 or 20 years from now, an exciting new Age of Discovery will begin. It will be comparable to the 1400s, 1500s, and 1600s, when European explorers spanned the globe. Yet most of the explorers this time won't be people, they'll be robots. Many of the robots will be descendants of the rolling, crawling, and hopping robots being developed at the Robotics Institute.

Today's robots are not very intelligent. Their senses are primitive, and their movements are jerky and limited. A robot "explorer" of today might not be able to find its way out of your bedroom.

But tomorrow's robots will be different. They will be smarter, more agile, and have advanced vision, hearing, touching, and other senses. They will still not be as sharp as a human being, but they will be far sturdier. They will be fabricated out of metal, durable plastic, and crystalline graphite. The robots will be able to survive in the extreme cold, the killing vacuum, and the awful radiation of outer space. They will be able to withstand the tons of pressure and cold, numbing water beneath the seas and the extreme heat under the earth's surface. They will go where no man or woman has gone before.

They will work in mines and factories on the far side of the moon, on Mars, on the moons of Saturn and Jupiter, in the Asteroid Belt, and in deep space.

They will dive to the bottom of the ocean, perform salvage operations on sunken ships, and mine and farm the ocean floor.

They will shrink down to microscopic size and become the eyes and fingers of surgeons as they travel on a fantastic voyage inside a person's veins, arteries, stomach, or lungs.

They will work in dark, dirty mines far beneath the ground, in erupting volcanoes, nuclear power plants, and amidst shrieking hurricanes. They will travel along miles of labyrinthine air ducts, sewers, and oil pipelines that are too narrow or too hazardous for human beings.

Robots will also work with human beings as their expert helpers and companions. Human beings and legged robots will scale tall mountains together, inspect and guard pipelines across the Arctic tundra, journey to the South Pole and through the unmapped interior of the Amazon jungle.

first version of his robot can fall down in only one direction since it is supported by a cushion of air blown out of a tilted wall to one side. A new version of the robot, now being built, will resemble a pogo stick wearing a bicycle helmet. The new robot will be able to balance entirely on its own.

It will be some time before one-legged, bouncing robots can leap tall buildings in a single bound. But Raibert's robot has already shown that it can leap onto curbs and over six-inch stacks of blocks.

The robot maintains its balance, even while jumping, by paying attention to a group of *sensors* (electronic senses) that send it information about its speed, the length and angle of its leg, and the texture and tilt of the surface it is hopping on.

The leg does not have its own onboard computer. Instead it functions on a "leash," an electronic tether attached to a high-speed computer in the lab. The robot's cord is actually more like an umbilical cord than a leash since the cord pipes in compressed air and pressurized oil, along with computer instructions. The robot uses the compressed air to power the leg and jump; it uses the pressurized oil to adjust the angle of its hips and leg to maintain its balance.

Sutherland's crawling boat and Raibert's bouncing pogo stick are a far cry from the walking robots in the *Star Wars* movies. But they are forerunners of robots of that size and complexity. Compared to factory robots that are bolted to the floor, these first legged robots are a great step forward.

The Robot Rover

There is another exciting robot at the Robotics Institute. It moves on old-fashioned wheels instead of legs. But it is one of the most advanced robots anywhere in the world. It is Hans Moravec's mobile robot Rover.

In shape and size, the Rover is a distant cousin of R2-D2. But it has more the appearance of a small barrel than that of a movie superstar. It is approximately one meter high, rests on three independently computer-controlled wheels, and is 50 centimeters in diameter. It is powered by six lead-acid batteries.

Atop Rover's head is a small model railroad track. On the track is a video camera resting on a little cart. The camera is Rover's lone "eye." But its eye can move up and down the track, swivel back and forth sideways, and tilt up and down.

How to get in touch

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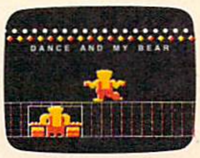
Paint the screen with colorful graphics or play lightning-fast games with just a touch of your finger. The KoalaPad™ Touch Tablet makes using your computer more fun than ever before. Just moving your finger across the special touch-sensitive surface controls graphics, game commands, and much more. It's a great way to get the most out of your computer while you just sit back and

with your computer.

relax. The KoalaPad fits comfortably in the palm of your hand for easy use. And once you have it in your hands, it's hard to put down. That's because the KoalaPad does much more than joysticks, paddle controllers or the "mouse." Each KoalaPad set is packaged with a KoalaWare™ graphics program* for creating beautiful, high-resolution graphics right on the screen. And that's just the beginning.



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*Software included with Touch Tablet varies with computer type.

With a quick signal from one of Rover's computers, the robot can swing its eye around and see in any direction.

Rover's guidance computer gets much of its information from the digitized patterns sent to it by the video camera. These patterns consist of tiny squares of light and shadow transmitted by the camera and translated by the computer into electronic bits of information. Together, the light and dark squares might represent a chair directly in front of Rover, or a person's knee. Rover's vision computer tries to decide which.

Rover has other ways of obtaining information about its world. It has an infrared sensor that detects the heat given off by different objects in the room. This sensor warns Rover if there is any danger of crashing into something.

And it has a bat-like sonar device that transmits a high-frequency sound wave, bounces it off a nearby object, and catches the wave when it returns, like a boomerang. A special *proximity* computer calculates how long it took the wave to make its complete trip. The result of this calculation is a new tidbit of information for Rover's guidance system. Now it knows how far it is from nearby objects. This enables it to plan how to get where it is going based on where it is now. It steers clear of any obstacles in its path.

Rover's 15 onboard computers let it do a lot of thinking on its own. But it still needs the help of a high-speed computer nearby to process the millions of bits of information that flood into its system from the TV camera. It sends this information over a UHF (Ultra-High Frequency, TV-like) channel. It gets the digested visual information back by way of an infrared wave transmitted by the computer. The infrared and UHF signals give Rover a lot more freedom. It can move about its world without being tethered by a wire to the computer (like the robot pogo stick). Robots with wires are somewhat free, but they often end up like a dog tied to a leash in the backyard—all tangled up.

One of the most interesting things about Rover is its control program, or rather its "orchestra" of programs. Rover's chief program is called the *conductor* because it coordinates all the other programs running on all the other computers. It must keep all the programs working in harmony, or Rover would crash into walls, fall off ledges, or maybe even stop working from total confusion.

Rover uses an electronic "blackboard" to keep from getting confused. The blackboard handles all the messages sent by each computer to the central conductor computer and to all other computers. A special computer (a high-speed Motorola 68000 chip) stores the blackboard in Rover's memory. As new messages flash in, the computer posts them on the blackboard to share with all the other computers. This way, anytime one of Rover's computers wants information—say, on what Rover sees, or how far its wheels have turned, or what its current destination is—the computer just has to check on the blackboard.

Rovers Of The Future

Rover's inventor, Hans Moravec, had to wrestle with hundreds of problems every day, just to design Rover and build it from scratch. He had to worry about the type of motors used inside the Rover (brushless), the number of computers to include (15), how to program the computers (using a "blackboard" system), and how to send signals from the main computer to the Rover's onboard computers (by UHF and infrared signals).

Yet Moravec never loses sight of his long-range objectives. His current Rover is a prisoner of the laboratory. It couldn't survive in the real world just outside the laboratory door. But the Rover's descendants will venture far beyond the laboratory—deep under the ocean, down beneath the earth's surface, and far out into the unexplored reaches of the solar system and beyond.

Moravec is already designing new, improved Rovers of the future. And he is busy planning all the exciting things they will do. ©

Report On

IBM's New PCjr

Tom R. Halfhill, Features Editor

After months of incessant speculation and rampant rumors, IBM finally unveiled its new home computer in New York on November 1. The PCjr (code-named "Peanut" before its introduction) will be demonstrated at IBM dealers in December and available sometime in January. This report is a firsthand look at the machine which industry observers predict will be a significant development in the evolution of the home computer industry.

Never before in the history of personal computing (admittedly a brief history) has a product been so eagerly awaited by so many. The rumors of a forthcoming IBM home computer started more than a year ago, and every week seemed to bring another theory about what the computer would be like. Many of these theories contradicted each other. IBM stubbornly refused to confirm even the existence of such a machine, but nobody let that slow them down.

On one subject everyone seemed to agree: The introduction of a home computer by IBM—the company which is virtually synonymous with computers—would be a turning point in the history of the personal computer industry. First, there was IBM's traditional domination of the mainframe industry. Second, there was the phenomenal success of the IBM Personal Computer, which by itself has spawned a whole subindustry in PC compatibles, look-alikes, and add-ons. And third, since IBM's research and development budget is larger than the budgets of some small nations, there were high hopes that IBM would deliver a revolutionary machine that would reinvent the home computer.

After all these expectations, perhaps it's inevitable that the PCjr is a bit less than what some people expected for the money. But there seems little doubt that it will indeed be a commercial success and exert a major impact on home computing.

Truly A Junior PC

Much can be grasped from the name "PCjr," favored by IBM over the more flippant code name "Peanut."

Once you get past the obvious cosmetic differences, the closer you look at the PCjr, the more it resembles the full-grown PC. Rather than designing the PCjr from the ground up, IBM chose to start with a PC and scale downwards. In almost every sense, the PCjr is truly a junior PC. It is apparent that one of IBM's overriding design considerations was to retain as much compatibility as possible between the PC and PCjr, while protecting the PC's business market against competition from the PCjr. These considerations explain both the PCjr's capabilities and its limitations.

To preserve compatibility, both computers share the same 16-bit microprocessor chip for their Central Processing Unit (CPU), the Intel 8088. The floppy disk drives, disk format, and Disk Operating Systems (DOS) are virtually identical, so disks are completely interchangeable. The fundamental keyboard functions are the same. The BASIC languages are generally compatible. And the internal operating systems, too, are virtually identical. The PCjr even looks like a downsized PC, with a main "System Unit" and remote keyboard.

As a result, a very large proportion of existing PC software will run as is on the PCjr. In fact, according to IBM, about the only programs that won't work are those which exceed the limitations imposed on the PCjr as a scaled-down PC—mainly memory limitations and the single disk drive. Although the 16-bit CPU can address up to 1000K (one megabyte) of memory, IBM has limited the PCjr to a maximum of 128K addressable RAM. There are also no provisions for adding more than one disk drive. Therefore, any PC program which fits in 112K (video subtracts 16K overhead) and requires only one drive should run without modification on the PCjr.

Two Basic Models

IBM plans to market two configurations of the same basic computer, although the higher model is expected to account for at least 80 percent of sales. The only difference is that the upper model comes with twice as much memory, a built-in disk drive, 80-column video capability, and (of course) a higher price tag.

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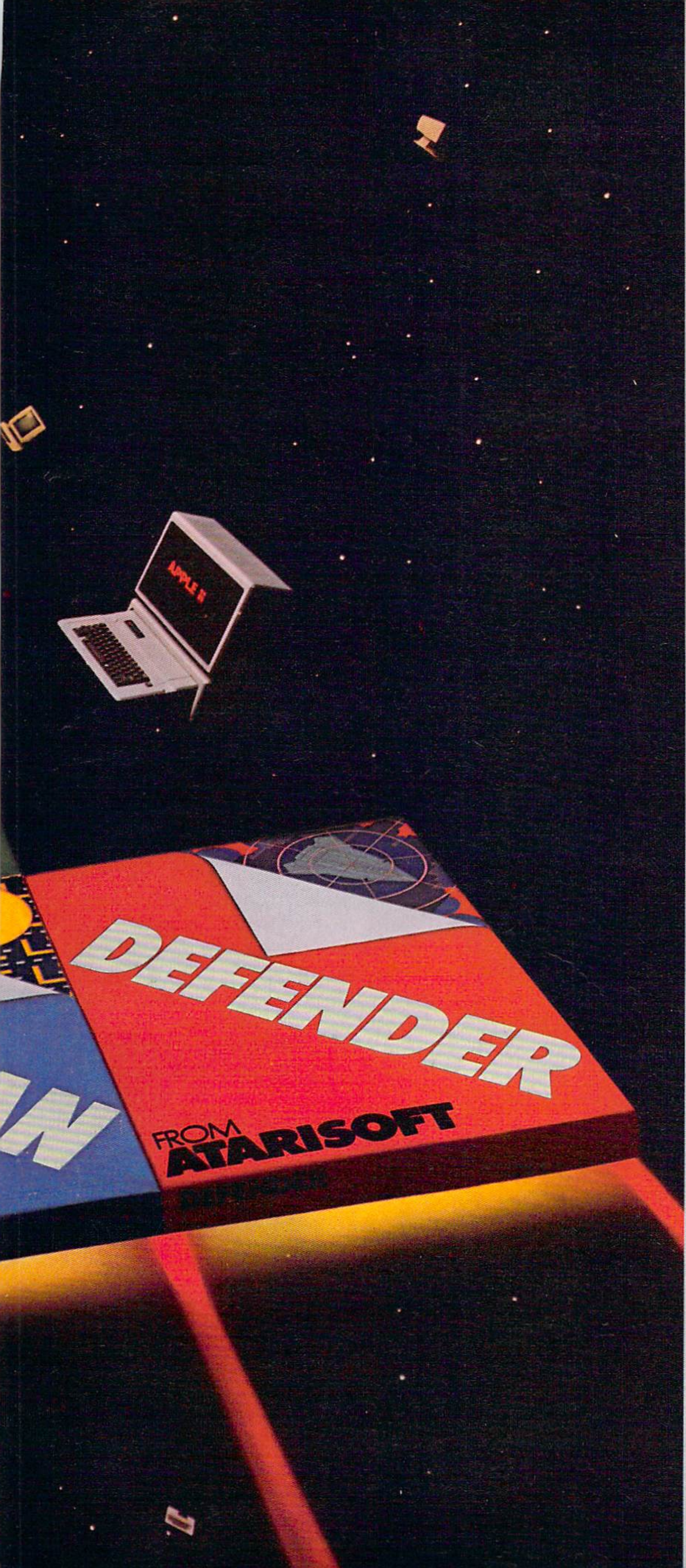

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ASM 3

The Entry Model can be upgraded to the Expanded Model by adding the 64K RAM/80-column video board ($140) and disk drive ($480).

The PCjr Entry Model, as it's called, retails for $669. It consists of a box-like System Unit (the actual computer), a remote cordless keyboard, and an external power transformer. The System Unit contains all the main circuit boards and chips, including 64K RAM and 64K of Read Only Memory (ROM). The 64K ROM includes a built-in Microsoft BASIC (referred to by IBM as "cassette BASIC"); the computer's main operating system, called BIOS (Basic Input/Output System); a self-testing diagnostic program activated when power is first switched on; and "Keyboard Adventure," a program which uses graphics to acquaint newcomers to the keyboard.

Like all home computers designed to work with ordinary TV sets, the Entry Model is limited to a 40-column-wide video display. An external RF modulator is required and costs $30 extra.

The Entry Model is designed to use cassettes for storing programs and data. Any standard, good-quality cassette recorder can be connected to the PCjr with an optional $30 cord. PC and PCjr cassettes are compatible. The data transfer rate is variable, but averages about 1200 baud (somewhat faster than a Commodore or Atari cassette recorder).

The PCjr Expanded Model ($1269) is identical except for an extra plug-in board which adds 64K RAM (for 128K total); switchable 40/80-column video capability (monitor required for 80 columns); and a double-sided, double-density 5¼" floppy disk drive built into the System Unit. The drive stores up to 360K per disk. The PCjr uses DOS 2.1 (available for $65), a slightly modified version of the current DOS 2.0. The Expanded Model also comes with two disks, "Exploring the PCjr," a tutorial, and "Your IBM PCjr Sampler," a collection of sample home application programs.

L For Later

Both versions of the PCjr have these features in common: two front-facing slots on the System Unit for plug-in program cartridges; an internal slot for a direct-connect, 300-baud modem card ($199); a serial port to which standard RS-232-C serial devices can be attached with an adapter cord ($25); rear connections for two analog-type joysticks ($80 per pair); light pen input; audio output jack; and outputs for both composite video and RGB (Red-Green-Blue) direct-drive video monitors. There's also an unused jack reserved for future expansion (labeled "L" for "Later," explained an IBM spokesman).

To add a parallel printer port, a snap-on interface ($99) attaches to the side of the System Unit. Internally, the PCjr System Unit has three slots: one for the modem card, one for the 64K RAM/80-column video board, and another for the disk drive controller card. The last two slots, therefore, are already occupied in the Expanded Model.

Infrared Keyboard

The most innovative feature of the PCjr is its cordless remote keyboard. Two tiny infrared "light bulbs" poking out the rear of the keyboard establish a remote link with an infrared sensor in the front of the System Unit. The lightweight (25-ounce) plastic keyboard, powered by four AA penlight batteries, can be operated up to 20 feet away from the System Unit. As long as the keyboard remains in line-of-sight of the System Unit, and within approximately a 60-degree arc of the infrared sensor, there are no clumsy cords to bother with. Keystrokes register on the screen reliably and instantly.

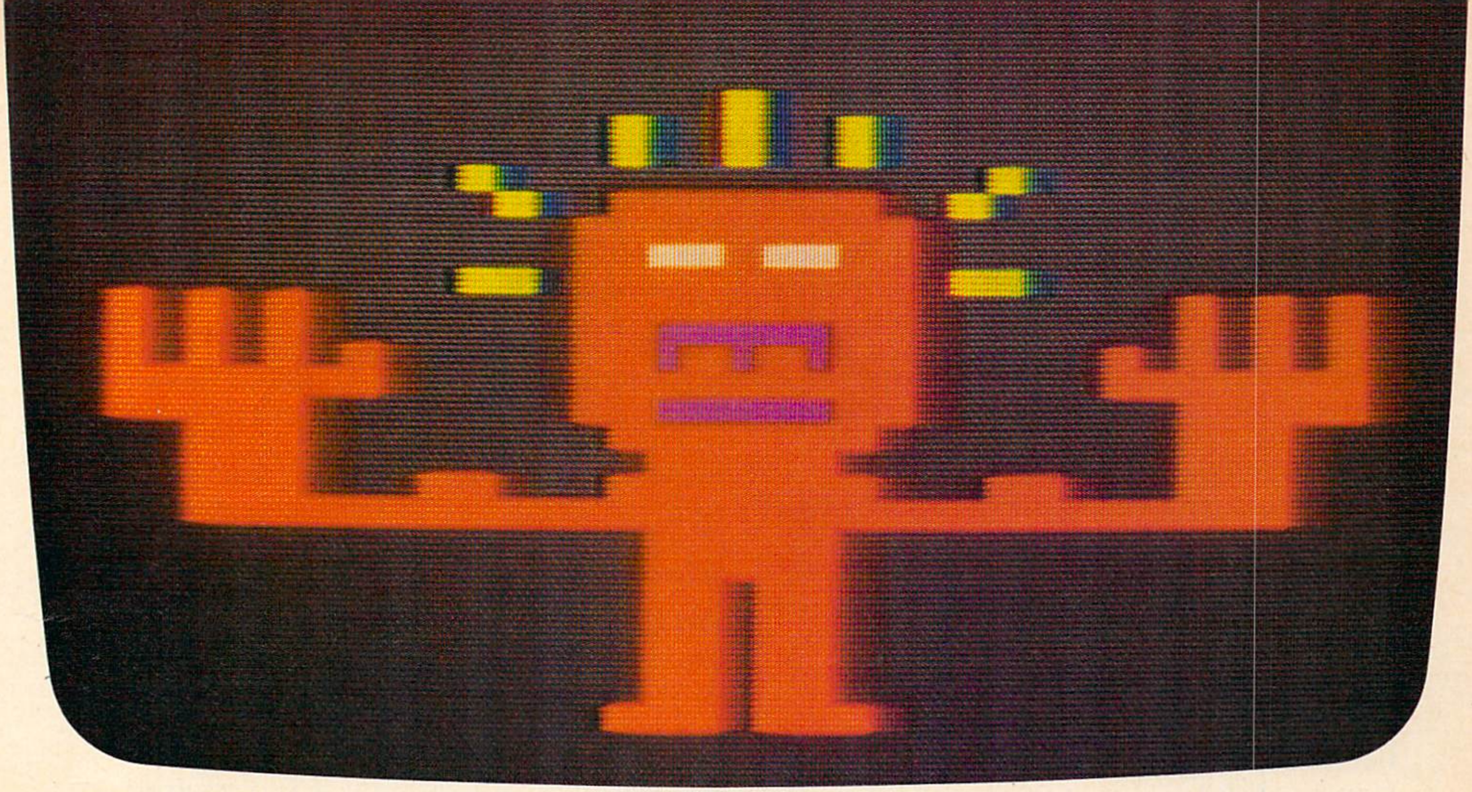
The PCjr constantly checks this invisible link and sounds a beeper if it's interrupted—for example, if someone walks between the keyboard and System Unit. IBM says the keyboard batteries should last for months with normal use. When they do begin to fail, the beeper will warn that keystrokes are not registering properly. Battery failures cannot erase programs or otherwise affect the computer.

If another PCjr is operated nearby, the keyboard can be hooked up to the System Unit with an optional cord ($20) to keep them from interfering with each other. (Incidentally, IBM says the PC keyboard is not compatible with the PCjr.)

Aside from its cordless convenience, the PCjr keyboard itself is somewhat disappointing for a computer in its price range. Perhaps to encourage some people to buy a PC instead of a PCjr, the PCjr keyboard consists of 62 small, flat, plastic calculator-style keys, similar to the so-called "chiclet" keyboards found on low-end home computers. It feels much like a TRS-80 Color Computer keyboard, except the keys are rectangular instead of square.

Also, the keycaps are totally blank—all the lettering is squeezed onto the keyboard surface between the keys. The lettering is crowded and difficult to read in places because some keys have multiple functions. For example, the PCjr lacks the ten special function keys found on the PC. Instead, the PCjr combines the special function keys with the numeral keys, accessed by first pressing a CONTROL-type function key. The PC's separate numeric keypad also is eliminated on the PCjr. However, the PCjr retains the four cursor keys arranged in a handy diamond pattern.

The PCjr's calculator-style keyboard does allow keyboard overlays, not possible on regular typewriter-style keyboards. Since the entire keyboard is redefinable, you can program any



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Color, Graphics, Sound

To keep things as compatible as possible, the PCjr's sound and graphics are basically the same as those on a PC equipped with a color graphics card. The PCjr does have additional color graphics modes and sound capabilities, but they require a $75 extended Microsoft BASIC cartridge to access. The 32K cartridge plugs into one of the two front slots on the System Unit and adds numerous graphics and sound commands.

Without the BASIC cartridge, the PCjr Entry Model has two high-resolution graphics modes: 320 × 200 pixels with four colors, and 640 × 200 pixels with two colors (the latter mode requires a monitor for legible resolution). Sound consists of a PC-type beeper (similar to the Apple II) and a second internal alarm beeper. The System Unit actually contains a more sophisticated sound chip, but the standard BASIC lacks the sound commands to use it.

Adding the BASIC cartridge to the Entry Model allows access to a medium-resolution graphics mode (160 × 200 pixels with 16 colors) and the sound chip. The sound chip has three tone generators covering seven octaves for music, plus white noise for sound effects, with 16 volume levels (similar to the Commodore VIC-20).

The PCjr Expanded Model offers more colors in the high-res graphics modes: 16 colors in the 320 × 200-pixel mode, and four colors in the 640 × 200 mode. The commands WIDTH 40 and WIDTH 80 switch between the 40- and 80-column text modes.

All of the graphics modes can display any of the PCjr's 16 colors, within the limits explained above. IBM says the PCjr has no sprites (also known as player/missile graphics) for animating objects on the screen. However, some animation is possible via "screen flipping"—drawing an alternate screen in memory while another screen is being displayed, then flipping instantly to the second screen.

A Luxurious BASIC

Thanks to the PCjr's Microsoft BASIC, it should be fairly easy to convert straightforward BASIC programs written for other computers to the new IBM. Some commands, such as CLS for "clear screen," resemble TRS-80 BASIC keywords.

It's also a very luxurious BASIC. Most home computers, including the Atari and Commodores, have 8K BASICs in ROM (Applesoft is 12K). IBM says the PCjr's built-in BASIC is 32K long, and the extended BASIC cartridge adds another 32K. This huge BASIC includes commands that are separate utilities on most other home computers, such as RENUM, for renumbering BASIC program statements; DELETE, for deleting ranges of BASIC lines; TRON (Trace On) and TROFF (Trace Off), a powerful debugging tool which lists line numbers on the screen as they are executed; FILES, to list the disk directory; and KILL, to scratch disk files.

Because of the 16-bit CPU's megabyte of address space, it was possible to add this large BASIC without mapping out any RAM. BASIC uses only a few kilobytes of RAM for overhead. However, IBM says the BASIC cannot address more than 64K, even in the 128K Expanded Model PCjr. The Expanded Model with cartridge BASIC leaves only 60130 bytes free for BASIC programming. The 64K Entry Model, without adding cartridge BASIC, has about 45K free.

An Open Computer

IBM says the PCjr is an "open architecture machine," meaning that full technical information will be available to independent software/hardware developers and users. This is to encourage third-party software and accessories. Expect to see a busy market in replacement keyboards, multiple disk drives, combination boards to make the most of the PCjr's three internal slots, and possibly expansion beyond 128K RAM.

IBM has a few peripherals of its own ready, plus some home software written by outside companies (albeit wrapped in IBM packaging). Besides the joysticks and modem card, IBM introduced a PCjr carrying case ($60) and the IBM PC Compact Printer ($175). This is an 80-column thermal printer, friction or tractor feed, which prints at 50 characters per second.

IBM says the PCjr will be sold only at IBM Product Centers and authorized IBM dealers, not mass-marketed through department stores and discount chains like other home computers.

Because of its narrower distribution, and also because of its much higher price, it seems likely that the PCjr will split the home computer market into two levels. With Texas Instruments off the scene, Commodore and Atari will battle for domination of the low-end market. Despite ominous predictions by some industry observers, the PCjr should not significantly cut into this under-$300 segment. Instead, it will compete more directly with the Apple and Atari's announced high-end models. The Coleco Adam probably will be considered a low-end computer in terms of price, because a complete system costs less than a bare PCjr Entry Model.

Nevertheless, the PCjr's impact will be felt at all levels of the home market. Those in search of elusive standards may settle on the PCjr, as they seem to be doing with the PC. It's also likely that lower-priced PCjr-compatibles will surface before long, perhaps even from Commodore or Atari. ©

Micro Mechanic

Robert L. Wright

This program makes it easy to keep up with automobile maintenance schedules, which are very important to your car's health and well-being. The original version runs on all Commodore computers. And versions for Atari, TI-99/4A, Apple, and Radio Shack Color Computer are included. A printer is required.

Few things are more important to the reliable operation of an automobile than performing routine maintenance on schedule. Failing to regularly change the oil or check the brake fluid could lead to major mechanical problems or even serious accidents. Unfortunately, most drivers have difficulty keeping up with just what should be done when. That's where "Micro Mechanic" can be of assistance. Your computer is much better than you at remembering such details.

When RUN, Micro Mechanic will ask for the current mileage on the car. It will then find when the next maintenance is scheduled and offer to print a checklist of the items called for at that mileage. If you are within a few hundred miles of the scheduled mileage, or if you've gone past the scheduled mileage, you'll want to print a copy. After you've completed and checked off all the required items, the list can serve as a record of the maintenance. These records could then be used to prove that you've taken good care of your vehicle, which should substantially improve its resale value.

Customizing The Program

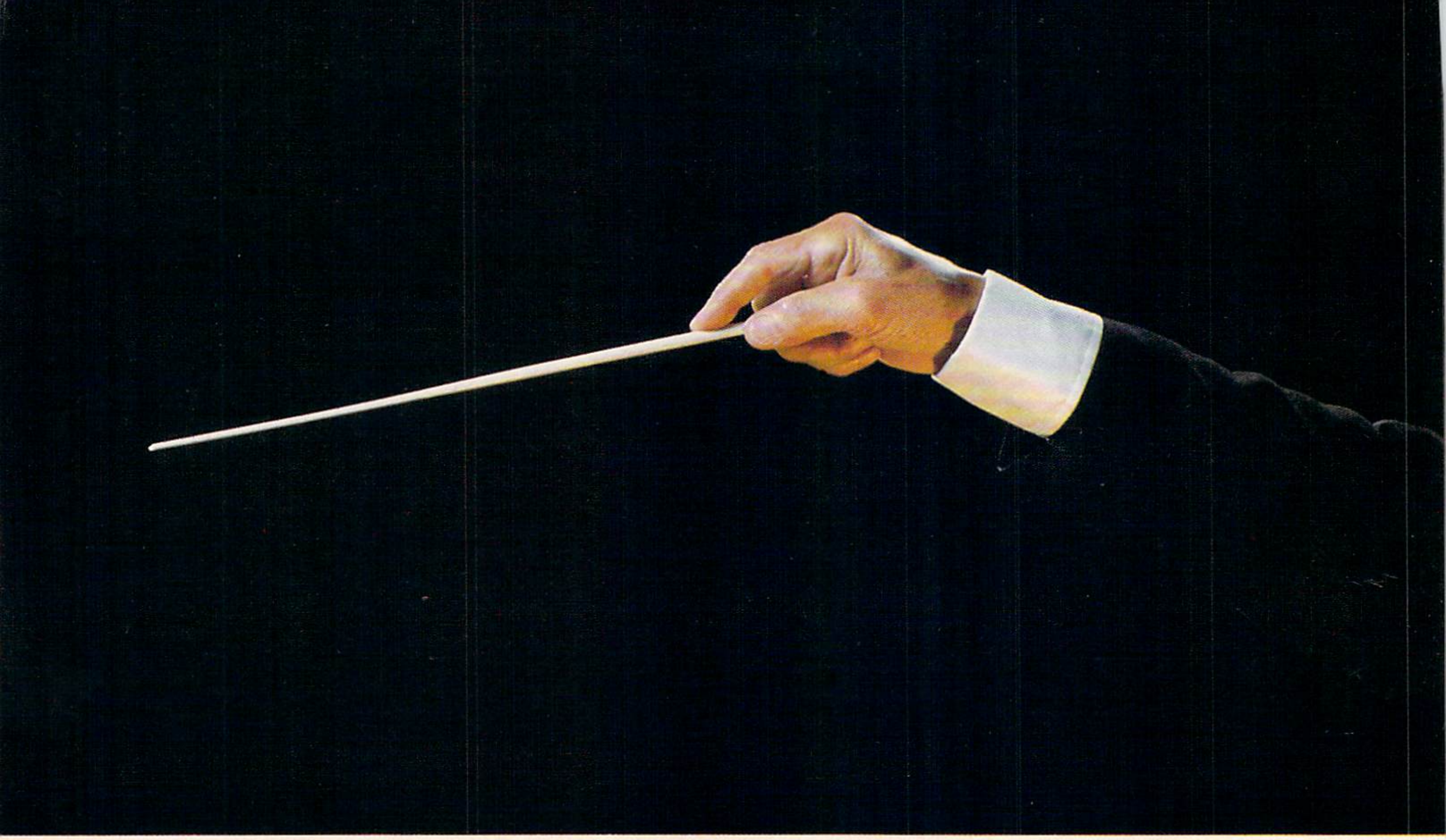
Micro Mechanic is written to be as flexible as possible. No two models have exactly the same maintenance requirements, so you will almost certainly have to modify the program for your own needs. In fact, if you have more than one car, you'll probably want to prepare a version of Micro Mechanic for each.

You can find the information for customizing the program in your owner's manual. More than likely, it contains a chart explaining when certain types of maintenance should be performed. These should occur at regular intervals. In the programs, these intervals are defined in line 110 (lines 100–110 in the TI Version).

For my car, the basic maintenance interval (I1) is 7500 miles. Every 7500 miles my car requires a change of oil and a check of the cooling system. I call these Interval 1 maintenance items, and they are defined in lines with numbers in the 4000 range. Every second 7500 miles, that is, every 15000 miles (I2), certain additional checkups are required. Call these Interval 2 maintenance items; they're defined in lines with numbers in the 3000 range. Then, every fourth 7500 miles (every 30000 miles [13]), other maintenance is called for in addition to the Interval 1 and Interval 2 items. These are Interval 3 maintenance items, and are defined in lines with numbers in the 2000 range. Note that the program assumes that I2 and I3 are even multiples of I1, but for most cars this is a valid assumption.

In addition to the maintenance which my car requires every 7500, 15000, and 30000 miles, other types of checks are called for at 50000 mile intervals (I4). The addition of an interval which is not an even multiple of the basic interval (I1) complicates the program significantly. If your car requires no maintenance at intervals which are not multiples of I1, you can streamline your version of Micro Mechanic by omitting lines 210–230, 340, 380 (except in the TI version), 400–420, and all lines with numbers in the 5000 range. On the other hand, use these lines as a guide if additional nonstandard intervals must be included.

To customize Micro Mechanic for your own use, change the intervals I1–I4 to match your car's requirements. Then add, delete, or modify the



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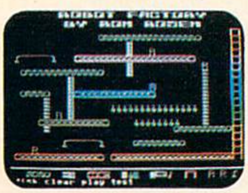

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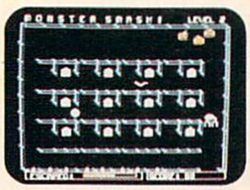

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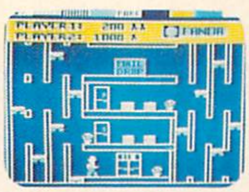

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Sample Checklist (VIC Version)

```
VEHICLE MAINTENANCE CHECKLIST FOR DODGE COLT

MILEAGE: 15238          DATE:____________

SCHEDULED MAINTENANCE FOR  15000  MILES

└─┘ REPLACE OIL FILTER
└─┘ CHECK VALVE CLEARANCE
└─┘ CHECK EXHAUST SYSTEM
└─┘ CHECK CLUTCH PEDAL FREE PLAY
└─┘ CHECK V-BELT ADJ & CONDITION
└─┘ CHECK LIGHTS AND SWITCHES
└─┘ CHECK HEADLIGHT AIM
└─┘ CHECK WINDSHIELD WIPERS & WASHER
└─┘ CHECK BATTERY
└─┘ CHECK CHARGING & STARTING SYSTEM
└─┘ CHECK BRAKE FLUID LEVEL
└─┘ CHECK BRAKE PADS
└─┘ CHECK BRAKE ADJ (PEDAL HEIGHT)
└─┘ CHECK BRAKE LINES & HOSES
└─┘ CHECK BRAKE LIGHTS
└─┘ CHECK TIRES, WEAR, DAMAGE, AIR PRESSURE
└─┘ CHECK BALL JOINT & TIE ROD DUST SEALS
└─┘ CHECK STEERING PLAY
└─┘ CHECK STEERING GEAR BOX BOOTS
└─┘ CHECK WHEEL CAMBER & TOE
└─┘ LUBRICATE DOOR HINGES & CHECKS
└─┘ LUBRICATE HOOD, TRUNK HINGES & LOCKS
└─┘ LUBRICATE THROTTLE LINKAGE, CLUTCH LINKAGE, ETC.
└─┘ CHANGE ENGINE OIL
└─┘ CHECK COOLING SYSTEM
NEXT MAINTENANCE DUE AT 22500 MILES
```

PRINT# statements to properly describe the maintenance which must be performed at the various intervals. Note that the line after the last maintenance item in the 4000 and 5000 line ranges must be a RETURN statement (see lines 4100 and 5100 in Program 1, for example).

Program 1 will work on all Commodore computers, except for the graphics characters used in the PRINT# statements to draw the boxes on the checklist and for the underlining in line 1020. They are for the 64 and VIC-20, and will have to be modified for PET/CBMs. If you have a VIC or 64 with an RS-232 printer attached to the user port as device 2 (instead of to the serial port as device 4), you'll have to change line 100 to match your configuration. For example, if your printer is set for 600 baud and no parity, you might use:

```
100 OPEN 1,2,0,CHR$(7)+CHR$(0)
```

See your *Programmer's Reference Guide* for more information on setting up RS-232 communication.

If you are using the TI-99/4A version (Program 3), you may need to change the OPEN statement in line 1000 to suit your particular printer configuration.

Programming Details

After setting up variable values and asking for initial information (lines 100–150), the program goes through a loop (lines 160–190) to determine the nearest multiple of I1 mileage for which maintenance is scheduled. The current mileage (MC) can be as much as 1000 miles greater than a scheduled mileage and still be within range (line 170, 175 in the TI version). The upper limit of 29 on the variable J in line 160 means that the program will work for cars with up to 226000 miles. This can be increased if necessary, but note that I1 times the maximum value of J in line 160 must be roughly equal to I4 times the maximum value of J in lines 210 and 400, so you will have to adjust those lines as well.

Lines 210–230 check to see if some multiple of the I4 mileage interval lies within the selected interval. If so, the scheduled mileage (MS) is adjusted accordingly, and the maintenance schedule variable (SC) is set to indicate that the Interval 4 list of maintenance items should be printed. If the current mileage is greater than the mileage for the scheduled work, line 240 sends the program to line 260 to print the appropriate message. Otherwise, line 250 tells you how many miles until the next maintenance is due. Lines 270–310 then give you the option of printing a checklist. If you do not wish to print, line 320 CLOSEs the channel to the printer before ENDing, to provide an orderly exit.

Line 330 calls a subroutine at line 1000 to print a heading for the checklist, then lines 340–380 determine which sets of maintenance items will be printed. Note that there is only one RETURN from the ON-GOSUB in line 390, at the end of the Interval 1 items in line 4100. This means that for mileages which are even multiples of interval I2 (SC=2), both the Interval 2 items (lines 3000–3220) and Interval 1 items (lines 4000–4010) will be printed. For I3 intervals (SC=3), all the items from lines 2000–4010 are printed.

Line 340 will cause the Interval 4 items (lines 5000–5080) to be printed if necessary. Placing this statement before lines 350–370 insures that if the I4 interval is also a multiple of I1 (as is the case for 150000 miles in the current version of Program 1), the Interval 4 items will be printed along with the Interval 1–3 items.

Lines 400–450 contain the necessary logic for determining the next mileage at which maintenance is scheduled (MN). The result is printed at the bottom of the checklist as a reminder. Line 460 CLOSEs the channel to the printer and ENDs the program.

Program 1:
Micro Mechanic For Commodore Computers

```
100 OPEN 1,4
110 I1=7500:I2=15000:I3=30000:I4=50000
120 PRINT"{CLR}":PRINT:PRINT"MICRO MECHAN
    IC":PRINT
130 PRINT"MODEL OF CAR":INPUT M$:PRINT
140 PRINT"CURRENT MILEAGE":INPUT MC
150 PRINT:PRINT
160 FOR J=0 TO 29
170 M1=I1*J:M2=I1*(J+1)+1000
180 IF MC>=M1 AND MC<=M2 THEN 200
190 NEXT
200 MS=M1+I1:MN=MS
210 FOR J=1 TO 4:MT=I4*J
220 IF (MT+1000)>=MC AND MT<=MS THEN MS=M
    T:SC=4:GOTO 240
230 NEXT
240 IF MC>MS THEN 260
```

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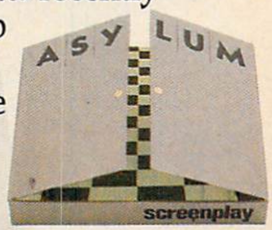

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```
250 PRINT"MAINTENANCE DUE IN":PRINT MS-MC
    ;"MILES":GOTO 270
260 PRINT MS;"MI MAINTENANCE":PRINT"IS";M
    C-MS;"MILES OVERDUE"
270 PRINT:PRINT"PRESS:":PRINT:PRINT"
    {4 SPACES}{RVS}P{OFF} TO PRINT":PRINT
    "{6 SPACES}CHECKLIST"
280 PRINT:PRINT"{4 SPACES}{RVS}E{OFF} TO
    {SPACE}END PROGRAM"
290 GET K$:IF K$="" THEN 290
300 IF K$="P" THEN 330
310 IF K$<>"E" THEN 290
320 CLOSE 1:END
330 GOSUB 1000
340 IF SC=4 THEN GOSUB 5000
350 IF INT(MS/I3)=(MS/I3) THEN SC=3:GOTO
    {SPACE}390
360 IF INT(MS/I2)=(MS/I2) THEN SC=2:GOTO
    {SPACE}390
370 IF INT(MS/I1)=(MS/I1) THEN SC=1:GOTO
    {SPACE}390
380 GOTO 440
390 ON SC GOSUB 4000,3000,2000
400 FOR J=1 TO 4:MT=I4*J
410 IF (MN+I1)>MT AND MN<MT THEN MN=MT:GO
    TO 440
420 NEXT
430 MN=MN+I1
440 PRINT#1,"":PRINT#1,"NEXT MAINTENANCE
    {SPACE}DUE AT";MN;"MILES"
450 PRINT#1,""
460 CLOSE 1:END
999 REM ** HEADING FOR CHECKLIST
1000 PRINT#1,"VEHICLE MAINTENANCE CHECKLI
     ST FOR ";M$
1010 PRINT#1
1020 PRINT#1,"MILEAGE:";MC,"DATE:[13 @]
     "
1030 PRINT#1
1040 PRINT#1,"SCHEDULED MAINTENANCE FOR "
     ;MS;" MILES"
1050 PRINT#1
1100 RETURN
1999 REM ** INTERVAL 3 MAINTENANCE ITEMS
2000 PRINT#1,"L[@]@ CLEAN CARBURETOR CH
     OKE MECHANISM & LINKAGE"
2010 PRINT#1,"L[@]@ REPLACE AIR FILTER"
2020 PRINT#1,"L[@]@ REPLACE SPARK PLUGS
     "
2030 PRINT#1,"L[@]@ REPLACE V-BELT"
2040 PRINT#1,"L[@]@ DRAIN FLUSH & REFIL
     L COOLING SYSTEM"
2050 PRINT#1,"L[@]@ CHECK BRAKE FLUID L
     EVEL & CHECK FOR LEAKS"
2060 PRINT#1,"L[@]@ CHECK REAR BRAKE LI
     NINGS & WHEEL CYLINDERS"
2070 PRINT#1,"L[@]@ CHECK REAR WHEEL BE
     ARING FOR GREASE LEAKS"
2999 REM ** INTERVAL 2 MAINTENANCE ITEMS
3000 PRINT#1,"L[@]@ REPLACE OIL FILTER"
3010 PRINT#1,"L[@]@ CHECK VALVE CLEARAN
     CE"
3020 PRINT#1,"L[@]@ CHECK EXHAUST SYSTE
     M"
3030 PRINT#1,"L[@]@ CHECK CLUTCH PEDAL
     {SPACE}FREE PLAY"
3040 PRINT#1,"L[@]@ CHECK V-BELT ADJ &
     {SPACE}CONDITION"
3050 PRINT#1,"L[@]@ CHECK LIGHTS AND SW
     ITCHES"
3060 PRINT#1,"L[@]@ CHECK HEADLIGHT AIM"
3070 PRINT#1,"L[@]@ CHECK WINDSHIELD WI
     PERS & WASHER"
3080 PRINT#1,"L[@]@ CHECK BATTERY"
3090 PRINT#1,"L[@]@ CHECK CHARGING & ST
     ARTING SYSTEM"
3100 PRINT#1,"L[@]@ CHECK BRAKE FLUID L
     EVEL"
3110 PRINT#1,"L[@]@ CHECK BRAKE PADS"
3120 PRINT#1,"L[@]@ CHECK BRAKE ADJ (PE
     DAL HEIGHT)"
3130 PRINT#1,"L[@]@ CHECK BRAKE LINES &
      HOSES"
3140 PRINT#1,"L[@]@ CHECK BRAKE LIGHTS"
3150 PRINT#1,"L[@]@ CHECK TIRES, WEAR,
     {SPACE}DAMAGE, AIR PRESSURE"
3160 PRINT#1,"L[@]@ CHECK BALL JOINT &
     {SPACE}TIE ROD DUST SEALS"
3170 PRINT#1,"L[@]@ CHECK STEERING PLAY
     "
3180 PRINT#1,"L[@]@ CHECK STEERING GEAR
      BOX BOOTS"
3190 PRINT#1,"L[@]@ CHECK WHEEL CAMBER
     {SPACE}& TOE"
3200 PRINT#1,"L[@]@ LUBRICATE DOOR HING
     ES & CHECKS"
3210 PRINT#1,"L[@]@ LUBRICATE HOOD, TRU
     NK HINGES & LOCKS"
3220 PRINT#1,"L[@]@ LUBRICATE THROTTLE
     {SPACE}LINKAGE, CLUTCH LINKAGE, ETC.
     "
3999 REM ** INTERVAL 1 MAINTENANCE ITEMS
4000 PRINT#1,"L[@]@ CHANGE ENGINE OIL"
4010 PRINT#1,"L[@]@ CHECK COOLING SYSTE
     M"
4100 RETURN
4999 REM ** INTERVAL 4 MAINTENANCE ITEMS
5000 PRINT#1,"L[@]@ CHECK IGNITION TIMI
     NG & ADJ AS REQUIRED"
5010 PRINT#1,"L[@]@ REPLACE FUEL FILTER
     "
5020 PRINT#1,"L[@]@ CHECK FUEL SYSTEM F
     OR LEAKS"
5030 PRINT#1,"L[@]@ CHECK IGNITION CABL
     ES & REPLACE AS REQUIRED"
5040 PRINT#1,"L[@]@ CHECK FUEL, WATER &
      FUEL VAPOR HOSES & REPLACE AS REQUI
     RED"
5050 PRINT#1,"L[@]@ CHECK CRANKCASE EMI
     SSION CONTROL SYSTEM & CLEAN AS REQU
     IRED"
5060 PRINT#1,"L[@]@ CHECK EVAPORATIVE E
     MISSION CONTROL SYSTEM FOR LEAKS/CLO
     GGING"
5070 PRINT#1,"L[@]@ REPLACE CANISTER"
5080 PRINT#1,"L[@]@ REPLACE BRAKE FLUID
     "
5100 RETURN
```

Program 2: Micro Mechanic—Atari Version

```
80 OPEN #1,4,0,"K:":TRAP 6000:REM TU
   RN ON PRINTER
90 DIM DA$(30),M$(35),PR$(10)
100 GRAPHICS 17:POSITION 3,7:? #6;"M
    icro Mechanic":FOR T=1 TO 1500:N
    EXT T
110 I1=7500:I2=15000:I3=30000:I4=500
    00
120 GRAPHICS 0:? :? "What is the dat
    e ":INPUT DA$
130 ? :? "What model is your car? ":
    INPUT M$
```

Jump on 10 monsters, 64 screens and $10,000 with Pogo Joe.™

A Mutated Wonderwhisk whisks by. The Spinning Top almost topples him!

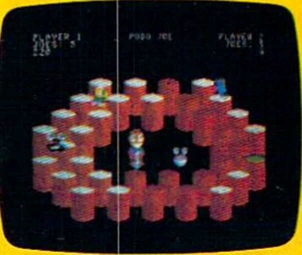
Close. But Pogo Joe bounces back. Bouncing from cylinder to cylinder, screen to screen, Pogo Joe racks up point after point.

You guide him from cylinder to cylinder, changing the color on top of each. Change the top of each cylinder on a screen, then you're on to the next.

The more screens you complete, the nastier the monsters you face, and the faster they attack.

Press the fire button! Jump two cylinders to safety. Hop into a transport tube, and then whoosh! Pogo Joe appears across the screen. Jump on an escaping monster. Blam! It's gone in a flash! Only to reappear out of thin air.

Keep bouncing Joe to original music on realistic 3-dimensional cylinders. All the characters in this rollicking game are also 3-dimensional and fully animated. The graphics almost jump off the screen, leaving the arcades behind.



What's ahead with *Pogo Joe*™ is $10,000. Simply tell us what magic word appears after *Pogo Joe's* tenth screen. If your name is drawn from among the correct answers you'll win $10,000!

No purchase is necessary. You'll find entry forms at any store that sells Screenplay™ games.

But if you don't win you can't lose. *Pogo Joe*™ is so much fun you'll jump for joy no matter what.

screenplay™

Box 3558, Chapel Hill, NC 27514 800-334-5470

Pogo Joe in 48-64K on the Atari and Commodore 64. See your local software dealer.

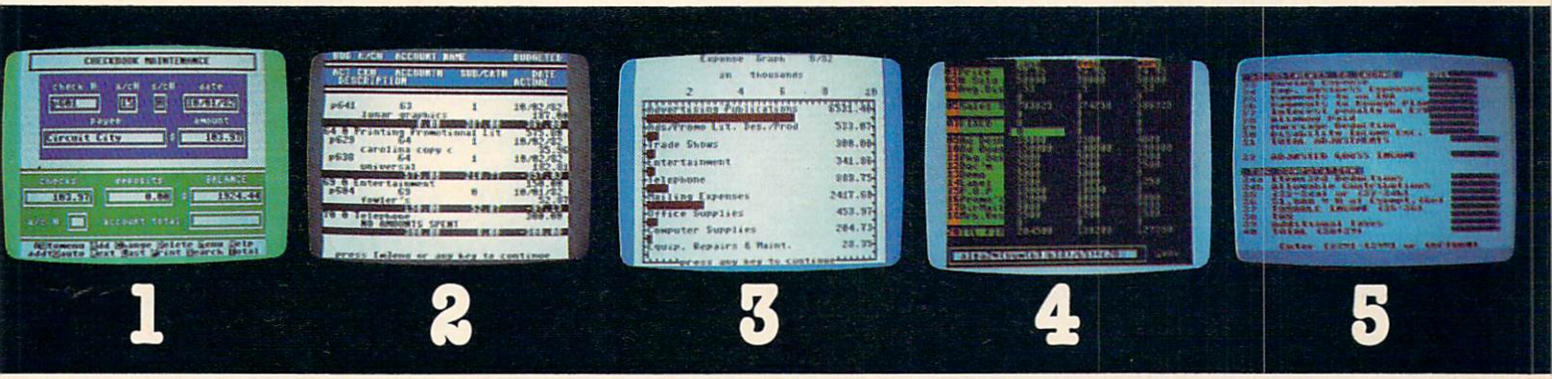
```
140 ? :? "What is your current milea
    ge? ":INPUT MC
150 PRINT :PRINT
160 FOR J=Ø TO 29
170 M1=I1*J:M2=I1*(J+1)+1ØØØ
180 IF MC>=M1 AND MC<=M2 THEN 2ØØ
190 NEXT J
200 MS=M1+I1:MN=MS
210 FOR J=1 TO 4:MT=I4*J
220 IF (MT+1ØØØ)>=MC AND MT<=MS THEN
     MS=MT:SC=4:GOTO 24Ø
230 NEXT J
240 IF MC>MS THEN 26Ø
250 ? "Maintenance due in ";MS-MC;"
    miles":GOTO 27Ø
260 ? MS;" Mile maintenance":? "is "
    ;MC-MS;" miles overdue"
270 ? :? "Press: (P) for checklist"
280 ? "Press: (E) to end program"
290 GET #1,K
300 IF K=ASC("P") THEN 325
310 IF K<>ASC("E") THEN 29Ø
320 END
325 OPEN #2,8,Ø,"P:"
330 TRAP 6ØØØ:GOSUB 1ØØØ
340 IF SC=4 THEN GOSUB 5ØØØ
350 IF INT(MS/I3)=(MS/I3) THEN SC=3:
    GOTO 39Ø
360 IF INT(MS/I2)=(MS/I2) THEN SC=2:
    GOTO 39Ø
370 IF INT(MS/I1)=(MS/I1) THEN SC=1:
    GOTO 39Ø
380 GOTO 44Ø
390 ON SC GOSUB 4ØØØ,3ØØØ,2ØØØ
400 FOR J=1 TO 4:MT=I4*J
410 IF (MN+I1)>MT AND MN<MT THEN MN=
    MT:GOTO 44Ø
420 NEXT J
430 MN=MN+I1
440 LPRINT :LPRINT "NEXT MAINTENANCE
     DUE AT ";MN;" MILES"
450 PRINT #2
460 CLOSE #2:END
999 REM ** HEADING FOR CHECKLIST **
1000 PRINT #2,"VEHICLE MAINTENANCE C
     HECKLIST FOR ";M$
1010 PRINT #2
1020 PRINT #2,"MILEAGE: ";MC;" ON ";
     DA$
1030 PRINT #2
1040 PRINT #2,"SCHEDULED MAINTENANCE
      FOR ";MS;" MILES"
1050 PRINT #2
1100 RETURN
1999 REM ** INTERVAL 3 MAINTENANCE I
     TEMS **
2000 PRINT #2,"[ ]: CLEAN CARBURETOR
      CHOKE MECHANISM & LINKAGE"
2010 PRINT #2,"[ ]: REPLACE AIR FILT
     ER"
2020 PRINT #2,"[ ]: REPLACE SPARK PL
     UGS"
2030 PRINT #2,"[ ]: REPLACE V-BELT"
2040 PRINT #2,"[ ]: DRAIN FLUSH & RE
     FILL COOLING SYSTEM"
2050 PRINT #2,"[ ]: CHECK BRAKE FLUI
     D LEVEL & CHECK FOR LEAKS"
2060 PRINT #2,"[ ]: CHECK REAR BRAKE
      LINING & WHEEL CYLINDERS"
2070 PRINT #2,"[ ]: CHECK REAR WHEEL
      BEARING FOR GREASE LEAKS"
2999 REM ** INTERVAL 2 MAINTENANCE I
     TEMS **
3000 PRINT #2,"[ ]: REPLACE OIL FILT
     ER"
3010 PRINT #2,"[ ]: CHECK VALVE CLEA
     RANCE"
3020 PRINT #2,"[ ]: CHECK EXHAUST SY
     STEM"
3030 PRINT #2,"[ ]: CHECK CLUTCH PED
     AL FREE PLAY"
3040 PRINT #2,"[ ]: CHECK V-BELT ADJ
     . & CONDITION"
3050 PRINT #2,"[ ]: CHECK LIGHTS AND
      SWITCHES"
3060 PRINT #2,"[ ]: CHECK HEADLIGHT
     AIM"
3070 PRINT #2,"[ ]: CHECK WINDSHIELD
      WIPERS & WASHER"
3080 PRINT #2,"[ ]: CHECK BATTERY"
3090 PRINT #2,"[ ]: CHECK CHARGING &
      STARTING SYSTEM"
3100 PRINT #2,"[ ]: CHECK BRAKE FLUI
     D LEVEL"
3110 PRINT #2,"[ ]: CHECK BRAKE PADS
     "
3120 PRINT #2,"[ ]: CHECK BRAKE ADJ.
      (PEDAL HEIGHT)"
3130 PRINT #2,"[ ]: CHECK BRAKE LINE
     S & HOSES"
3140 PRINT #2,"[ ]: CHECK BRAKE LIGH
     TS"
3150 PRINT #2,"[ ]: CHECK TIRES, WEA
     R, DAMAGE, AIR PRESSURE"
3160 PRINT #2,"[ ]: CHECK BALL JOINT
      & TIE ROD DUST SEALS"
3170 PRINT #2,"[ ]: CHECK STEERING P
     LAY"
3180 PRINT #2,"[ ]: CHECK STEERING G
     EAR BOX BOOTS"
3190 PRINT #2,"[ ]: CHECK WHEEL CAMB
     ER & TOE"
3200 PRINT #2,"[ ]: LUBRICATE DOOR H
     INGES & CHECKS"
3210 PRINT #2,"[ ]: LUBRICATE HOOD,
     TRUNK HINGES & LOCKS"
3220 PRINT #2,"[ ]: LUBRICATE THROTT
     LE LINKAGE, CLUTCH LINKAGE, ETC
     ."
3999 REM ** INTERVAL 1 MAINTENANCE I
     TEMS **
4000 PRINT #2,"[ ]: CHANGE ENGINE OI
     L"
4010 PRINT #2,"[ ]: CHECK COOLING SY
     STEM"
4100 RETURN
4999 REM ** INTERVAL 4 MAINTENANCE I
     TEMS **
5000 PRINT #2,"[ ]: CHECK IGNITION T
     IMING & ADJ. AS REQUIRED"
5010 PRINT #2,"[ ]: REPLACE FUEL FIL
     TER"
5020 PRINT #2,"[ ]: CHECK FUEL SYSTE
     M FOR LEAKS"
5030 PRINT #2,"[ ]: CHECK IGNITION C
     ABLES & REPLACE AS REQUIRED"
5040 PRINT #2,"[ ]: CHECK FUEL, WATE
     R & FUEL VAPOR HOSES & REPLACE
     AS REQUIRED"
5050 PRINT #2,"[ ]: CHECK CRANKCASE
     EMISSION CONTROL SYSTEM & CLEAN
      AS REQUIRED"
5060 PRINT #2,"[ ]: CHECK EVAPORATIV
     E EMISSION CONTROL FOR LEAKS/CL
     OGGING"
5070 PRINT #2,"[ ]: REPLACE CANISTER"
5080 PRINT #2,"[ ]: REPLACE BRAKE FL
     UID"
```

```
5100 RETURN
6000 PRINT :PRINT "Please turn on yo
     ur printer, and then hit RETURN
     ":INPUT PR$
6010 GOTO 330
```

Program 3:
Micro Mechanic—TI-99/4A Version

```
100 I1=7500
102 I2=15000
104 I3=30000
110 I4=50000
115 CALL CLEAR
120 PRINT TAB(6);"MICRO MECHANIC"
125 PRINT
130 PRINT "DATE (eg., 10/25/1983)"
135 INPUT DATE$
140 PRINT
142 INPUT "MODEL OF CAR ?":MAKE$
144 PRINT
146 INPUT "CURRENT MILEAGE ?":MC
150 PRINT
160 FOR J=0 TO 29
170 M1=I1*J
175 M2=I1*(J+1)+1000
180 IF (MC>=M1)*(MC<=M2)THEN 196
190 NEXT J
196 MS=M1+I1
200 MN=MS
210 FOR J=1 TO 4
214 MT=I4*J
218 IF ((MT+1000)>=MC)*(MT<=MS)THEN
     223
221 NEXT J
222 GOTO 240
223 MS=MT
230 SC=4
240 IF MC>MS THEN 260
250 PRINT "MAINTENANCE DUE IN ";MS-
    MC;" MILES"
252 PRINT
255 GOTO 270
260 PRINT MS;" MILE MAINTENANCE IS"
265 PRINT MC-MS;" MILES OVERDUE"
268 PRINT
270 PRINT "PRESS (P) FOR CHECKLIST"
280 PRINT "PRINT (E) TO END"
290 CALL KEY(0,K,S)
300 IF K=80 THEN 330
310 IF K<>69 THEN 290
320 STOP
330 GOSUB 1000
340 IF SC=4 THEN 5000
350 IF INT(MS/I3)<>(MS/I3)THEN 360
353 SC=3
356 GOTO 390
360 IF INT(MS/I2)<>(MS/I2)THEN 370
363 SC=2
366 GOTO 390
370 IF INT(MS/I1)<>(MS/I1)THEN 380
373 SC=1
376 GOTO 390
380 GOTO 440
390 ON SC GOSUB 4000,3000,2000
400 FOR J=1 TO 4
404 MT=I4*J
410 IF ((MN+I1)>MT)*(MN<MT)THEN 415
412 NEXT J
413 GOTO 430
415 MN=MT
420 GOTO 440
430 MN=MN+I1
440 PRINT #1
450 PRINT #1:"NEXT MAINTENANCE DUE
    AT ";MN;" MILES"
460 CLOSE #1
465 STOP
999 REM  ** HEADING FOR CHECKLIST
1000 OPEN #1:"RS232"
1005 PRINT #1:"VEHICLE CHECKLIST FO
     R ";MAKE$
1010 PRINT #1
1020 PRINT #1:"MILEAGE: ";MC;" ON "
     ;DATE$
1030 PRINT #1
1040 PRINT #1:"SCHEDULED MAINTENANC
     E FOR ";MS;" MILES"
1050 PRINT #1
1100 RETURN
1999 REM  ** INTERVAL 3 MAINTENANCE
      ITEMS **
2000 PRINT #1:"( ): CLEAN CARBURETO
     R CHOKE MECHANISM & LINKAGE"
2010 PRINT #1:"( ): REPLACE AIR FIL
     TER"
2020 PRINT #1:"( ): REPLACE SPARK P
     LUGS"
2030 PRINT #1:"( ): REPLACE V-BELT"
2040 PRINT #1:"( ): DRAIN FLUSH & R
     EFILL COOLING SYSTEM"
2050 PRINT #1:"( ): CHECK BRAKE FLU
     ID LEVEL & CHECK FOR LEAKS"
2060 PRINT #1:"( ): CHECK REAR BRAK
     E LINING & WHEEL CYLINDERS"
2070 PRINT #1:"( ): CHECK REAR WHEE
     L BEARING FOR GREASE LEAKS"
2999 REM  ** INTERVAL 2 MAINTENANCE
      ITEMS
3000 PRINT #1:"( ): REPLACE OIL FIL
     TER"
3010 PRINT #1:"( ): CHECK VALVE CLE
     ARANCE"
3020 PRINT #1:"( ): CHECK EXHAUST S
     YSTEM"
3030 PRINT #1:"( ): CHECK CLUTCH PE
     DAL FREE PLAY"
3040 PRINT #1:"( ): CHECK V-BELT AD
     J & CONDITION"
3050 PRINT #1:"( ): CHECK LIGHTS AN
     D SWITCHES"
3060 PRINT #1:"( ): CHECK HEADLIGHT
      AIM"
3070 PRINT #1:"( ): CHECK WINDSHIEL
     D WIPERS & WASHER"
3080 PRINT #1:"( ): CHECK BATTERY"
3090 PRINT #1:"( ): CHECK CHARGING
     & STARTING SYSTEM"
3100 PRINT #1:"( ): CHECK BRAKE FLU
     ID LEVEL"
3110 PRINT #1:"( ): CHECK BRAKE PAD
     S"
3120 PRINT #1:"( ): CHECK BRAKE ADJ
      (PEDAL HEIGHT)"
3130 PRINT #1:"( ): CHECK BRAKE LIN
     ES & HOSES"
3140 PRINT #1:"( ): CHECK BRAKE LIG
     HTS"
3150 PRINT #1:"( ): CHECK TIRES, WE
     AR, DAMAGE, AIR PRESSURE"
3160 PRINT #1:"( ): CHECK BALL JOIN
     T & TIE ROD DUST SEALS"
```

Five Easy Ways To Clean Up Your Finances.



actual screen display   *indicates function being shown

1	2	3	4	5
Chart of Accounts *Checkbook Maintenance Check Search Prints Checks	*Detail Budget Analysis Summary Budget Analysis Income/Expense Statements Net Worth Statement	Appointments Calendar Payments Calendar *Color Chart Package Mailing List	*Spreadsheet Compatible with Finance 1, 2 and 5	*Income Tax Prints forms Most schedules Uses Finance 1, 2 and 4

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Ask you local deal to see a running demo or call 1-800-334-SOFT to order direct.

*Varies according to computer.

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```
3170 PRINT #1:"( ): CHECK STEERING
      PLAY"
3180 PRINT #1:"( ): CHECK STEERING
      GEAR BOX BOOTS"
3190 PRINT #1:"( ): CHECK WHEEL CAM
      BER & TOE"
3200 PRINT #1:"( ): LUBRICATE DOOR
      HINGES & CHECKS"
3210 PRINT #1:"( ): LUBRICATE HOOD,
       TRUNK HINGES & LOCKS"
3220 PRINT #1:"( ): LUBRICATE THROT
      TLE LINKAGE, CLUTCH LINKAGE, E
      TC."
3999 REM  ** INTERVAL 1 MAINTENANCE
       ITEMS
4000 PRINT #1:"( ): CHANGE ENGINE O
      IL"
4010 PRINT #1:"( ): CHECK COOLING S
      YSTEM"
4020 RETURN
4999 REM  ** INTERVAL 4 MAINTENANCE
       ITEMS
5000 PRINT #1:"( ): CHECK IGNITION
      TIMING & ADJ AS REQUIRED"
5010 PRINT #1:"( ): REPLACE FUEL FI
      LTER"
5020 PRINT #1:"( ): CHECK FUEL SYST
      EM FOR LEAKS"
5030 PRINT #1:"( ): CHECK IGNITION
      CABLES & REPLACE AS REQUIRED"
5040 PRINT #1:"( ): CHECK FUEL, WAT
      ER & FUEL VAPOR HOSES & REPLAC
      E AS REQUIRED"
5050 PRINT #1:"( ): CHECK CRANKCASE
       EMISSION CONTROL SYSTEM & CLE
      AN AS REQUIRED"
5060 PRINT #1:"( ): CHECK EVAPORATI
      VE EMISSION CONTROL SYSTEM FOR
       LEAKS/CLOGGING"
5070 PRINT #1:"( ): REPLACE CANISTE
      R"
5080 PRINT #1:"( ): REPLACE BRAKE F
      LUID"
5100 GOTO 350
```

Program 4: Micro Mechanic—Apple Version

```
110 I1 = 7500:I2 = 15000:I3 = 30000:I4 =
     50000
120  HOME : INVERSE : PRINT : PRINT : HTAB
     14: PRINT "MICRO MECHANIC ": PRINT
     : NORMAL
130  INPUT "ENTER DATE (IE., 10/26/83)
     ? ";DA$: PRINT : PRINT : INPUT "MO
     DEL OF CAR ? ";M$
140  PRINT : PRINT : INPUT "CURRENT MIL
     EAGE ? ";MC
150  PRINT
160  FOR J = 0 TO 29
170 M1 = I1 * J:M2 = I1 * (J + 1) + 100
     0
180  IF MC >  = M1 AND MC <  = M2 THEN
     200
190  NEXT
200 MS = M1 + I1:MN = MS
210  FOR J = 1 TO 4:MT = I4 * J
220  IF (MT + 1000) >  = MC AND MT <  =
     MS THEN MS = MT:SC = 4: GOTO 240
230  NEXT
240  IF MC > MS THEN 260
250  PRINT "MAINTENANCE DUE IN ";MS - M
     C;" MILES": GOTO 270
260  PRINT "YOUR ";MS;" MILE MAINTENANC
     E ": PRINT : PRINT "IS ";MC - MS;"
      MILES OVERDUE"
270  PRINT : PRINT "PRESS:": PRINT : PRINT
     "     P TO PRINT CHECKLIST"
280  PRINT "     E TO END PROGRAM"
290  GET K$: IF K$ = "" THEN 290
300  IF K$ = "P" THEN 330
310  IF K$ <  > "E" THEN 290
320  END
330  PR# 1: GOSUB 1000
340  IF SC = 4 THEN  GOSUB 5000
350  IF  INT (MS / I3) = (MS / I3) THEN
     SC = 3: GOTO 390
360  IF  INT (MS / I2) = (MS / I2) THEN
     SC = 2: GOTO 390
370  IF  INT (MS / I1) = (MS / I1) THEN
     SC = 1: GOTO 390
380  GOTO 440
390  ON SC GOSUB 4000,3000,2000
400  FOR J = 1 TO 4:MT = I4 * J
410  IF MT < (MN + I1) AND MT > MN THEN
     MN = MT: GOTO 440
420  NEXT
430 MN = MN + I1
440  PRINT : PRINT "NEXT MAINTENENCE DU
     E AT ";MN;" MILES"
450  PRINT
460  PR# 0: END
999  REM ** HEADING FOR CHECKLIST
1000  PRINT "VEHICLE MAINTENANCE CHECKL
     IST FOR ";M$
1010  PRINT
1020  PRINT "MILEAGE:";MC,"DATE ";DA$
1030  PRINT
1040  PRINT "SCHEDULED MAINTENANCE FOR
     ";MS;" MILES"
1050  PRINT
1060  RETURN
1999  REM   ** INTERVAL 3 MAINTENANCE I
     TEMS
2000  PRINT "( ): CLEAN CARBURETOR CHOK
     E MECHANISM & LINKAGE"
2010  PRINT "( ): REPLACE AIR FILTER"
2020  PRINT "( ): REPLACE SPARK PLUGS"
2030  PRINT "( ): REPLACE V-BELT"
2040  PRINT "( ): DRAIN FLUSH AND REFIL
     L COOLING SYSTEM"
2050  PRINT "( ): CHECK BRAKE FLUID LEV
     EL & CHECK FOR LEAKS"
2060  PRINT "( ): CHECK REAR BRAKE LINI
     NGS & WHEEL CYLINDERS"
2070  PRINT "( ): CHECK REAR WHEEL BEAR
     INGS FOR GREASE LEAKS"
2999  REM ** INTERVAL 2 MAINTENANCE ITE
     MS
3000  PRINT "( ): REPLACE OIL FILTER"
3010  PRINT "( ): CHECK VALVE CLEARANCE
     "
3020  PRINT "( ): CHECK EXHAUST SYSTEM"
3030  PRINT "( ): CHECK CLUTCH PEDAL FR
     EE PLAY"
3040  PRINT "( ): CHECK V-BELT ADJ & CO
     NDITION"
3050  PRINT "( ): CHECK LIGHTS AND SWIT
     CHES"
3060  PRINT "( ): CHECK HEADLIGHT AIM"
3070  PRINT "( ): CHECK WINDSHIELD WIPE
     RS & WASHERS"
3080  PRINT "( ): CHECK BATTERY"
3090  PRINT "( ): CHECK CHARGING & STAR
     TING SYSTEM"
```


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```
3100  PRINT "( ): CHECK BRAKE FLUID LEV
     EL"
3110  PRINT "( ): CHECK BRAKE PADS"
3120  PRINT "( ): CHECK BRAKE ADJ (PEDA
     L HEIGHT)"
3130  PRINT "( ): CHECK BRAKE LINES & H
     OSES"
3140  PRINT "( ): CHECK BRAKE LIGHTS"
3150  PRINT "( ): CHECK TIRES, WEAR, DA
     MAGE, AIR PRESSURE"
3160  PRINT "( ): CHECK BALL JOINT & TI
     E ROD DUST SEALS"
3170  PRINT "( ): CHECK STEERING PLAY"
3180  PRINT "( ): CHECK STEERING GEAR B
     OX BOOTS"
3190  PRINT "( ): CHECK WHEEL CAMBER &
     TOE"
3200  PRINT "( ): LUBRICATE DOOR HINGES
      & CHECKS"
3210  PRINT "( ): LUBRICATE HOOD, TRUNK
      HINGES & LOCKS"
3220  PRINT "( ): LUBRICATE THROTTLE LI
     NKAGE, CLUTCH LINKAGE, ETC."
3999  REM  INTERVAL 1 MAINTENANCE ITEMS

4000  PRINT "( ): CHANGE ENGINE OIL"
4010  PRINT "( ): CHECK COOLING SYSTEM"

4020  RETURN
4999  REM ** INTERVAL 4 MAINTENANCE ITE
     MS
5000  PRINT "( ): CHECK IGNITION TIMING
      & ADJ AS REQUIRED"
5010  PRINT "( ): REPLACE FUEL FILTER"
5020  PRINT "( ): CHECK FUEL SYSTEM FOR
      LEAKS"
5030  PRINT "( ): CHECK IGNITION CABLES
      & REPLACE AS REQUIRED"
5040  PRINT "( ): CHECK FUEL, WATER & F
     UEL VAPOR HOSES & REPLACE AS REQUI
     RED"
5050  PRINT "( ): CHECK CRANKCASE EMISS
     ION CONTROL SYSTEM & CLEAN AS REQU
     IRED"
5060  PRINT "( ): CHECK EVAPORATIVE EMI
     SSION CONTROL SYSTEM FOR LEAKS/CLO
     GGING"
5070  PRINT "( ): REPLACE CANISTER"
5080  PRINT "( ): REPLACE BRAKE FLUID"
5090  RETURN
```

Program 5:
Micro Mechanic—TRS-80 Color Computer Version

```
100 CLS
110 I1=7500:I2=15000:I3=30000:I4=50
    000
120 PRINT:PRINT:PRINT"MICRO MECHANI
    C":PRINT
130 PRINT"WHAT IS THE DATE (IE., 10
    /25/83)";:INPUT DA$:PRINT:INPUT
    "MODEL OF CAR ";M$
140 PRINT:INPUT"CURRENT MILEAGE ";M
    C
150 PRINT:PRINT
160 FOR J=0TO29
170 M1=I1*J:M2=I1*(J+1)+1000
180 IF MC>=M1 AND MC<=M2 THEN 200
190 NEXTJ
200 MS=M1+I1:MN=MS
210 FOR J=1TO4:MT=I4*J
220 IF (MT+1000)>=MC AND MT<=MS THE
    N MS=MT :SC=4:GOTO240
230 NEXTJ
240 IF MS<MC THEN 260
250 PRINT"MAINTENANCE DUE IN ";MS-M
    C;" MILES":GOTO270
260 PRINT MS;"MILE MAINTENANCE":PRI
    NT" IS ";MC-MS;" MILES OVERDUE"
270 PRINT:PRINT"PRESS (P) FOR PRINT
     OUT"
280 PRINT:PRINT"PRESS (E) TO END"
290 K$=INKEY$:IF K$=""THEN290
300 IF K$="P" THEN 330
310 IF K$<>"E" THEN 290
320 END
330 GOSUB 1000
340 IF SC=4 THEN GOSUB 5000
350 IF INT(MS/I3)=(MS/I3)THEN SC=3:
    GOTO390
360 IF INT(MS/I2)=(MS/I2) THEN SC=2
    :GOTO390
370 IF INT(MS/I1)=(MS/I1)THEN SC=1:
    GOTO390
380 GOTO440
390 ON SC GOSUB 4000,3000,2000
400 FOR J=1TO4:MT=I4*J
410 IF (MN+I1)>MT AND MN<MT THEN MN
    =MT:GOTO 440
420 NEXT J
430 MN=MN+I1
440 PRINT #-2:PRINT#-2,"NEXT MAINTE
    NANCE DUE AT ";MN;" MILES"
450 PRINT #-2,""
455 PRINT #-2,"63999 END"
460 END
999 REM ** HEADING FOR CHECKLIST
1000 PRINT#-2,"VEHICLE MAINTENANCE
     CHECKLIST FOR ";M$
1010 PRINT#-2
1020 PRINT#-2,"MILEAGE: ";MC;" ON "
     ;DA$
1030 PRINT#-2
1040 PRINT#-2,"SCHEDULED MAINTENANC
     E FOR ";MS;" MILES"
1050 PRINT#-2
1100 RETURN
1999 REM ** INTERVAL 3 MAINTENANCE
     ITEMS
2000 PRINT #-2,"( ): CLEAN CARBURET
     OR CHOKE MECHANISM & LINKAGE"
2010 PRINT#-2,"( ): REPLACE AIR FIL
     TER"
2020 PRINT#-2,"( ): REPLACE SPARK P
     LUGS"
2030 PRINT #-2,"( ): REPLACE V-BELT"
2040 PRINT #-2,"( ): DRAIN FLUSH &
     REFILL COOLING SYSTEM"
2050 PRINT #-2,"( ): CHECK BRAKE FL
     UID LEVEL & CHECK FOR LEAKS"
2060 PRINT #-2,"( ): CHECK REAR BRA
     KE LINING & WHEEL CYLINDERS"
2070 PRINT #-2,"( ): CHECK REAR WHE
     EL BEARING FOR GREASE LEAKS"
2999 REM ** INTERVAL 2 MAINTENANCE
     ITEMS
3000 PRINT #-2,"( ): REPLACE OIL FI
     LTER"
3010 PRINT #-2,"( ): CHECK VALVE CL
     EARANCE"
3020 PRINT #-2,"( ): CHECK EXHAUST
     SYSTEM"
3030 PRINT #-2,"( ): CHECK CLUTCH P
```

```
     EDAL FREE PLAY"
3040 PRINT #-2,"( ): CHECK V-BELT A
     DJ & CONDITION"
3050 PRINT #-2."( ): CHECK LIGHTS A
     ND SWITCHES"
3060 PRINT #-2."( ): CHECK HEADLIGH
     T AIM"
3070 PRINT #-2,"( ): CHECK WINDSHIE
     LD WIPERS & WASHER"
3080 PRINT#-2,"( ): CHECK BATTERY"
3090 PRINT #-2,"( ): CHECK CHARGING
      & STARTING SYSTEM"
3100 PRINT #-2,"( ): CHECK BRAKE FL
     UID LEVEL"
3110 PRINT #-2,"( ): CHECK BRAKE PA
     DS"
3120 PRINT #-2,"( ): CHECK BRAKE AD
     J (PEDAL HEIGHT)"
3130 PRINT #-2,"( ): CHECK BRAKE LI
     NES & HOSES"
3140 PRINT #-2,"( ): CHECK BRAKE LI
     GHTS"
3150 PRINT #-2,"( ): CHECK TIRES, W
     EAR, DAMAGE, AIR PRESSURE"
3160 PRINT #-2,"( ): CHECK BALL JOI
     NT & TIE ROD DUST SEALS"
3170 PRINT #-2,"( ): CHECK STEERING
      PLAY"
3180 PRINT #-2,"( ): CHECK STEERING
      GEAR BOX BOOTS"
3190 PRINT #-2,"( ): CHECK WHEEL CA
     MBER & TOE"
3200 PRINT #-2,"( ): LUBRICATE DOOR
      HINGES & CHECKS"
3210 PRINT #-2,"( ): LUBRICATE HOOD
     , TRUNK HINGES & LOCKS"
3220 PRINT #-2,"( ): LUBRICATE THRO
     TTLE LINKAGE, CLUTCH LINKAGE,
     ETC."
3999 REM ** INTERVAL 1 MAINTENANCE
     ITEMS
4000 PRINT #-2,"( ): CHANGE ENGINE
     OIL"
4010 PRINT #-2,"( ): CHECK COOLING
     SYSTEM"
4100 RETURN
4999 REM ** INTERVAL 4 MAINTENANCE
     ITEMS
5000 PRINT #-2,"( ): CHECK IGNITION
      TIMING & ADJ AS REQUIRED"
5010 PRINT #-2,"( ): REPLACE FUEL F
     ILTER"
5020 PRINT #-2,"( ): CHECK FUEL SYS
     TEM FOR LEAKS"
5030 PRINT #-2,"( ): CHECK IGNITION
      CABLES & REPLACE AS REQUIRED"
5040 PRINT #-2."( ): CHECK FUEL, WA
     TER & FUEL VAPOR HOSES & REPLA
     CE AS REQUIRED"
5050 PRINT #-2,"( ): CHECK CRANKCAS
     E EMISSION CONTROL SYSTEM & CL
     EAN AS REQUIRED"
5060 PRINT #-2,"( ): CHECK EVAPORAT
     IVE EMISSION CONTROL SYSTEM FO
     R LEAKS/CLOGGING"
5070 PRINT #-2,"( ): REPLACE CANIST
     ER"
5080 PRINT #-2,"( ): REPLACE BRAKE
     FLUID"
5100 RETURN
```

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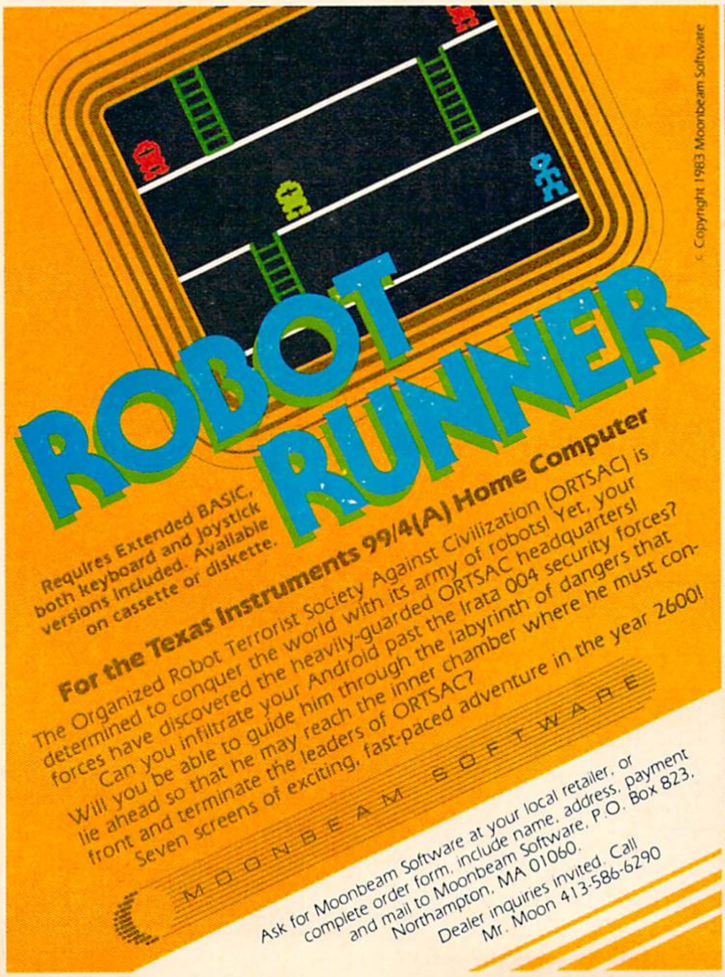
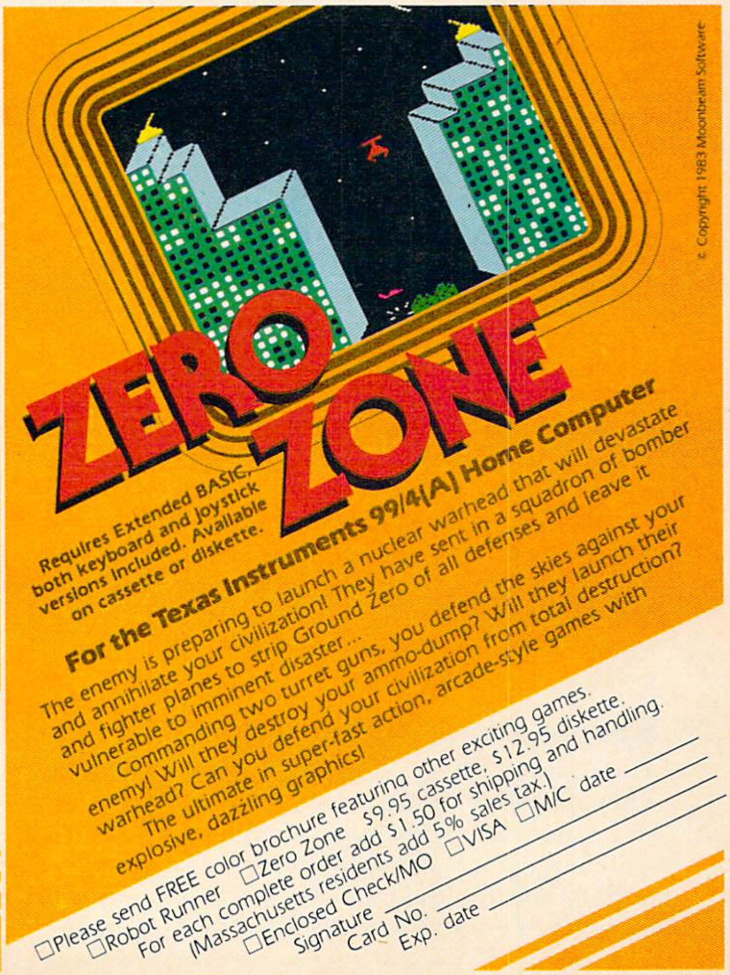
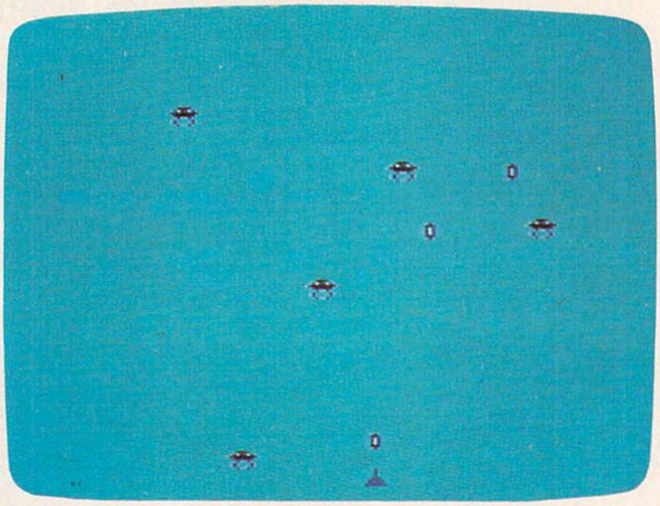




Demons Of Osiris

Steve Haynal

You must defend your fleet of base ships against wave after wave of lightning-fast Osirian attackers as they weave and dodge through your covering fire. The Osirians do not descend blindly; they counter your evasive moves and seek you out. Theirs is a maniacal mission. Written for the unexpanded VIC, versions are included for 64 and Atari.



The player defends against descending demons in the VIC version of "Demons of Osiris."

"Demons of Osiris" is a fast-paced, arcade-style machine language game. The object is to shoot the falling Osirians, but at the same time they'll use their intelligence to try to destroy you. You can choose from 240 speed levels, with level 1 being the fastest. You may also choose between 1–240 base ships. Be prepared to battle as many as eight Osirians at a time.

Your base ship is located at the bottom of the screen. You control its functions as follows: Press T to move left, U to move right, and SHIFT to fire. Pressing the SHIFT-LOCK key will give you rapid fire. When the screen flashes red it means you have lost a base ship.

Simple, But Effective

The Osirians have a simple but effective strategy. They have two moves, a defensive and an offensive move. On a defensive move, the Osirians will dodge your oncoming bullet, moving either right or left. On the offensive, they will move to one side of your line of fire. They do not come down directly above you because it would increase their chances of being hit. The Osirians can destroy your base ship by being in the space directly above your base ship, directly above you and to the right, and directly above you and to the left. On some occasions they will activate a special defensive mechanism which triggers evasive action around your missiles.

The strategy is to keep moving and fire rapidly. At slow speeds (25–240), try to aim as much as possible. At fast speeds (1–24), things move so quickly it's best just to try to dodge the Osirians.

You'll Need To Abbreviate

The machine language portion of Demons of Osiris takes 696 bytes and the BASIC part, which runs with the machine language portion, is only three lines long. The machine language portion is in the form of DATA statements which are POKEd into memory. The whole program, including the DATA statements, takes all of an unexpanded VIC-20's memory.

Because of the VIC's limited memory, most of the program lines are quite long. You may need to abbreviate some BASIC keywords (see Appendix D of *Personal Computing on the VIC-20*, which came with your computer). In particular, you should use the abbreviation for DATA, D and SHIFT-A, in lines 35–190.

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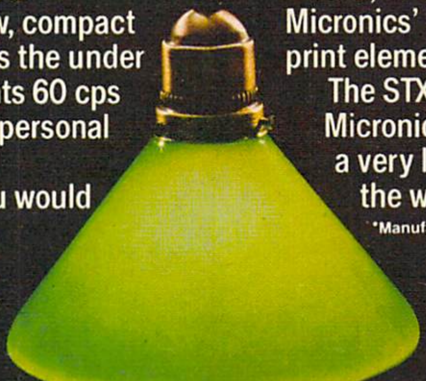

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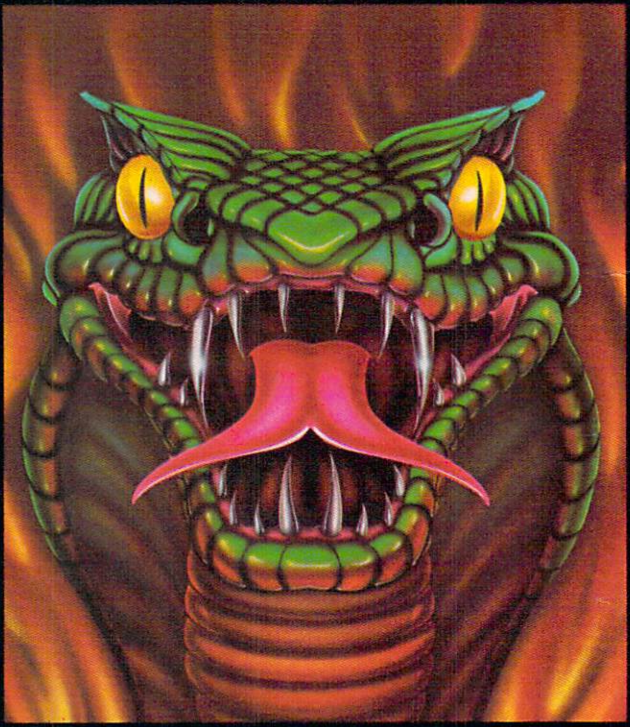

CHOPLIFTER*
For the Commodore VIC-20.

Sixty-four Americans are being held hostage behind enemy lines. You've got to shoot your way in there and bring them back alive. Sneak over the border, make your way through heavily fortified enemy fire, and blast your way back to safety. It may be a suicide mission, but somebody's got to do it. America is counting on you!

SERPENTINE*
For the Commodore VIC-20.

Three huge and evil red snakes are slithering through the corridors of a burnt-out city, closing in on your good blue serpent from all sides. Move fast, watch your tail, and try to survive long enough to let your eggs hatch into reinforcements. Swallow the magical frogs or your enemy's eggs and you get the strength to go on! Complex strategy-action and increasing levels of difficulty.

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After typing the program, be sure to SAVE it before you RUN it. One mistake in the DATA statements might cause a crash, and you would have to type the program again.

When you run it, there will be a short wait while the computer reads the DATA. It will then ask you for your speed and the number of base ships you want. Both of these can be from 1 to 240. An average game would use 60 for speed and 5 for ships. There will again be a short wait, to allow you time to position your fingers on the T and U keys. Press SHIFT-LOCK at this time if you want rapid fire. Otherwise, use SHIFT for normal fire. When the game is finished, it will display your score and will repeat the cycle at the point where it asks for the speed.

If you don't want to type this program into your computer, I will make you a copy of it on tape (VIC version only). Send $3 and a self-addressed stamped mailer to:

Steve Haynal
1325 Olive Ave.
Redlands, CA 92373

Program 1: Demons Of Osiris For VIC

```
10 POKE52,27:POKE56,27:POKE51,71:POKE55,7
   1:PRINT"{CLR}":FORA=6984TO7679:READB:P
   OKEA,B:NEXT
15 POKE649,1Ø:INPUT"SPEED";A:INPUT"SHIPS"
   ;B:IFA>24ØORB>24ØORA<1ORB<1THEN15
2Ø POKE7Ø74,A:POKE7Ø39,B:POKE649,Ø:FORB=Ø
   TO2ØØØ:NEXT
25 SYS6984:POKE36869,24Ø:PRINT"{CLR}SCORE
   :"PEEK(248)+PEEK(249)*256:GOTO15
35 DATA162,1Ø,169,Ø,149,247,2Ø2,2Ø8,251,1
   68,169,59,157,Ø,3Ø,157,Ø,31,232,2Ø8,24
   7,141,15
4Ø DATA144,169,255,141,5,144,169,15,141,1
   4,144,138,157,Ø,15Ø,157,228,15Ø,232,2Ø
   8,247
45 DATA169,6,162,22,157,227,151,2Ø2,2Ø8,2
   5Ø,169,5,133,253,2ØØ,2Ø8,253,232,2Ø8,2
   53,169
5Ø DATA238,133,251,169,31,133,252,169,63,
   145,251,165,197,2Ø1,5Ø,24Ø,31,2Ø1,51,2
   4Ø,13
55 DATA14Ø,13,144,162,63,2ØØ,2Ø8,253,2Ø2,
   2Ø8,25Ø,24Ø,41,165,251,2Ø1,249,24Ø,237
   ,32,2Ø2
6Ø DATA27,23Ø,251,76,196,27,165,251,2Ø1,2
   28,24Ø,223,32,2Ø2,27,198,251,169,63,14
   5,251
65 DATA2Ø8,215,169,129,141,13,144,169,59,
   145,251,96,169,1,44,141,2,24Ø,44,162,6
   6,189
7Ø DATA161,31,2Ø1,61,24Ø,35,2Ø2,2Ø8,246,1
   65,251,56,233,22,133,251,169,61,145,25
   1,165
75 DATA251,24,1Ø5,22,133,251,14Ø,13,144,1
   69,16Ø,141,11,144,141,1Ø,144,232,2Ø8,2
   53,169
8Ø DATA3Ø,133,255,169,21,133,254,162,21,1
   6Ø,22,177,254,2Ø1,61,2Ø8,29,32,246,28,
   177,254
85 DATA2Ø1,59,24Ø,9,32,14,29,32,232,28,76
   ,5Ø,28,169,61,145,254,32,232,28,169,59
   ,145
9Ø DATA254,136,2Ø8,218,32,232,28,2Ø2,2Ø8,
   21Ø,162,22,189,255,29,2Ø1,61,2Ø8,5,169
   ,59,157
95 DATA255,29,2Ø2,2Ø8,241,14Ø,1Ø,144,14Ø,
   11,144,162,66,189,255,29,2Ø1,62,24Ø,21
   ,2Ø2,2Ø8
1ØØ DATA246,32,86,29,165,141,162,Ø,232,56
    ,233,12,176,25Ø,169,62,157,255,29
1Ø5 DATA169,31,133,255,169,227,133,254,16
    Ø,22,177,254,2Ø1,63,24Ø,3,136,2Ø8,247
11Ø DATA132,25Ø,32,246,28,177,254,2Ø1,62,
    2Ø8,6,169,59,145,254,16,27,136,177,25
    4,2Ø1,62
115 DATA2Ø8,7,169,59,145,254,2ØØ,16,13,2Ø
    Ø,2ØØ,177,254,2Ø1,62,2Ø8,24,169,59,14
    5,254,136
12Ø DATA32,232,28,32,4,29,169,59,16Ø,22,1
    53,227,31,136,2Ø8,25Ø,76,13Ø,27,16Ø,2
    2,169,59
125 DATA145,254,136,2Ø8,251,162,21,32,246
    ,28,16Ø,22,177,254,2Ø1,62,2Ø8,3,32,11
    3,29,136
13Ø DATA2Ø8,244,2Ø2,2Ø8,236,76,148,27,165
    ,254,24,1Ø5,22,133,254,165,255,1Ø5,Ø,
    133,255,96
135 DATA165,254,56,233,22,133,254,165,255
    ,233,Ø,133,255,96,177,254,2Ø1,63,24Ø,
    12,2Ø1,61
14Ø DATA2Ø8,67,23Ø,248,2Ø8,13,23Ø,249,2Ø8
    ,9,169,42,141,15,144,198,253,24Ø,69,1
    69,6Ø,145
145 DATA254,165,255,24,1Ø5,12Ø,133,255,17
    7,254,72,169,2,145,254,169,222,141,13
    ,144,23Ø
15Ø DATA146,2Ø8,252,2Ø6,13,144,48,247,1Ø4
    ,145,254,165,255,56,233,12Ø,133,255,1
    69,59,145
155 DATA254,141,15,144,96,169,62,145,254,
    96,72,138,72,152,72,32,148,224,1Ø4,16
    8,1Ø4,17Ø
16Ø DATA1Ø4,96,16Ø,Ø,14Ø,14,144,169,27,14
    1,15,144,1Ø4,1Ø4,96,169,24Ø,141,12,14
    4,169,59
165 DATA145,254,32,86,29,32,232,28,138,24
    ,1Ø5,32,1Ø,1Ø,197,141,16,42,177,254,2
    Ø1,59,2Ø8
17Ø DATA6,169,62,145,254,16,58,169,48,197
    ,141,16,12,192,1,24Ø,8,136,169,62,145
    ,254,2ØØ
175 DATA16,4Ø,192,22,24Ø,24Ø,2ØØ,169,62,1
    45,254,136,16,28,196,25Ø,24Ø,228,48,1
    2,136,196
18Ø DATA25Ø,2Ø8,1,2ØØ,169,62,145,254,16,1
    Ø,2ØØ,196,25Ø,2Ø8,1,136,169,62,145,25
    4,169,Ø
185 DATA141,12,144,76,246,28,Ø,Ø,Ø,Ø,Ø,Ø,
    Ø,Ø,4,168,214,72,37,17Ø,8Ø,2Ø,Ø,16,56
19Ø DATA4Ø,4Ø,4Ø,56,16,6Ø,9Ø,255,126,36,6
    6,66,36,16,16,16,16,56,124,124,254
```

BEGINNING PROGRAMMERS

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Programming Notes, 64 Version

Gregg Peele, Assistant Programming Supervisor

The 64 version of "Demons of Osiris" (Program 2) uses seven sprites for the demons which swoop down relentlessly toward your base. There are six levels of difficulty in this version, and you may choose the number of base ships you want—up to 99 ships per play.

You may use either a joystick (plugged into port 2) or the keyboard (press T to move left and U to move right) to move your base and evade the descending demons. Either press the joystick fire button (trigger) or one of the SHIFT keys to shoot at the demons. SHIFT LOCK can be used for continuous fire. Press the f7 function key to freeze the program, then press any other key to continue play.

Use MLX

To enter the 64 version of Demons of Osiris, you *must* first LOAD and RUN MLX, the Machine Language Editor (which can be found elsewhere in this issue). When the MLX program asks for the starting and ending addresses of Demons, enter 49152 and 51005, respectively. After you've entered Demons with MLX and SAVEd it to tape or disk, you can get it back by typing LOAD "DEMONS",1,1 (for tape) or LOAD "DEMONS",8,1 (for disk). Type SYS 49152 to start the game.

Demons of Osiris was written entirely in machine language using modular programming. The program consists of a series of routines (modules) which are executed from a main or "master" loop. This programming technique allows you to test routines as individual units. Once you decide that one routine works correctly, then you can start on the next routine. Modules used within this program include a routine to detect collision between sprites and other sprites, routines to detect collision between characters and sprites, and a routine to let any of the eight sprites cross the notorious seam on the right of the screen (sprite X–position 255).

The demons appear to wiggle their claws as they descend toward your base. This is accomplished by changing the pointer which defines the location in memory of a particular sprite image. Each of two areas contains slightly different "pictures" of the demons. By alternating rapidly between these pictures (by changing the sprite pointers), we can easily animate the crab-like demons.

Program 2: Demons Of Osiris For The 64

Version by Gregg Peele, Assistant Programming Supervisor

```
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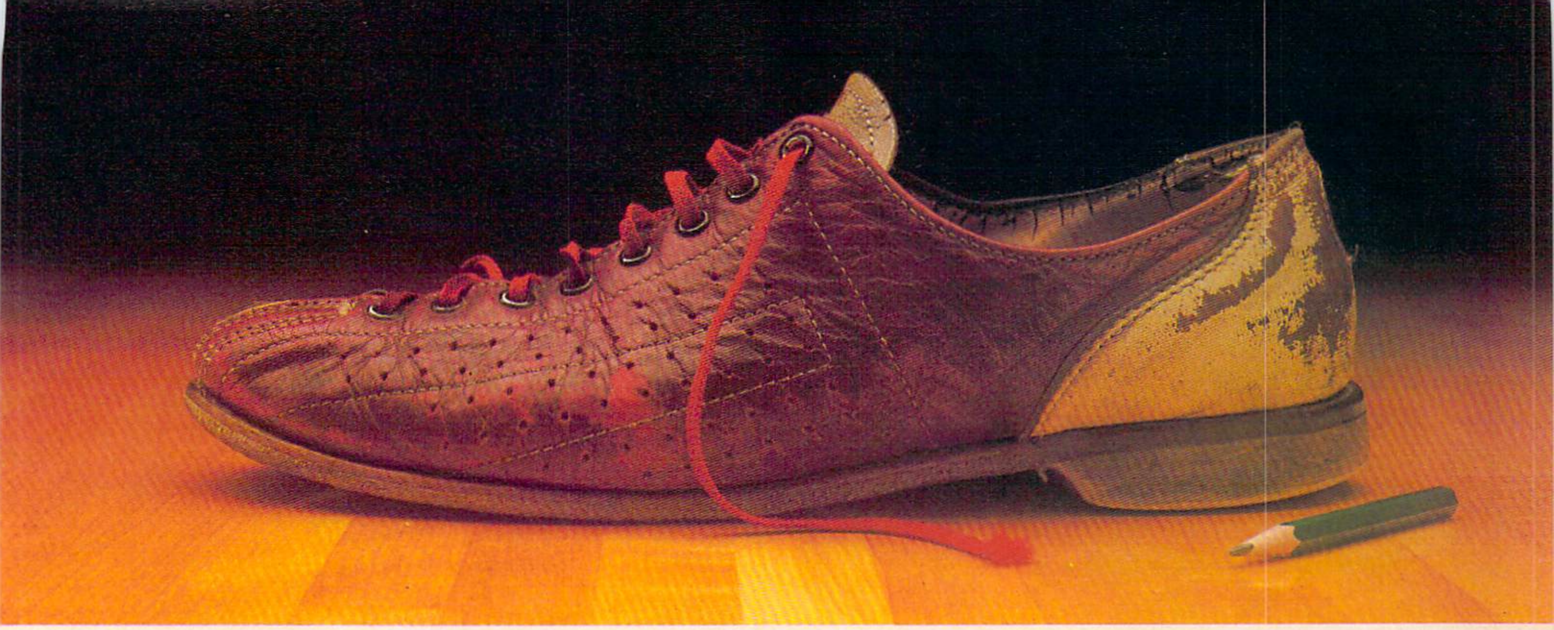

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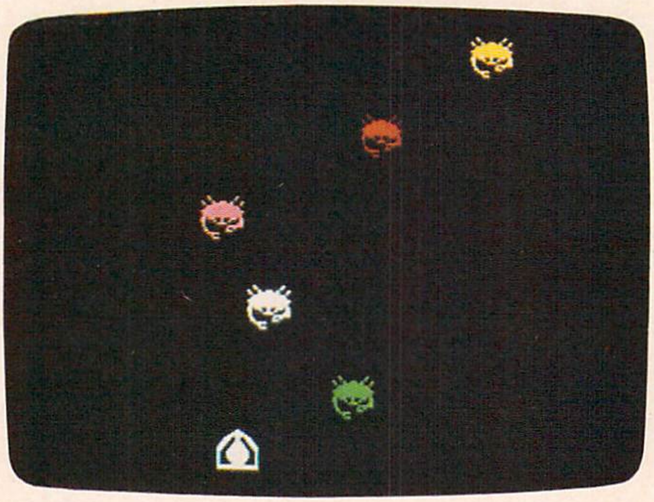

64 version of "Demons of Osiris."

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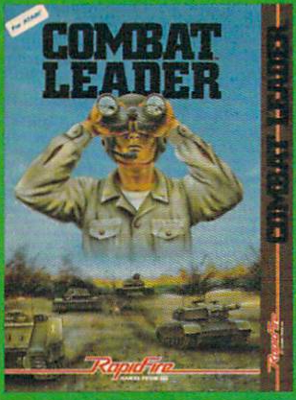

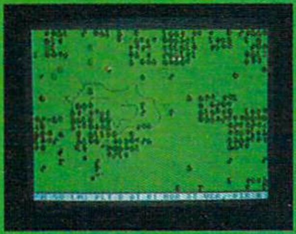

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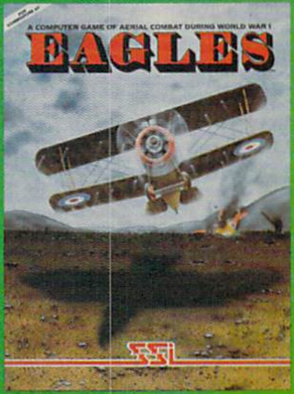

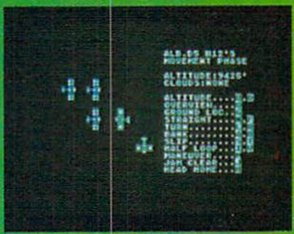

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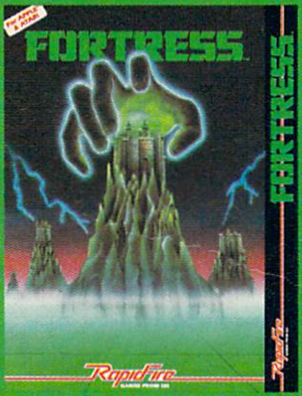

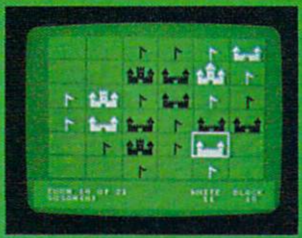

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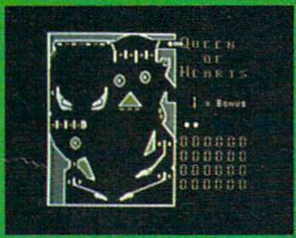

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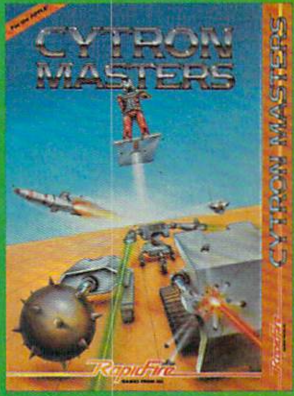

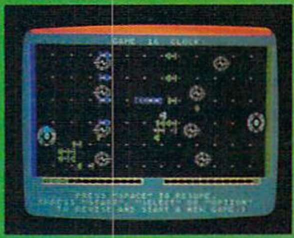

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50946 :000,000,000,048,219,012,025
50952 :000,102,000,000,219,096,169
50958 :000,060,000,182,219,109,072
50964 :001,153,128,048,219,012,069
50970 :000,060,000,054,219,108,211
50976 :000,102,000,024,219,012,133
50982 :000,000,128,006,195,096,207
50988 :000,000,000,000,000,000,044
50994 :000,000,000,000,000,000,050
51000 :000,000,000,255,000,013,068
```
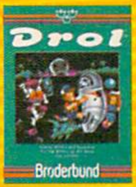
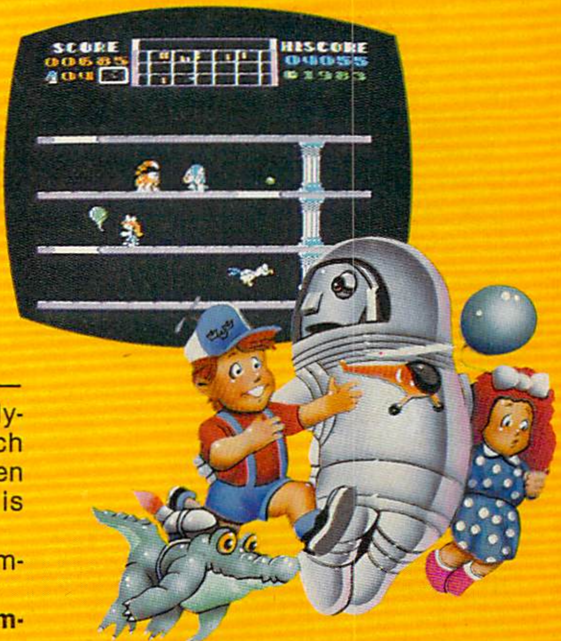

Bet'cha Can't Play Just One!



Drol™



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Drol's wry sense of humor and amazingly detailed cartoon imagery, make this game a charmer!

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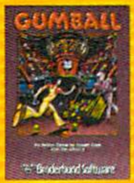
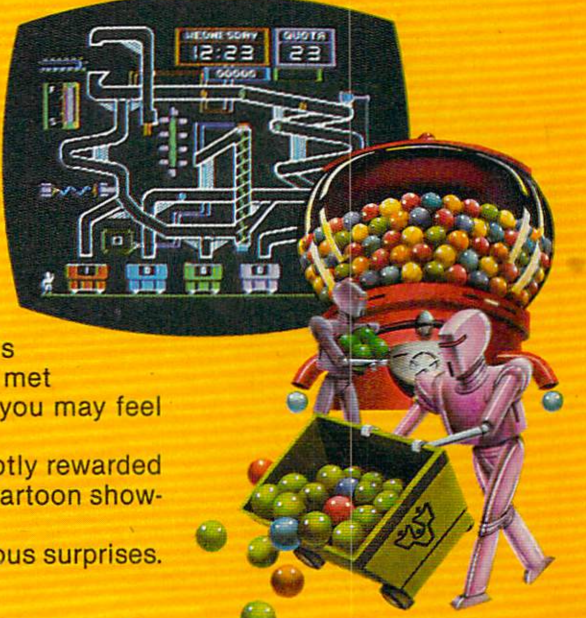


Gumball™



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Programming Notes, Atari Version

John Krause, Assistant Technical Editor

The Atari version of "Demons of Osiris" (Program 3) is similar to the VIC version. The only major difference is in controlling the base ship. The ship is controlled using the joystick plugged into port 1. The joystick fire button launches the missiles. Hold down the button for rapid fire. When you RUN the program, you will have to wait a few seconds for the computer to POKE in the machine language (ML) portion of the game. Then it will prompt you to enter the speed of play and number of base ships. Enter a speed from 0 (fastest) to 255 (slowest) and specify from 1 to 255 ships.

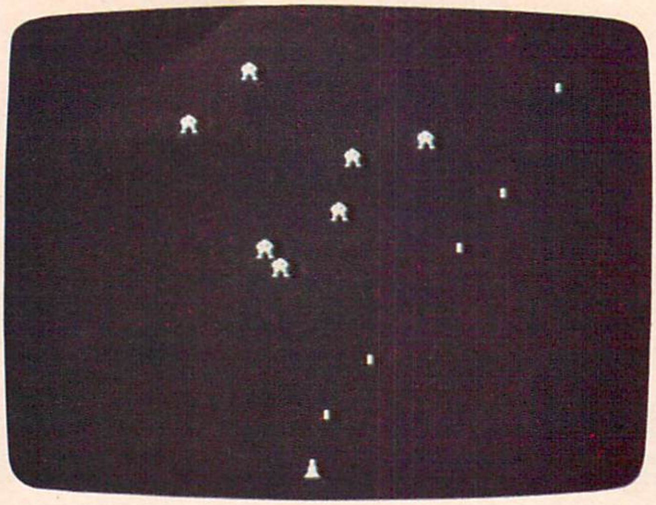
Press the fire button to start the game. Pressing the space bar will pause the game until you press any other key. When a demon hits your ship, the ship will be destroyed, the screen will flash, and another ship will appear at the middle of the screen. Each demon you hit with your missiles is worth ten points. After all your ships are destroyed, the final score will be displayed.

The program consists mostly of machine language, which line 20 READs from the DATA statements and POKEs into the buffer at locations 14592–15380. Lines 130–160 contain the information for the redefined characters. BASIC is used for things that do not require the speed of machine language, such as the input prompts and displaying the final score. The speed and number of ships are POKEd into memory so the ML routine can access this information during play. Line 70 executes the ML routine. When the game ends, line 80 will calculate the score from the values stored by the ML routine.

Program 3: Demons Of Osiris For Atari

Version by John Krause, Assistant Technical Editor

```
10 POKE 106,64:GRAPHICS Ø
15 ? "Demons of Osiris"
17 IF PEEK(14592)=169 THEN 5Ø
18 ? :? "Please wait 15 seconds."
20 RESTORE 14592:FOR I=14592 TO 1538
   Ø:READ A:C=C+A:POKE I,A:NEXT I:GO
   SUB 1ØØ
25 IF C<>98549 THEN ? "Error in DATA
   ":END
5Ø POKE 764,255:TRAP 5Ø:? "Speed";:I
   NPUT I:POKE 2Ø8,I
6Ø TRAP 6Ø:? "Ships";:INPUT I:IF I=Ø
    THEN 6Ø
61 POKE 2Ø7,I
62 ? :? "Press FIRE:";
64 IF STRIG(Ø) THEN 64
65 POKE 71Ø,Ø
7Ø POKE 752,1:? CHR$(125):TRAP 8Ø:PO
   KE 756,4:I=USR(14592)
8Ø GRAPHICS Ø:? "Score:";1Ø*PEEK(135
   27)+256Ø*PEEK(13526)
9Ø GOTO 5Ø
1ØØ RESTORE 13Ø
11Ø FOR I=1 TO 4:READ A:A=1Ø24+A*8:F
    OR J=Ø TO 7:READ B:POKE A+J,B:NE
    XT J:NEXT I
12Ø RETURN
13Ø DATA 84,24,126,219,255,126,1Ø2,6
    6,195
14Ø DATA 92,Ø,Ø,24,24,24,24,Ø,Ø
15Ø DATA 33,24,24,24,6Ø,6Ø,6Ø,126,25
    5
16Ø DATA Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø
14592 DATA 169,52,133,2Ø4,169,Ø
14598 DATA 133,2Ø3,168,145,2Ø3,2ØØ
146Ø4 DATA 192,Ø,2Ø8,249,23Ø,2Ø4
1461Ø DATA 166,2Ø4,224,57,2Ø8,241
14616 DATA 169,63,133,2Ø4,169,236
14622 DATA 133,2Ø3,169,2Ø,141,223
14628 DATA 52,16Ø,Ø,152,145,2Ø3
14634 DATA 173,12Ø,2,41,4,2Ø8
1464Ø DATA 12,173,223,52,2Ø1,Ø
14646 DATA 24Ø,5,2Ø6,223,52,198
14652 DATA 2Ø3,173,12Ø,2,41,8
14658 DATA 2Ø8,12,173,223,52,2Ø1
14664 DATA 39,24Ø,5,238,223,52
1467Ø DATA 23Ø,2Ø3,169,33,16Ø,Ø
14676 DATA 145,2Ø3,238,222,52,169
14682 DATA 2,2Ø5,222,52,16,3
14688 DATA 14Ø,222,52,173,132,2
14694 DATA 2Ø1,1,24Ø,49,174,221
147ØØ DATA 52,189,Ø,53,2Ø1,1
147Ø6 DATA 24Ø,39,173,222,52,2Ø1
14712 DATA 2,48,32,169,1,157
14718 DATA Ø,53,165,2Ø4,157,8
14724 DATA 53,165,2Ø3,56,233,4Ø
1473Ø DATA 157,16,53,238,221,52
14736 DATA 169,7,2Ø5,221,52,16
14742 DATA 4,152,141,221,52,162
14748 DATA Ø,142,217,52,189,Ø
14754 DATA 53,2Ø1,Ø,24Ø,4Ø,189
1476Ø DATA 16,53,133,2Ø5,189,8
14766 DATA 53,133,2Ø6,152,145,2Ø5
14772 DATA 32,222,59,145,2Ø5,189
14778 DATA 8,53,2Ø1,6Ø,2Ø8,18
14784 DATA 189,16,53,2Ø1,Ø,48
1479Ø DATA 11,2Ø1,1Ø4,16,7,152
14796 DATA 157,Ø,53,76,48,58
148Ø2 DATA 189,16,53,56,233,4Ø
148Ø8 DATA 157,16,53,176,3,222
14814 DATA 8,53,133,2Ø5,189,8
1482Ø DATA 53,133,2Ø6,32,222,59
14826 DATA 177,2Ø5,141,216,52,2Ø1
14832 DATA 2,16,26,189,16,53
14838 DATA 133,2Ø5,189,8,53,133
14844 DATA 2Ø6,169,92,145,2Ø5,32
1485Ø DATA 222,59,138,24,1Ø5,9
14856 DATA 145,2Ø5,76,48,58,152
14862 DATA 157,Ø,53,174,216,52
14868 DATA 2Ø2,157,232,52,189,248
14874 DATA 52,133,2Ø5,189,24Ø,52
1488Ø DATA 133,2Ø6,152,145,2Ø5,32
```



Atari version of "Demons of Osiris."

```
14886 DATA 222,59,145,205,32,2
14892 DATA 60,32,243,59,238,217
14898 DATA 52,174,217,52,224,8
14904 DATA 240,3,76,160,57,173
14910 DATA 10,210,201,0,16,48
14916 DATA 174,220,52,169,1,221
14922 DATA 232,52,240,38,157,232
14928 DATA 52,169,60,157,240,52
14934 DATA 173,10,210,41,31,24
14940 DATA 105,4,157,224,52,24
14946 DATA 105,64,157,248,52,238
14952 DATA 220,52,169,7,205,220
14958 DATA 52,16,3,140,220,52
14964 DATA 162,0,142,217,52,189
14970 DATA 232,52,201,0,208,3
14976 DATA 76,172,59,189,240,52
14982 DATA 201,63,208,100,189,248
14988 DATA 52,201,0,16,93,201
14994 DATA 176,48,89,152,157,232
15000 DATA 52,189,248,52,133,205
15006 DATA 189,240,52,133,206,152
15012 DATA 145,205,32,222,59,145
15018 DATA 205,189,224,52,24,105
15024 DATA 1,205,223,52,16,3
15030 DATA 76,172,59,56,233,3
15036 DATA 205,223,52,48,3,76
15042 DATA 172,59,169,8,141,198
15048 DATA 2,198,207,32,2,60
15054 DATA 152,141,198,2,152,145
15060 DATA 203,169,63,133,204,169
15066 DATA 236,133,203,169,20,141
15072 DATA 223,52,169,33,145,203
15078 DATA 196,207,240,3,76,172
15084 DATA 59,96,140,219,52,189
15090 DATA 224,52,205,223,52,208
15096 DATA 8,152,205,10,210,16
15102 DATA 13,48,27,173,223,52
15108 DATA 24,105,1,221,224,52
15114 DATA 16,5,169,255,141,219
15120 DATA 52,189,224,52,24,105
15126 DATA 1,205,223,52,16,5
15132 DATA 169,1,141,219,52,152
15138 DATA 205,10,210,16,3,141
15144 DATA 219,52,189,224,52,24
15150 DATA 109,219,52,157,224,52
15156 DATA 189,248,52,133,205,189
15162 DATA 240,52,133,206,152,145
15168 DATA 205,32,222,59,145,205
15174 DATA 173,219,52,24,105,40
15180 DATA 24,125,248,52,157,248
15186 DATA 52,144,3,254,240,52
15192 DATA 189,248,52,133,205,189
15198 DATA 240,52,133,206,32,222
15204 DATA 59,177,205,141,216,52
15210 DATA 201,9,16,23,138,24
15216 DATA 105,1,145,205,189,248
15222 DATA 52,133,205,189,240,52
15228 DATA 133,206,169,84,145,205
15234 DATA 76,172,59,152,157,232
15240 DATA 52,173,216,52,56,233
15246 DATA 9,170,152,157,0,53
15252 DATA 189,16,53,133,205,189
15258 DATA 8,53,133,206,152,145
15264 DATA 205,32,222,59,145,205
15270 DATA 32,2,60,32,243,59
15276 DATA 238,217,52,174,217,52
15282 DATA 224,8,240,3,76,121
15288 DATA 58,165,208,32,200,59
15294 DATA 173,252,2,201,33,240
15300 DATA 249,76,39,57,141,213
15306 DATA 52,162,255,160,0,200
15312 DATA 192,0,208,251,232,236
15318 DATA 213,52,208,245,174,217
15324 DATA 52,96,165,206,56,233
15330 DATA 7,133,206,165,205,56
15336 DATA 233,40,133,205,176,2
15342 DATA 198,206,169,0,96,173
15348 DATA 215,52,24,105,1,141
15354 DATA 215,52,144,3,238,214
15360 DATA 52,96,169,15,141,1
15366 DATA 210,169,20,141,0,210
15372 DATA 169,64,32,200,59,140
15378 DATA 1,210,96
```

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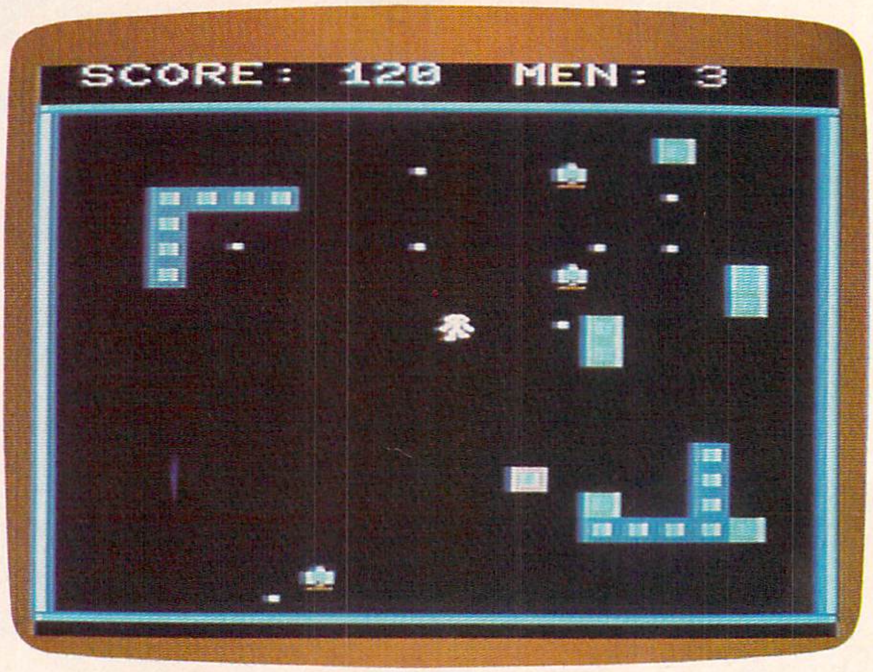
COLORBOT

John R. Dondzila

"Colorbot" is an exciting game for the unexpanded VIC-20, Commodore 64, or Atari which features extensive use of multicolor graphics and sound effects. The game is for one player and requires a joystick. The longer the game is played, the harder it becomes to win.



Three robots pressure the player in the VIC version of "Colorbot."

In the year 1987 man has overpopulated the world with TVs, videogames, home computers, and every electronic device manufacturable.

Through an incredible genetic experiment, all of these surplus electronics have mutated into the Colorbots, a hyperintelligent race of robots who are capable of thinking on their own. The Colorbots have concluded that—according to their alien logic—man is inferior and must be destroyed.

After noting man's vulnerability to electricity and then supercharging Earth with a high-voltage proton forcefield, these creatures of man's invention have turned all matter into glowing debris.

You and some others, however, have somehow become partially immune to the Colorbot forces. Armed with a supply of stolen Electron Frisbees, you will try to destroy the Colorbots before they destroy all of mankind.

Defeating The Colorbots

You are positioned in the center of the playfield. Positioned elsewhere on the playfield are three Colorbot warriors. You can move your man in any direction by positioning the joystick in that direction. (Use joystick 2 on the 64 and joystick 1 on the Atari.) To fire an Electron Frisbee, simply hold down the fire button and push the joystick in the direction that you want to fire.

Also on the playfield is a random display of flashing high-voltage walls, which neither you nor the Colorbots can walk into without being destroyed.

The Colorbots are programmed to follow you. Try to lead the robots into the walls so that they destroy themselves. Whenever a Colorbot is destroyed (whether by you or its own foolish bravado), you gain ten points and a new Colorbot appears somewhere else on the screen. The walls gradually decrease in number as the game progresses.

Every now and then a Colorbot leaves behind a small Colorbomb, which is fatal if you walk on it. The more Colorbots destroyed, the faster they will get. After a while only one or two Colorbots will chase you, and they chase fast.

When you begin the game, you are given four men. If you are destroyed you lose a man. Lose all of your men and the game is over and mankind is doomed to extinction. You lose a man if you walk into anything that is glowing or flashing in different colors. You receive a free man plus 100 bonus points if you score 200 or 800 points.

Using The Programs

Colorbot is written entirely in BASIC except for one small machine language routine installed right on top of the custom character set. This routine is used to continuously change the auxiliary color set without delaying the game.

Please note that you must first type in Program 1 and SAVE it. This program installs the custom character set and machine language routine. After saving it, type NEW and enter the second program. Save this on tape right after Program 1. You may now LOAD and RUN Program 1. It will perform its task and then LOAD and run Program 2 automatically.

If you have a disk drive, type in Program 1 (delete line 140) and SAVE it. Then ENTER Program 2 and SAVE it. RUN Program 1 to define the custom characters. When it is finished, LOAD and RUN Program 2.

One last thing: There are lots of sound effects in this program, so make sure you have the TV volume turned up. This program also has the best visual effect on a color TV or monitor.

> **BEGINNING PROGRAMMERS**
> **If you're new to computing, please read "How To Type COMPUTE!'s Programs" and "A Beginner's Guide To Typing In Programs."**

Program 1: VIC Character Loader

```
10 POKE55,Ø:POKE56,29:CLR
15 POKE36869,240:POKE36879,10:PRINT"{CLR}
   {2 DOWN}{CYN}COLORBOT"
20 PRINT"{2 DOWN}{WHT}LOADING THE":PRINT"
   MAIN CHARACTER SET"
25 DATAØ,Ø,Ø,Ø,Ø,Ø,Ø,Ø
30 DATA56,84,56,84,146,40,104,12
35 DATA56,84,56,84,146,40,44,96
40 DATAØ,Ø,32,184,32,Ø,Ø,Ø
45 DATA4,8,63,63,46,38,4,21
50 DATAØ,Ø,48,48,Ø,Ø,Ø,Ø
55 DATAØ,Ø,Ø,Ø,Ø,255,255,170
60 DATA224,224,224,224,224,224,224,224
65 DATA11,11,11,11,11,11,11,11
70 DATA170,255,255,Ø,Ø,Ø,Ø,Ø
75 DATA170,170,190,190,190,190,170,170
80 DATA141,253,29,238,255,29,173,255
85 DATA29,201,255,208,6,173,253,29
90 DATA76,191,234,238,254,29,173,254
95 DATA29,201,2,208,240,169,Ø,141
100 DATA254,29,24,173,14,144,105,16
105 DATA141,14,144,76,104,29,14,144
110 DATA201,224,48,5,169,15,141,14
115 DATA144,174,252,29,76,104,29
120 FORI=ØTO150:READX
125 POKE7424+I,X:NEXTI
130 PRINT"{CLR}{2 DOWN}DONE, NOW LOAD THE
    ":PRINT"MAIN PROGRAM..."
135 PRINT
140 POKE198,1:POKE631,131:END
145 REM IF YOU ARE USING A DISK DRIVE DEL
    ETE LINE 140
146 REM THEN LOAD & RUN PART 2
```

Program 2: VIC Colorbot, Main Program

```
10 POKE7679,1:POKE7678,1
15 POKE37158,200:POKE37159,200
20 POKE37166,128:POKE788,88:POKE789,29:PO
   KE37166,192
25 POKE36878,15:POKE36869,255:POKE36879,1
   Ø
30 DIMX(3),Y(3),Z(4):FORI=1TO3:DEFFNP(I)=
   7680+X(I)+22*Y(I)
35 A=Ø:C=30720:DEFFNQ(A)=7680+X+22*Y:X1=3
   3:SL=10:S1=5:S2=15:MN=4
40 FORI=1TO4:READZ(I):NEXT:DATA150,160,18
   Ø,200
45 PRINT"{CLR}":FORI=1TOS2:R=7724+RND(1)*
   374:POKER,42:POKER+C,11+RND(1)*3
50 POKE36876,200+RND(1)*50:NEXT:POKE36876
   ,Ø
55 FORI=7702TO7723:POKEI,38:POKEI+C,14:PO
   KEI+462,41:POKEI+C+462,14:NEXT
60 FORI=7724TO8142STEP22:POKEI,39:POKEI+C
   ,14:POKEI+21,40:POKEI+C+21,14:NEXT
65 POKE646,14:PRINT"{HOME}{5 DOWN}
   {3 RIGHT}****{3 LEFT}{DOWN}{LEFT}*
   {DOWN}{LEFT}*{DOWN}{LEFT}*"
70 PRINT"{6 DOWN}{18 RIGHT}*{DOWN}{LEFT}*
   {DOWN}{LEFT}*{DOWN}{LEFT}*{4 LEFT}****
   "
75 POKE646,Ø
80 H=Ø:X=10:Y=10
85 FORI=1TO3:X(I)=INT(RND(1)*18)+3:Y(I)=I
   NT(RND(1)*19)+3:NEXTI
90 GOSUB430:POKE37154,127
95 FORI=1TO3:POKEFNP(I),36:POKEFNP(I)+C,1
   3:NEXT
100 POKEFNQ(Ø),X1:POKEFNQ(Ø)+C,1:FORI=128
    TO254:POKE36874,I:NEXT:POKE36874,Ø:Z1
    =1
105 FORI=1TO3:POKEFNP(I),36:POKEFNP(I)+C,
    13:NEXT
110 POKEFNQ(Ø),X1:POKEFNQ(Ø)+C,1
115 GOSUB440
120 IFF=1THEN205
125 IFJØ=1THENGOSUB475:GOSUB450
130 IFJ1=1THENGOSUB485:GOSUB450
135 IFJ2=1THENGOSUB495:GOSUB450
140 IFJ3=1THENGOSUB505:GOSUB450
145 POKE36875,Ø
150 IFH=1THEN325
155 R=INT(RND(1)*SL)+1:IFR>3THENGOTO105
```

```
160 POKEFNP(R),32:POKE36874,128+(R*20)
165 IFINT(RND(1)*S1)=1THENPOKEFNP(R),37:P
    OKEFNP(R)+C,44
170 IFX<X(R)THENX(R)=X(R)-1
175 IFX>X(R)THENX(R)=X(R)+1
180 IFY<Y(R)THENY(R)=Y(R)-1
185 IFY>Y(R)THENY(R)=Y(R)+1
190 POKE36874,0:IFX(R)=XANDY(R)=YTHENGOTO
    325
195 IFPEEK(FNP(R))=42THENFORI=254TO240STE
    P-.8:POKE36874,I:NEXT:POKE36874,0:I=R
    :GOTO290
200 GOTO105
205 B=X:D=Y
210 IFJ0=0ANDJ1=0ANDJ2=0ANDJ3=0THEN155
215 GOTO225
220 POKE7680+B+22*D,32
225 IFJ0=1THENB=B+1
230 IFJ1=1THEND=D+1
235 IFJ2=1THENB=B-1
240 IFJ3=1THEND=D-1
245 IFPEEK(7680+B+22*D)>35THEN260
250 POKE7680+B+22*D,35:POKE38400+B+22*D,1
    5
255 FORO=1TO2:NEXT:GOTO220
260 P=7680+B+22*D:P1=PEEK(P)
265 IFP1>37THEN155
270 FORO=250TO210STEP-3:POKE36877,O:POKEP
    ,RND(1)*255:NEXT:POKE36877,0
275 IFP1=37THENPOKEP,32:GOTO155
280 POKEP,32:FORI=1TO3:IFX(I)=BANDY(I)=DT
    HEN290
285 NEXT:GOTO155
290 X(I)=INT(RND(1)*18)+3:Y(I)=INT(RND(1)
    *19)+3
295 SC=SC+10:IFSC=200ORSC=800THENGOSUB415
300 GOSUB430:FORO=1TO400:NEXT:POKEFNP(I),
    36:POKEFNP(I)+C,13:FORO=250TO140STEP-
    8
305 POKE36876,O:NEXT:POKE36876,0
310 SL=SL-.2:IFSL<1THENSL=1
315 S1=S1-.2:IFS1<2THENS1=2
320 GOTO155
325 MN=MN-1:GOSUB430
330 FORQ1=1TO16:FORQ2=180TO240STEP6:POKE3
    6876,Q2:NEXT:POKEFNQ(0)+C,1+RND(1)*8
335 NEXT
340 POKE36876,0:POKEFNQ(0),32
345 S2=S2-5
350 IFMN<>0THEN45
355 POKE646,10
360 PRINT"{HOME}";:FORI=1TO22:PRINT"*****
    *****************";:NEXT:FORI=8164TO8
    185:POKEI,42
365 POKEI+C,10:NEXT
370 POKE36879,14:PRINT"{WHT}{HOME}
    {5 DOWN}{6 RIGHT}{RVS}GAME{2 SPACES}O
    VER"
375 PRINT"{2 DOWN}{2 RIGHT}{RVS}PLAY AGAI
    N{SHIFT-SPACE}(Y/N){SHIFT-SPACE}?"
380 FORQ1=128TO254:POKE36875,Q1:POKE36875
    ,Q1-10:NEXT:POKE36875,0
385 POKE37154,255
390 GETA$:IFA$<>"Y"ANDA$<>"N"THEN390
395 IFA$="Y"THENRUN
400 SYS65418
405 POKE37158,137:POKE37159,66
410 POKE36879,27:POKE36869,240:PRINT"
    {CLR}{BLU}":END
415 MN=MN+1:SC=SC+100:GOSUB430
420 FORQ1=1TO10:POKE36876,240:FORQ2=1TO80
    :NEXT:POKE36876,0:FORQ2=1TO80:NEXT:NE
    XT
425 RETURN
430 PRINT"{HOME}{YEL}{RVS} SCORE:{CYN}";S
    C;" {YEL}MEN:{PUR}";MN;"{SHIFT-SPACE}
    {OFF}";
435 RETURN
440 P=PEEK(37152)AND128:J0=-(P=0):P=PEEK(
    37151):J1=-((PAND8)=0):J2=-((PAND16)=
    0)
445 J3=-((PAND4)=0):F=-((PAND32)=0):RETUR
    N
450 X1=X1+1:IFX1>34THENX1=33
455 Z1=Z1+1:IFZ1>4THENZ1=1
460 POKE36875,Z(Z1)
465 IFPEEK(FNQ(0))>34THENH=1
470 POKEFNQ(0),X1:POKEFNQ(0)+C,1:RETURN
475 POKEFNQ(0),32:X=X+1:IFX>20THENX=X-1:H
    =1
480 RETURN
485 POKEFNQ(0),32:Y=Y+1:IFY>21THENY=Y-1:H
    =1
490 RETURN
495 POKEFNQ(0),32:X=X-1:IFX<1THENX=X+1:H=
    1
500 RETURN
505 POKEFNQ(0),32:Y=Y-1:IFY<2THENY=Y+1:H=
    1
510 RETURN
```

Program 3: Colorbot For The 64

Translation by Kevin Martin, Editorial Programmer

```
1 POKE52,48:POKE56,48:CLR:POKE53280,15:PO
  KE53281,0
2 PRINT"{CLR}{WHT}{12 DOWN}{9 RIGHT}REDEF
  INING{2 SPACES}CHARACTERS"
3 PRINT"{HOME}{7 DOWN}{16 RIGHT}COLORBOT"
  :GOSUB1000
4 DIMX(3),Y(3),Z(4):X=RND(0)
5 Z(1)=150:Z(2)=160:Z(3)=180:Z(4)=200
7 C=54272:FORI=CTOC+24:POKEI,0:NEXT
8 POKEC+24,15:POKEG+5,17:POKEC+6,240:POKE
  C,100
20 POKE56333,127:POKE788,88:POKE789,49:PO
   KE56333,129
25 POKE53280,2:POKE53281,0
30 FORI=1TO3:DEFFNP(I)=1024+X(I)+40*Y(I)
35 A=0:DEFFNQ(A)=1024+X+40*Y:X1=33:SL=10:
   S1=5:S2=15:MN=4
45 PRINT"{CLR}":FORI=1TOS2:R=1104+RND(1)*
   880:POKER,42:POKER+C,11+RND(1)*3
50 POKEC+1,100+RND(1)*50:POKEC+4,17:NEXT:
   POKEC+4,16
55 FORI=1064TO1103:POKEI,38:POKEI+C,14:PO
   KEI+920,41:POKEI+C+920,14:NEXT
60 FORI=1104TO1944STEP40:POKEI,39:POKEI+C
   ,14:POKEI+39,40:POKEI+C+39,14:NEXT
65 PRINT"{HOME}[7]{5 DOWN}{3 RIGHT}****
   {3 LEFT}{DOWN}{LEFT}*{DOWN}{LEFT}*
   {DOWN}{LEFT}*"
70 PRINT"[7]{7 DOWN}{33 RIGHT}*{DOWN}
   {LEFT}*{DOWN}{LEFT}*{DOWN}{LEFT}*
   {4 LEFT}****"
80 H=0:X=20:Y=10
85 FORI=1TO3:X(I)=INT(RND(1)*36)+3:Y(I)=I
   NT(RND(1)*19)+3:NEXTI
90 GOSUB430
```

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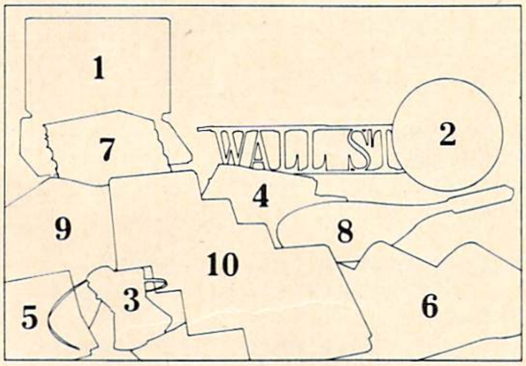

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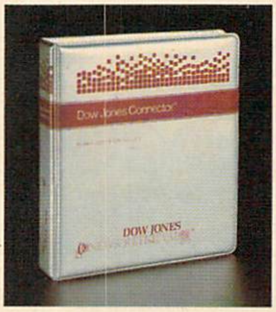

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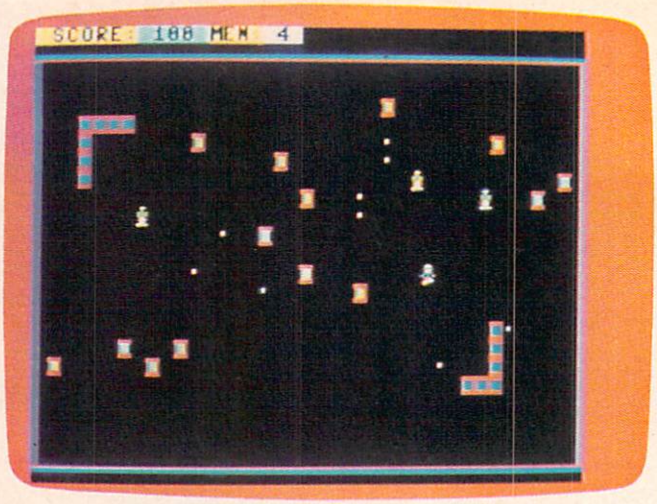
```
95 FORI=1TO3:POKEFNP(I),36:POKEFNP(I)+C,1
   3:NEXT
100 POKEFNQ(Ø),X1:POKEFNQ(Ø)+C,1:Z1=1
105 FORI=1TO3:POKEFNP(I),36:POKEFNP(I)+C,
    13:NEXT
110 POKEFNQ(Ø),X1:POKEFNQ(Ø)+C,1
115 GOSUB44Ø
120 IFF=1THEN2Ø5
125 IFJØ=1THENGOSUB475:GOSUB45Ø
130 IFJ1=1THENGOSUB485:GOSUB45Ø
135 IFJ2=1THENGOSUB495:GOSUB45Ø
140 IFJ3=1THENGOSUB5Ø5:GOSUB45Ø
145 POKEC+4,16
150 IFH=1THEN325
155 R=INT(RND(1)*SL)+1:IFR>3THENGOTO1Ø5
160 POKEFNP(R),32:POKEC+1,8Ø+(R*2Ø):POKEC
    +4,17
165 IFINT(RND(1)*S1)=1THENPOKEFNP(R),37:P
    OKEFNP(R)+C,44
17Ø IFX<X(R)THENX(R)=X(R)-1
175 IFX>X(R)THENX(R)=X(R)+1
18Ø IFY<Y(R)THENY(R)=Y(R)-1
185 IFY>Y(R)THENY(R)=Y(R)+1
19Ø POKEC+4,16:IFX(R)=XANDY(R)=YTHENGOTO3
    25
195 IFPEEK(FNP(R))=42THENI=R:GOTO29Ø
2ØØ GOTO1Ø5
2Ø5 B=X:D=Y
21Ø IFJØ=ØANDJ1=ØANDJ2=ØANDJ3=ØTHEN155
215 GOTO225
22Ø POKE1Ø24+B+4Ø*D,32
225 IFJØ=1THENB=B+1
23Ø IFJ1=1THEND=D+1
235 IFJ2=1THENB=B-1
24Ø IFJ3=1THEND=D-1
245 IFPEEK(1Ø24+B+4Ø*D)>35THEN26Ø
25Ø POKE1Ø24+B+4Ø*D,35:POKE55296+B+4Ø*D,1
    5
255 FORO=1TO2:NEXT:GOTO22Ø
26Ø P=1Ø24+B+4Ø*D:P1=PEEK(P)
265 IFP1>37THEN155
27Ø FORO=25ØTO21ØSTEP-3:POKEC+1,O:POKEC+4
    ,129:POKEP,RND(1)*255:NEXT:POKEC+4,16
275 IFP1=37THENPOKEP,32:GOTO155
28Ø POKEP,32:FORI=1TO3:IFX(I)=BANDY(I)=DT
    HEN29Ø
285 NEXT:GOTO155
29Ø X(I)=INT(RND(1)*36)+3:Y(I)=INT(RND(1)
    *19)+3
295 SC=SC+1Ø:IFSC=2ØØORSC=8ØØTHENGOSUB415
3ØØ GOSUB43Ø:FORO=1TO4ØØ:NEXT:POKEFNP(I),
    36:POKEFNP(I)+C,13
3Ø5 FORO=25ØTO14ØSTEP-8:POKEC+1,O:POKEC+4
    ,17:NEXT:POKEC+4,16
31Ø SL=SL-.2:IFSL<1THENSL=1
315 S1=S1-.2:IFS1<2THENS1=2
32Ø GOTO155
325 MN=MN-1:GOSUB43Ø:POKEC+1,1ØØ:POKEC+4,
    129
33Ø FORQ1=1TO16:POKEFNQ(Ø)+C,1+RND(1)*8
335 NEXT:POKEC+4,128
34Ø POKEC+4,16:POKEFNQ(Ø),32
345 S2=S2-5
35Ø IFMN>ØTHEN45
36Ø PRINT"{HOME}[1]";:FORI=1TO24:PRINT"
    *************************************
    ***";:NEXT
362 FORI=1984TO2Ø23:POKEI,42
365 POKEI+C,8:NEXT
```



64 version of "Colorbot."

```
37Ø POKE5328Ø,6:PRINT"{WHT}{HOME}{8 DOWN}
    {16 RIGHT}{RVS}GAME{2 SPACES}OVER"
372 PRINT"{WHT}{HOME}{8 DOWN}{16 RIGHT}
    {RVS}GAME{2 SPACES}OVER"
375 PRINT"{4 DOWN}{12 RIGHT}{RVS}PLAY AGA
    IN{SHIFT-SPACE}(Y/N){SHIFT-SPACE}?"
38Ø FORQ1=128TO254:POKEC+1,Q1:POKEC+4,17:
    NEXT:POKEC+4,16
39Ø GETA$:IFA$<>"Y"ANDA$<>"N"THEN39Ø
395 IFA$="Y"THENCLR:PRINT"{CLR}":GOTO4
4ØØ POKE53272,21:POKE5327Ø,PEEK(5327Ø)AND
    239
41Ø POKE5328Ø,14:POKE53281,6:PRINT"{CLR}
    [7]";:END
415 MN=MN+1:SC=SC+1ØØ:GOSUB43Ø
42Ø RETURN
43Ø SC$=STR$(SC):MN$=STR$(MN)
433 PRINT"{HOME}{YEL}{RVS} SCORE:{CYN}";S
    C$;" {YEL}MEN:{PUR}";MN$;"
    {SHIFT-SPACE}{OFF}";
435 RETURN
44Ø PQ=PEEK(5632Ø):P=PQAND15:P1=PQAND16
441 JØ=-((P=7)OR(P=6)OR(P=5)):J1=-((P=13)
    OR(P=5)OR(P=9))
445 J2=-((P=11)OR(P=9)OR(P=1Ø)):J3=-((P=1
    4)OR(P=1Ø)OR(P=6)):F=-(P1=Ø):RETURN
45Ø X1=X1+1:IFX1>34THENX1=33
455 Z1=Z1+1:IFZ1>4THENZ1=1
46Ø POKEC+1,Z(Z1):POKEC+4,17
465 IFPEEK(FNQ(Ø))>34THENH=1
47Ø POKEFNQ(Ø),X1:POKEFNQ(Ø)+C,1:RETURN
475 POKEFNQ(Ø),32:X=X+1:IFX>38THENX=X-1:H
    =1
48Ø RETURN
485 POKEFNQ(Ø),32:Y=Y+1:IFY>23THENY=Y-1:H
    =1
49Ø RETURN
495 POKEFNQ(Ø),32:X=X-1:IFX<1THENX=X+1:H=
    1
5ØØ RETURN
5Ø5 POKEFNQ(Ø),32:Y=Y-1:IFY<2THENY=Y+1:H=
    1
51Ø RETURN
1ØØØ POKE56334,PEEK(56334)AND254:POKE1,PE
     EK(1)AND251
1Ø1Ø FORI=12288TO12288+256*8:POKEI,PEEK(I
     +4096Ø):NEXTI
```

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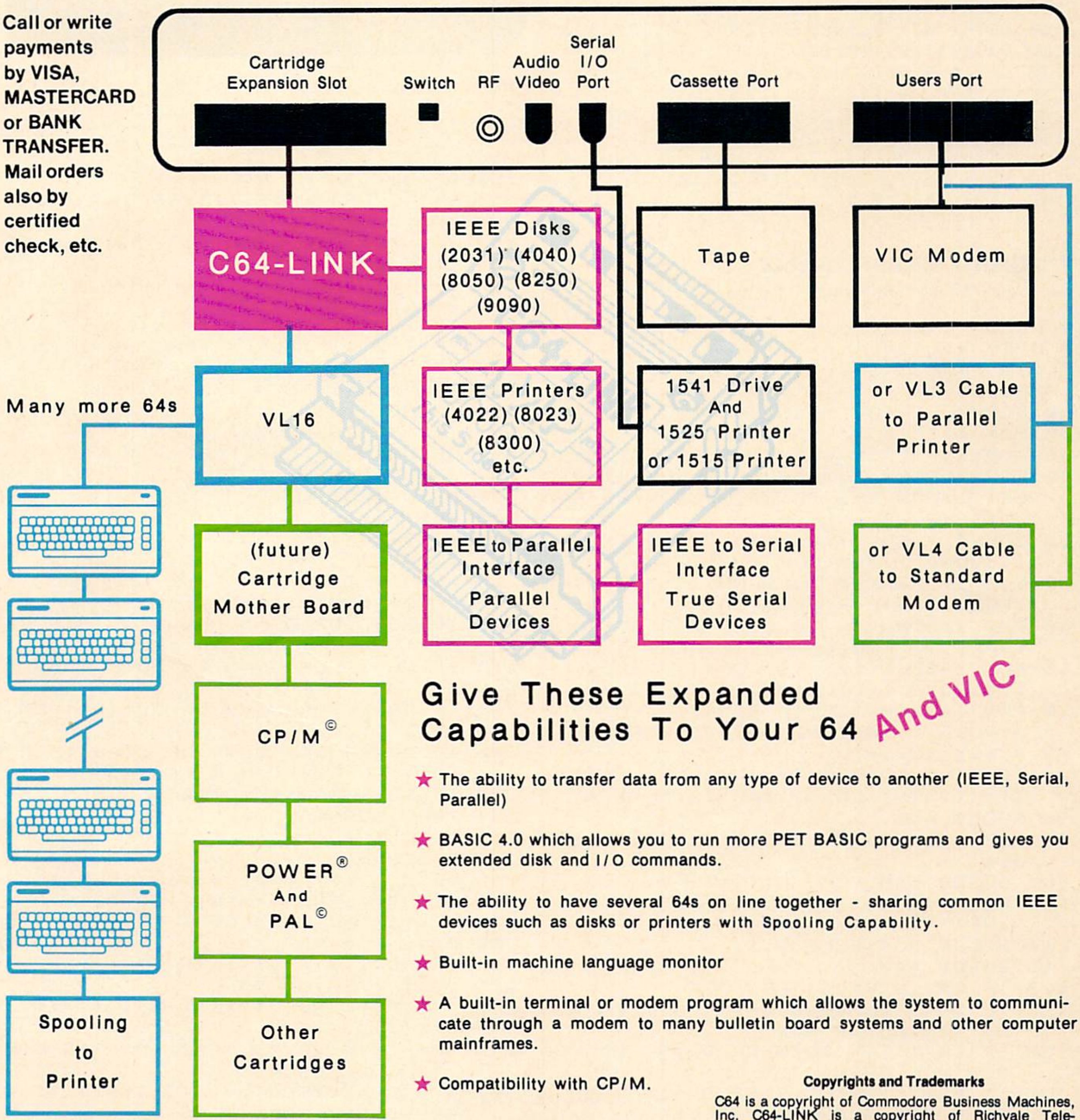

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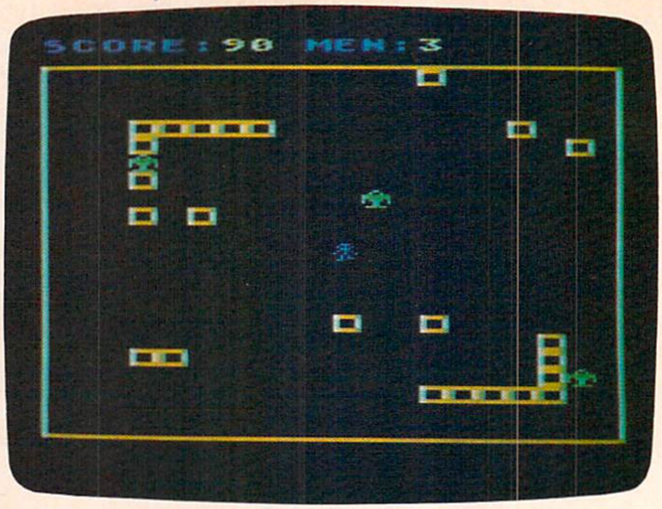
```
1020 FORI=12288+32*8TO12288+150+32*8:READ
     X:POKEI,X:NEXTI
1030 POKE1,(PEEK(1)OR4):POKE56334,(PEEK(5
     6334)OR1)
1040 POKE53272,(PEEK(53272)AND240)+12
1045 POKE53270,PEEK(53270)OR16
1050 RETURN
2000 DATAØ,Ø,Ø,Ø,Ø,Ø,Ø,Ø
2010 DATA56,84,56,84,146,40,104,12
2020 DATA56,84,56,84,146,40,44,96
2030 DATAØ,Ø,32,184,32,Ø,Ø,Ø
2040 DATA4,8,63,63,46,38,4,21
2050 DATAØ,Ø,48,48,Ø,Ø,Ø,Ø
2060 DATAØ,Ø,Ø,Ø,Ø,255,255,170
2070 DATA224,224,224,224,224,224,224,224
2080 DATA11,11,11,11,11,11,11,11
2090 DATA170,255,255,Ø,Ø,Ø,Ø,Ø
2100 DATA170,170,190,190,190,190,170,170
2110 DATA141,Ø,192,238,2,192,173,2
2120 DATA192,201,255,208,6,173,Ø,192
2130 DATA76,49,234,238,1,192,173,1
2140 DATA192,201,5,208,240,169,Ø,141
2160 DATA1,192,24,173,35,208,105,1
2170 DATA141,35,208,76,101,49,14,144
2180 DATA201,224,48,5,169,15,141,14
2190 DATA144,174,252,29,76,104,29
```



Atari version of "Colorbot."

Program 4: Atari Colorbot

Translation by Kevin Martin, Editorial Programmer

```
2 COLOR 1
3 OPEN #1,4,Ø,"K:"
5 DIM X(3),Y(3),Z(4),A$(1)
1Ø GOSUB 1ØØØ
2Ø SCRN=PEEK(88)+256*PEEK(89)
3Ø FOR I=1 TO 3
35 A=Ø:X1=129:SL=1Ø:S1=5:S2=15:MN=4
45 FOR I=SCRN TO SCRN+479:POKE I,Ø:N
   EXT I:FOR I=1 TO S2:R=SCRN+4Ø+RND
   (1)*36Ø:POKE R,1Ø
5Ø SOUND 1,RND(1)*5Ø+1ØØ,1Ø,15:NEXT
   I:SOUND 1,Ø,Ø,Ø
55 FOR I=SCRN+2Ø TO SCRN+39:POKE I,6
   :POKE I+44Ø,9:NEXT I
6Ø FOR I=SCRN+4Ø TO SCRN+44Ø STEP 2Ø
   :POKE I,7:POKE I+19,8:NEXT I
65 FOR I=SCRN+1Ø3 TO SCRN+1Ø7:POKE I
   ,1Ø:POKE I+31Ø,1Ø:NEXT I
7Ø FOR I=SCRN+123 TO SCRN+163 STEP 2
   Ø:POKE I,1Ø:POKE I+234,1Ø:NEXT I
8Ø H=Ø:X=1Ø:Y=12
85 FOR I=1 TO 3:X(I)=INT(RND(1)*16)+
   3:Y(I)=INT(RND(1)*2Ø)+3:NEXT I
9Ø GOSUB 43Ø
95 FOR I=1 TO 3:GOSUB 55Ø:POKE P,68:
   NEXT I
1ØØ GOSUB 56Ø:POKE Q,X1:Z1=1
1Ø5 FOR I=1 TO 3:GOSUB 55Ø:POKE P,68
    :NEXT I
11Ø GOSUB 56Ø:POKE Q,X1
115 GOSUB 44Ø
12Ø IF STRIG(Ø)=Ø THEN 2Ø5
125 IF QQ=7 OR QQ=6 OR QQ=5 THEN GOS
    UB 475:GOSUB 45Ø
13Ø IF QQ=13 OR QQ=5 OR QQ=9 THEN GO
    SUB 485:GOSUB 45Ø
135 IF QQ=11 OR QQ=9 OR QQ=1Ø THEN G
    OSUB 495:GOSUB 45Ø
14Ø IF QQ=14 OR QQ=1Ø OR QQ=6 THEN G
    OSUB 5Ø5:GOSUB 45Ø
145 SOUND 1,Ø,Ø,Ø
15Ø IF H=1 THEN 325
155 R=INT(RND(1)*SL)+1:IF R>3 THEN 1
    Ø5
16Ø GOSUB 57Ø:POKE P,Ø:SOUND 1,RND(1
    )*5Ø+1ØØ,1Ø,15
165 IF INT(RND(1)*S1)=1 THEN GOSUB 5
    5Ø:POKE P,197
17Ø IF X<X(R) THEN X(R)=X(R)-1
175 IF X>X(R) THEN X(R)=X(R)+1
18Ø IF Y<Y(R) THEN Y(R)=Y(R)-1
185 IF Y>Y(R) THEN Y(R)=Y(R)+1
19Ø SOUND 1,Ø,Ø,Ø:IF (X(R)=X) AND (Y
    (R)=Y) THEN 325
195 GOSUB 57Ø:IF PEEK(P)=1Ø THEN I=R
    :GOTO 29Ø
2ØØ GOTO 1Ø5
2Ø5 B=X:D=Y
2Ø7 QQ=STICK(Ø)
21Ø IF QQ=15 THEN 155
215 GOTO 225
22Ø POKE SCRN+B+2Ø*D,Ø
225 IF QQ=7 OR QQ=6 OR QQ=5 THEN B=B
    +1
23Ø IF QQ=13 OR QQ=5 OR QQ=9 THEN D=
    D+1
235 IF QQ=11 OR QQ=9 OR QQ=1Ø THEN B
    =B-1
24Ø IF QQ=14 OR QQ=1Ø OR QQ=6 THEN D
    =D-1
245 IF PEEK(SCRN+B+2Ø*D)>3 THEN 26Ø
25Ø POKE SCRN+B+2Ø*D,3
255 GOTO 22Ø
26Ø P=SCRN+B+2Ø*D:P1=PEEK(P)
265 IF P1<>197 AND P1<>68 THEN 155
27Ø SOUND 1,RND(1)*1ØØ+1ØØ,Ø,15
275 IF P1=197 THEN POKE P,Ø:GOTO 155
28Ø POKE P,Ø:FOR I=1 TO 3:IF (X(I)=B
    ) AND (Y(I)=D) THEN 29Ø
285 NEXT I:GOTO 155
29Ø X(I)=INT(RND(1)*16)+3:Y(I)=INT(R
    ND(1)*2Ø)+3
295 SC=SC+1Ø:IF (SC=2ØØ) OR (SC=8ØØ)
     THEN GOSUB 415
3ØØ GOSUB 43Ø:FOR O=1 TO 4ØØ:NEXT O:
    GOSUB 55Ø:POKE P,68
3Ø5 FOR O=25Ø TO 14Ø STEP -8:SOUND 1
    ,O,1Ø,15:NEXT O:SOUND 1,Ø,Ø,Ø
```

```
310 SL=SL-0.2:IF SL<1 THEN SL=1
315 S1=S1-0.2:IF S1<2 THEN S1=2
320 GOTO 155
325 MN=MN-1:GOSUB 430
330 FOR I=50 TO 100 STEP 5:SOUND 1,I,10,15:GOSUB 560:POKE Q,RND(1)*255
335 NEXT I
340 SOUND 1,0,0,0:GOSUB 550:POKE P,0
345 S2=S2-5
350 IF MN<>0 THEN 45
360 FOR Q2=SCRN TO SCRN+479:POKE Q2,138:NEXT Q2
370 POSITION 5,8:? #6;"GAME  OVER"
375 POSITION 1,16:? #6;"PLAY AGAIN [Y/N] ?"
390 GET #1,A:A$=CHR$(A):IF (A$<>"Y") AND (A$<>"N") THEN 390
395 IF A$="Y" THEN RUN
400 POKE 106,PEEK(106)+5:GRAPHICS 0:END
415 MN=MN+1:SC=SC+100:GOSUB 430
420 RETURN
430 POSITION 0,0:? #6;"SCORE:";SC;"MEN:";MN;" ";
440 QQ=STICK(0):POKE 708,PEEK(53770):RETURN
450 X1=X1+1:IF X1>130 THEN X1=129
455 Z1=Z1+1:IF Z1>4 THEN Z1=4
460 SOUND 1,50*RND(1)+100,10,15
465 GOSUB 560:IF PEEK(Q)>2 THEN H=1
470 GOSUB 560:POKE Q,X1:RETURN
475 GOSUB 560:POKE Q,0:X=X+1:IF X>19 THEN X=19:H=1
480 RETURN
485 GOSUB 560:POKE Q,0:Y=Y+1:IF Y>22 THEN Y=22:H=1
490 RETURN
495 GOSUB 560:POKE Q,0:X=X-1:IF X<1 THEN X=1:H=1
500 RETURN
505 GOSUB 560:POKE Q,0:Y=Y-1:IF Y<2 THEN Y=2:H=1
510 RETURN
550 IF I<4 THEN P=SCRN+X(I)+20*Y(I):RETURN
555 RETURN
560 Q=SCRN+X+20*Y:RETURN
570 IF R<4 THEN P=SCRN+X(R)+20*Y(R):RETURN
575 RETURN
1000 IF PEEK(106)=155 THEN CHSET=(PEEK(106)+1)*256:GRAPHICS 17:POKE 756,CHSET/256:RETURN
1005 POKE 106,PEEK(106)-5:GRAPHICS 17
1007 POSITION 5,5:? #6;"redefining"
1008 POSITION 5,10:? #6;"CHARACTERS"
1009 POSITION 4,15:? #6;"PLEASE   WAIT"
1010 CHSET=(PEEK(106)+1)*256
1015 POKE 756,CHSET/256
1020 FOR X=0 TO 1023:POKE CHSET+X,PEEK(57344+X):NEXT X
1030 FOR I=8 TO 87:READ X:POKE CHSET+I,X:NEXT I
1040 RETURN
2000 DATA 56,84,56,84,146,40,44,96
2010 DATA 56,84,56,84,146,40,104,12
2020 DATA 0,0,0,24,102,24,0,0
2030 DATA 24,36,255,255,189,153,24,126
2040 DATA 0,0,0,24,24,0,0,0
2050 DATA 0,0,0,0,0,0,255,255
2060 DATA 192,192,192,192,192,192,192,192
2070 DATA 3,3,3,3,3,3,3,3
2080 DATA 255,255,0,0,0,0,0,0
2090 DATA 255,255,195,195,195,195,255,255
```
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The Robot Teddy Bear

Just about this time last year my three-year-old son, Eric, and I went to the World Science Fiction Convention in Chicago. It was an experience neither of us will ever forget.

The hotel where the convention took place was filled with over 7,000 science fiction movie makers, writers, hucksters, and fans. Most of the fans were in costume.

Since the fans were in costume, Eric and I decided to wear costumes, too. We went with three friends we were staying with in Chicago. Hope (8 years old) dressed as a bride, Felicity (10) as a princess, Hugh (6) as an Indian, Eric was the Lone Ranger, and I went in the most bizarre costume of all—a business suit with a narrow tie, dark shoes, and a briefcase.

The kids' costumes fit right in, but my costume got a lot of surprised and baffled stares. Each time someone stared at me in wonder, I secretly patted myself on the back for my originality.

You Will Always Be In My Memory Bank

Eric and I returned to the convention on another day by ourselves. That's when Eric met Denby, a show robot from the International Robotics Corporation in Dearborn, Michigan. Denby was about six feet tall and all white except for a "billboard" advertisement on the front of his cylindrical body that advertised two of the leading science fiction magazines.

Denby was a real character. When he spotted Eric, he rolled over and greeted him. "What's your name, young man?" he asked.

Eric told him his name. He also told Denby about his mother, his sister, and his black cat, Mowie. He told Denby he had seen Darth Vader and Yoda at the convention, and that he had worn his Lone Ranger outfit last time he was there.

Denby told Eric that he was the nicest little boy he had seen at the entire convention.

Eric shook Denby's hand and gave him a big hug. Denby got so excited he started bouncing around the floor, spinning his head, and blinking his baby-blue eyes. "Whooweee!" he said.

Denby told Eric good-bye and rolled off across the convention floor. That didn't shake Eric. He followed Denby around the convention, up an elevator, and into a conference room. He didn't miss an opportunity to engage Denby in further conversation, shake his "gripper" hand, and give him kisses and hugs. (Eric couldn't reach more than a third of the way around Denby's barrel waist, so he hugged Denby's leg.)

Denby was a nice robot. Every time Eric appeared he acted really happy to see him. I think he must have realized that he had stolen Eric's heart.

Eric finally said good-bye to Denby, but not before he had collected a Polaroid photo of himself and Denby in front of the *OMNI* magazine booth, and another 8 × 10 color photo of Denby, complete with Denby's personalized autograph. On the photo Denby wrote: "To Eric, You will always be in my memory bank."

Now, a year later, the photos are still among Eric's prized possessions. One hangs on his bedroom wall; the other sits on his dresser and often gets taken to bed.

Eric Meets Little Denby

Big Denby made such an impression on Eric that when I saw a little toy robot at one of the booths at the convention, I immediately picked it up.

The new robot became known as "Little Denby," then simply as "Denby."

From the first night he got him, Eric began taking Denby to bed with him, like a mechanical teddy bear.

Denby does not look like a teddy bear. He

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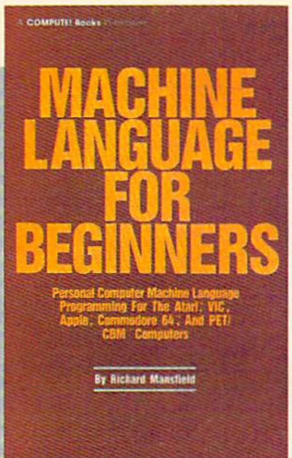

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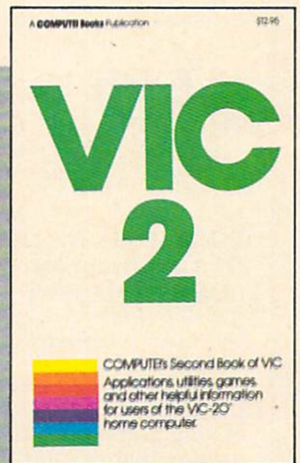

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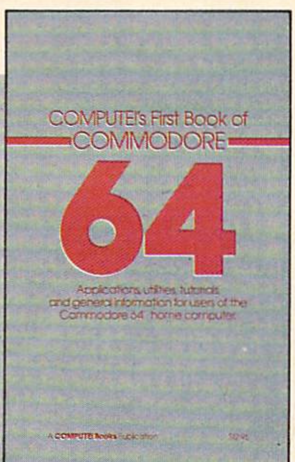

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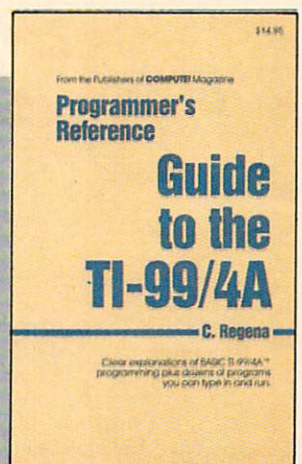

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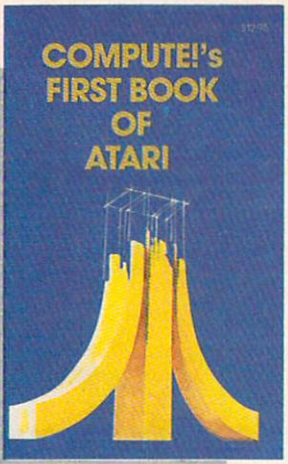

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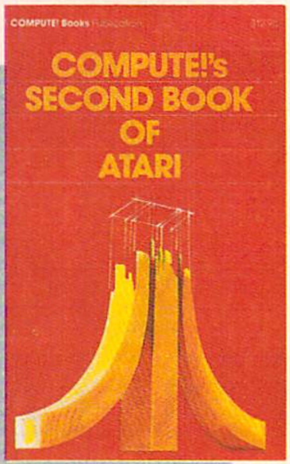

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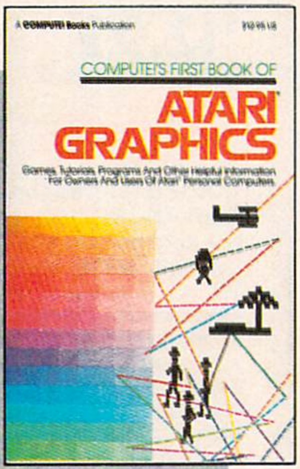

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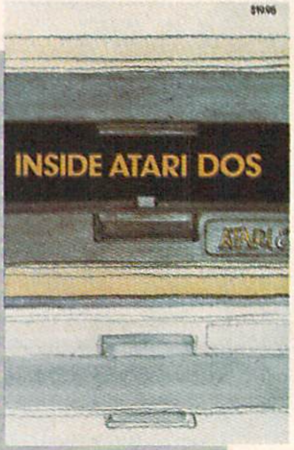

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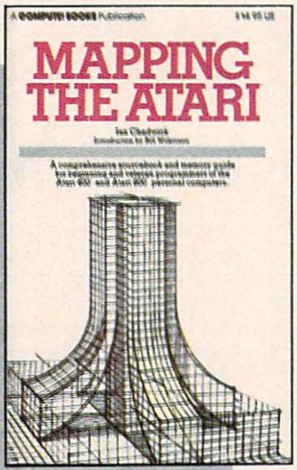

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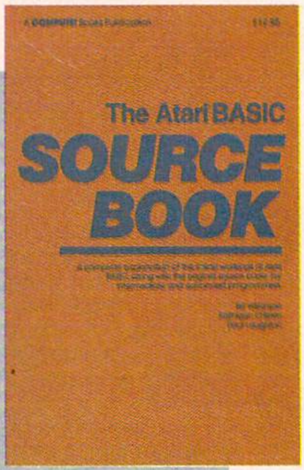

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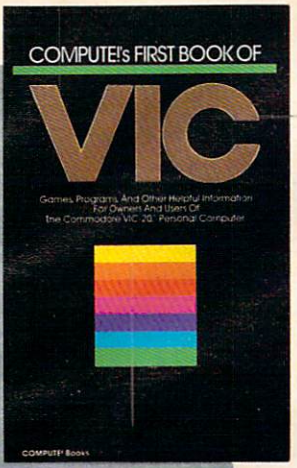

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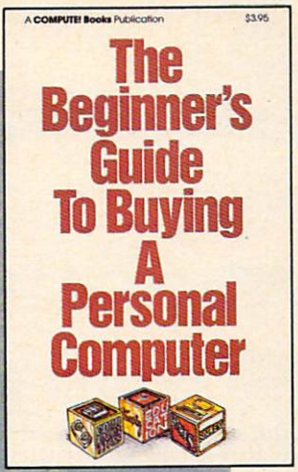

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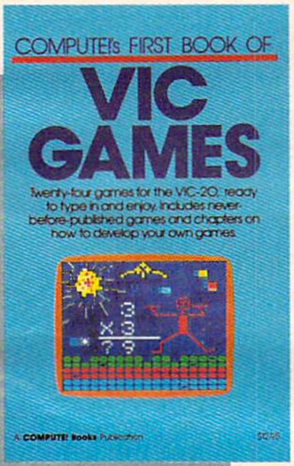

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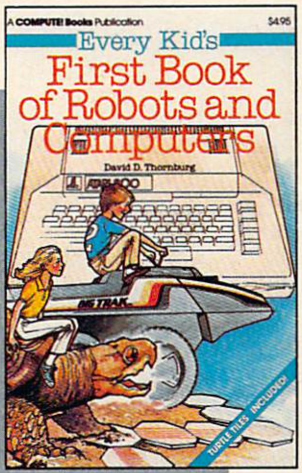

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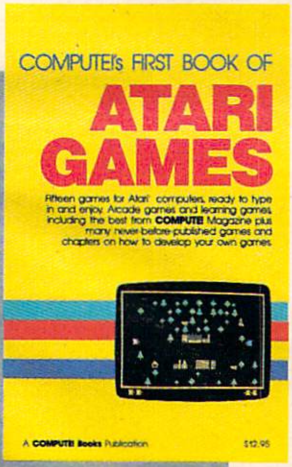

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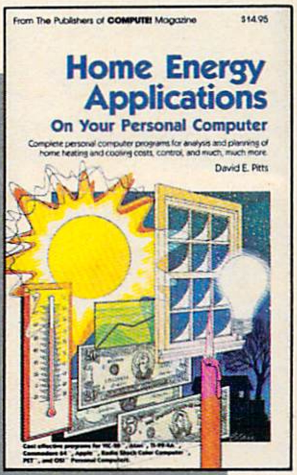

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TOPO the robot flanked by D'Ignazio family (from left): Catie, Fred, Janet, Eric
Credit: Roanoke Times & World-News. *Photo by Wayne Deel*

is made of hard, black plastic. And his eyes flash when he is turned on. But, to Eric, Little Denby is like a teddy bear. He is Eric's link to his friend Big Denby. And few people—biological or mechanical—ever made as deep an impression on Eric as Big Denby.

My Best Wishes To Everybody!

Learning to live intimately with a robot has not exactly been easy.

When Eric and I returned from Chicago, he continued taking Little Denby to bed with him every night. I remember nights when I would wake up and hear Eric crying in his bedroom. I would rush in and Eric would sob and tell me "Denby hit me" or "Denby stuck me." Eric had rolled over on Denby in his sleep. Denby is hard with lots of angles and bumps. He is not the kind of robot you can snuggle with and escape unbruised.

One night shortly after Eric and I returned from Chicago, my wife Janet and I were sound asleep in our room when I heard a loud *clunk!* come from Eric's bedroom.

Then came a loud, shrill air-raid siren.

Janet and I sat up in bed, alarmed and confused. We began climbing out of bed, and the siren stopped. Then, real loud, a buzzing, mechanical voice announced, "I am the atomic robot! My best wishes to *everybody!*"

It was Denby. He had fallen out of Eric's bed and landed on his head. On Denby's head is a yellow button. When you press the button (even when Denby is turned off), Denby makes an air-raid siren noise and tells every one who he is and wishes them his best. And Denby doesn't just say these things. He blasts them out like a bullhorn.

This is an okay feature for a robot to have during the daylight hours, but when a robot does this at two in the morning it can make you come unglued.

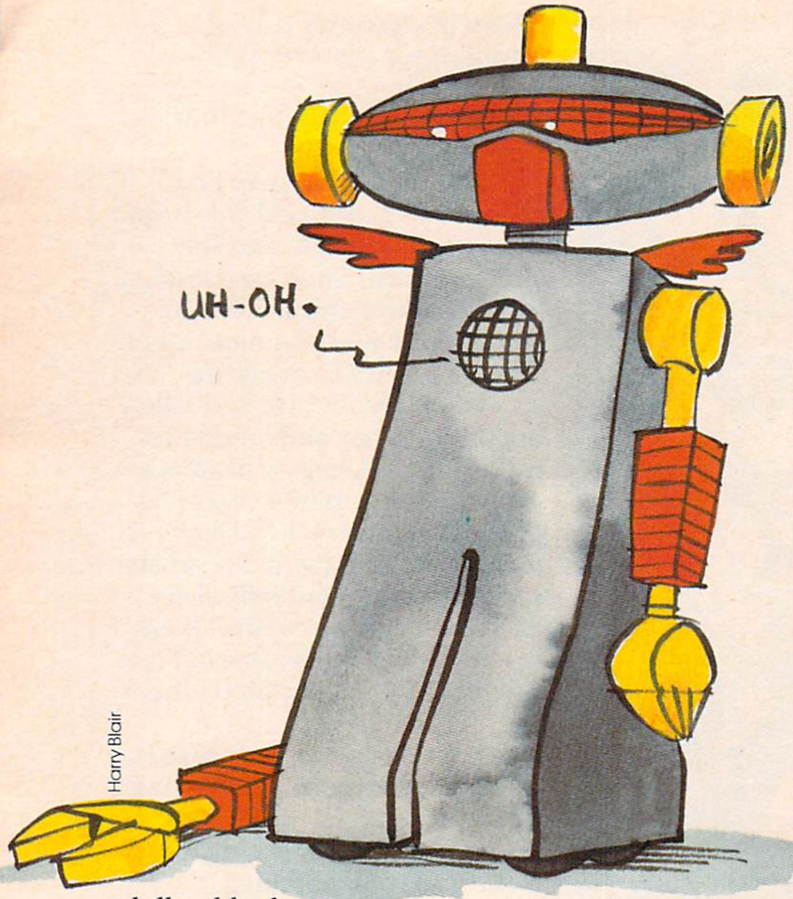
One further qualification: Robots should only be seen and not heard in the middle of the night or *in a car.* I don't know how many car trips we've taken where we have had to confiscate Denby from Eric and my daughter Catie. When Denby shouts out his greetings from the back seat, and, worse, when his alarm goes off unexpectedly, it takes all the self-control I've got to keep from swerving the car into a tree.

The One-Armed Robot

When children fall in love with dolls, blankets, and stuffed animals, they carry them around everywhere. Eventually the object of the child's affection begins to take on a very different look. It looks more and more faded, pummelled, mauled, unpleasant, and unhygienic.

My daughter, for example, had a mouse ("Mousie") that had been hugged and carried so much its skin grew so thin that its stuffing started leaking through. And she had a blue blanket ("Ni-Ni") that, despite frequent washings, took on a greasy gray color and looked more like a shredded garbage bag than a child's blanket.

The same is true of robots. Except they're more sturdy. Eventually, however, all that love and affection begins to get to them. After a while they begin to look as ragged as a favorite stuffed



doll or blanket.

Denby is a very tough little robot. For several months he continued to look as good as new. Then, one day, Eric decided to "walk" Denby down the basement stairs. Denby is only ten inches high, and he has no legs—just wheels. He made it to the top of the first stair, then he turned into a robotic pogo stick and bounced his way down the remaining stairs.

That was how Denby lost his arm.

(The arm still sits, forlorn looking, in a small demitasse coffee cup in the kitchen. Janet has performed several surgical operations with Krazy Glue and Miracle Glue to try to reattach the arm to Denby. The arm stays on Denby for a short time, to Eric's acute joy and pleasure. Eventually, however, the arm ends up back in the coffee cup.)

On that same trip down the basement stairs the little door on Denby's bottom burst open and spilled Denby's batteries all over the basement floor.

Today Denby wears a truss—three arcade-store game tokens underneath four layers of masking tape fastened to his bottom. The tokens and the tape keep Denby's batteries inside his body where they belong. But they don't always work, and this makes Denby sort of cranky and unpredictable. Sometimes he races around the kitchen floor, but sometimes he just sits on the floor and makes his air-raid siren in slow motion. It sounds a lot like a whine.

TOPO, The Bag Lady

We recently acquired a new member of our family—TOPO the robot from Androbot (101 East Daggett Drive, San Jose, CA 95134, 408/BOB-TOPO). Now we are a three-robot family (including the robot turtle who lives in the piano room).

I think TOPO looks fine just the way he came out of the packing crate from the factory—like a little white snowman. But my kids think differently. He must look naked to them, because ever since we first got him they have been dressing him up.

At different times TOPO has worn capes, shawls, cowboy guns, hats, flags, bracelets, and rainbow-colored Smurf belts. But my favorite is the time my kids dressed TOPO as a bag lady.

One night, very late, I was going around the house turning off lights and making sure all the doors were locked. I went into my daughter Catie's room. She was sleeping soundly. Then I went into Eric's room.

I got the shock of my life!

Looming over Eric's bed was a small figure dressed in a shawl, a scarf, and a faded purple skirt. It looked like a pygmy bag lady. The bag lady carried a bulging paper sack in each arm. Large, tacky, plastic bracelets dangled from her wrists.

And there was more. In the darkened bedroom she seemed somehow ominous and threatening. I think it must have been the white plastic Dracula teeth taped to her mouth.

I was relieved when I finally realized that the creature in my son's room was TOPO the robot. Then I grew amused. It was that "Look what I've gotten myself into" feeling that I often get when I hang around Catie and Eric. You see, when we got TOPO I didn't realize what we were doing. I thought we were acquiring a robot. But we weren't acquiring a robot, we were adopting a pygmy bag lady—a pygmy bag lady *vampire*.

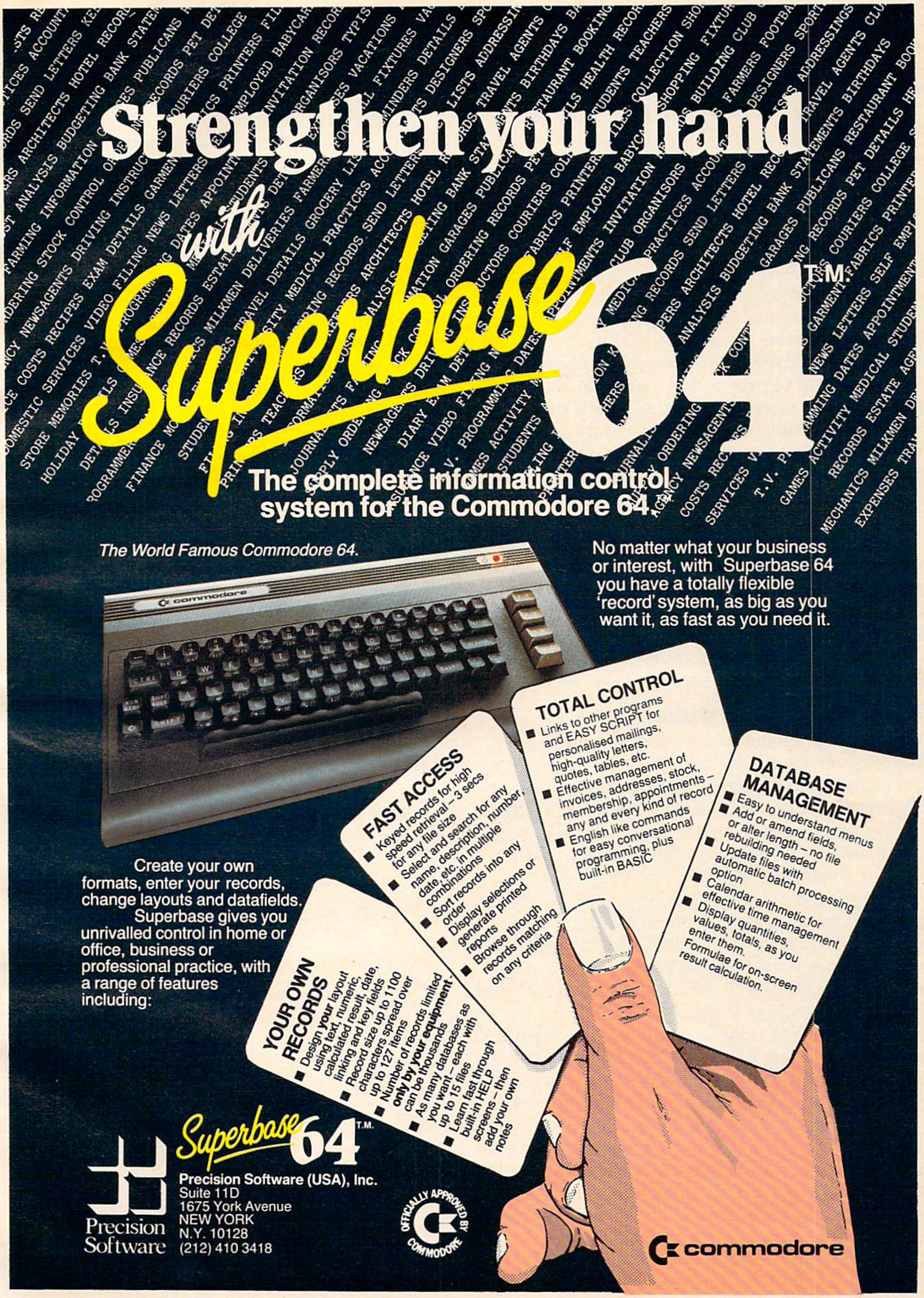
Just what every family needs.

Now You Can Be Real To Everyone

When I was a kid one of my favorite stories was *The Velveteen Rabbit* by Margery Williams. The story is fairly well known, but the subtitle is less familiar: *How Toys Become Real*.

Denby and TOPO remind me of the velveteen rabbit. When they first arrived they were just "things." But before long they became vital members of our family. Now we talk about them as if they have personalities, ideas, and feelings. We act as if they are *real*.

On ABC-TV's *World News* program last night, Peter Jennings, the show's anchor person, went to a teddy-bear convention. The title of the piece was "America Is Bullish on Bears." Hundreds of people had come to this convention with their favorite teddy bears. There were fat bears, beauti-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ful bears, dumpy bears, big bears, and bears the size of pins and match sticks. There were wise bears, silly bears, watch bears, and guard bears.

The people who own teddy bears love them as much as we love our robots, maybe even more. To those people, the bears are alive. They are real.

How do robots and bears become members of your family? How do toys become real?

They become real when we project our ideas, thoughts, personalities, and feelings into them. It's the same thing novelists do when they create characters with words on paper. They create lifelike beings who inhabit the pages of their books.

And, almost as soon as we project lifelike traits into them, our toys become independent from their creators. They seem to have an identity all their own. They seem to exist whether or not we are around to project life into them. We never know what to expect from them. Their thoughts, feelings, and imaginary actions are always a surprise. We can't predict what they'll do next. All their actions are consistent with the personality that they have evolved, but they are not preprogrammed or "mechanical."

The reality of the teddy bear or robot is greatly heightened when its personality becomes a shared fantasy among several family members or friends. Then it becomes an ongoing "joint invention" of several people. When we hear other people talk about these creatures as if they were real, we come to accept their reality even more than before.

Robot Maids And Butlers

All of this brings me to the conclusion that the real reason we will buy robots by the thousands and millions is *not* so they can become our household servants. Instead we will buy them so they can become our pets, our companions, and our friends—just like a dog, a cat, a blanket, a teddy bear, or a velveteen rabbit.

According to most robotics experts, we are a couple of decades away from general-purpose household-servant robots. The sensors and computers in today's robots are too primitive for a robot maid or butler to survive in the hubbub and chaos of the average home.

Yet there are a dozen companies which are already marketing relatively low-cost "consumer" robots destined for the classroom or the home.

In *People* magazine and on TV talk shows, we see robot owners and their robots acting out our fantasies about what we'd do if we had our own personal robot. The robots are shown walking the dog, washing a window, or bringing the man of the house a beer while he reads the evening paper or watches a football game on TV.

This is silly!

How do you program a blind, wheeled robot who only accepts hexadecimal commands to walk a dog around the neighborhood?

How do you get a two-foot-high robot who can't pick up a dishcloth to go to the refrigerator, open the door, pick out a beer, and somehow find the TV room?

Even robot sentries and guard dogs are pure fantasy—a dangerous fantasy. I know how much trouble my parents and their friends have with their computerized security alarms they have purchased for their homes. They are constantly setting off the alarms and sending the police and the fire trucks to their homes by accident.

How would *you* like to face a guard-dog robot armed with mace, tear gas, or an electrified snout? Would you trust that robot to consistently distinguish you from a burglar or robber? Would you trust that robot alone with your children?

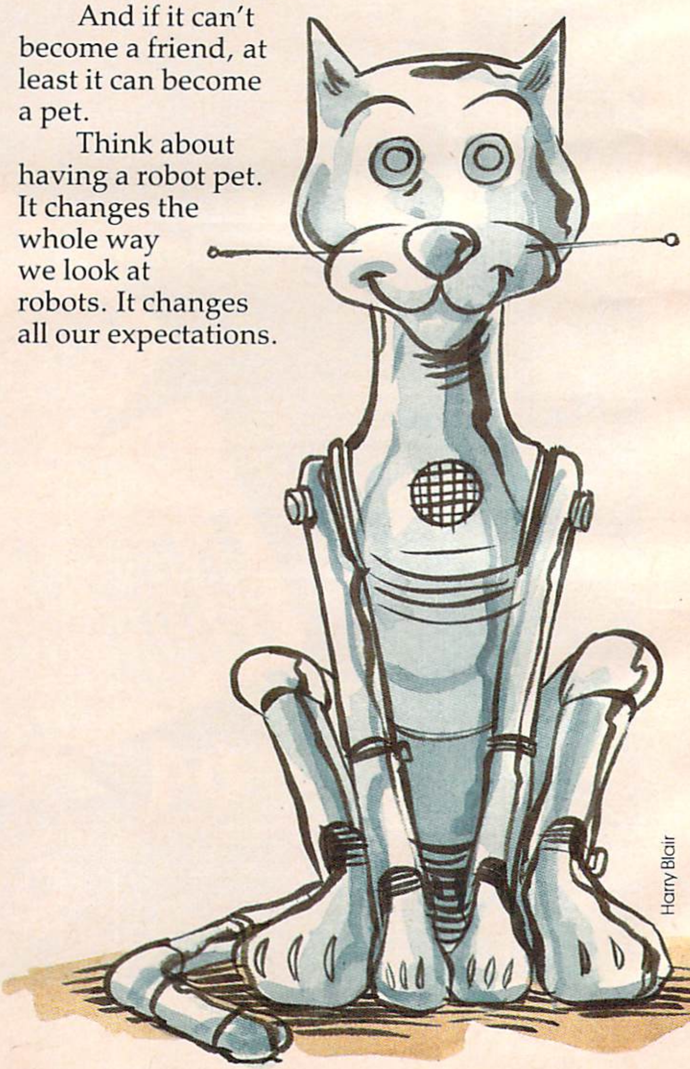
Why Buy A Robot?

Several months ago I wrote a number of columns about a "computer friend" that parents could program for their children. I said that, ultimately, user-friendly computers would evolve into computer friends, and not just for our children.

Now I think that the biggest justification for buying a robot is that it can become a friend—to our children and to us.

And if it can't become a friend, at least it can become a pet.

Think about having a robot pet. It changes the whole way we look at robots. It changes all our expectations.



If we look at robots as servants, we expect them to be convenient, hardworking, labor-saving devices. This, robots emphatically are not.

But if we expect robots to act like pets—like the family cat, dog, guinea pig, or goldfish—then we have a whole new set of expectations. And we can define a whole new set of standards. These standards can be just as rigorous as the standards for a robot maid or butler. But they can also be a lot more realistic.

We don't expect our dog or cat to wash dishes or take out the trash. We sometimes expect them to guard and protect us, but their performance in this area (as anyone who has ever had a watchdog will attest) is notoriously spotty. Our fearless watchdog might lick a burglar's hand, then turn around and bite the newspaper boy on the seat of the pants.

What can we expect from robot pets?

First, we can expect them to be lovable. To be lovable they should be cuddly, fuzzy, and huggable. They should be small enough so we can pick them up and carry them around with us. They should be " lap robots."

Also, they shouldn't be perfect. They should be just as quirky and silly as our cat or our pet gerbil. On occasion, they should be naughty, they should pout, they should be perverse and impossible. Or they should at least give the right appearance. We can easily imagine the rest.

Second, they should be teachable. We should be able to "imprint" ourselves as much on them as they do on us. They should learn our names, our favorite interests, jokes, and whimsies. They should be nice to us. They should be like the big old dog who acts like he is excited to see us when we come through the front door, or like the cat who can't wait to hop in our lap the moment we sit down.

Third, they should be tough. They should wear more like Denby than like a teddy bear or a blanket. They should be survivors of a lot of rough-and-tumble affection.

Fourth, they should be portable. They should be able to go on car, train, and plane rides. They should be able to go on vacations to the beach and still work even though they have sand in their sensors.

Fifth, they should teach us. They can teach us formal things like arithmetic, the names of countries and presidents, and the spelling of polysyllabic words. But they should also teach us little intangible things, like loyalty, affection, trust, ethics, and values. They should learn our values then echo them to our children and our friends.

They Could Become Friends

We should remember that robots are, above all, creatures of our imaginations. That is why we find them so fascinating. The more a robot encourages us to use our imagination when we deal with it, the more successful that robot will be. On the other hand, the more a robot tries to act like a mobile appliance, the more it will set us up for frustration and disappointment.

After all, what is a robot? I'm not sure I can answer my own question. But I do know that a robot is something more than an average machine like a dishwasher or vacuum cleaner. We project a great deal of ourselves into robots. We do not do this with vacuum cleaners and dishwashers.

What else do we project ourselves into? We project ourselves into pets, dolls, and toys. This is why we value these creatures more than our vacuum cleaners and dishwashers. It would be a shame if we were to build robots to imitate common household appliances. Then we would devalue our robots and they could never realize their potential. They could never be truly real.

If we want robots to become real, we should stop trying to get them to "grow up" and become common appliances. Instead we should direct them toward their greatest potential—to become mirrors of our minds, our feelings, and our imaginations. Today, using current technology, robots cannot become our household servants. But today's robots can become our toys and our pets. And, perhaps someday they may become our friends. ©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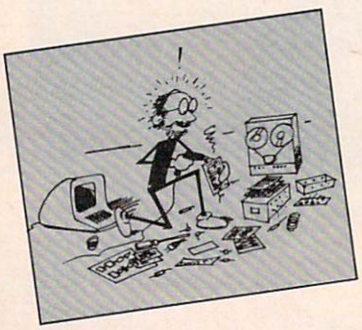
Computer Popcorn

Fred D'Ignazio, Associate Editor



Last night I woke up in the dark with my head spinning. I turned to the digital clock beside the bed. It said 3:00 a.m. Musical notes and rainbow-colored rubber bands bounced around inside my mind. Over and over, a little voice inside me kept repeating two words: "Computer popcorn. Computer popcorn. Computer popcorn."

The voice told me that I was supposed to get out of my warm bed and go into my dark, cold study. And what was I supposed to do when I got there? I was supposed to write about *computer popcorn*.

When I protested that it was the middle of the night and that I didn't want to get out of bed, the voice became surly. "If you don't get out of bed," it said, "you'll forget everything by morning."

"Forget what?" I thought.

"Computer popcorn," said the voice. "Computer popcorn is a computer program that is so good you can't put it down. You can't stop thinking about it. You even dream about it."

Fred D'Ignazio is a computer enthusiast and author of several books on computers for young people. His books include Katie and the Computer *(Creative Computing),* Chip Mitchell: The Case of the Stolen Computer Brains *(Dutton/Lodestar),* The Star Wars Question and Answer Book About Computers *(Random House), and* How To Get Intimate With Your Computer (A 10-Step Plan To Conquer Computer Anxiety) *(McGraw-Hill).*

As the father of two young children, Fred has become concerned with introducing the computer to children as a wonderful tool rather than as a forbidding electronic device. His column appears monthly in COMPUTE!.

Dreaming In French

At different periods of my life I have become so obsessed by and so immersed in a new subject that I can't stop thinking about it. I even take it to bed with me at night.

For example, I spent a couple of months backpacking around Europe one summer when I was in college. I spent the first night away from home in a hostel in Paris with a lot of my college friends. The next morning they all yelled at me. "You kept us awake all night," they complained. "We don't know what you said, but it was all in French."

I used to be an international relations major. I learned a lot of languages and visited a lot of countries. When I visited Mexico I dreamed in Spanish. When I went to Brazil I dreamed in Portuguese.

I doubt if my French, my Spanish, and my Portuguese were grammatically correct, and I'm

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sure my pronunciation was not perfect. But the important thing is that I was excited about exploring a country and a new culture—so excited that I continued my exploration even while I was asleep.

Doorways Into New Worlds

This experience is a little like a religious conversion. It is a sense of rapture that you feel when you throw open a door and see endless vistas you've never imagined. Then you step through the door.

This is the feeling I've gotten recently from some of the new programs and computer peripherals I've been reviewing. In this article I'll take a look at one of these programs (*The Music Construction Set* from Electronic Arts) and a combined program/peripheral (the KoalaPad and the *Micro Illustrator* program from Koala Technologies).

Mechanical Drawing

When I was in high school, I took two classes that I thought were particularly painful. One class was mechanical drawing. The other was geometry. I found these classes so agonizing because they both involved the painstaking, *precise* drawing of geometric figures. In geometry class we mostly stuck to two-dimensional figures like squares, triangles, circles, and polygons. In mechanical drawing we began with blocks and cubes, and ended up drawing spaceship nose cones, automobile crankshafts, and "exploded" watch gears.

Surprisingly, I got good grades in both classes. I got the grades because I was such a perfectionist. I would struggle with the assignments for hours and finally turn out a beautiful, finished drawing.

But I hated every minute of it. By the time I finished doing the drawings my arm, wrist, and finger muscles felt so cramped I thought I would go crazy.

And I never thought about what I had drawn. I was too exhausted just getting the shapes down on the paper. The engineering and mathematical concepts underlying these drawings went right over my head. I never even considered them.

Rainbow-Colored Rubber Bands

With images of nose cones and polygons floating through my mind, I sat down for the first time and tried a new product, the KoalaPad from Koala Technologies (4962 El Camino Real, Suite 125, Los Altos, CA 94022, 415/964-2992).

You can buy a KoalaPad for $125 and all supporting software packages for less than $50. Different versions of the KoalaPad are made for the IBM PC; the Apple II, II+, and IIe; the Commodore 64; and the Atari 400, 800, and XL computers.

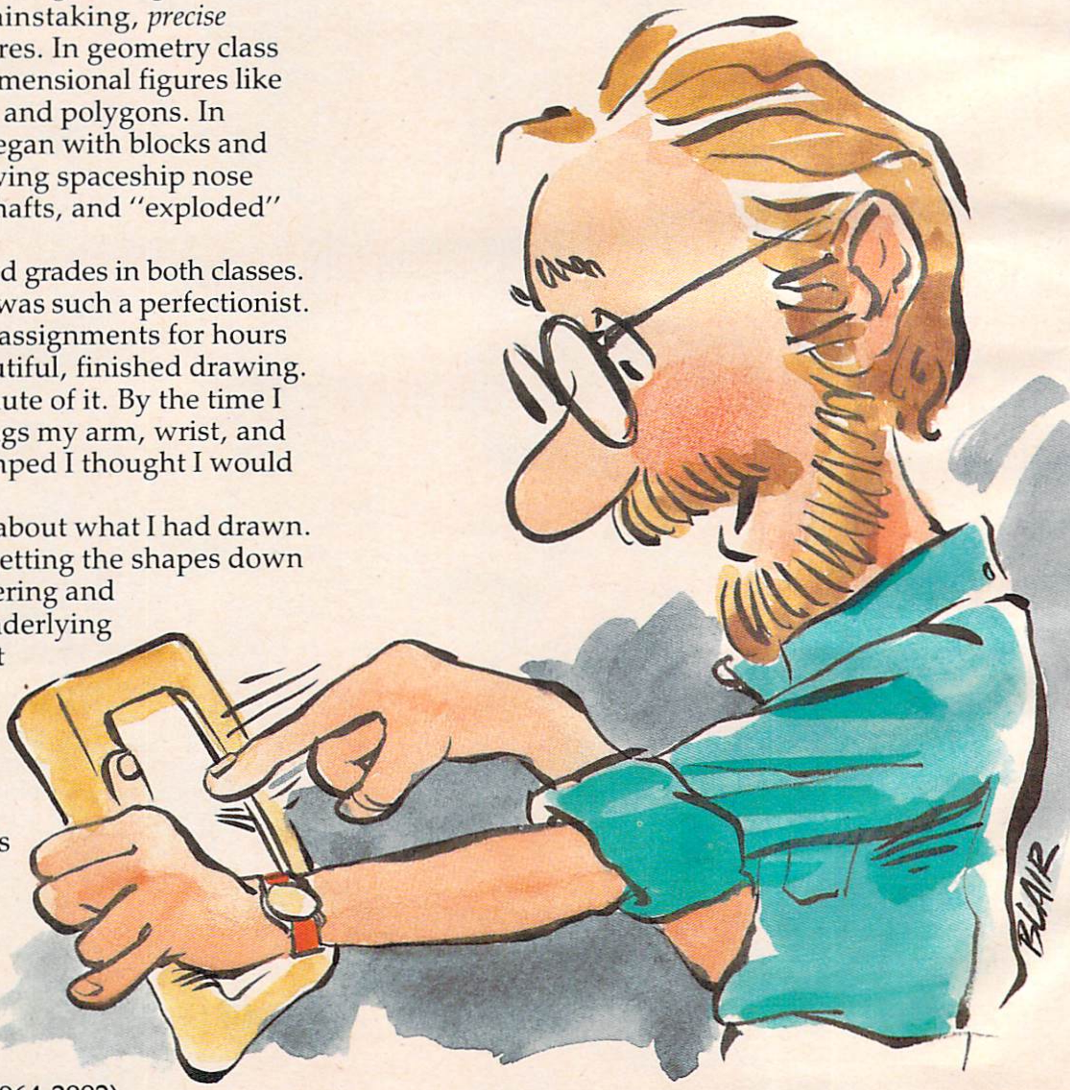
The pad is smaller than a TV dinner and weighs about as much as a paperback book. You plug the pad into the joystick port of your computer, and you hold it in your hand or lap while you draw, using either your finger or a plastic stylus that comes with the pad.

The KoalaPad comes with the *Micro Illustrator* program from Island Graphics (for the basic price of $125).

"Growing" Circles And Boxes

The KoalaPad and *Micro Illustrator* are *computer popcorn*. They're delicious! Once you and your family start using them, you won't be able to stop.

When you boot up the *Micro Illustrator* program, you see a menu of lots of little boxes with words and pictures inside. Each box is a doorway



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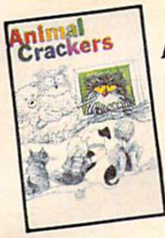

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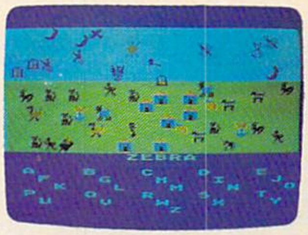

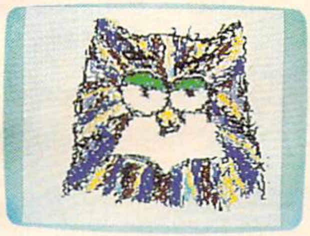

Unleash the creative talents of the big kids and the little kids in your family with the first electronic coloring book. **Computer Crayons™** comes complete with ready-to-paint scenes and an artist's palette of vibrant color. Additional options permit you to save and restore pictures easily, draw circles, lines, boxes, and erase in a single stroke.

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into new worlds of self-expression for you and your family.

With a KoalaPad and *Micro Illustrator*, all of a sudden making geometric figures is easy. *Micro Illustrator* encourages you to make figures of great beauty and complexity. It's seductive. It's so easy to draw elaborate, symmetrical shapes that you keep thinking: What if? What if I connected these two lines, or what if I created some circles over here? What if I rotated this figure and colored it in?

With Micro Illustrator, *drawing geometric shapes and figures is easy. The program, which is used with a touch tablet, makes picture creation effortless. This menu screen allows you to choose various brushes and colors.*

My family and I have only had the KoalaPad and *Micro Illustrator* for a week, but, already, each of us has used them for several hours apiece.

And we still haven't explored all the features. I love the circle, disc, box, and frame commands. Using these commands you can "grow" geometric shapes in seconds.

Our favorite feature is the mirror. The mirror lets you draw simultaneously in four directions. Combine the mirror command and the line command and you can create glowing rubber-band lines that stretch like a net across the screen. Tack the circle command onto the mirror command and you can draw hosts of rotating circles. In no time at all you can create beautiful patchwork quilts, ornate tiles, bug-eyed aliens, and solar systems full of planets and moons.

The KoalaPad and *Micro Illustrator* are marvelous skill and imagination amplifiers. They allow me and my family to do things we could never do on paper. And they make it so effortless that we don't have to concentrate on the mechanical aspect of creating new shapes and pictures. We are free to create and to discover, and when we're finished, we're still fresh enough to be amazed.

The proof of how amazing these products are is how proud we are of what we create. The person on the computer is always calling to the other members of the family: "Come here, everybody! Look what I've drawn! You've got to see this one!"

Mechanical Bach

When I was seven years old, my mother started me on piano lessons. Maybe I wanted to learn about the piano at the time. I really can't remember, because the original joy of making music was quickly submerged by the daily grind of practicing and the weekly pilgrimage to the music studio where I suffered under the harsh tutelage of a nonstop stream of boring and unimaginative music teachers.

The teachers weren't really so bad. It was the method I hated. Like any kid, I had aspirations to create my own music, to make beautiful, original sounds that expressed how I felt and what I thought. But all I ever did was mechanically translate the printed musical notes of mediocre songs from the scores onto the piano keyboard.

I never realized that my teachers weren't treating me like a human being. They were treating me like a machine—a music player, like a player piano. I learned how to read other people's "frozen" music and then miserably try to reproduce it on the piano keyboard. The problem was that I didn't care for the music I was playing, and the sounds I made rarely pleased me. If I liked music (as I did) it was a lot easier to go to a record store and buy a record. Then I could hear the music I liked and it sounded right.

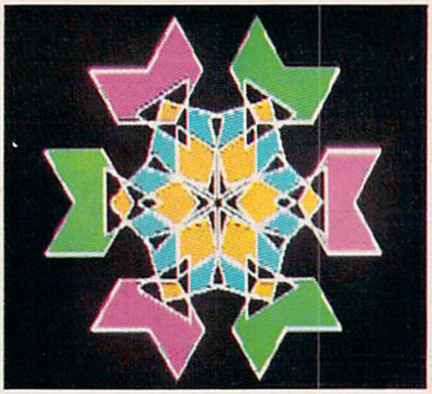
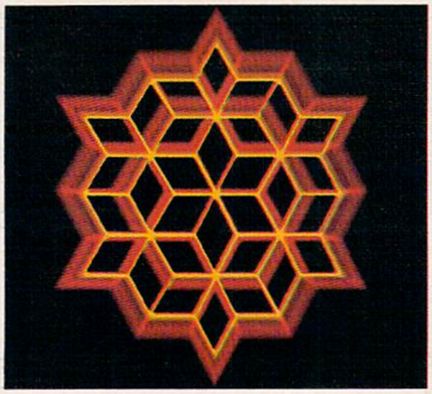
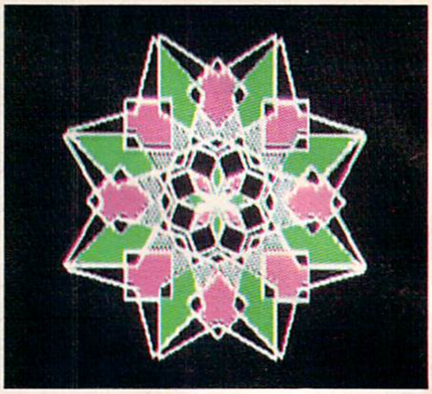
At some level I realized that my original purpose had been perverted. And, like any decent human being, I made a very bad machine. I repeatedly showed up for class late, I never practiced, and I never played a piece the way it was written.

This used to drive piano teachers crazy, and they never lost the opportunity to tell me how little musical talent I had.

I didn't care. I would rather have been playing baseball or touch football. Anything rather than have to practice the G major scale for another half hour.

The Music Construction Set

The Music Construction Set is Will Harvey's response to piano teachers who teach their pupils

to pretend they are machines. Will Harvey is a 16-year-old from Uplands High School in Foster City, California. When asked why he wrote *Music Construction Set*, Will replied: "It was something that needed to be done. I wanted someone who didn't know anything about music to be able to learn it simply and have a lot of fun doing it. I also thought it would be great if you could save what you wrote."

According to Will, his program is "simple, hot, and deep." By this he means that it is easy to use, it appeals to a person's senses, and it can grow with a person. The program is enchanting to musical novices as well as musicologists and musicians.

Music Construction Set (*MCS*) retails for $40 and is published by Electronic Arts (2755 Campus Drive, San Mateo, CA 94403, 415/571-7171).

MCS currently runs on the Apple IIe and the Commodore 64 and will soon run on the Atari computers.

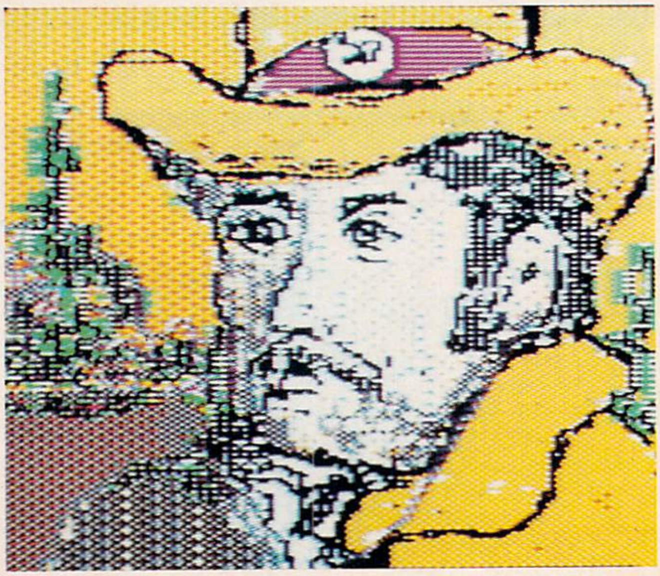
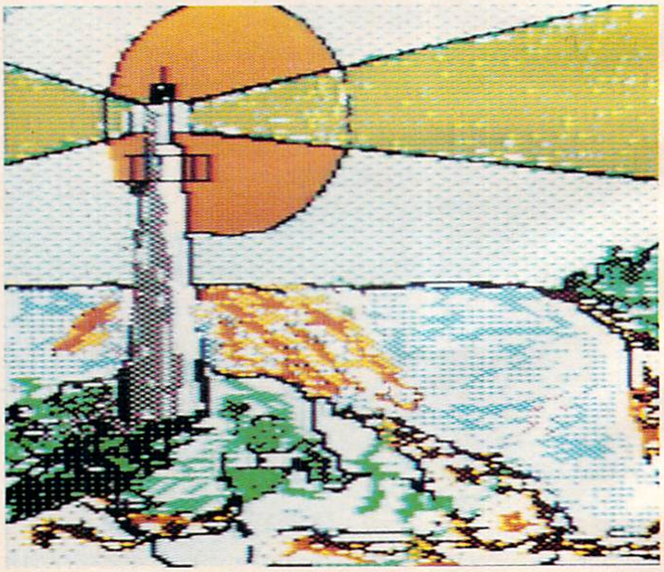
If you plan to use *MCS* on an Apple, you should consider a special offer by Electronic Arts. You can buy a Mockingboard stereo sound card for $100 ($25 off the regular price of $125). The Mockingboard lets you create polyphonic sound on the Apple. That means you can create chords with up to six notes playing at the same time. And you get stereo, too. Sweet Micro Systems is at 150 Chestnut Street, Providence, RI 02903 (401/273-5333).

If you have the Commodore 64, you have the SID (sound synthesis) chip, and you don't need the Mockingboard. When you run *MCS* on the Commodore 64, you will be able to compose and play music with up to three notes playing at a time. On the Atari, you will be able to create music with up to four notes playing at a time.

The other add-on to *MCS* that I enthusiastically recommend is the KoalaPad from Koala Technologies (see review above). You use the KoalaPad to move the notes and other musical symbols around on the picture screen. You can also move symbols using a joystick or the keyboard. But the *easiest* and *fastest* way to move musical symbols is using the KoalaPad.

This is how *MCS* works--on the Apple II+ with the Mockingboard and the KoalaPad:

First, you boot up the *MCS* disk, and you see empty musical staffs at the top of the screen and a pictorial menu on the lower half of the screen. If you do nothing, the computer starts playing music itself, as if you have just put a record on your stereo. You hear ten songs, including Pachelbel's "Canon," Rimsky-Korsakov's "Flight of the Bumblebee," and the "Pat the Hat" rag by Douglas

Fulton. Then the music starts again. It will keep playing until you press the RETURN button.

Since you're into creating your own music, you immediately press RETURN. The next thing you do is press the plastic stylus on the KoalaPad down on the pad. Immediately a pointing-hand "icon" appears on the screen. You use the hand to "build" your song.

You move the stylus point across the pad and the hand moves across the screen. When the hand on the screen gets to an eighth note (there are also whole notes, half notes, quarter notes, sixteenth notes, and thirty-second notes), you press the top left-hand button on the KoalaPad. The note "jumps" into the hand. You move the hand onto the empty musical staffs and position the note in the E-note position on the treble clef. When you let go of the KoalaPad button, the note falls out of the hand and glues itself to the staff.

You can do all this in just a couple of seconds.

Then you move the hand back to the menu of notes, rests, sharps, flats, ties, octave raisers, and time signatures, and pick them up, one at a time, and deposit them on the staffs.

When you are finished creating some music—up to 1400 notes and up to 70 measures—you move the hand across the screen to point at the picture of the little house ("Home") and press the KoalaPad button. The musical score on the picture screen *scrolls* to the left, back to the first measure—the beginning of the music. Then you move your hand to point at the picture of the grand piano. You press the button, and the song you just created plays—in stereo.

This is just the beginning.

Cut And Paste

Now that you have created a song, you can play with it. By moving the hand around the screen and pressing the KoalaPad button, you can speed the music up, raise or lower the volume of each speaker, change the type of sound from regular to smooth, to vibrato, to drum-like. With the push of a button, you can transpose the music to other keys and replay the music in each key.

And you can use *MCS* like a word processor to *cut and paste* measures of music. On the screen is a little pair of scissors and a paste pot. Using them, you can cut up to nine measures out of the beginning part of your song and move them forward or backward in your song.

This is one of the most exciting parts of *MCS*. As I said earlier, when you play your music, the measures filled with notes scroll by on the picture screen, from right to left. As you listen to the notes you also watch them scroll by. Playing music becomes an effortless experience that is visual as well as auditory. You can concentrate on hearing and seeing the notes, not just playing them. It's a great joy (to an ex-player piano like myself) not to have to concentrate on stretching your hands and positioning your fingers to get each note right. The computer takes care of these details for you.

Since music now becomes a visual experience, you can begin perceiving patterns visually as well as by sound. And, if you like certain patterns, you can repeat them in the music by using the hand and the scissors to cut the measures in which they appear and "paste" them into other places in the music.

When you are done creating your own music, you can fool around with it. Then you can save it on disk. And, if you have a printer, you can print out a copy of the score.

Poppin' Hot

Now you see why I have trouble sleeping at night. You can see why I go to bed and dream about rainbow-colored rubber bands and dancing musical notes.

Perhaps you can also see why the little voice inside my head so persistently kept telling me to write about "computer popcorn." The KoalaPad, *Micro Illustrator*, and *Music Construction Set* are like popcorn. They are so much fun and taste so good, once you start with them you just can't stop. ©

Richard Mansfield, Senior Editor

Canned Calculations

Many of the personal computer's most useful home applications could also be worked out on a $3 calculator. Why use a computer?

The best answer is that a computer does far more of the work for you than a calculator. Once you teach your computer how to solve a problem, it can remember the method and apply it to a whole class of similar problems. Instead of having to go through all the mathematics each time, you can just give the computer the numbers (the *data*) and it will automatically perform all the necessary steps on its own. That's why computers are sometimes called *data processors*.

Let's see what this means with a practical example. Most home improvements involve the same kind of estimate: How many gallons of paint will I need to repaint the bedroom? Or bags of fertilizer for the lawn, or squares of tile for the floor? To figure paint, you've first got to find out how many square feet you're trying to cover, then decide how many square feet a single can of paint covers, then how much each can costs.

Figuring square feet is the hard part. The computer can ask questions, though, and find the answer for nearly any situation. After the square feet are calculated, it's easy. Just ask for coverage and cost and the estimate is complete.

Valuable Techniques

Take a look at the program. There are some interesting techniques to learn. First, we want the program to be as generally useful as possible. It should be able to calculate all kinds of home improvements. So we have the user give a name to the problem in line 10. Then, as a reminder, lines 30–70 define how to go about gathering the data that the program needs to reach a solution. After the user has told the computer how many rectangles are involved in the area to be painted, it guides him or her through the necessary number of inputs. This guidance takes place between lines 100–190 within a *loop*.

The computer cycles the user through the length-width question as many times as necessary. It counts up until each rectangle has been accounted for. The variable RECTS in line 100 governs the loop. Line 190's NEXT keeps bouncing us back up to line 100 until the information is completely entered.

There's a convenience feature in line 140. If you were estimating a typical bedroom, it's likely that two, or even all four, of the walls would have identical measurements. Rather than having to enter the same numbers over and over, you can just answer 0 to the question LENGTH ? and the computer will skip down to line 180. This is possible because the previous answers are calculated in line 170 and are held in the variable LATEST. If we skip over this line, LATEST will still be holding the amount calculated from the previous entries. So, the calculation in line 180 will add the size of the previous rectangle into our running total of square feet, SFEET.

It's Not Algebra

Notice that variables in computers are handled somewhat differently than you might remember them from algebra class. The equals sign in line 180 does not make this group of numbers, these variables, into an equation. Rather, the line is

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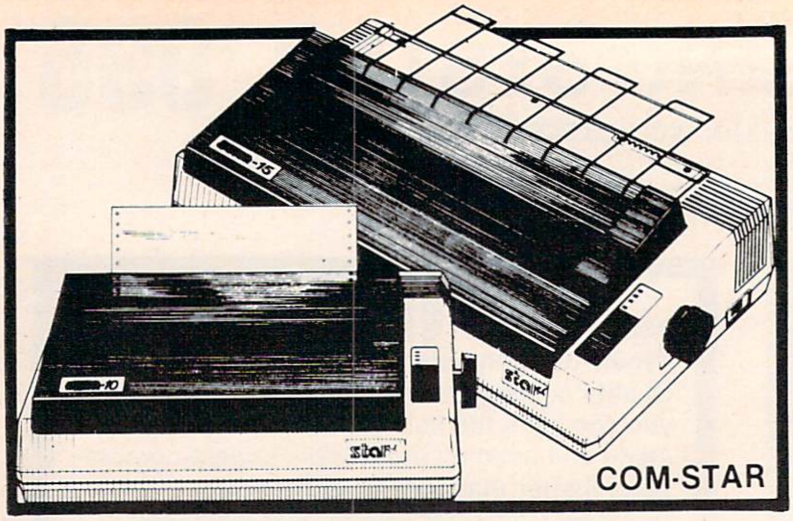

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assigning a value to the variable SFEET.

You read such lines from left to right to understand their meaning. To put line 180 into words: The current amount in (the number "held by") the variable SFEET is now added to the current amount in the variable LATEST. And then this total is placed into the variable SFEET (SFEET is a running total). In other words, SFEET is being changed in this line. Before line 180 executes, the SFEET on the right holds the number resulting from the previous execution of line 180. And after the line executes, the SFEET on the left is going to hold a larger number than it did before. The same thing happens to the variable PRICE in line 290.

Lines 200–230 are pretty straightforward. Here, we're just gathering our last two pieces of information: coverage and cost. Line 240 isn't necessary; it just clears the screen so we can print out the answers on a clean screen.

Since SFEET has been keeping a running total of square feet for us, we can just print SFEET in line 250 without any further calculations. Line 260 calculates the total number of cans of paint you'll need to buy. It divides the total number of square feet to be painted by how many square feet each can of paint covers. Then line 270 reports these results.

The total cost is figured in line 290 by multiplying the price of each can by the number of cans needed. This line also figures in the tax (6 percent in this example) by multiplying the result of the mathematics within the parentheses by 1.06. If your state charges 4 percent, just change it to 1.04.

It's important to remember that when you are performing two or more mathematical operations, sometimes one operation must be performed before another. When you put something inside parentheses, it will be worked on first. We want the whole result multiplied by 1.06, not just AMOUNT. So, we put AMOUNT*PRICE within parentheses and that gets figured out before the 1.06 is even looked at.

Stripping With INT

Finally, line 300 rounds off the PRICE to dollars and cents. It's possible to get results like $12.080993 if you leave out the rounding off functions in this line. How does this work? Imagine that the computer gets a final result of $12.080993 for PRICE. First it's multiplied by 100 since that's inside the parentheses and since multiplication is performed before addition. (When parentheses aren't involved, the order in which things are performed is My Dear Aunt Sally—multiplication, division, addition, subtraction.)

Anyway, after *100, our 12.080993 becomes 1208.0993. Next, .5 is added, which makes it 1208.5993. Then the INT takes effect and INT doesn't really round anything off, it just strips away the decimal. That is, INT (5.9999) would result in 5. To make it round accurately, we have to add .5 to a number before INTing it. In this way, if the fraction part of a number were .5 or higher, when we add .5 we effectively add 1 to the integer part of the number. 5.9999 + .5 becomes 6.4999 and when that's stripped with INT, it's 6, the accurately rounded result.

So INT (1208.5993) becomes 1208. Finally, we move the decimal point back over two places by /100 for our final answer: $12.08.

This estimating program will provide answers for various types of home improvements. And it can be extended to ask more questions and give more answers. One of the most powerful aspects of computers is the ease with which you can modify a program like this to make it solve all kinds of other problems for you. For example, why not try modifying line 250 to also give you the results in square meters? (1 meter = 3.281 feet.)

Home Improvements

```
10 PRINT"WHAT DO YOU NEED TO BUY? (CANS O
   F PAINT, ROOFING TILES, ETC.)"
20 INPUT ITEM$
30 PRINT"WE NEED TO MEASURE THE AREA YOU'
   RE GOING TO COVER."
40 PRINT"THE EASIEST WAY IS TO DIVIDE THE
    AREA INTO RECTANGLES."
50 PRINT"FOR EXAMPLE, TO PAINT THE BEDROO
   M, YOU'LL HAVE 5 RECTANGLES:"
60 PRINT"THE FOUR WALLS AND THE CEILING."
70 PRINT"SO, FIRST, HOW MANY RECTANGLES A
   RE INVOLVED IN THIS JOB"
80 INPUT RECTS
90 PRINT"NOW, FOR EACH RECTANGLE, ENTER I
   TS LENGTH AND WIDTH:"
100 FOR I = 1 TO RECTS
110 PRINT"{14 SPACES}RECTANGLE #";I
120 PRINT"LENGTH"
130 INPUT L
140 IF L = 0 THEN 180
150 PRINT"WIDTH"
160 INPUT W
170 LATEST = L * W
180 SFEET = SFEET + LATEST
190 NEXT I
200 PRINT"HOW MANY SQUARE FEET DOES EACH
    {SPACE}OF THESE ";ITEM$;" COVER"
210 INPUT COVERAGE
220 PRINT"HOW MUCH DOES EACH OF THESE ";I
    TEM$;" COST"
230 INPUT PRICE
240 PRINT"{CLR}":REM CLEAR THE SCREEN
250 PRINT"YOU ARE GOING TO BE COVERING ";
    SFEET;" SQUARE FEET OF AREA"
260 AMOUNT = SFEET/COVERAGE
270 PRINT"YOU WILL NEED "; AMOUNT; ITEM$
280 PRINT"TOTAL COST (INCLUDING TAX)-- $"
    ;
290 PRICE ={2 SPACES}1.06 * (AMOUNT * PRI
    CE)
300 PRINT INT (PRICE * 100+.5)/100
```

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David D. Thornburg, Associate Editor

Computers And The Arts

From time to time I have used the space of this column to explore the use of computer technology in the fine arts. Because of continuing activity in this area, I want to address this issue again.

As I look back on 1983, I feel that one of the more significant developments in the use of personal computers has been in the application of computers as tools for personal expression. Whether this expression is through writing (for which word processors are most valuable) or in the visual or auditory arts, many thousands of computer users are finding that this technology is a powerful tool with which to unleash creative energies.

On the surface, it may seem strange to think of an analytical tool such as the computer as a medium by which creative energies can be unleashed, but the reasons that computers can (and should) be used in this fashion are quite clear.

Much of the effort involved in the expression of creative ideas requires tedious work that is not directly related to the creative task. The unpleasant job of transcription, for example, can interfere with creative writing.

And yet the computer brings something else to the creative act. Rather than being just a tool through which creativity can be expressed, the computer can be the creative medium itself. In this fashion the computer serves as far more than a simple transcription tool and is transformed into a tool with which totally new ideas can be developed and expressed.

Genesis II

A new book, *Genesis II*, by Dale Peterson, deals with this very topic. Peterson acknowledges that a literal comparison between his book and the biblical account of the origins of the world is inappropriate. He says instead that while the original Genesis tells of a universal creation, his book deals with the creative possibilities of a tool which also might have universal applications. The subtitle of his book, *Creation and Recreation with Computers*, is an accurate assessment of its content. The book is divided into four major sections involving creation in: light, sound, symbol, and recreation.

I have met people who feel that it is inappropriate for an artist to use high technology. As Peterson points out, however, artists have always depended on technological advances—easels, oil-based paints, lithography, or, in music, the highly technical pipe organ. His point is that the computer is not going to replace other tools in the artist's kit, but will simply be a new tool with which to explore and develop ideas.

There has always been a distinction between "machines" and "art"; machines are designed to do, and art is designed to be. As he says, "... art's purposes are distant, often obscure, often psychological or spiritual. Whereas a machine's purposes are immediate, obvious, direct, and physical."

With this starting point, Peterson traces the development of the use of the computer in the fine arts from its beginnings to the present time. In computer graphics, for example, he starts with the Whirlwind computer at MIT in the 1950s, and traces the work of Whitney and others who have explored the computer as a medium of visual expression.

He identifies some characteristics of the computer that make it sufficiently different from other media to warrant its use by artists. Specifically, he observes that precision, iteration, transformation, and serendipity are four characteristics of computer assisted artistic expression that are unique to this medium. The computer's ability to drive a pen plotter with extraordinary precision is well-known, and the use of programming loops for repeating picture elements is also of great utility.

Also, the fact that a computer can calculate "in between" images that allow one to see a transformation, for example, of a butterfly into an ice cream cone, is of obvious value to an artist. But the most exciting aspect of computer assisted art is that it offers many chances for serendipitous events to occur. Because computers allow more

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experimentation than most media, the artist can remain open to some exchange between mastery of technique and accident. Often this leads to unexpected results that the artist finds quite fascinating.

Sound And Symbol

In his section on creation with sound, Peterson quotes the brilliant composer Edgar Varese, who in 1917 wrote: "I dream of instruments obedient to thought—and which, supported by a flowering of undreamed-of timbres—will lend themselves to any combination I choose to impose and will submit to the exigencies of my inner rhythm."

Varese anticipated the type of freedom and power that modern day musicians have when a computer is used to help in the creation and/or performance of a musical score. By presenting a good background on the nature of computer-synthesized music, Dale Peterson gives the reader a basis for a deeper appreciation of the new musical ideas that are being developed with the aid of the computer.

Creation with symbol implies (more or less) creation with the written word. While not spending much time on topics as obvious as the use of word processors, Peterson instead focuses on the use of computers to create "computer generated" poetry and prose. It is fascinating to see and read some of the results in this area, and it is important to understand that when a computer generates poetry, it does so because the human poet programmed it to do so. Nonetheless, the results of these programs are somewhat unpredictable and some of them are even very interesting.

The work of Scott Kim, author of the beautiful book *Inversions* (Byte/McGraw-Hill), is also presented in this chapter. Scott is a calligrapher who delights in writing words in such a stylized manner that they read the same way when turned upside down, or when viewed in a mirror. His creation of word-specific alphabets that allow words to be written this way is aided by computer technology. Peterson acknowledges that Kim's work might also fit well in his section on graphics, and herein lies an important message.

The computer artist is not that easy to categorize. Rather than being limited to visual expression, for example, the artist has all the expressive capabilities of the computer at his or her disposal. The use of graphics (and animation) and sound, and text, can all appear in a new synthesis of art that defies categorization.

It is this combination that I think really shows the power of the computer as a creative tool. This is certainly true in some modern computer-based games, and is touched on in the section on "creation in recreation."

Creative Possibilities

The computer as a game tool dates back to the early days of computing. I was delighted to read, for example, that Charles Babbage (who proposed the development of the Analytical Engine, a mechanical computer designed in the 1800s) suggested that the machine be programmed to play "tit tat to" and be set up to operate by having the player insert coins for each game. The concept of the coin-operated computer game predates the actual appearance of such games by over 100 years.

As a beautifully written book on a fascinating topic, *Genesis II* deserves a wide audience. By providing a brief history of the use of computers in the fine arts, it can serve as a springboard to future work in this area.

While *Genesis II* focuses on the pioneers who used large computer systems to do their work, I continue to be excited by the prospect that significant contributions to the use of computers in the arts will come from those of us who use personal computers. The fact that these machines are so widely accessible guarantees that they can be used by artists who would otherwise not have access to computer technology.

Next month we will explore two ways that the personal computer can be your tool for creative exploration. ©

Questions Beginners Ask

Tom R. Halfhill, Features Editor

Are you thinking about buying a computer for the first time, but don't know much about computers? Or maybe you just purchased a computer and are still a bit baffled. Each month in this column, COMPUTE! *will answer some questions commonly asked by beginners.*

Note to readers: In the September 1983 "Questions Beginners Ask," I answered a question about why some computers have numeric keypads while others don't. I also noted that computer and calculator keypads are arranged exactly the opposite of Touch-Tone telephone keypads: Computers and calculators arrange the keys in descending numerical order, starting at the upper right and ending at the lower left, while telephone keys are just the reverse. I invited any readers who knew why to share the information.

Over the last couple of months I've received several answers—some of them contradictory. Interestingly, people seem to be divided into two camps on the subject. Therefore, in this month's column, I'll let the readers provide the answers. Here are samples:

Keypads on telephones and calculators, computers, etc., differ because an experienced bookkeeper and/or keypad operator would drive the telephone company "straight up the wall"—the new equipment of today might handle the speed, but equipment prior to (?) 1981 just wouldn't work—so we slowed them down by reversing the numbers.

Harry Allston
Old Telephoneman (27 yrs.)

When push-button phones were first available, the difference between calculator keyboards and telephone push buttons was commented on in several places. The explanation then was that a skilled calculator operator could enter numbers faster than the telephone equipment could respond. I can't quote a source.

Bob Strickland

When push-button telephones came out, the keypad was arranged differently because the letters which share keys with the numbers would be arranged in a confusing pattern if the adding machine standard had been followed (try imagining the telephone letters on a calculator keypad sometime to see this effect). Calculator and computer manufacturers followed the adding machine standard, their products being closely related in use to adding machines. Thus we have two keypad standards.

Rod Smith

Here in Illinois, our phone company includes a monthly newsletter with each bill, entitled "Telebriefs." It just so happens that the August issue has a feature on the difference, entitled "It Adds Up: Touch-Tone Buttons Are 'Letter-Perfect'." The article goes on to explain that people still question the difference 19 years after the introduction of Touch-Tone service. They explain that despite the ideas of many people, having identical keypads would not reduce wrong numbers.

The arrangement of Touch-Tone pads allows for the alphabet to be in proper order from top to bottom. Also, the arrangement was decided upon by the engineers at Bell Labs only after careful consideration and experimentation. Sixteen different arrangements were tested. The results showed that even bookkeepers who constantly use calculators could "dial" calls faster with the present Touch-Tone keypads.

Interestingly, ITT [International Telephone & Telegraph] *is introducing a new style of phone which has a linear keypad—a single row from left to right!*

Robert M. Bara

I think the enclosed article from a monthly publication of Illinois Bell Telephone Company will at least explain the telephone company's logic in using their current configuration on Touch-Tone phones.

William R. Kunkel

Since two readers cited the article in Illinois Bell's "Telebriefs," I'll quote from it briefly: "If Touch-Tone dials followed the same pattern as the face of a calculator, the telephone alphabet would begin with 'PRS' and end with 'DEF'—not an ideal arrangement for most people. There's another reason...engineers at Bell Laboratories tested 16 different button arrangements. The result? Even bookkeepers, for whom calculators are everyday tools of the trade, found they could dial calls faster and more accurately with the buttons arranged as they are now."

So there you have it—two exactly opposite

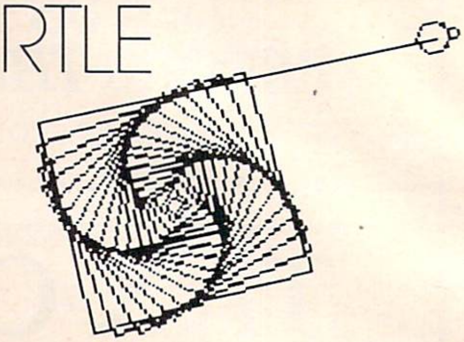
explanations as to why computer and telephone keypads are exactly opposite. One camp contends the phone company tried to slow down keypad typists, while the other side (including a phone company itself) claims that alphabetic order was the deciding factor, and that keypad typists aren't slowed down at all.

Who to believe? It's conceivable that both sides are right. Maybe the original push-button equipment really couldn't handle fast entry by bookkeepers, but today the phone company doesn't want to admit that it based its decision on obsolete equipment. Or, maybe Bell really did object to a backward alphabet—although the letters are rarely used when dialing phone calls.

In any case, is it really true, as Illinois Bell says, that even bookkeepers can dial calls "faster and more accurately" with telephone-style pads? Personally, I have trouble switching back and forth between the subtle differences of Atari and Commodore computer keyboards. On the other hand, I've heard that many experienced touch-typists have no problems adapting to the radical changes of Dvorak typewriter keyboards.

Anyway, pretty soon the whole question will become moot when machines are no longer mute. If voice-synthesis and voice-recognition technology keeps advancing, someday we might do away with keyboards and keypads altogether. ©

FRIENDS OF THE TURTLE



David D. Thornburg, Associate Editor

The Demons Of Atari Logo

It is amazing, when one thinks about it, that within a very short time Logo has gone from a university-based research language to one of the most affordable and powerful programming languages ever to appear on personal computers.

What is even more exciting are the evidences of dynamic growth and development in Logo as new versions appear in the marketplace. Among the most powerful implementations of Logo ever to appear on an eight-bit computer is Atari Logo, developed by Atari and LCSI. In addition to having all the list-processing capability and turtle graphics that Logo is known for, Atari Logo also supports multiple turtles (four) and animation. From a graphics perspective, the excellence of this version derives from the fact that (using graphics mode 7) Atari computers can display any of 128 combinations of hue and luminance. Even with only four colors on the screen at a time, this ability to choose and change colors, even after they have been painted on the screen, gives the computer artist a flexibility and freedom lacking in other systems.

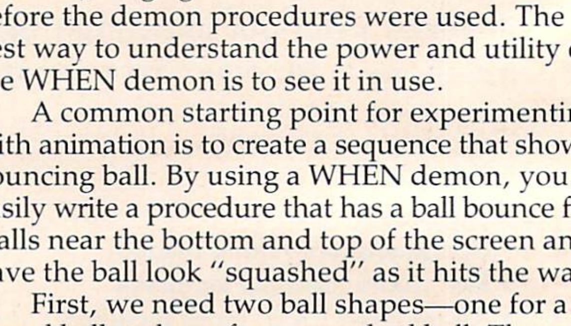
The WHEN Demon

But, when I was writing my book on Atari Logo (*Computer Art and Animation—A User's Guide to Atari Logo*, Addison-Wesley, Spring, 1984), the feature that struck me as being most powerful was the WHEN demon.

A WHEN demon is a special Logo object that continuously monitors the computer, waiting for any of 21 special events to occur. Whenever one of these events takes place, the "demon" associated with that event executes its own set of Logo instructions no matter what other instructions or procedures are being used at the time. When these demon instructions or procedures are finished (and the WHEN condition is no longer satisfied), Logo goes back to whatever it was doing before the demon procedures were used. The best way to understand the power and utility of the WHEN demon is to see it in use.

A common starting point for experimenting with animation is to create a sequence that shows a bouncing ball. By using a WHEN demon, you can easily write a procedure that has a ball bounce from walls near the bottom and top of the screen and have the ball look "squashed" as it hits the walls.

First, we need two ball shapes—one for a round ball and one for a squashed ball. These shapes can be defined in Atari Logo as two of the 15 user-definable shapes available at any one time. We will assign shape 1 to the round ball and shape 2 to the squashed one. The easiest way to create shapes in Atari Logo is with the EDSH command that gives you access to the graphic shape editor. By moving the cursor to the appropriate places on the screen and pressing the space bar, you can build any shape you want in the available grid.



Turtle Collisions

Next, enter the following procedure:

```
TO BOUNCE
CS
WHEN 0 [SETSH 2 WAIT 5 SETSP -SPEED WAIT
  10 SETSH 1]
PU HT SETPOS [-100 100] PD
SETH 90 FD 200
PU SETPOS [-100 -60] PD
FD 200
PU SETH 0 SETPOS [0 0]
SETSH 1 ST
SETSP -30
END
```

Before using this procedure we will explain how it works. The first line that might appear cryptic is:

```
WHEN 0 [SETSH 2 WAIT 5 SETSP -SPEED WAIT
  10 SETSH 1]
```

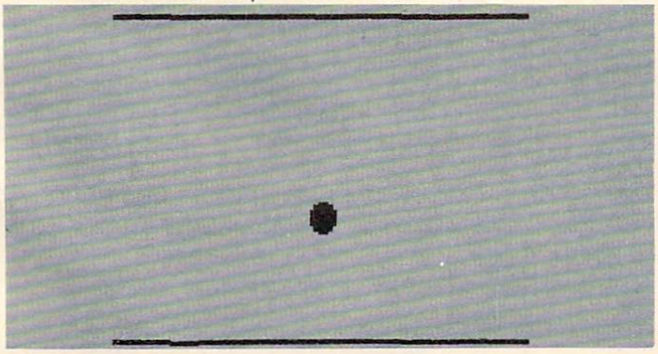
The WHEN command is followed by a number and a list of instructions. The number refers to a condition (shown in the table). Whenever this condition is satisfied, the list of instructions is executed. As you can see from the table, condition 0 will occur whenever turtle 0 collides with a line drawn by pen 0. So, whenever our default turtle touches a line drawn with the default pen, the WHEN demon will execute the list of commands shown, no matter what other commands or procedures Logo may be executing at the time. The commands we have chosen replace the round ball with the squashed one for a short time, and then reverse the direction of the turtle motion by changing its speed (given by the Logo function SPEED) to its negative value.

WHEN demons must be created while the computer is in either the split screen or full screen mode. Once a demon is created it remains active until you return it to its inactive state or clear the screen with the CS command. To return a demon to an inactive state you just enter, for example,

```
WHEN 0 [ ]
```

Automatic Bounce

The next six lines of the BOUNCE procedure draw horizontal border lines at the top and bottom of the screen with pen 0 and place turtle 0 (with the round ball shape) in the center of the screen.



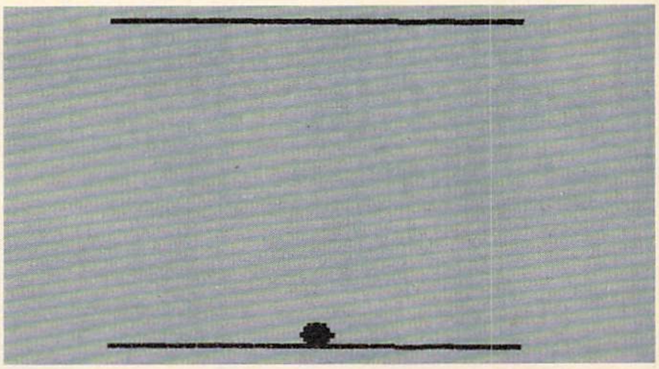
WHEN Demon Condition Table

Condition Number	Detects When
0	turtle 0 touches a line drawn with pen 0
1	turtle 0 touches a line drawn with pen 1
2	turtle 0 touches a line drawn with pen 2
3	button on joystick is pressed
4	turtle 1 touches a line drawn with pen 0
5	turtle 1 touches a line drawn with pen 1
6	turtle 1 touches a line drawn with pen 2
7	each second has elapsed
8	turtle 2 touches a line drawn with pen 0
9	turtle 2 touches a line drawn with pen 1
10	turtle 2 touches a line drawn with pen 2
11	not used
12	turtle 3 touches a line drawn with pen 0
13	turtle 3 touches a line drawn with pen 1
14	turtle 3 touches a line drawn with pen 2
15	joystick position is changed
16	turtle 3 touches turtle 0
17	turtle 3 touches turtle 1
18	turtle 3 touches turtle 2
19	turtle 0 touches turtle 1
20	turtle 0 touches turtle 2
21	turtle 1 touches turtle 2

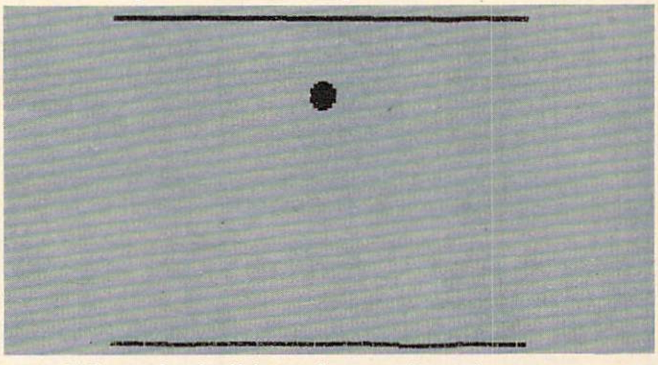
The command

```
SETSP -30
```

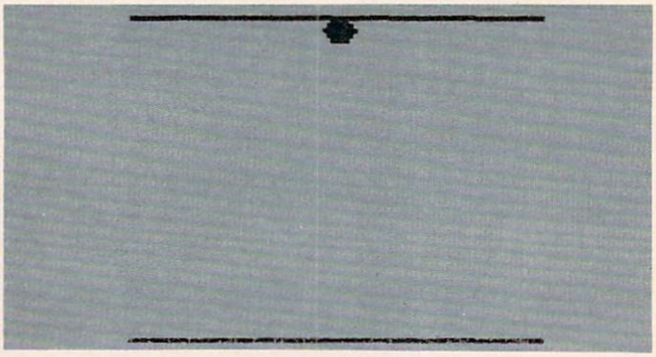
starts the ball moving down towards the bottom line. When the ball reaches the bottom, it takes on the squashed appearance and starts back up the screen.



The squashed ball quickly restores itself to its round shape as it moves up.



When the ball hits the top line, it gets squashed again and starts back down to repeat the process forever.



To see how automatic the process is, press the BREAK key to stop the procedure. It will keep on going by itself until you type something like CS.

WHEN demons allow you to do all sorts of interesting things as your turtles collide with lines or with each other, and can form the heart of many spectacular animation projects.

The experience of writing procedures that use this powerful feature is one of the more rewarding benefits of using Atari Logo. ©

Commodore EXBASIC LEVEL II

Louis F. Sander

EXBASIC LEVEL II is a plug-in cartridge that adds to the built-in capabilities of PET, CBM, VIC-20, and Commodore 64 computers. The version tested is for the PET, and consists of two plug-in ROMs rather than a cartridge. In all, EXBASIC LEVEL II adds over 80 new commands, statements, and functions to the computer's built-in BASIC. The extended BASIC it provides is similar to Radio Shack's TRS-80 LEVEL II BASIC, and many TRS-80 programs should run on an EXBASIC II-equipped computer with little or no translation.

The table lists the new commands which EXBASIC II provides, along with a brief explanation of each. They are of three distinct types—programmer's aids, improvements to existing BASIC statements, and completely new statements and commands.

The programmer's aids are numerous and powerful and are more than satisfactory for the serious programmer.

Nevertheless, the additions and improvements to BASIC are what make this accessory so interesting—there are lots of them, and most of them you probably wish you had already. PRINT USING and PRINT@ are good examples of these, as are

EXBASIC LEVEL II Commands—Alphabetical List

AUTO	Automatically renumbers program lines
BASIC	Disables EXBASIC
BEEP	Does a timed CB2 beep
BEEP OFF	Disables BEEP
CALL	Like USR, but with named calls, multiple parameter passing
DEC	Converts hex to decimal
DEEK	Double-byte PEEK
DEF CALL	Sets CALL vector
DEF USR	Sets USR vector
DEL	Deletes a range of line numbers
DISPOSE	Allows graceful exit from GOSUB or FOR-NEXT loop
DOKE	Double-byte POKE
DOS Support	DOS support, or "wedge," commands are included
DUMP	Lists values of all variables (for arrays, see MATRIX)
ELSE	See IF...THEN
EVAL	Evaluates expressions in string format
EXEC	Executes BASIC statements in string format
FAST	Speeds up PRINTing
FAST OFF	Disables FAST
FIND	Finds desired statements in a program
FRAC	Returns fractional part of a number
GO	Calls the ML monitor (Extended monitor on 80-column machines)
GOTO	Improved: '.' shorthand
HARDCOPY	Dumps the screen to the printer
HELP	Lists all EXBASIC keywords
HELP*	Lists all Commodore BASIC keywords
HEX$	Converts decimal to hex
HIMEM	Sets top of memory
HPLOT	Plots horizontal bar graphs
IF...THEN	Improved: ELSE allowed, THEN optional, '.' shorthand
INPUTFORM	Improved INPUT statement #1
INPUTLINE	Improved INPUT statement #2
INSTR	Locates substrings
LETTER	Selects lowercase mode
LETTER OFF	Selects graphics mode
LIST	Improved: @ key causes pause, any key resumes; '.' shorthand
LOAD	Loads tapes made at fast speed (see SAVE and MOD)
LOAD*	Loads tapes made at standard Commodore speed (see SAVE*)
MATRIX	Lists values of array variables (for other variables, see DUMP)
MAX	Finds the largest of a group of values
MEM	Greatly expanded FRE(0)
MERGE	Merges or appends from fast tapes (see SAVE)

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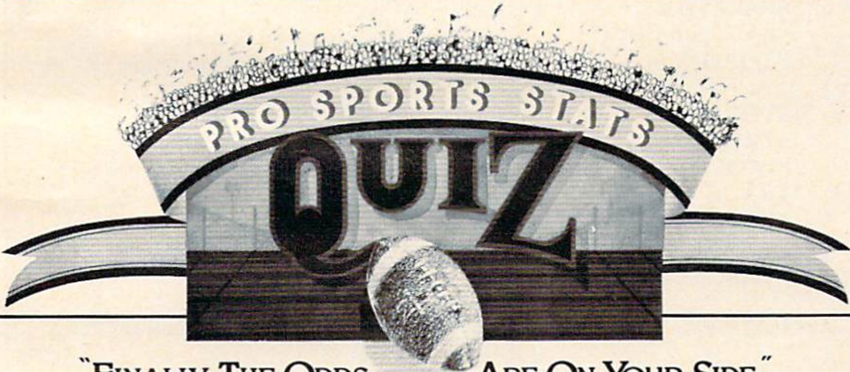

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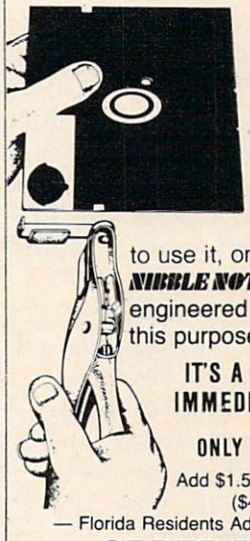

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PAT. PEND.

INPUTFORM and INPUTLINE. The first two are familiar to users of non-Commodore BASICs, while the latter allow easy formatting of INPUT statements, also allowing commas and semicolons to be input. The new IF...THEN...ELSE construction is another improvement, one that can eliminate a lot of confusing loops in your programs.

Graphics commands SET, RESET, and POINT allow you to do high-resolution plotting with ¼ square pixels, while VPLOT and HPLOT make it easy to draw bar graphs. DOKE (Double-byte pOKE) simplifies things if you need to put a decimal number into low-byte/high-byte form and POKE it into two consecutive memory cells. DOKE828,1000 will automatically put the proper values for 1000 into cells 828 and 829, all numbers being expressed directly in decimal. DEEK is the corresponding double-byte equivalent of PEEK.

Particularly noteworthy are the improved SAVE, LOAD, and VERIFY commands, which speed up tape operations by a factor of about five. An 8K program takes 162 seconds to LOAD the old way, but only 35 seconds from an EXBASIC tape.

EXBASIC adds many new commands; programs written with it will not run on computers which lack it. You'll have to weigh that disadvantage against the many benefits of having the extra commands at your disposal.

All in all, EXBASIC LEVEL II is a useful and powerful addition to the Commodore programmer's bag of tricks. Its capabilities are meaningful, and I now wonder how I ever got along without many of them. The 60-page manual is a good one, and includes many examples of using the new commands and statements.

EXBASIC LEVEL II is available from:

Data Dynamics Technology
P.O. Box 1217 Cerritos, CA 90701
Price: $98

MERGE*	Merges or appends from disk
MIN	Finds the smallest of a group of values
MOD	Makes auto-RUNning fast speed tapes (see SAVE)
ODD	Tells whether a number is odd or even
ON	Enables repeat key and special error mode
OFF	Disables repeat key and special error mode
ON ERROR GOTO	Allows error recovery
ON...RESTORE	See RESTORE
POINT	Tells if a given hi-res point is SET or RESET
PRINT@	Simplifies screen placement of PRINT statements
PRINT USING	Allows formatting of PRINT statements
REK	Expands the stack
REK OFF	Disables REK
REM	Improved: Allows use of ' as shorthand for REM
RENUM	Renumbers a program
RESET	Extinguishes a hi-res point (see SET)
RESTORE	Improved: DATA can be RESTORED selectively; ON...RESTORE allowed
RESUME	Terminates an error recovery routine
RND	Improved: Easier to set desired range
ROUND	Rounds off numbers to selected number of places
RUN	Improved: '.' shorthand
SAVE	Saves at high speed; longer program names; ML saves from BASIC
SAVE*	Saves at standard Commodore speed
SEC	Pauses for a given number of seconds
SET	Illuminates a hi-res point (80 × 50 resolution)
SPACE	Inserts spaces in listings
SPACE OFF	Disables SPACE
SPACE(a,b,c,d)	Clears or fills a rectangle on screen
STOP ON	Enables STOP key for machine language programs
STOP OFF	Disables STOP ON
STRING$	Sets up strings of identical characters
SWAP	Swaps the values of two variables
TRACE	Traces execution of BASIC programs
TRACE OFF	Disables TRACE
VARPTR	Returns memory location of any variable
VERIFY	Verifies tapes made at fast speed (see SAVE)
VERIFY*	Verifies tapes made at standard Commodore speed (see SAVE*)
VPLOT	Plots vertical bar graphs
WAIT	Improved: STOP key now interrupts a WAIT
'.'	Shorthand for "last line used" in IF... THEN...ELSE, GOTO, LIST, RUN

80-Column Screen Commands

BEGINLINE	Erases current line up to the cursor
DELLINE	Deletes current line, moves text upward to fill
ENDLINE	Erases current line rightward from the cursor
INSTLINE	Inserts a line at the cursor's position
SCREEN*	Lets 40-column programs run on 80-column machines
SCREEN	Disables SCREEN*
SCREEN DOWN	Scrolls screen downward
SCREEN UP	Scrolls screen upward

©

Atari *Starbowl Football*

Orson Scott Card

If you like computer football, but don't have a regular playing partner, Gamestar's *Starbowl Football* for the Atari 400/800 is the answer. The computer opponent in the one-player option is *very* good. It will take all your skill on defense to keep the blue team out of the end zone, and on offense you have to be a superb quarterback or your passes will be picked off every time you aren't sacked!

And even if you have a human opponent, *Starbowl* lets the two of you struggle to outwit or outrun each other in a very convincing simulation of football action.

The football field scrolls horizontally across the screen as the players move. There are lots of little niceties. The game begins with the last few measures of "The Star-Spangled Banner." There is a musical interlude during half time. The crowd roars at the right moments. The players run back and forth across the field to get in place for the next play—eating up time on the clock.

The game itself offers good touches of realism. Take penalties, for instance. Let your safety touch the receiver while the ball is in the air, and pass interference is called. Blitz before the ball is snapped, and you are called offside. Take too long choosing your offensive play and snapping the ball, and you lose five yards on a delay-of-game penalty.

You can also be clumsy. The computer sees to it that your receiver is always in position to catch a perfectly thrown ball, but you have to push the joystick button at exactly the moment the ball arrives, or the pass is incomplete. It takes a lot of dropped balls before you get the timing down. If you try to run too soon after catching the ball, your player fumbles—and the other team recovers. And if you throw a pass when your receiver is covered, you get to know how quarterbacks feel when their passes are picked off by a man in a jersey of the wrong color.

Each team has six players—a quarterback, two receivers, and a three-man line on offense; a safety, two defensive backs, and a three-man line on defense. On offense, you control the quarterback until a pass is released and the receiver after the pass is caught. On defense, you control the safety.

There are some things to watch out for. During play selection, you get no feedback when you push a button to choose the eligible receiver—after all, you don't want your opponent to know which receiver is going to get the ball. But if you pushed the button too soon, and it wasn't registered, you won't find out until you try to pass the ball and nothing happens. Also, if you aren't careful while you hurry to make play assignments before the 30-second clock expires, you can find yourself accidentally punting on first down or trying for a field goal from 80 yards back.

But these are minor issues. With practice, you can quickly memorize the play-selection procedure without ever looking at the book, and you soon develop good enough reflexes to catch the ball every time your eligible receiver is open. In fact, I got so good in a couple of games that I decided to switch from college level to the pro game setting. Then I discovered that the *Starbowl* is going to provide a challenge for a long time to come.

Starbowl Football
Gamestar, Inc.
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Interpod Interface For VIC/64

Larry Bihlmeyer

If you own a VIC or Commodore 64, you are probably aware of limitations when trying to use the User Port with an RS-232 device. Most VIC/64 software fully supports the serial port (device #4), but does not address the User Port (device #2).

For example, if you try using a serial RS-232 printer with an interface connected to the User Port, software that doesn't support printing to a device #2 will not let you print.

One way to resolve this is to add an Interpod to your system, a dual interface which allows you to hook up a single RS-232 device and up to 30 parallel or serial IEEE devices to your VIC or 64.

Interpod has its own power supply and attaches at the serial port with a six-pin connector. This serial port is used by most software programs since it is the "normal" device #4. You can connect a single serial RS-232 device to the Interpod—a printer or modem, and up to 30 serial or parallel devices, like 1541, 2030, 4040, 8050, D9090 disk drives or 4022 and 4023 printers.

Its 6502 microprocessor allows data to be transferred to either the IEEE-488 or RS-232 port contained within the unit, or to both. Interpod contains both an IEEE bus and a true 25-pin DB-RS-232 port.

With this arrangement, the expansion port and eight-bit User Port are not tied up. Also, no software is required to load the Interpod. It's a stand-alone module, "hardwired" into your system. When it powers up, a red light indicates a self-test procedure by flashing 1.5 seconds and then stays on during operation unless there's a fault.

Addressing

Device addressing through Interpod is entirely transparent to the user. However, because it is possible to connect both IEEE serial and parallel devices at the same time, situations may arise in which two peripherals with the same device address need to be connected simultaneously. In these cases, Interpod will recognize only the serial device. In order to access, say, a 1541 single disk drive and an 8050 dual disk drive, both of which are device #8, it is necessary to change their device numbers under software control. Programs to do this are included with the Interpod's instructions.

The RS-232 standard allows for a wide variety of baud rates and other options such as parity, stop bits, and carriage return delays. Interpod is easily configured to cope with all these, but for many cases, no reconfiguration is needed. Interpod powers up with the RS-232 interface configured as shown in the table.

Since RS-232 devices do not have device numbers associated with them, Interpod can be connected only to a single RS-232 component. Interpod will treat any RS-232 device by default as device #4. It is possible to communicate with the Interpod, much like communicating with a Commodore disk drive. The Interpod has a command channel similar to channel 15 on disk drives. So you can change baud rates, parity, and other settings as required.

One other feature incorporated in the Interpod is a CBM to ASCII conversion program. This interface will convert CBM ASCII to standard ASCII (uppercase letters substituted for lowercase and vice versa). This allows you to eliminate conversion routines in your programs for many applications.

Setting Up

The Interpod that I evaluated performed accurately and resolved a problem which had plagued me ever since I'd added a serial RS-232 printer to my 64. Many word processing, spreadsheet, and other software programs do not print out to device #2. When I connected the Interpod, this problem disappeared as the software output to device #4 (the serial port).

Interpod comes with good operating instructions which should allow you to handle most situations. However, you may need dealer help in configuring a cable from the Interpod's RS-232 port to your printer or other device. This is not a fault—there is a wide range of printer cable configurations. Some printers have a male connector while others have female. And the pin designations can vary. So the best bet is to order a cable with the Interpod and be sure to specify the printer connector details when ordering.

The Interpod includes the Interpod module with 6502

Interpod module contains both an IEEE port and RS-232 port to support output. It also has a power supply connection and two serial attachments for the VIC/64 mating cable and a spare outlet for a serial unit such as a 1541 disk drive.

Summary Of Interpod Commands

Command	Meaning	Default Value
baud = (50, 75, 110, 134.5, 150, 300, 600, 1200, 1800, 2400, 3600)	set baud rates	1200
parity = (odd, even, none)	set parity	none
chrsize = (7, 8)	7 or 8 bits	8
crdelay = (on, off)	carriage return delay (¼ sec.)	off
stopbits = (1, 2)	select number stop bits	1
break	send break	N/A
unbreak	release break	N/A
change	readdress Interpod's command channel and RS-232 port	Device #4
clear	clear buffer	N/A
convert	convert CBM ASCII to standard ASCII*	no conversion
unconvert	cancel convert	no conversion

*This substitutes uppercase for lowercase letters and vice versa.

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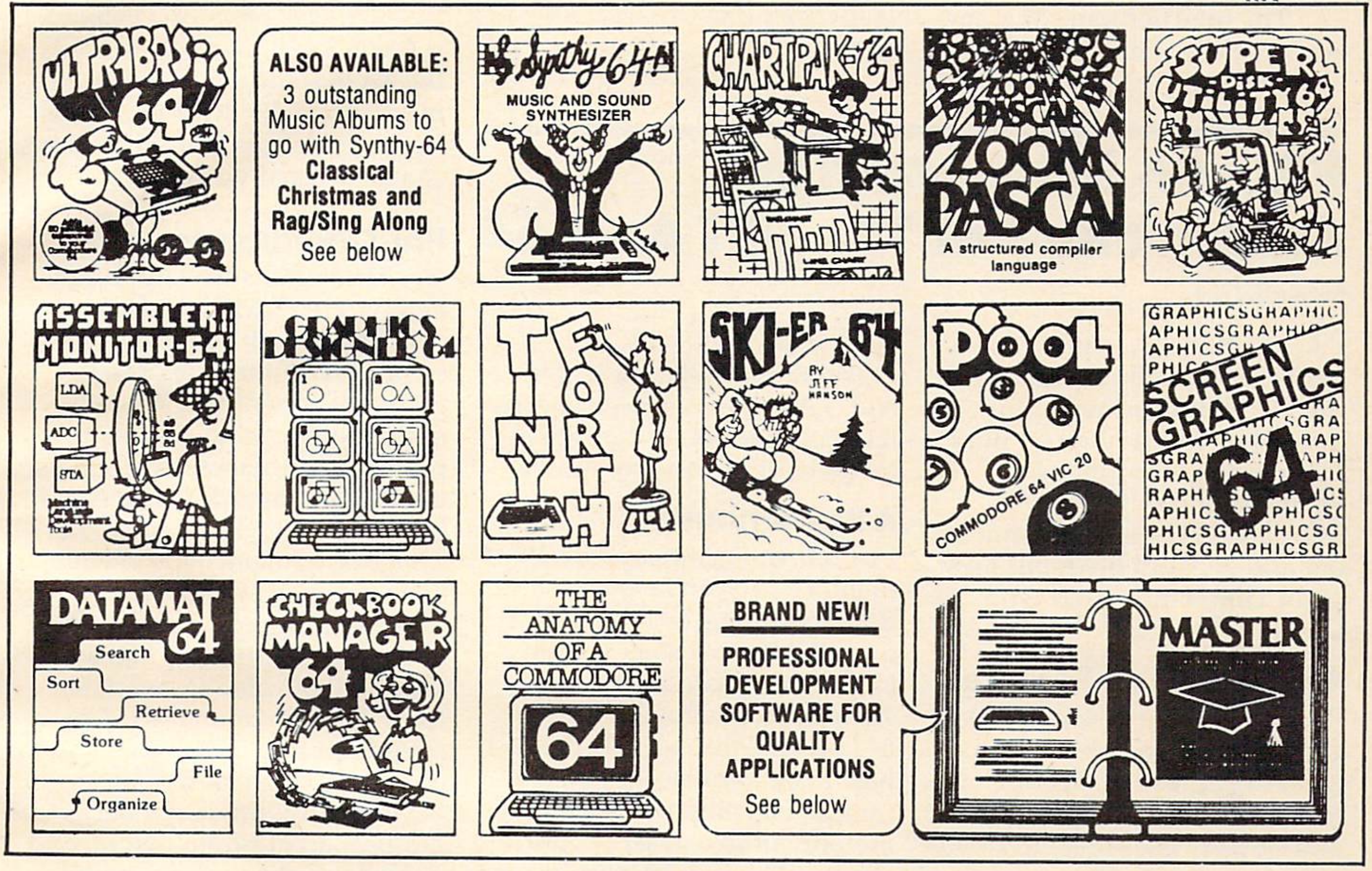

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PAL: An Extraordinary Assembler For The PET And 64

Elizabeth Deal

PAL (Personal Assembly System) is a symbolic assembler for the PET/CBM and the Commodore 64. It was written by Brad Templeton, the author of POWER for the PET and POWER64. The system is memory and disk-oriented, but most of the commands work with tape too.

A Multitude Of Features

PAL is a unique assembler. It is very fast, convenient, and easy to learn and use. It taps the best features of the PET and the 64 and cleverly uses them to create a powerful assembler in a rather small area of memory. Working with PAL is pure pleasure. In fact, working with PAL is sometimes easier than working with BASIC, especially considering some tricky features of the 64 (sound, sprites, bitmapped graphics), since you can freely program in binary or hexadecimal and can use long, eight-character labels.

Unlike several other assemblers of comparable versatility, PAL is very simple to use. Traditional fragmentation of tasks has been eliminated: Editing, assembling, and testing can be done without repeated loading and reloading. PAL coexists at all times with the BASIC environment, including BASIC aids, such as POWER or POWER64, Toolkit, or BASIC Aid. PAL does not need special loaders or editors—they are already built into the computer.

A Powerhouse

PET's PAL fits into exactly 4K of memory and can be put on a ROM chip. The 64 PAL is a bit over 4K. It can also be put on a chip, perhaps on a cartridge or some sort of adapter, since the 64 lacks the free sockets the PET has. RAM versions of PAL are relocatable, either to the top of memory or to a place of your choice. PAL can, in turn, create relocatable code attached to one BASIC line, such as 10 SYS 1234. As if this weren't enough, the 64 PAL can create combined BASIC and machine language programs with machine language trailing right after BASIC. It's a powerhouse.

PAL also permits customizing. You may add opcodes if you wish, but everything I need is already built-in.

PAL works with the IEEE and 1541 serial disk drives, but the 64 IEEE support depends on the link software in the 64 (RTC-Link is OK). Many printers and other output devices, such as printers on the User Port or modems, can be used.

PAL syntax is almost identical to the standard for the 65xx chips. Hence, Commodore assembler files can move to the PAL environment with little conversion. MAE assembler files are a bit harder to convert since they use nonstandard syntax, but Jim Strasma has written a conversion to PAL program which is included in the package.

PAL's expression evaluator is second to none; it far exceeds the MOS standard. PAL has no macro assembly feature. This is not a problem as needed routines can be merged via BASIC.

PAL Commands

The commands supported by PAL are all MOS assembler commands with provision for complex arithmetic expressions within the operands. All common numeric modes are supported, and their syntax follows the MOS standard. (Octal is not included, but who needs it?) Three assignment-type pseudo-ops are: equal (assignment), asterisk (program counter, label, and table definitions), and assignment of value to a variable for IF-GOTO commands. The pseudo-ops include: ASC (strings in quotes), BYTE, WORD, FILE (for assembling multisegment programs), IF and GOTO (conditional assembly), GTB (go to BASIC), SYS (functions as a BASIC SYS command), STM (sets symbol table address for unusual configurations), SST (saves symbol table files), LST (loads symbol table), END, BAS (only on the 64). The OPT pseudo-op has numerous forms. It deals with the disposition of object code (memory, file) and assembler output in formatted form (screen, printer). It is a very flexible command.

Special Ease Of Editing

Using PAL is convenient because PAL source files (the code you write) are BASIC files. You write as if you were writing BASIC, only better. For instance, you may use long variable names,

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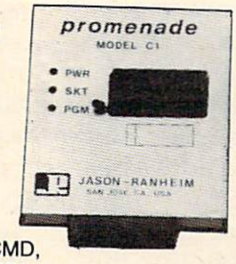

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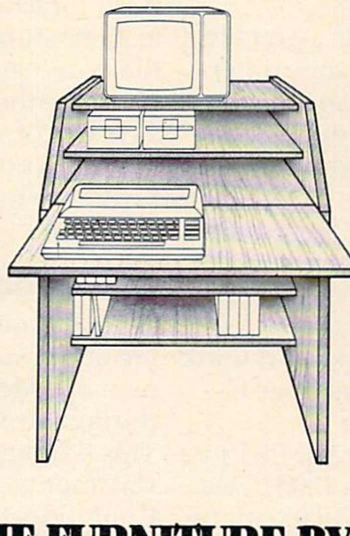

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multiple statements per line, comments within a line, and so on. It prints out, neatly, one instruction per line.

You use the computer's resident screen editor to fix the program and edit. You may also use Toolkit, POWER, or BASIC Aid to find things, replace them, renumber the program, delete, append—your familiar and useful commands are still valid.

The program is saved, loaded, and listed as if it were a BASIC program. This is convenient not only in editing, but also in the transportability of your programs.

You can assemble into memory. Consequently, the program is immediately available for use or for testing with BASIC without the gymnastics usually required in other assemblers.

Jim Butterfield once described (COMPUTE!, August 1982) the difficulties in fixing conventional assembly language: "The test program must be thrown out and the assembler loaded; a new 'object' program must be created. The clincher is...paperwork...the new program should be version-numbered... a program listing should be generated." Not so with PAL. PAL elegantly solves such housekeeping headaches once and for all.

PAL also permits assembly to tape, disk, screen, or printer. The output options can be switched on and off during the assembly. The flexibility is pretty amazing. Object files can be loaded via BASIC or Supermon as normal program files.

Assembly to memory is fast. Blink an eye and it's done. Assembly to disk is also fast (I think I got about 2000 bytes done in close to 15 seconds).

The nominal size of PET in-memory assembly is 1000 bytes. I've done a bit over 2000 with no problems at all. It depends on how tight the source code is.

PAL can be used to assemble huge programs—POWER, for instance. Chaining is used in the process, and the number of chained files is unlimited. There are some limitations on moving the program counter, and there might be limits on the size of the symbol table. It's all described in the book. If you wish, the symbol table, variables, and addresses you used in writing the program can be in a library on disk and then it can be brought into the assembly process, precooked. This is one feature not available to tape users.

PAL also provides a nice expression evaluator. Expressions are not limited to the usual plus or minus one. They permit shifts, multiplication, and the PET's normal logical functions. Expressions can include modifications to, and use of, the program counter (*). This is tricky, but the explanation in the book is meticulous.

Error trapping works well. Each error message (9 syntax-type and 12 housekeeping-type) is clearly explained in the book. Errors are shown on the screen, full text, PET fashion, as in, for example, BRANCH OUT OF RANGE. Phase errors are handled by one clever line of code, very handy for people like me who always mess up .byte statements.

In the event of an error, PAL, for a bit of additional protection, stuffs zeros (BRK) into the code. Should you carelessly try to use the bad code, you stand a chance of surviving, since you may land on a Break command. Errors are not counted, a minor nuisance.

Other Features

Several exotic commands are included, such as adding your own opcodes or going to BASIC during the assembly process. This is limited to some BASIC statements, but has its place. Conditional assembly is permitted by use of IF and GOTO (renumberable). It is useful in getting the PET to assemble a bunch of repetitive instructions, in skipping assembly of some code, or in chaining a particular file, depending on the result of IF, for instance, a computer type.

Commodore 64 users get a nice command that permits including BASIC programs in the assembled object code. A corresponding POWER64 command permits immediate testing of such code in a partition. If you don't use POWER64 you can do the same thing, but it is tricky to set up. In any case, the source code is never erased; you can go back and edit anytime.

Other nice touches appear throughout the system: Line indentation is permitted, the beginning and end (plus 1) address of the object program is displayed, so you can save it via the machine language monitor if you wish.

On start-up, PAL changes the top of memory pointer to itself, conveniently, if (and only if) the current top is higher than PAL. Otherwise the system setup is left alone. A nice touch.

I found no glitches after using PAL for two years. Everything seems to work well. I dislike only one thing: If I forget to specify where to place the code, it defaults to the tape buffer (PET) or $C000 (64)—defaults I could do without. I'd rather get an error message.

Documentation

The PAL system is excellently documented. Each command is clearly described, and several thoroughly annotated coding examples will get you started. The book itself is not a tutorial text, but recommends sources for learning machine language.

For adventurous people who like to design and redesign things, the key subroutines have been documented. Their addresses, functions, and use of memory locations are described. The method of assembly is also briefly described; it is important to understand this process if you wish to do strange things.

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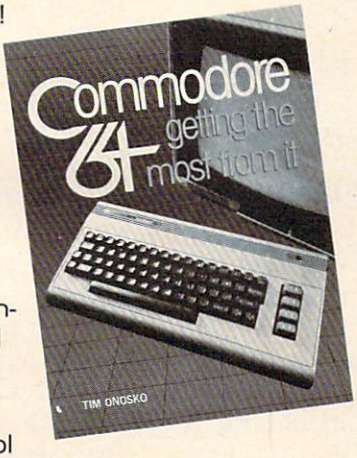

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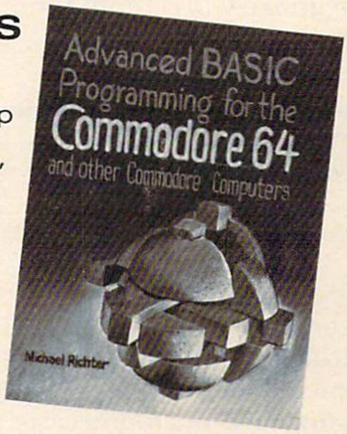

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A Note To Beginners

PAL is, in my opinion, ideally suited for both the expert and the beginner. It is friendly; it needs no special editors or loaders; it is superfast, and it coexists with BASIC programs in memory. It truly eliminates editing and testing headaches. And the multiple statements per line option is efficient in more than one way.

Anyone familiar with the tiny assemblers in monitor extensions such as Supermon; anyone who has gone through the nasty experience of hand assembly; or anyone experienced with machine language will find PAL a pleasure to use and will be unlikely to commit serious errors.

Once you have PAL, there is little reason to use tiny assemblers, except for small patches or corrections. You will never get away from Supermon, though, as its disassembler features will always be needed, unless, of course, you have the rare capacity to write supercode the first time around.

PET's PAL has been around for a while. It has proven to be a very nice assembler. PAL64 is new and has extra features. PAL is a very good buy, worth your serious consideration.

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Robot Runner For The TI

Tony Roberts, Assistant Managing Editor

Games written in BASIC or Extended BASIC for the Texas Instruments 99/4A computer sometimes suffer from painfully slow action. The microprocessor just can't interpret BASIC fast enough to maintain a proper pace in an action game.

Moonbeam Software, however, has found a way to solve the problem in *Robot Runner*, one of the company's recent Extended BASIC releases. The game has seven screens, each requiring a slightly different approach. The game progresses quickly from one scenario to the next, eliminating the boredom that might set in if any one screen had to be played for long periods.

This multiple-screen approach accomplishes several things. For one thing, the programmer can limit the possibilities available at any given moment, allowing tighter, and thus faster, program loops. In addition, this method also permits the programmer to put the player through some very difficult, but very short, game situations.

Taking Out Robot Terrorists

It's the year 2600. The Organized Robot Terrorist Society Against Civilization (ORTSAC) plans to send out its robots to conquer the world. Your mission is to guide your own android into the heavily guarded ORTSAC headquarters, find your way to the Inner Chamber, and there confront the five ORTSAC leaders.

At game's start, you find yourself at the bottom of a six-story building. Your goal, a transporter cage, is at the top. Your android must move from floor to floor while avoiding the Irata 004 Security Force Robots. A yellow chute provides a shortcut to the transporter cage, but to reach it, you'll have to run directly toward one of the security robots. Any mistake will be fatal.

When you reach the cage, the scene shifts to screen two. Your robot, in the cage, moves across the top of the screen over an acid pit. Before the cage crashes into the far wall, the robot must jump onto a small ledge. Then he must jump again onto a pod floating on the surface of the acid. Timing the jumps is important, but there's no time to spare—an onrushing security robot makes sure of that.

Should your jumps be successful, the next obstacle is a long hallway guarded by six groups of security robots. Scurry through gaps in the robots' formation, take cover behind the pillars, and strive for the energizer at the other end.

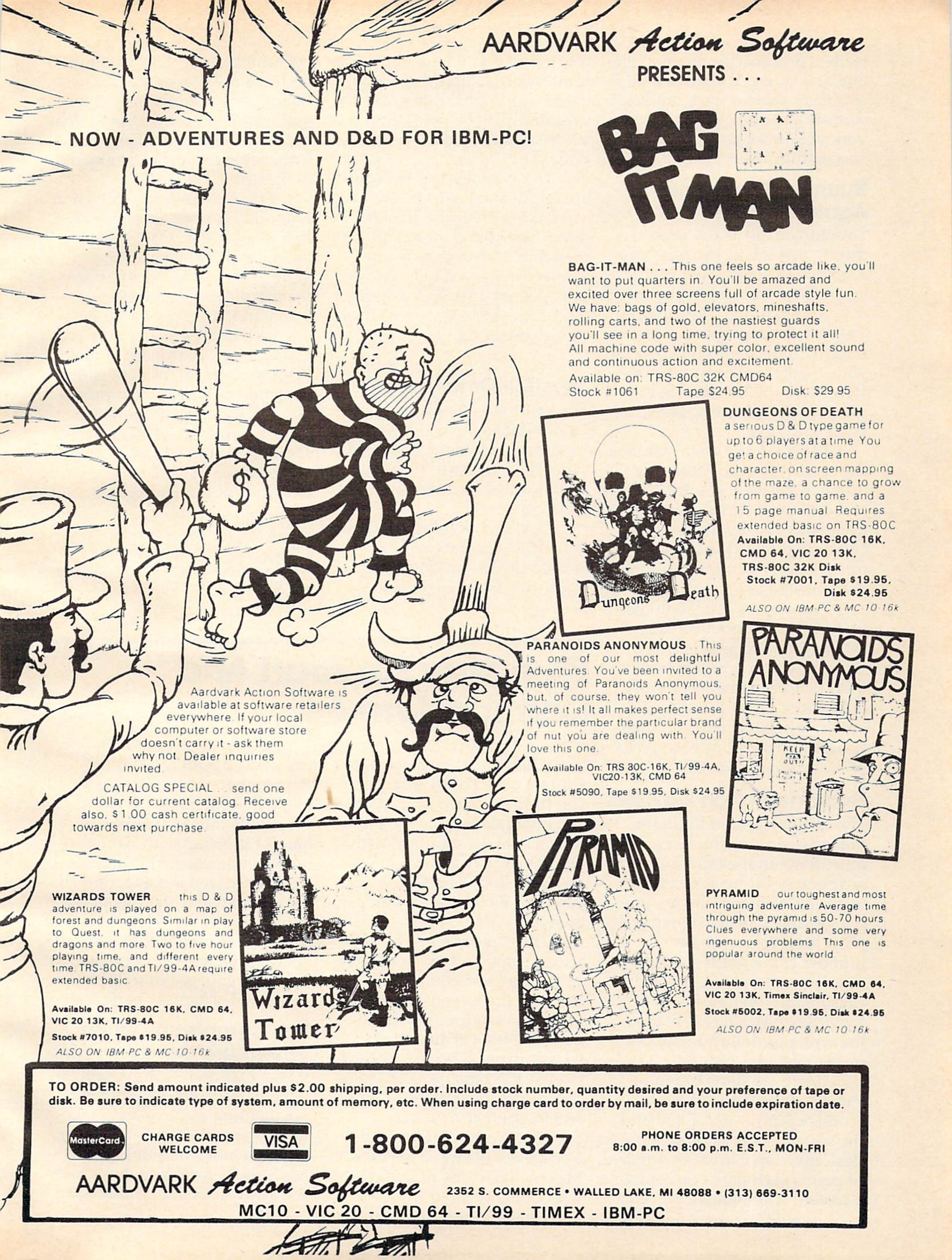
The Second Acid Test

Once through the hallway, you'll face another acid pit test. As a guard robot rolls toward you, you must jump onto a floating pod which will carry you to a waiting elevator. And once on the elevator, you must jump again to an island in the center of the acid pit.

Upon reaching the island, you find yourself in a series of crisscross corridors with three groups of robots on patrol. Again your goal is to reach an energizer, but this time, once you put your android in motion—there's no place to hide. You'll have to fall in between a couple of guard robots, taking care to maintain your distance. The problem is that your android and the security robots travel at different speeds.

The next challenge is the final one before the dreaded Inner Chamber. In a two-tiered room filled with racing red automobiles, the robot must leap car after car, reach and climb a ladder, then jump more cars before clambering aboard the platform that leads to ORTSAC's officials.

The Inner Chamber is where the battle is fought. It's where you do what you've come to do. You've used your skills of locomotion to get this far, now you must fight—and quickly. In rapid succession, ORTSAC's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leaders descend upon you. Take aim and shoot. You have only a couple of shots at each, and as soon as any one of them reaches you, your mission is over—unsuccessfully over.

Running The Gamut Again

Should you fail at any time during this whole process, you return to the beginning to try again. Each time through, however, things are slightly different. The difference is speed. The security robots are a bit faster, so your robot must be more alert. Sometimes he'll be forced to jump even before his target has come into sight.

The opening scene includes the score, the high score, the number of robots you have left, and a counter for the number of times you've started from the beginning. Note the last statistic, for each time through the game, you must adjust your timing.

The first time through the first screen, for example, it's almost impossible to fail. The third time through, however, there can be neither error nor indecision. One false step and you're caught. The fourth time, your progress is complicated by invisible guard robots.

Documentation Oddities

The documentation for *Robot Runner* is sketchy in places. It's difficult to understand the description of the seven scenes until you've played them, and the four-page instruction pamphlet is embarrassed by a number of misspelled words. This is most startling in the discussion of a "yellow shoot." Eventually, you'll realize that the writer is attempting to describe a yellow chute.

There are some minor inconsistencies between the scorekeeping as described and the scorekeeping as programmed. Basically, you earn a set number of points each time you complete a screen. After you've played a few times, you'll find your scores remarkably similar game after game. Additional robots are awarded at 3,000 points and 10,000 points, and every 10,000 points thereafter.

The graphics in *Robot Runner* are bright and colorful. The screens are crisp and uncluttered. The sound effects are pleasant, and are a welcome change from what I've come to call "default TI sound effects"—the silly sounds that come from clumsy use of the noise generator.

Joystick Or Keyboard

The game is available on both tape and disk in versions for joystick or keyboard. I preferred using the keyboard, which is more responsive than the stiff TI joysticks.

However, I did have some difficulty with the cassette keyboard version. The program was inconsistent in detecting a collision between the jumping android and one of the pods floating over the acid pit. It was aggravating to see the robot float right through the pod and end up sizzling to a metal fragment in the acid.

Precision collision-detection is another problem area for TI Extended BASIC. The collision must occur at the time the program is executing the line containing the collision-detection command. Tolerances can be specified so that a near miss is as good as a collision, and in most cases in *Robot Runner*, collision detection is fair, if a bit imprecise.

Though none of its seven screens could stand alone as a successful game, *Robot Runner*'s combination of challenges provides a truly amusing game.

Robot Runner
Moonbeam Software
2 Bridge Street
Northampton, MA 01060
$19.95

©

Blue Max For Atari And Commodore 64

Dan Gutman

Just when you thought shoot-em-ups were passé, just when you thought you'd played every variation, along comes a game that may make standard two-dimensional eye/hand games obsolete. Bob Polin's *Blue Max* may well be the best action game there is.

The comparisons to *Zaxxon* are obvious. Both games feature a diagonally scrolling three-dimensional screen within which the player controls an aircraft that can shoot at air and ground targets. Unlike *Zaxxon*, here you pilot a 1915 biplane over a landscape of roads, bridges, tanks, and buildings.

It is World War I, and the Germans will award the Blue Max medal to any of their flyers who can gun you down. The plane banks and rolls, as in *Zaxxon*, but even smoother—you may be tempted to sway your body into the turns. The biggest problem with *Zaxxon*—determining your ship's altitude—has been solved in this game. The background and shadow of the plane make it very clear how high you're flying. And, just for good measure, you've got an altimeter gauge. What *Zaxxon* pioneered, *Blue Max* perfected.

The Complexity Of An Adventure Game

If *Blue Max* merely improved on *Zaxxon*, it would not be such an outstanding game. What makes *Max* so special is that it does what no other shooting game has done before. You don't just fire away until your thumb gets

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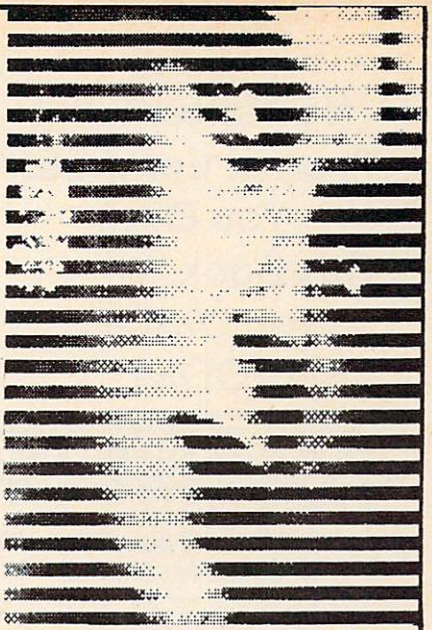

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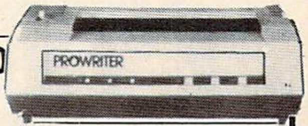

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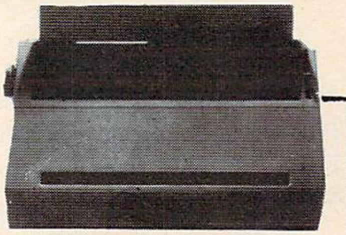

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THE **Printer** STORE — **2720 S. Harbor Blvd., Suite E, Santa Ana, CA 92704** sore. There's a lot of work to be done—bridges, tanks, and enemy planes are all destroyed in different ways. Your instrument panel tells you how much fuel you've got, how many bombs remain, the speed, altitude, wind, approaching enemy planes, and any damage to your aircraft. This control panel is not just for show: You have to use it to succeed. In fact, you have to use it to take off. This kind of complexity is usually found only in adventure games. So adventure game fans as well as arcade game buffs will appreciate it.

At the same time, *Blue Max* is not so complicated that it overwhelms. *Defender* is a great defensive game, but so much happens onscreen that a lot of people experience stimulus overload. Since *Blue Max* is mainly an offensive game, you don't have to be constantly on edge for that next assault. There is actually very little shooting at you. So you can look over the side and enjoy the scenery a bit—bomb a few bridges here, strafe a few tanks there. And if you miss, don't worry about it. There will be more bridges and tanks down the road.

Bombing is accomplished by hitting the fire button and pulling down on the stick at the same time. This takes some getting used to, especially when you consider that pulling down also causes your plane to dive. Realistically, pilots in World War I did not have sophisticated bomb site techniques.

In *Blue Max*, you have to drop bombs before you reach your target, depending on your location and altitude. It's similar to the way a quarterback has to "lead" his receiver with the ball. The initial frustration is offset by satisfaction as you gain control later in the game.

Perhaps the toughest part of the game involves periodically landing your plane to refuel and make repairs. First a tone sounds, indicating you are approaching a friendly runway, and you'd better go for it or you'll run out of fuel before you see another one. Then you've got to quickly descend to 25 feet and press the fire button to lower your landing gear. A blue L on the control panel indicates it's safe to land. You position yourself over the runway and touch down. You want the first half of the runway; otherwise, you won't be able to build up enough speed to take off again. If this all sounds easy, wait until you crash and burn the first ten times.

Graphics And Sound

As for technical qualities, *Blue Max* is good to very good. The graphics are crisp and colorful. The screen lights up with explosives as you strafe a row of tanks. Little cars and trucks drive over the bridges, and when you bomb the bridges, chunks of it blow up, not the whole bridge. The sound is mostly explosions, but even here attention has been paid to the detail. Bombs dropped on the ground blow up, but the ones that hit the water make a splashing noise. There is also a jaunty rendition of *Hail Britannia* between games.

My complaints with *Blue Max* are nitpicking. I wish there was a little more variety to the scenery instead of the endless military suburbia of bridges, tanks, factories, and more bridges. There should be some sort of ultimate goal. Though you *can* enter an enemy city if you survive and hit four specific targets, only top-of-the-line players will ever see it. And the "city" is not that different from the rest of the countryside.

But again, these are small quibbles about a great game. *Blue Max* is head and shoulders above other shooting games.

Blue Max
Synapse Software
820 Coventry Road
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(415) 527-7751
$34.95

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C. Regena

Programming Tips And Hints

This month I will cover a variety of hints that I hope will be helpful in your programming, and answer some questions I have received that I think will be of general interest.

I appreciate your letters concerning my book, *Programmer's Reference Guide to the TI-99/4A*. Several people have written to me with problems concerning certain programs. All those programs have been checked, and I am happy to report the listings are correct. The most likely cause for errors is mistyping DATA statements. Be sure the numbers are typed correctly, and be sure all commas are placed correctly. See my November 1983 column for debugging hints.

MEMORY FULL Error

None of the programs I have published requires the 32K Memory Expansion. In fact, you cannot access the memory expansion with regular, built-in TI BASIC. You need the Extended BASIC command module or another module that can use the memory expansion. If you get a MEMORY FULL error, my first guess would be that you have a disk drive and disk controller connected. The disk system automatically uses up some memory with open files. The default number of files is three. To make memory available, specify only one opened file by typing

```
CALL FILES(1)   (enter)
NEW             (enter)
```

then proceed normally. You may type in a program or load a program from cassette or disk. CALL FILES(1) uses up a little over 1000 bytes of RAM.

As a matter of general procedure, I do a CALL FILES(1) whenever I turn on my computer (if I have the disk system attached). There are still cases when you may be able to save a program on cassette, but not use it with the disk system—because of the 1000 bytes less when the disk system is connected. If you are loading a cassette and it stops with a DATA ERROR right after the header sound, full memory could be the cause.

Another cause of a MEMORY FULL error could be typing errors involving line numbers (especially if GOSUB and RETURN statements are involved) or user-defined functions.

TI BASIC And Extended BASIC

Some TI Extended BASIC owners have tried to run *all* TI BASIC programs with Extended BASIC. If the program is designed for TI BASIC, it may not work with Extended BASIC. First, Extended BASIC uses up some of the available memory, so the TI BASIC program may not even fit in Extended BASIC. Second, TI BASIC may use graphic characters numbered from 144 to 159 in color sets 15 and 16; they are unavailable in Extended BASIC. Third, any PRINT statements using colons (for blank lines) in TI BASIC will confuse the computer in Extended BASIC because the double colon is used for separating commands.

For you new TI owners, TI Extended BASIC is a programming language on a command module that can give you even more powerful programming capability, including smoothly moving sprites. Any program written in TI Extended BASIC requires the TI Extended BASIC command module to run. The programming language that is built into the computer is called console BASIC or just TI BASIC.

Programming Speech And Games

How do you use speech? The TI Speech Synthesizer is a little box that attaches to the side of the computer and provides speech capabilities. To make it work, you also need a command module that has speech capabilities.

To program your own speech, you may use Speech Editor, TI Extended BASIC, or Terminal Emulator II. The first two command modules have a limited vocabulary; Terminal Emulator II is more versatile and allows unlimited speech. A manual comes with the module that illustrates how you can make the computer talk either by using allophones or by spelling words phonetically.

Several readers have requested help on writing a program for Spanish—using the tilde and accents. I hope to have such a program ready for next month's column. It will have optional speech.

If your joysticks don't seem to work right on the TI-99/4A, remember to release the ALPHA LOCK key. The ALPHA LOCK key should be in the "up" position for joysticks and down for most other programming.

Yes, there is a book of games specifically for the TI-99/4A. By the time you read this column, *COMPUTE!'s First Book of TI Games* will be available. There are games by several authors, including a few favorite games from past issues of COMPUTE!. Most of the games have not been published previously, and there is a variety to choose from. The book includes suggestions on how to adapt the games for your own use or how to write your own games using the illustrated techniques. One section of the book includes games written in TI Extended BASIC.

Numeric Functions

The price of the TI-99/4A may lead some people to think that this computer is "just a toy." Actually, the TI has such a powerful built-in BASIC that it can do many tasks that a few years ago only the very large (and expensive) computers could handle. For an example, I'd like to describe some of the built-in numeric functions that are available. In my college days we would spend hours (or days) working on calculations for problems. (That was in the slide rule days.) If you wanted more than three-digit accuracy, you could use math tables and interpolation. Of course, calculators became readily available and reduced the drudgery considerably. Now, however, you can write a program and practically instantly solve *several* problems.

Let N stand for a numeric expression—a number or combination of numbers or a variable name for a number. SQR(N) will return the square root of a number. Try PRINT SQR(64) and press ENTER. Next try PRINT SQR(60). The square root of the number in parentheses is printed, and it may contain a decimal portion. The number N must be zero or positive.

ABS(N) returns the absolute value of a numeric expression N. I usually think of the absolute value of a number as the number without the positive or negative sign.

INT(N) returns the integer value of a numeric expression N. The integer is the whole number part of a number, or the number without the fractional part. If you picture a number line, the integer function always returns the closest whole number to the left of the number specified. Thus INT(6.4) is 6, but for negative numbers INT(−3.45) is −4.

EXP(N) is the exponential function and returns the value of e^N where e is the number 2.718281828.... The inverse is the natural logarithm function LOG(N). Remember that this function is using the base e, $\log_e(N)$. If you want a logarithm to a different base, use this formula:

$$\log_B(N) = \log_e(N)/\log_e(B)$$

For example, if you want the logarithm of N to the base 10:

PRINT LOG(N)/LOG(10)

SGN(N) is the signum function which gives the algebraic sign of a number and is useful in evaluations where you need to know if a number is positive, zero, or negative. The values returned are 1 if the number is positive, 0 if the number is zero, and −1 if the number is negative.

SIN(N), COS(N), and TAN(N) are the trigonometric functions sine, cosine, and tangent. The angle N is expressed in radians. If you prefer to think of the angle in degrees, you can multiply the number of degrees by $\pi/180$ or .01745329251994 to get the equivalent radians. Also remember that for some angles some of the functions may not be defined. If you need the other trigonometric functions, the secant is the reciprocal of the cosine, the cosecant is the reciprocal of the sine, and the cotangent is the reciprocal of the tangent. ATN(N) is the arc tangent of the number N and returns the angle whose tangent is N. Again, the angle is expressed in radians.

The above numeric functions can be used in combinations or as numeric expressions in other statements. For example, the following are valid statements:

```
200 PRINT COS(A)
300 PRINT SIN(X/Y)+COS(N-.5)
400 ON SGN(A-B)+2 GOTO 300,520,600
500 L=LOG(X)/LOG(10)
600 S=INT(SQR(M))
```

User-Defined Functions

DEF allows you to define your own function if you want to use a formula that is not built-in or if you want to use a combination of functions and save some typing effort. The DEF statement number must be lower than the line number where the function is used, so it is wise to simply put DEF statements near the beginning of the program. An example using DEF is to have the definition statement near the beginning:

```
110 DEF F(X)=X^3+2*X*X-X/2
```

and later you may use such statements as:

```
500 PRINT F(4)
650 IF F(N)=0 THEN 780
680 A=F(L)+F(M)
```

Each time the function is used, the function is evaluated with the numeric value within the parentheses.

You do not have to specify a parameter in the DEFinition statement. For example, you may wish to define a random number R from 1 to 16:

```
120 DEF R=INT(16*RND+1)
```

Later, every time R is used in a statement, a random number from 1 to 16 will be used:

```
350 PRINT A$(R)
400 CALL COLOR(R,R,R)
```

(three possibly different values of R will be used)

Controlling Screen Scrolls

If you have long lists of information, as you print the data the printing scrolls upward and off the screen. There are several techniques to control the scrolling. One method is to keep track of how many lines are printed. After a certain number are printed, create a pause or wait until the user presses ENTER or another key. "Control Scrolling" prints a list of 50 names, each with a random number. I'm using names and numbers for illustration purposes only; you would have your own information generated previously. L is a line counter, and line 200 increments the number of lines. Line 210 checks to see if 20 lines have been printed. If so, the counter L is reset to zero and a message to press ENTER is printed. CALL key waits for the ENTER key to be pressed before the program continues. Lines 200–260 could be put into a subroutine if you prefer. Remember that if you double-space your output, line 200 would be changed to L=L+2. L keeps track of how many lines on the screen have been used.

Another method to stop the printing from disappearing off the top of the screen is to have the user press any key to pause. When she or he lets go of the key, the printing resumes. The CALL KEY statement is used to detect if a key has been pressed. The general form is CALL KEY(0,KEY, STATUS) where 0 indicates for the computer to scan the whole keyboard. KEY returns a number corresponding to the key pressed (the ASCII code). STATUS returns 1 if a new key is pressed, 0 if no key is pressed, and −1 if the same key is pressed. You may use any variable names for KEY and STATUS.

The following sample program chooses a random number C then prints a letter corresponding to C along with C. One hundred letters and numbers are printed. If you want to stop the printing, hold a key down. When you want the printing to resume, release the key.

```
100 REM PRESS A KEY
110 CALL CLEAR
120 FOR N=1 TO 100
130 RANDOMIZE
140 C=INT(26*RND+1)
150 PRINT CHR$(C+64),C
160 CALL KEY(0,K,S)
170 IF S<>0 THEN 160
180 NEXT N
190 END
```

You may not want to keep holding a key down to stop the printing. The following program illustrates how you can stop the printing by pressing any key, wait as long as you wish, then start the printing again by pressing another key. Line 170 checks the status of the CALL KEY statement in line 160. If no key is being pressed, control goes to line 200, which indicates to go to the next number. If a key is pressed, S will not equal zero and the program goes to line 180, another CALL KEY statement. This time line 190 checks to see if a new key is pressed. When a new key is pressed, S will be 1 and the program goes to line 200.

```
100 REM PRESS TWO KEYS
110 CALL CLEAR
120 FOR N=1 TO 100
130 RANDOMIZE
140 C=INT(26*RND+1)
150 PRINT CHR$(C+64),C
160 CALL KEY(0,K,S)
170 IF S=0 THEN 200
180 CALL KEY(0,K,S)
190 IF S<1 THEN 180
200 NEXT N
210 END
```

Neat Numbers Columns

You have probably noticed that the computer prints items starting at the left column. You can use commas and semicolons to separate items and to make nice columns, but the numbers line up starting at the left column rather than right-justifying lines as is standard. There are several techniques to get your columns to look prettier.

I often use a subroutine to convert a number to a dollars and cents amount, then the dollars and cents can be lined up. One of the easiest ways is to keep the money expressed as a whole number of cents; for example, 525 would correspond to 5 dollars and 25 cents. If you know the range of the money ahead of time, the coding can be simplified. In this example, let's assume a dollar amount of less than $9.99. The cost is expressed in the number of cents, C. Let C$ be the string value of C. Next check the length of C$. If the length is 1, that means there is a single digit and we'll need a leading zero in our standard form of dollars and cents. If the length is 2, there are only cents and I will want a space between the dollar sign and the decimal point, so I want a leading space added to the string. The next step is to put two characters to the right of the decimal point. The subroutine is:

```
900 C$=STR$(C)
910 IF LEN(C$)>1 THEN 930
920 C$="0"&C$
930 IF LEN(C$)>2 THEN 950
940 C$=" "&C$
950 R$=SEG$(C$,LEN(C$)-1,2)
960 L$=SEG$(C$,1,LEN(C$)-2)
970 C$="$"&L$&"."&R$
980 RETURN
```

SEG$ refers to the segment of C$ starting at the middle number of the three within parentheses and going to the last number.

You can use the same general idea to line up a column of any numbers. In the following example problem, lines 110–140 READ in nine numbers from the DATA statement in line 150 and print the numbers in a column. Notice that line 130 tells the computer to start printing the numbers in column 9 with the TAB(9) function. The TAB function is just like the tabulator on a typewriter—the computer goes to that column then starts printing, rather than starting at the left margin.

Lines 170 to 210 print out the numbers again, but this time right-justified (ones column, tens column, hundreds column). First, the number N(I) is converted to a string N$ so that I can get the length L by using the LEN function. This length tells how many digits are in the number. Line 200 uses the TAB function again, but the starting column depends on the length of the number. If the number is one digit, L=1 and the computer TABs 12; if the number is two digits, the starting column is 11; and if the number is three digits, the starting column is 10.

```
100 CALL CLEAR
110 FOR I=1 TO 9
120 READ N(I)
130 PRINT TAB(9);N(I)
140 NEXT I
150 DATA 3,15,5,200,79,8,179,2,11
160 PRINT
170 FOR I=1 TO 9
180 N$=STR$(N(I))
190 L=LEN(N$)
200 PRINT TAB(13-L);N$
210 NEXT I
220 END
```

Keep in mind that there are usually many ways to write a given program. There are several techniques to get a column of numbers lined up right. If you can get the computer to do what you want it to do, your method is fine.

More Techniques

A note on calculations: Keep in mind that if you type a formula, the computer will evaluate the expression using the standard algebraic order of operations—powers, multiplication and division, addition and subtraction. You may use parentheses to group numbers to keep within the standard order.

Tip of the month: Use the left-hand SHIFT key to type the plus sign, +. (That's standard typing position anyway.) If you use the right SHIFT with the +, it is possible to hit the FCTN key instead, which results in QUIT, and you're back to the title screen and your program is gone.

The function keys can be used within a program by detecting their code numbers after a CALL KEY statement. For example, if you check to see if the ENTER key was pressed, you check IF KEY=13. If you wish to use REDO, which corresponds to FCTN 8, then check for the key code of 6. In the "Southern States" program in the August 1983 issue of COMPUTE!, the user types in an answer. The typing is printed on the screen. The method used is CALL KEY rather than INPUT to prevent scrolling. If you want to be able to erase your answer as you are typing, add the following lines:

```
782 IF K=6 THEN 720
1062 IF K=6 THEN 1000
```

Now after the CALL KEY statement, the computer checks to see if a letter was pressed, the ENTER key, or FCTN 8.

I do appreciate your letters and can answer general questions in this column, or your questions can be answered in "Readers' Feedback" or "Questions Beginners Ask." If you have problems running any of my programs, I can also try to help. Please be specific about which program it is (and which computer, since I own several brands) and what the error is. The exact error message and line number helps to pinpoint the error. Please do not ask me to debug your own programs or programs from other authors.

A special welcome to all our new readers who may have just received a computer for Christmas. I will try to continue to write programs and columns that will meet your needs. May 1984 be a productive year for all of you TI owners.

Control Scrolling

```
100 REM CONTROL SCROLLING
110 DIM N$(50),P(50)
120 FOR I=1 TO 50
130 READ N$(I)
140 P(I)=INT(80*RND+10)
150 NEXT I
160 L=0
170 CALL CLEAR
180 FOR I=1 TO 50
190 PRINT N$(I),P(I)
200 L=L+1
210 IF L<20 THEN 270
220 L=0
230 PRINT :"PRESS <ENTER>"
240 CALL KEY(0,K,S)
250 IF K<>13 THEN 240
260 CALL CLEAR
270 NEXT I
280 GOTO 330
290 DATA ANDY,AURA,LENA,BILL,ED,GRA
    NT,JIM,JOHN,RANDY,RICHARD,CHERY
    ,CINDY,SHEILA,JOANN,GEORGE,SUSA
    N
300 DATA KELLY,JENNIE,ANGELA,BRYAN,
    DEAN,RELLE,LEWIS,MELISSA,DOUG,S
    HERYL,EUGENE,MITCH,KATHY,JEREMY
310 DATA JUSTIN,STEVE,JASON,PAM,TRA
    CY,KIM,JOELLE,JUDY,BRENDA,BOB,J
    ERRY,GARY,MARILYN
320 DATA JODI,DEBBIE,BRENDA,RON,MAE
    ,RAY,LINDA
330 END
```

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All About Commodore Chaining

Melvyn D. Magree

If you've tried chaining programs, but found that variables were lost in the process, you'll find the solution here. The article tells you how to chain programs so that variables are safe, and how to handle the variables you don't want to pass from one program to another.

You are writing a program which is rapidly becoming larger and larger. Then the dreaded message is displayed:

OUT OF MEMORY

What to do? You "crunch" the program again and again; you search for hours for one more thing to eliminate. Everything that you have left is important. (*Crunching* means saving memory by eliminating REM statements, combining commands onto multiple-statement lines, and using abbreviations such as ? for PRINT.)

At wit's end, you discover at least one part of the program that you use at the very beginning and never use again. You may even find that you have more sections you use only once and then move on to another section. Now, if you could load that section in only when it is needed and then load the next section when it is needed.

Many microcomputers do allow you to do this. You can use the LOAD command as a statement in your first program, and your computer will execute the first program and then LOAD in the requested program and go to the first statement of the second program. This is called *chaining*.

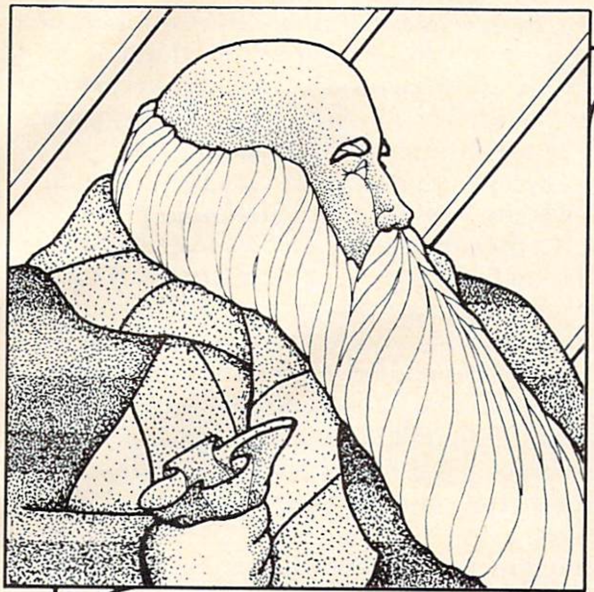
Changes In Variables

If you have a VIC-20 or a Commodore 64, you can chain. The *Commodore 64 Programmer's Reference Guide* states on page 59: "None of the variables are cleared during a chain operation." The *VIC-20 Programmer's Reference Guide* is a bit more thorough about this and states on page 8: "Variables used in the first program will not be cleared as long as the new program is *shorter* in length than the older one." You might find that this restriction causes you problems, especially if you have a small initialization section that you want to use as the first program.

But, beware! There is another "gotcha." It may be true that "none of the variables are cleared," but not all variables remain the same "during a chain operation." Programs 1 and 2 demonstrate this.

Program 1 is 89 bytes long, Program 2 is 25 bytes; so we have no problem with the size restriction. However, Program 2 does not print the variable S$ as "TEST" as set in Program 1, but as "S$".

All good designs, whether of space shuttles or of can openers, are compromises. Microcomputers are no exception. In order to conserve space in programs, the designers of Commodore BASIC chose to leave string text directly in the program rather than copy it to a separate area. Thus, when Program 2 overlays Program 1, the descriptor for S$ points to the same location, but to different



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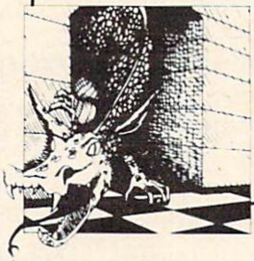

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text. In the case of Program 2, this happens to be a part of line 2 and line 3 (I inserted the REM at line 1 to force S$ to become something at least partly recognizable). To see what has happened, let's examine the contents of S$ character by character. We do this by the direct statement:

```
FOR I=1 TO 4:PRINT ASC(MID$(S$,I));:NEXT
```

and get

```
83     36     0     23
```

that is, "S", "$", and two nonprinting characters.

The structure of a BASIC statement is:

next statement	statement number	tokenized statement	statement terminator
low byte / high byte	low byte / high byte		(0)

So we realize that the first two characters are the "S$" of line 2, the zero is the terminator for line 2, and 23 is the low byte of the location of the line following line 3 (the program termination characters).

Passing Variables

If you are willing to make your programs look a bit clumsy, you can get around this problem rather simply (see Program 3). I modified line 1 of Program 1 so that S$ is set to a null string plus "test". This causes space to be created in variable storage which is not overwritten when Program 2 is loaded. And so, when Program 3 calls Program 2, Program 2 prints S$ correctly.

Another solution would be to set all strings with READ and DATA statements, which would put them beyond the area to be overlaid by any subsequent programs. But this can cause difficulties if you need to call bigger programs.

Here's a solution. As you write your various programs, monitor the size of each. You can do this by

```
PRINT PEEK(45),PEEK(46)
```

remembering the low-byte, high-byte format used. If any program is larger than the first in the chain, then do the following. In your first program set the start of numeric variables (memory addresses 45,46), the start of arrays (47,48), and the end of arrays (49,50) to the value for the size of the largest program in the chain or greater. You should do this as the first thing in your program so that you do not lose any variables. See Program 4 and Program 5. (I put line 2 in Program 5 for no other reason than to help make it bigger than Program 4.) These examples are for the Commodore 64. If you have a VIC-20, the 8 POKEd into locations 46, 48, and 50 would be replaced by 16 for an unexpanded version; by 4 for a 3K expansion; and by 18 for 8K or more expansion.

Of course, you may have variables that you do not wish to pass from the first program to others. To prevent these variables from being passed, you must use them in the first part of the first program. (Also, you can't use any variables in the first part that you wish to pass to other programs.) After you have used the variables which are not to be passed, do a CLR to clear variable storage; then POKE locations 45 to 50 with the size of the largest program. Now you can define and set the variables you wish to pass to other programs.

One final remark. As you update your programs, do not do so after one has been loaded by another program. When you SAVE, it will be the size of the largest program in the chain or even larger. This could have some side effects later that you would have difficulty figuring out. Reload any program you update before you SAVE. If you have done this consistently, its size as given in locations 45 and 46 will be accurate.

Program 1

```
1 N=99:S$="TEST"
2 PRINT"TEST1, A BIGGER PROGRAM THAN TEST
  2"
3 PRINTN,S$
4 LOAD"TEST2",8
```

Program 2

```
1 REM
2 PRINTN,S$
3 END
4 LOAD"TEST2",8
```

Program 3

```
1 N=99:S$=""+"TEST"
2 PRINT"TEST3, A BIGGER PROGRAM THAN TEST
  2"
3 PRINTN,S$
4 LOAD"TEST2",8
```

Program 4

```
1 POKE45,1Ø4:POKE46,8:POKE47,1Ø4:POKE48,8
  :POKE49,1Ø4:POKE5Ø,8
2 N=99:S$=""+"TEST"
3 PRINTN,S$
4 LOAD"TEST5",8
```

Program 5

```
1 PRINT"TEST5, A PROGRAM WHICH WE WANT TO
   BE SOMEWHAT BIGGER THAN TEST4"
2 S$="*"+S$
3 PRINTN,S$
4 END
```

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The Mozart Machine

Donald J. Eddington

Your computer can compose music with this special technique. The compositions are remarkably Mozartian in style.

If you've ever gone through the steps to make your computer play a particular piece of music, you realize that it can be a significant programming task. To have your computer actually *write* music is a real feat.

To accomplish this, we've first got to find a way to work with POKE values in DATA statements in order to make the measures of music. Also, we need to be able to READ the values in any order so that the songs will be different with each run of the program. The commonly used string manipulation methods won't work very well here. We need variety, and the traditional way of working with strings quickly results in a tangled mess.

Alternatively, you could write each measure as a series of POKE Note/Duration/Next Note repeats. But by the time you had about a dozen measures entered this way, you'd see the ?OUT OF MEMORY error message on a VIC. The results of this method are fine, but you'll probably find it too long and repetitive.

Array Referencing

The shortest, best way to solve this problem is to use a technique called array referencing. First, to get the measures of music, you set up an array of all variables, then reference them by subscript into a POKE loop. Specifically, 14 variations on nine variables are required to make the music for this program. The random number generator is used to make the music different every time the program is run.

A Mozartian flavor results from a deliberate shortening of the low notes and making the high notes of varying lengths. And to keep the music from becoming totally random, DATA statements select the measures by their underlying tonality—tonic, subdominant, dominant, or supertonic. You also need to provide for cadence measures every four measures and for a final ending chord for each tune.

This line-by-line explanation (of the VIC version) will help illustrate the programming steps involved.

Following The Composer

Lines	
10	DIMension an array for notes—9 notes per measure, 14 variations.
25	Green screen with a red border.
30–50	Educational information printed on the screen.
75	Wait for two seconds before continuing.
80	Orange screen with a green border.
90	READ into the array all notes in the following DATA statements until 14 variations of the 9 measures are all read in. Add 212 to each note to make it a pitch value before the note is POKEd.
91–95	The DATA statements that line 90 READs to fill the array.
100–130	Speed value and voice numbers—line 130 is the volume.
160–178	The DATA statements which keep the music like Mozart's by controlling the next tonality used and where the cadences will fall.
180	READ the next item in the DATA statements (170–178).
190–270	Determine the value of Y, then GOTO 1010 IF RR is 2, 5, or 7. If RR is 8, then 500; if RR is 9, then 1500.
300–332	These lines guarantee that the value of Y will be different each time the program is run. This section is a random number generator. Note: Y is used to select the variation READ from the array DIMed in line 10. At line 1010, these values of Y will be used to create a measure of music.
500–510	The ending module that is printed on the screen when the program is finished.
900	REM line telling the programmer that this is where the music is actually produced and POKEd into the correct voices.
1010–1035	This is where the music is created—by taking the value of Y determined in lines 190–331 and reading the array at position Y (1–14) for 9 notes (subscripts) then POKEing these values into the correct voices to get the notes. Line 1035 ends with a GOTO 160 to make the program create another measure of music.
1500–1510	This section ends each tune with a long chord, then waits two seconds between tunes. Then the program plays another tune.

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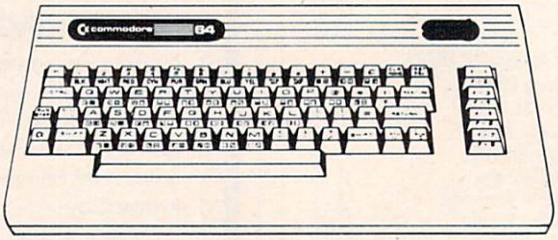

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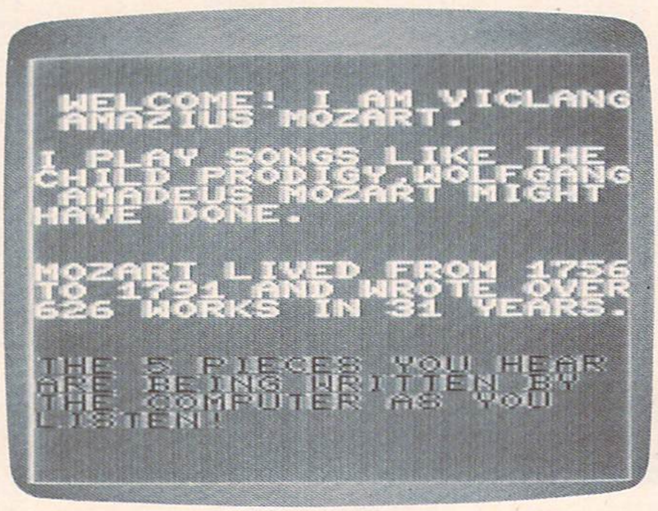
Entertainment And Education

Significantly, this program does not copy any of Mozart's music; rather it imitates Mozart's style. You might want to introduce some alternative composition rules and stylistic ideas and come up with a mechanical composer of your own. How about a Pink Floyd machine or a Bartok machine?

If you don't want to type this program in yourself, cassette copies *of the VIC version* are available upon request. Send $3, a blank cassette, and a stamped, self-addressed mailer to:

VIC Mozart Machine
1810 South 4th St.
Springfield, IL 62703



This screen introduces "The Mozart Machine" to VIC users. (Other versions similar.)

Program 1: VIC Mozart

```
10 DIMX(14,9)
25 POKE36879,9Ø
3Ø PRINT"{CLR}{2 DOWN}{RIGHT}{WHT}WELCOME
   ! I AM VICLANG AMAZIUS MOZART."
35 PRINT"{DOWN}I PLAY SONGS LIKE THE CHIL
   D PRODIGY,WOLFGANG AMADEUS MOZART MIGH
   T HAVE DONE."
4Ø PRINT"{2 DOWN}MOZART LIVED FROM 1756TO
    1791 AND WROTE OVER626 WORKS IN 31 YE
   ARS."
5Ø PRINT"{DOWN}{RED}THE 5 PIECES YOU HEAR
    ARE BEING WRITTEN BY{2 SPACES}THE COM
   PUTER AS YOU{3 SPACES}LISTEN!"
75 FORT=1TO2ØØØ:NEXT
8Ø POKE36879,141
9Ø FORT=1TO14:FORTT=1TO9:READX:X(T,TT)=X+
   212:NEXTTT:NEXTT
91 DATA3,11,11,11,11,16,16,11,7,3,11,16,1
   1,16,13,16,11,16,3,11,13,11,16,13,16,1
   1,16
92 DATA3,13,16,13,19,22,19,23,13,3,13,19,
   13,19,16,19,13,13,3,19,13,13,3,19,19,1
   3,3
93 DATA7,13,16,13,22,16,16,13,7,Ø,7,16,7,
   13,11,16,7,13,7,19,22,13,16,13,16,11,7
94 DATA7,13,11,13,7,11,19,13,7,7,13,11,13
   ,7,11,19,13,13,3,11,13,11,16,16,16,16,
   16
95 DATAØ,16,13,7,7,7,16,7,7,3,19,16,13,13
   ,13,19,13,13
1ØØ REM SET VOICE NUMBERS,AND{2 SPACES}SP
    EED VALUE
12Ø K=36875:L=36876:P=175
13Ø POKE36878,12
16Ø REM SET SELECTED{2 SPACES}MEASURE BY
    {SPACE}DATA NUMBER
17Ø DATA1,3,6,2,1,4,6,2,3,4,1,5,1,4,6,7,1
    ,4,6,2,1,3,6,9
172 DATA 1,1,4,5,1,4,6,2,3,4,1,5,1,4,1,5,
    1,4,6,9
174 DATA 1,4,6,2,3,6,1,5,1,4,6,7,3,4,6,2,
    1,4,3,7,1,4,6,9
176 DATA 1,4,3,7,1,6,4,5,6,3,6,2,4,6,1,5,
    1,4,6,9
178 DATA 1,4,3,7,6,3,6,2,4,6,1,5,1,3,6,7,
    3,6,1,5,1,4,6,9,8
18Ø READRR
19Ø IFRR=1THEN3ØØ
2ØØ IFRR=2THENY=12:GOTO1Ø1Ø
21Ø IFRR=3THEN31Ø
22Ø IFRR=4THEN32Ø
23Ø IFRR=5THENY=14:GOTO1Ø1Ø
24Ø IFRR=6THEN33Ø
25Ø IFRR=7THENY=13:GOTO1Ø1Ø
26Ø IFRR=8THEN5ØØ
27Ø IFRR=9THEN15ØØ
3ØØ Y=1:X=RND(1):IFX<.35THENY=3
3Ø1 IFX>.75THENY=2
3Ø2 GOTO1Ø1Ø
31Ø Y=1Ø:IFRND(1)<.4THENY=11:GOTO1Ø1Ø
32Ø Y=4:X=RND(1):IFX<.35THENY=5
321 IFX>.75THENY=6
322 GOTO1Ø1Ø
33Ø Y=7:X=RND(1):IFX<.35THENY=8
331 IFX>.75THENY=9
332 GOTO1Ø1Ø
5ØØ PRINT"{CLR}{DOWN}{YEL}WELL,THAT'S ALL
    --HOPE{4 SPACES}YOU LIKED IT!!"
51Ø PRINT"{DOWN}RUN IT AGAIN--AND HEAR FI
    VE MORE SONGS!!":END
9ØØ REM FOLLOWING ARE THE MUSIC MEASURES
    {SPACE}THAT VICLANG USES TO MAKETHE W
    HOLE TUNE
1Ø1Ø POKEK,X(Y,1):POKEL,X(Y,2):FORT=1TOP:
     NEXT:POKEK,Ø:POKEL,X(Y,3):FORT=1TOP:
     NEXT
1Ø2Ø POKEK,X(Y,4):POKEL,X(Y,5):FORT=1TOP:
     NEXT:POKEK,Ø:POKEL,X(Y,6):FORT=1TOP:
     NEXT
1Ø3Ø POKEK,X(Y,7):POKEL,X(Y,8):FORT=1TOP:
     NEXT:POKEK,Ø
1Ø35 POKEL,X(Y,9):FORT=1TOP:NEXT:GOTO16Ø
15ØØ POKE36876,235:POKE36875,239:POKE3687
     4,235:FORT=1TO12ØØ:NEXT
151Ø POKE36874,Ø:POKE36875,Ø:POKE36876,Ø:
     FORT=1TO2ØØØ:NEXT:GOTO16Ø
```

Program 2: Mozart For The 64

Translation by Gregg Peele, Assistant Programming Supervisor

```
1ØØ DIMH(14,9),L(14,9)
1Ø1 FORT=54272TO54272+24:POKET,Ø:NEXT
1Ø2 POKE54296,15
```

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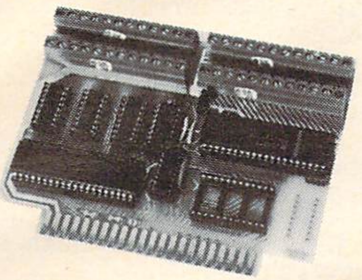

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```
103 FORT=54272+5TO54272+24STEP7:POKET,17:
    POKET+1,244:NEXT
110 POKE53281,7:POKE53280,5
120 PRINT"{CLR}{2 DOWN}{RIGHT}{WHT}WELCOM
    E! I AM 64CLANG AMAZIUS MOZART."
130 PRINT"{DOWN}{2 SPACES}I PLAY SONGS LI
    KE THE CHILD PRODIGY,"
135 PRINT"WOLFGANG AMADEUS MOZART MIGHT H
    AVE DONE"
140 PRINT"{2 DOWN}MOZART LIVED FROM 1756
    {SPACE}TO 1791 AND WROTE";
145 PRINT"{6 SPACES}OVER 626 WORKS IN 31
    {SPACE}YEARS"
150 PRINT"{DOWN}{BLK}{4 SPACES}THE 5 PIEC
    ES YOU HEAR ARE BEING"
155 PRINT" COMPOSED BY THE COMPUTER AS YO
    U LISTEN"
160 FORT=1TO2000:NEXT
170 POKE53281,5:POKE53280,7
180 FORT=1TO14:FORTT=1TO9:READH,L:H(T,TT)
    =H:L(T,TT)=L:NEXTTT:NEXTT
190 DATA12,143,31,165,31,165,15,210,31,16
    5,37,162,18,209,31,165,14,24
200 DATA12,143,31,165,37,162,15,210,37,16
    2,33,135,18,209,31,165,18,209
210 DATA12,143,31,165,33,135,15,210,37,16
    2,33,135,18,209,31,165,18,209
220 DATA12,143,33,135,37,162,16,195,42,62
    ,50,60,21,31,50,60,16,195
230 DATA12,143,33,135,42,62,16,195,42,62,
    37,162,21,31,33,135,16,195
240 DATA12,143,42,62,33,135,16,195,25,30,
    84,125,21,31,33,135,12,143
250 DATA14,24,33,135,37,162,16,195,50,60,
    37,162,18,209,33,135,12,143
260 DATA14,24,28,49,37,162,14,24,33,135,3
    1,165,18,209,28,49,16,195
270 DATA14,24,42,62,50,60,16,195,37,162,3
    3,135,18,209,31,165,14,24
280 DATA14,24,33,135,31,165,16,195,28,49,
    31,165,21,31,33,135,14,24
290 DATA14,24,33,135,31,165,16,195,28,49,
    31,165,21,31,33,135,16,195
300 DATA12,143,31,165,33,135,15,210,37,16
    2,37,162,18,209,37,162,18,209
310 DATA 12,143,37,162,33,135,14,24,28,49
    ,28,49,18,209,28,49,14,24
320 DATA12,143,42,62,37,162,16,195,33,135
    ,33,135,21,31,33,135,16,195
330 REM SET VOICE NUMBERS,AND{2 SPACES}SP
    EED VALUE
340 K=54272:P=175:W=K+4
350 POKE54296,15
360 REM SET SELECTED{2 SPACES}MEASURE BY
    {SPACE}DATA NUMBER
370 DATA1,3,6,2,1,4,6,2,3,4,1,5,1,4,6,7,1
    ,4,6,2,1,3,6,9
380 DATA 1,1,4,5,1,4,6,2,3,4,1,5,1,4,1,5,
    1,4,6,9
390 DATA 1,4,6,2,3,6,1,5,1,4,6,7,3,4,6,2,
    1,4,3,7,1,4,6,9
400 DATA 1,4,3,7,1,6,4,5,6,3,6,2,4,6,1,5,
    1,4,6,9
410 DATA 1,4,3,7,6,3,6,2,4,6,1,5,1,3,6,7,
    3,6,1,5,1,4,6,9,8
420 READRR
425 ON RR GOTO520,426,550,560,427,590,428
    ,620,1000
426 Y=12:GOTO650
427 Y=14:GOTO650
428 Y=13:GOTO650
```

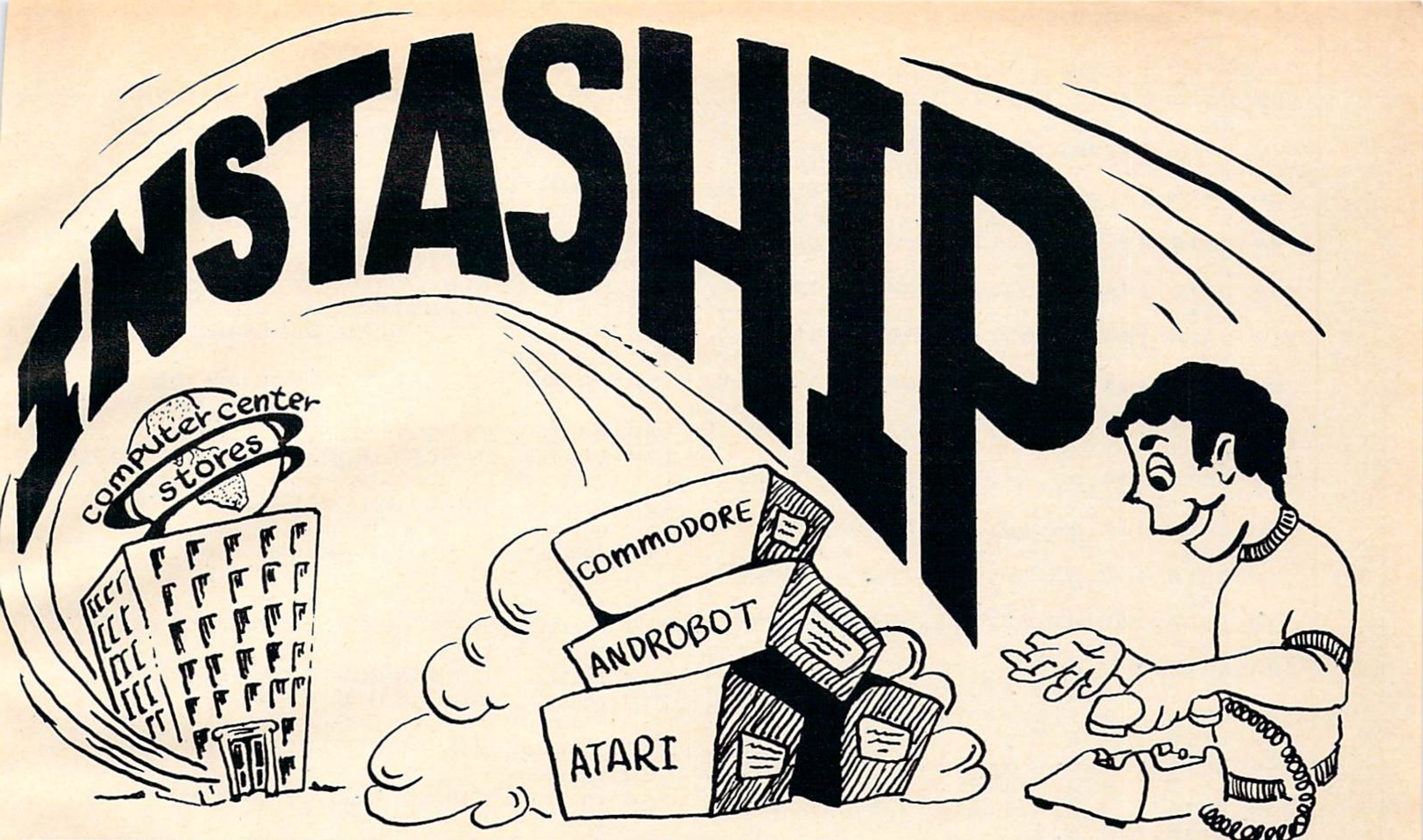


```
520 Y=1:X=RND(1):IFX<.35THENY=3
530 IFX>.75THENY=2
540 GOTO650
550 Y=10:IFRND(0)<.4THENY=11:GOTO650
560 Y=4:X=RND(1):IFX<.35THENY=5
570 IFX>.75THENY=6
580 GOTO650
590 Y=7:X=RND(1):IFX<.35THENY=8
600 IFX>.75THENY=9
610 GOTO650
620 PRINT"{CLR}{DOWN}{BLU}{2 SPACES}WELL,
    THAT'S ALL--HOPE YOU LIKED IT!!"
625 POKE53281,1
630 PRINT"{DOWN}RUN IT AGAIN--AND HEAR FI
    VE MORE SONGS!!":END
640 REM FOLLOWING ARE THE MUSIC MEASURES
    {SPACE}THAT VICLANG USES TO MAKETHE W
    HOLE TUNE
650 POKEW,17:POKEK,L(Y,1):POKEK+1,H(Y,1):
    POKEK+7,L(Y,2):POKEK+8,H(Y,2)
655 POKEW+7,17:FORQ=1TOP:NEXT:POKEW,16
660 POKEK,L(Y,3):POKEK+1,H(Y,3):FORT=1TOP
    :NEXT
670 POKEW,17:POKEK,L(Y,4):POKEK+1,H(Y,4):
    POKEK+7,L(Y,5):POKEK+8,H(Y,5)
675 POKEW+7,17:FORQ=1TOP:NEXT:POKEW,16
680 POKEK,L(Y,6):POKEK+1,H(Y,6):FORT=1TOP
    :NEXT
690 POKEW,17:POKEK,L(Y,7):POKEK+1,H(Y,7):
    POKEK+7,L(Y,8):POKEK+8,H(Y,8)
695 POKEW+7,17:FORQ=1TOP:NEXT:POKEW,16
700 POKEK,L(Y,9):POKEK+1,H(Y,9):FORT=1TOP
    :NEXT:GOTO370
1000 POKEK,143:POKEK+1,12:POKEK+7,165:POK
     EK+8,31:POKEK+14,30:POKEK+15,25
1010 POKEW,17:POKEW+7,17:POKEW+14,17:FORT
     =1TO2000:NEXT:POKEW,16:POKEW+7,16
1020 POKEW+14,16:GOTO370
```

Program 3: Atari Mozart

Translation by Gregg Peele, Assistant Programming Supervisor

```
3 GRAPHICS 18:POSITION 3,5:? #6;"cOMP
  UTEr mOZARt"
5 RESTORE :FOR T=1 TO 1000:NEXT T:GR
  APHICS 0:POKE 752,1:SETCOLOR 4,8,1
  0:SETCOLOR 1,12,2:SETCOLOR 2,13,14
10 DIM X(14,9)
20 REM SCREEN COLOR
25 POSITION 2,5
30 ? "Welcome! I am Wolfgang Atari M
   ozart.{DOWN}"
40 ? "I play songs like the child pr
   odigy,{DOWN}"
50 ? "Wolfgang A. Mozart might have
   done.{2 DOWN}"
60 ? "Mozart lived from 1756 to 1791
    and{DOWN}"
70 ? "wrote over 626 works in 31 yea
   rs.{DOWN}"
80 ? "the five pieces you are listen
   ing to{DOWN}"
90 ? "are being composed by the comp
   uter.{DOWN}"
120 REM CHANGE COLOR
130 FOR T=1 TO 14:FOR TT=1 TO 9:READ
     A:X(T,TT)=A:NEXT TT:NEXT T
140 DATA 40,64,64,128,64,53,108,64,1
    44
150 DATA 40,64,53,128,53,60,108,64,1
    08
```



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```
160 DATA 40,64,60,128,53,60,108,64,1
    Ø8
170 DATA 40,60,53,121,47,40,96,40,12
    1
180 DATA 40,60,47,121,47,53,96,60,12
    1
190 DATA 40,47,60,121,81,47,96,60,16
    2
200 DATA 144,60,53,121,40,53,108,60,
    144
210 DATA 144,72,53,144,60,64,108,72,
    121
220 DATA 144,47,40,121,64,53,108,64,
    144
230 DATA 144,60,64,121,72,64,96,60,1
    44
240 DATA 144,60,64,121,72,64,96,60,1
    14
250 DATA 162,64,60,128,53,53,108,53,
    108
260 DATA 162,53,60,144,72,72,108,72,
    144
270 DATA 162,47,53,121,60,60,96,60,1
    21
300 DATA 1,3,6,2,1,4,6,2,3,4,1,5,1,4
    ,6,7,1,4,6,2,1,3,6,9
310 DATA 1,1,4,5,1,4,6,2,3,4,1,5,1,4
    ,1,5,1,4,6,9
320 DATA 1,4,6,2,3,6,1,5,1,4,6,7,3,4
    ,6,2,1,4,3,7,1,4,6,9
330 DATA 1,4,3,7,1,6,4,5,6,3,6,2,4,6
    ,1,5,1,4,6,9
340 DATA 1,4,3,7,6,3,6,2,4,6,1,5,1,3
    ,6,7,3,6,1,5,1,4,6,9,8
350 P=75
400 READ RR
401 ON RR GOTO 500,420,521,525,430,5
    29,440,535,1500
420 Y=12:GOTO 1010
430 Y=14:GOTO 1010
440 Y=13:GOTO 1010
500 Y=1:X=RND(Ø):IF X<Ø.35 THEN Y=3
510 IF X>Ø.75 THEN Y=2
520 GOTO 1010
521 Y=10:IF RND(Ø)<Ø.4 THEN Y=11:GOT
    O 1010
525 Y=4:X=RND(Ø):IF X<Ø.35 THEN Y=5
527 IF X>Ø.75 THEN Y=6
528 GOTO 1010
529 Y=7:X=RND(Ø):IF X<Ø.35 THEN Y=8
533 IF X>Ø.75 THEN Y=9
534 GOTO 1010
535 GRAPHICS Ø:? "{CLEAR}{DOWN}Well,
     that's all--hope you liked it!!
    "
540 ? "Run it again--to hear 5 more
    songs!!":POKE 752,Ø:END
1010 SOUND Ø,X(Y,1),10,8:SOUND 1,X(Y
     ,2),10,8:FOR T=1 TO P:NEXT T
1020 SOUND Ø,Ø,Ø,Ø:SOUND 1,X(Y,3),10
     ,8:FOR T=1 TO P:NEXT T
1030 SOUND Ø,X(Y,4),10,8:SOUND 1,X(Y
     ,5),10,8:FOR T=1 TO P:NEXT T
1040 SOUND Ø,Ø,Ø,Ø:SOUND 1,X(Y,6),10
     ,8:FOR T=1 TO P:NEXT T
1050 SOUND Ø,X(Y,7),10,8:SOUND 1,X(Y
     ,8),10,8:FOR T=1 TO P:NEXT T
1060 SOUND Ø,Ø,Ø,Ø:SOUND 1,X(Y,9),10
     ,8:FOR T=1 TO P:NEXT T:GOTO 350
1500 SOUND Ø,40,10,8:SOUND 1,64,10,8
     :SOUND 2,81,10,8:FOR T=1 TO 600
     :NEXT T
1510 SOUND Ø,Ø,Ø,Ø:SOUND 1,Ø,Ø,Ø:SOU
     ND 2,Ø,Ø,Ø:FOR T=1 TO 1000:NEXT
      T
1520 GOTO 350
```

Program 4: TI Mozart

Translation by Gregg Peele, Assistant Programming Supervisor

```
100 DIM X(14,9)
110 REM  THE TICLANG AMAZIUS MOZART
120 CALL CLEAR
130 CALL SCREEN(14)
140 PRINT "{3 SPACES}WELCOME! I AM
    TICLANG"
150 PRINT "{6 SPACES}AMAZIUS MOZART
    ."
160 PRINT
170 PRINT "I PLAY SONGS LIKE THE CH
    ILD"
180 PRINT "PRODIGY, WOLFGANG  AMADE
    US "
190 PRINT "  MOZART MIGHT HAVE DONE
    ."
200 PRINT
210 PRINT "{5 SPACES}MOZART LIVED F
    ROM"
220 PRINT "{8 SPACES}1756 TO 1791"
230 PRINT "AND WROTE OVER 626 WORKS
     IN"
240 PRINT "{8 SPACES}31 YEARS."
250 PRINT
260 PRINT "THE 5 PIECES YOU HEAR AR
    E"
270 PRINT "{3 SPACES}BEING WRITTEN
    BY THE "
280 PRINT "  COMPUTER AS YOU LISTEN!"
290 PRINT
300 PRINT
310 PRINT
320 FOR T=1 TO 14
330 FOR TT=1 TO 9
340 READ X(T,TT)
350 NEXT TT
360 NEXT T
370 DATA 196,494,494,247,494,587,29
    4,494,220
380 DATA 196,494,587,247,587,523,29
    4,494,294
390 DATA 196,494,523,247,587,523,29
    4,494,294
400 DATA 196,523,587,262,659,784,33
    Ø,784,262
410 DATA 196,523,659,262,659,587,33
    Ø,523,262
420 DATA 196,659,523,262,392,659,33
    Ø,523,196
430 DATA 220,523,587,262,784,587,29
    4,523,220
440 DATA 220,440,587,220,523,494,29
    4,440,262
450 DATA 220,659,784,262,587,523,29
    4,494,220
460 DATA 220,523,494,262,440,494,33
    Ø,523,220
470 DATA 220,523,494,262,440,494,33
    Ø,523,262
480 DATA 196,494,523,247,587,587,29
    4,287,294
490 DATA 196,587,523,220,440,440,29
    4,440,220
500 DATA 196,659,587,262,523,523,33
    Ø,523,262
510 P=250
```

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```
520 DATA 1,3,6,2,1,4,6,2,3,4,1,5,1,
    4,6,7,1,4,6,2,1,3,6,9
530 DATA 1,1,4,5,1,4,6,2,3,4,1,5,1,
    4,1,5,1,4,6,9
540 DATA 1,4,6,2,3,6,1,5,1,4,6,7,3,
    4,6,2,1,4,3,7,1,4,6,9
550 DATA 1,4,3,7,1,6,4,5,6,3,6,2,4,
    6,1,5,1,4,6,9
560 DATA 1,4,3,7,6,3,6,2,4,6,1,5,1,
    3,6,7,3,6,1,5,1,4,6,9,8
570 READ RR
580 ON RR GOTO 650,590,730,780,610,
    860,640,940,1040
590 Y=12
600 GOTO 990
610 Y=14
620 GOTO 990
630 Y=13
640 GOTO 990
650 Y=1
660 RANDOMIZE
670 IF RND>.35 THEN 700
680 Y=3
690 RANDOMIZE
700 IF RND<.75 THEN 720
710 Y=2
720 GOTO 990
730 Y=10
740 RANDOMIZE
750 IF RND>.4 THEN 780
760 Y=11
770 GOTO 990
780 Y=4
790 RANDOMIZE
800 IF RND>.35 THEN 820
810 Y=5
820 RANDOMIZE
830 IF RND<.75 THEN 850
840 Y=6
850 GOTO 990
860 Y=7
870 RANDOMIZE
880 IF RND>.35 THEN 900
890 Y=8
900 RANDOMIZE
910 IF RND<.75 THEN 930
920 Y=9
930 GOTO 990
940 PRINT "{5 SPACES}WELL, THAT'S A
    LL"
950 PRINT "{4 SPACES}HOPE YOU LIKED
     IT!!"
960 PRINT "RUN IT AGAIN AND HEAR FI
    VE "
970 PRINT "{8 SPACES}MORE SONGS."
980 END
990 FOR I=1 TO 9 STEP 3
1000 CALL SOUND(P,X(Y,I),2,X(Y,I+1)
     ,2)
1010 CALL SOUND(P,X(Y,I),30,X(Y,I+2
     ),2)
1020 NEXT I
1030 GOTO 570
1040 CALL SOUND(1800,196,2,494,2,78
     4,2)
1050 FOR T=1 TO 800
1060 NEXT T
1070 KOL=INT(RND*8)+8
1080 CALL SCREEN(KOL)
1090 GOTO 570
```

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Hidden 64 Memory

Alan R. and Julie R. Krauss

BASIC programmers can POKE data into the Commodore 64's hidden RAM, but retrieving that data requires switching between blocks of RAM and ROM. The machine language program given here makes it easy to do what BASIC can't do directly—giving you an extra 20K.

The Commodore 64 contains 24 kilobytes of Random Access Memory (RAM) which cannot immediately be used by BASIC. However, that memory is accessible to the VIC-II chip, so it seems an ideal place to store a high-resolution (bit-mapped) screen (as well as other large arrays of data). The catch is that although it is possible to move data into this area using POKE statements, you can't retrieve all of it directly using BASIC. In this article we describe a technique which makes most of this large block of memory available to the BASIC programmer.

How To Get Five Quarts To A Gallon

The microprocessor in most smaller computers, including the Timex 1000, IBM PC, and DEC PDP-11, has 16 or fewer memory address lines. So these computers can address no more than 2^{16}—64K—bytes of memory directly. The more expensive machines *appear* to have a larger addressable memory because their memory-management circuitry and operating systems allow them to switch blocks of memory into and out of their actual address space. The inexpensive Commodore 64 has no special Memory Management Unit, yet it is able to address 20K of Read Only Memory (ROM) and numerous I/O chips plus 64K of RAM. This is like filling a one-gallon pitcher with five quarts of water. It works because the microprocessor can switch between various blocks of ROM and RAM even when they have the same addresses.

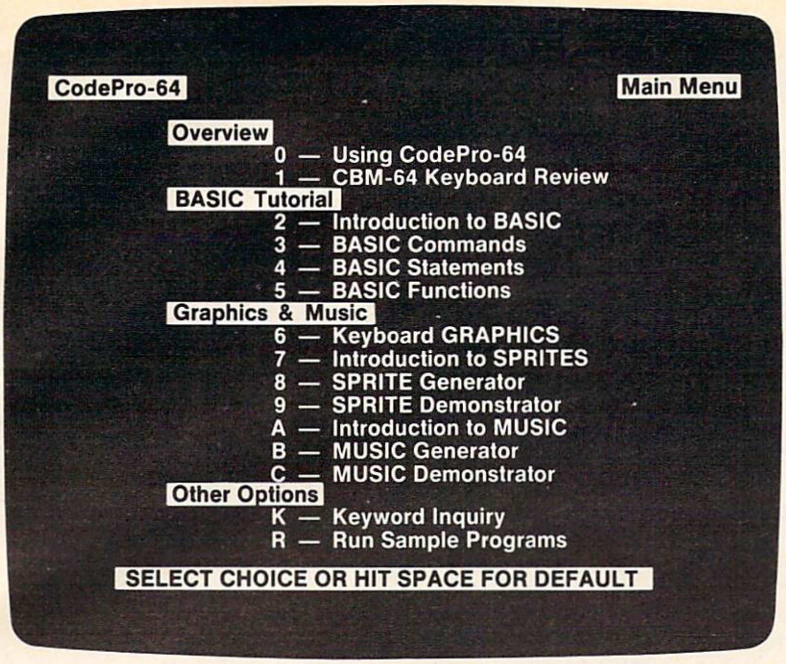
In its normal configuration, the first 2K of the 64's memory is used as a work area for the Operating System, and for screen memory. Of the remaining RAM, locations 2048 through 40959 are the programmer's BASIC area. The space above 40959 contains 4K of RAM (addresses 49152–53247) which is not contiguous with BASIC's dedicated area and can be accessed by BASIC only via PEEKs and POKEs; by the ROM BASIC interpreter (40960–49151); by the Kernal Operating System (57344–65535); and by the Input-Output (I/O) circuitry (53248–57343). However, there is another 20K of RAM which is similarly addressed; to be used, it must be switched in and out of the ROM-masked space. This chore is handled by registers at locations 0 and 1.

What The Pointers Mean

Although the extra RAM isn't directly available to BASIC, data may be stored there by using the POKE instruction. However, a PEEK of one of these locations will return the value stored at that address in ROM. In order to have access to the corresponding RAM, it is necessary to set a pointer so that the processor will ignore the ROM. Bits 0, 1, and 2 of location 1 are the pointers. Their functions are as follows:

Bit	Value	Meaning
0	1	Indicates normal BASIC ROM
	0	Indicates noncontiguous RAM (addresses 40960–49151)
1	1	Indicates Kernal ROM
	0	Indicates underlying RAM (addresses 57344–65535)
2	1	Indicates I/O chips
	0	Indicates ROM character tables (addresses 53248–57343)

If we wished to save a variable—call it A—at, say, address 45000, and later retrieve it, we might envision a routine like this:



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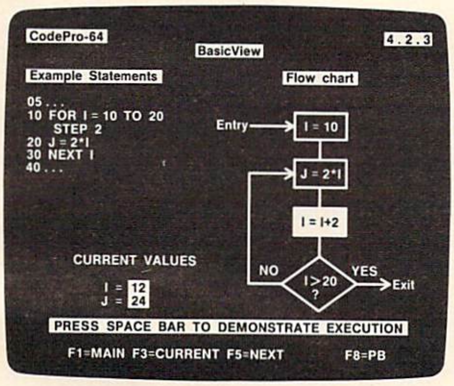

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CodePro-64's extensive tutorial guides you through each BASIC command, program statement, and function. You get clear explanations. Then you enter program statements as interactive examples. Where appropriate, you invoke BasicView to see examples execute and watch their flow charts and variables change.

By seeing graphic displays of program segment execution you learn by visual example. You **learn faster and grasp programming concepts easier** with CodePro-64 because you immediately see the results of your input.

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CodePro-64 **lets you follow your interests** and practice with interactive examples. But you can never get "lost". F1 will always return you to the main menu. Once you have practiced and mastered the BASIC language elements you move on to more advanced concepts. You learn about sprite and music programming.

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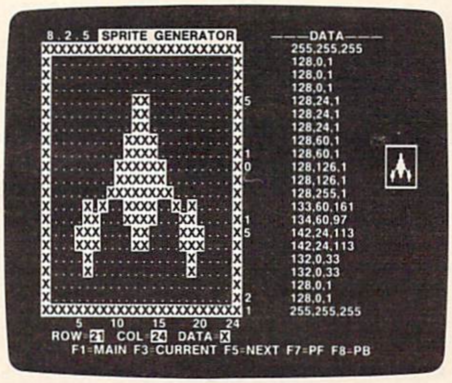

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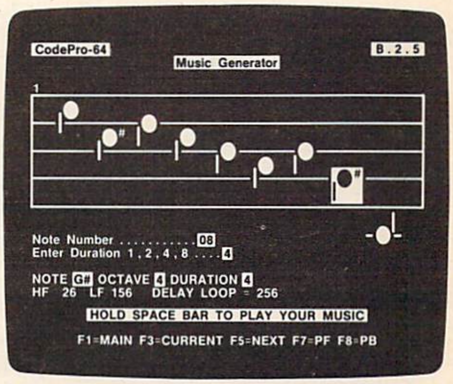

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```
10 POKE 45000,A :REM STORE THE VALUE
20 POKE 1,54 :REM SET POINTER TO RAM
30 A=PEEK(45000):REM GET THE VALUE
40 POKE 1,55 :REM RESTORE POINTER
50 END
```

This, though, amounts to sawing off the branch we're sitting on. The result is a lovely crash.

It's easy to see why. Line 20 tells the processor to look not at the BASIC interpreter in ROM, but somewhere else instead. So when line 30 calls for the BASIC PEEK instruction, it can't be found, and the system hangs. If we change the pointer for Kernal ROM or for I/O, we also crash.

Machine Language Makes It Easy

But the extra memory is too tantalizing to pass up. Since we can't get at it properly from BASIC, we'll try machine language (ML). We'll use a BASIC loader for the routine, as in Program 1.

It works! We can now store data in the formerly unavailable area of masked RAM. The ML routine, which is only 14 bytes long, sets the appropriate pointer (bit 0 in this example) to ignore the ROM (here, the BASIC interpreter). It then puts the byte of data into a location normally accessible to BASIC (since location 251 is in unused zero page space, we chose that) and resets the pointer. A disassembly of the machine language for this routine is shown in Program 2.

Let's take a look at Program 1. Lines 100–120, 340, and 350 are not really part of our routine—lines 100 and 110 give us some data to use in illustration, and line 340 prints the data that the ML routine saved for us, just to prove it really worked. The 4K of RAM beginning at location 49152 is unused, and since it is not contiguous with the BASIC area, it can't be overwritten by BASIC; so we've chosen to put our ML there. Line 130 sets location 49152 as the starting location for the machine language routine.

Lines 140, 160, 170, and 180 determine what value location 1 should contain, and put that value in BL. The numbers in the DATA statements (lines 190 and 200) are the bytes of ML (in decimal). Three of these are 0. The first (shown as 00 for prominence) will hold the block pointer, BL. The second and third, 000 and 0000, will hold the low-order and the high-order bytes, respectively, of the address of the target masked-RAM location.

Lines 210–240 POKE the ML into place. Line 250 inserts the value of the block pointer into byte 2 of the ML routine. Lines 260 and 270 calculate the high- and low-order bytes, respectively, of the target address; lines 280 and 290 POKE them into place. Line 300 disables interrupts so that the keyboard will not be scanned during execution of the machine language routine; this obviates the possibility of the system's hanging should the scan interrupt occur at the wrong moment.

The innocuous-looking line 310, the system call, signals the real action—here is where we branch out to perform our machine language routine. When the subroutine is finished, it returns control to BASIC. Now we can get our data whenever we need it: It has been left in location 251 for us.

Note that the ML could reside virtually anywhere—even in masked RAM. If it is placed within the normal BASIC area, of course, the appropriate BASIC pointers should be altered to protect it. From line 140 on, the routine is perfectly general and may be used to read the value stored at any RAM address within the range 0–65535, except for that lying beneath the I/O area (53248–57343). To see the underlying 4K of RAM in this area would require another technique, since there are three layers of memory here; our routine uncovers the second layer and lets us look at Character ROM directly. This could be useful in programs using custom-character routines, in order to restore portions of the ROM character table selectively.

Finally, we must note two things. First, this routine may be used to read memory locations in which either the BASIC program or the ML routine resides. However, we must not permit a POKE instruction (for example, line 120) to alter the program unless we specifically wish to do so. Also, if we POKE to a location in the I/O area, we may drastically alter our output.

Program 1: ML Access To Hidden RAM

```
100 A=3{15 SPACES}:REM{2 SPACES}PUT DESIR
    ED DATA BYTE IN VARIABLE "A"
110 AD=45000{10 SPACES}:REM{2 SPACES}WE'L
    L SAVE "A" AT LOC. 45000 (IN MASKED R
    AM)
120 POKE AD,A{9 SPACES}:REM{2 SPACES}SAVE
     "A"
130 MS=49152{10 SPACES}:REM{2 SPACES}MACH
    INE CODE WILL BE LOADED STARTING AT L
    OC. 49152
140 IF 40959<AD AND AD<49152 THEN BL=54:
    {SPACE}GO TO 190
145 REM{21 SPACES}LOCATION 1 WILL CONTAIN
     BLOCK POINTER, BL
150 REM{21 SPACES}BL = 54 -- BASIC INTERP
    RETER ROM OUT
160 IF 53247<AD AND AD<57344 THEN BL=51:
    {SPACE}GO TO 190
165 REM{21 SPACES}BL = 51 -- I/O ROUTINES
     OUT
170 IF 57343<AD AND AD<=65535 THEN BL=53:
     GO TO 190
175 REM{21 SPACES}BL = 53 -- KERNAL ROM O
    UT
180 BL = 55{11 SPACES}:REM{2 SPACES}WITHI
    N NORMAL BASIC AREA
190 DATA 162,00,134,1 :REM{2 SPACES}MACHI
    NE LANGUAGE ROUTINE
200 DATA 174,000,0000,134,251,162,55,134,
    1,96
210 FOR I=0 TO 13{5 SPACES}:REM{2 SPACES}
    LOOP FOR BASIC LOADER
```

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```
220 READ ML{11 SPACES}:REM{2 SPACES}GET N
    EXT BYTE OF M. L. ROUTINE
230 POKE (MS+I),ML{4 SPACES}:REM
    {2 SPACES}PUT M. L. BYTE INTO PLACE
240 NEXT
250 POKE(MS+1),BL{5 SPACES}:REM{2 SPACES}
    STORE BLOCK POINTER IN 2ND BYTE OF M.
     L. ROUTINE
260 HA=INT(AD/256){4 SPACES}:REM
    {2 SPACES}HIGH-ORDER BYTE OF MASKED-R
    AM ADDRESS
270 LA=AD-256*HA{6 SPACES}:REM{2 SPACES}L
    OW-ORDER{3 SPACES}"{3 SPACES}"
    {4 SPACES}"{5 SPACES}"{4 SPACES}"
280 POKE MS+5,LA{6 SPACES}:REM{2 SPACES}P
    UT ADDRESSES INTO M. L. ROUTINE
290 POKE MS+6,HA
300 POKE 56333,127{4 SPACES}:REM
    {2 SPACES}DISABLE INTERRUPTS
310 SYS(MS){11 SPACES}:REM{2 SPACES}EXECU
    TE M. L. ROUTINE
320 POKE 56333,129{4 SPACES}:REM
    {2 SPACES}RE-ENABLE INTERRUPTS
330 A=PEEK(251){7 SPACES}:REM{2 SPACES}RE
    AD THE DATA BYTE
340 PRINT A
350 END
```

Program 2: Disassembly Of ML Routine

```
LDX #$00   ;BLOCK POINTER TO X REGISTER
STX  $01   ;STORE IN LOCATION 1
LDX  $0000;CONTENTS OF MASKED RAM TO X-REGISTER
STX  $FB   ;STORE IN LOCATION 251 (DECIMAL)
LDX #$37   ;NORMAL VALUE OF POINTER (55 DECIMAL)
STX  $01   ;RESTORE NORMAL VALUE TO LOCATION 1
RTS        ;RETURN TO BASIC
```

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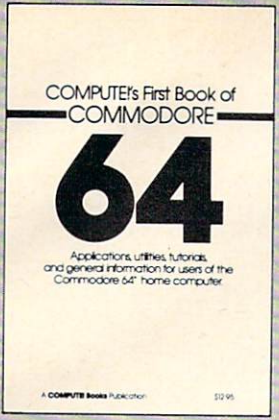

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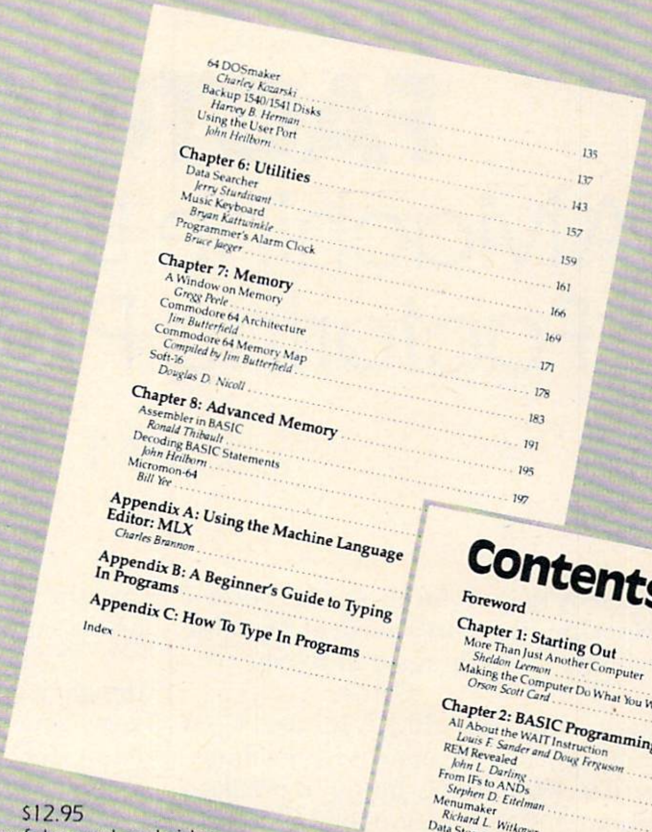

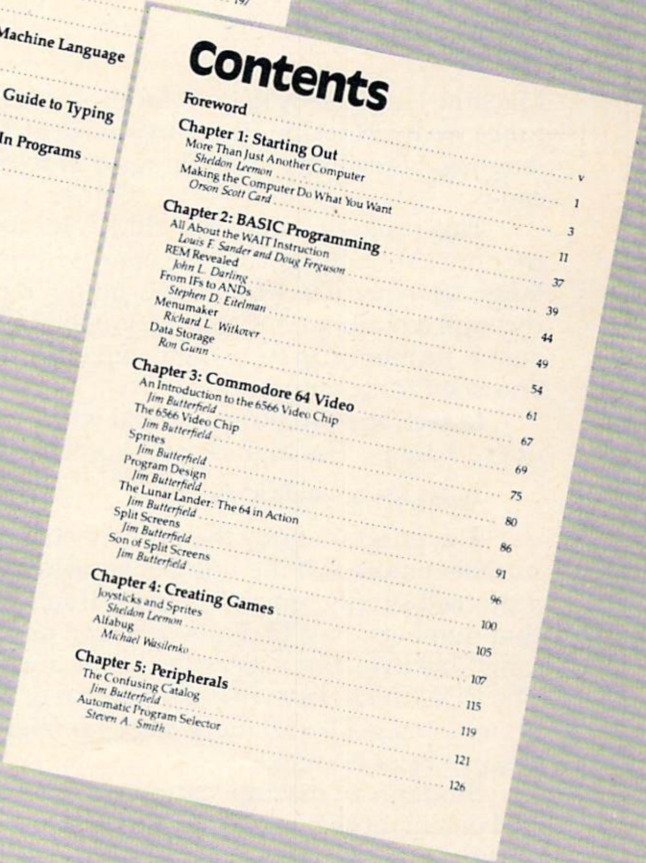

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FACTORS: A Machine Language Factoring Program

Part 1

Machine language is known for its speed. Sometimes we overlook another advantage of machine language: the ability to do things that BASIC can't.

This program—for PET/CBM, VIC, and Commodore 64—runs quickly because of its machine language structure. More importantly, it breaks through a boundary of conventional BASIC: It allows numbers up to 19 digits long to be entered and used for computation.

In fact, the program can deal with slightly over 19 digits. The highest number it will take is:

18,445,055,223,849,287,685

The program finds the prime factors of any number entered. If the number is prime, the program will simply repeat it. Users should know that numbers over 12 digits or so can take a very long time to factor, especially if they are prime. The RUN/STOP key will take you out of the program if you get bored (very large numbers could take up to 24 hours!).

Students of machine language will find several useful modules in the program: a numeric input, a numeric output, and a division subroutine. But you don't need to be a machine language buff to use it, of course.

You'll need a monitor to enter this program. Once it's safely saved on tape or disk, the monitor is no longer needed; it's there only to help you get the program in place. Any convenient monitor will do: the built-in monitor in PET/CBM models, Tinymon, Supermon, VICmon, HESmon, etc. VIC users may need to adjust slightly; many VIC monitors present memory locations five at a time, and the memory printout here gives them in groups of eight.

The method is generally a simple one of trial division. We divide by two, by three, by five, searching for an "exact" result (no remainder). After that, we use a cyclical method of generating divisors. For example, if we have established that a number will not divide by 3, there's no point in trying divisors of 9 or 15.

When numbers get big, there are more efficient methods of looking for factors, but they are not used in this simple program. Even if more advanced methods were used, very large numbers are hard to crack. There's no guaranteed way to factor a huge number within a reasonable amount of time.

Machine language nuts will easily be able to extend this program to allow more digits: 50, 100, or whatever. But for really large numbers, time catches up with you.

How To Enter "Factors"

For the PET/CBM, enter Program 1 using a machine language monitor. After it has been entered, set the BASIC pointers with:

```
.: 0028 01 04 6D 07 6D 07 6D 07
```

Then return to BASIC and save Factors to tape or disk like a normal BASIC program.

For the VIC-20 and Commodore 64, type in the following commands before entering Program 2.

```
POKE 4608,0:POKE 43,18:NEW
```

Now switch to any machine language monitor, and enter the program.


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Now enter the following memory changes:

.: 002B 01 12 6D 15 6D 15 6D 15

You may now return to BASIC and save the program to tape or disk. When you load this program at a later time, you won't need any special POKE commands; the program will adapt to any configuration.

To use either the VIC/64 or PET/CBM version of Factors, simply LOAD the program from tape or disk and give the usual BASIC RUN command.

Next month we'll disassemble the machine language for Factors to see how it works in more detail.

Program 1: Factors—PET/CBM Version

```
Ø4ØØ ØØ 24 Ø4 64 ØØ 99 22 5Ø
Ø4Ø8 52 49 4D 45 2Ø 46 41 43
Ø41Ø 54 4F 52 53 2Ø 4F 46 2Ø
Ø418 41 4E 2Ø 49 4E 54 45 47
Ø42Ø 45 52 22 ØØ 46 Ø4 6E ØØ
Ø428 99 22 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø
Ø43Ø 2Ø 2Ø 2Ø 2Ø 2Ø 4A 49 4D
Ø438 2Ø 42 55 54 54 45 52 46
Ø44Ø 49 45 4C 44 22 ØØ 65 Ø4
Ø448 78 ØØ 99 22 55 5Ø 2Ø 54
Ø45Ø 4F 2Ø 31 39 2Ø 44 49 47
Ø458 49 54 53 2Ø 4E 55 4D 42
Ø46Ø 45 52 53 22 ØØ 79 Ø4 82
Ø468 ØØ 99 22 4D 41 59 2Ø 42
Ø47Ø 45 2Ø 55 53 45 44 2Ø 2D
Ø478 ØØ 97 Ø4 8C ØØ 99 22 42
Ø48Ø 55 54 2Ø 56 45 52 59 2Ø
Ø488 4C 41 52 47 45 2Ø 4E 55
Ø49Ø 4D 42 45 52 53 22 ØØ B7
Ø498 Ø4 96 ØØ 99 22 4D 41 59
Ø4AØ 2Ø 54 41 4B 45 2Ø 41 2Ø
Ø4A8 56 45 52 59 2Ø 4C 4F 4E
Ø4BØ 47 2Ø 54 49 4D 45 ØØ CA
Ø4B8 Ø4 AØ ØØ 99 22 54 4F 2Ø
Ø4CØ 46 41 43 54 4F 52 2E 2E
Ø4C8 2E ØØ D5 Ø4 AA ØØ 9E 2Ø
Ø4DØ 31 32 38 3Ø ØØ ØØ ØØ 81
Ø4D8 ØØ ØØ ØØ ØØ 83 4Ø ØØ ØØ
Ø4EØ ØØ 81 ØØ ØØ ØØ ØØ 83 2Ø
Ø4E8 ØØ ØØ ØØ 83 2Ø ØØ ØØ ØØ
Ø4FØ 84 1Ø ØØ ØØ ØØ ØØ ØØ ØØ
Ø4F8 ØØ ØØ 83 6Ø ØØ ØØ ØØ 82
Ø5ØØ A9 ØD 2Ø D2 FF 2Ø BA Ø5
Ø5Ø8 A9 3D 8D 4A Ø3 A2 ØF A9
Ø51Ø ØØ 9D 5Ø Ø3 9D 58 Ø3 9D
Ø518 6Ø Ø3 CA 1Ø F4 2Ø E1 FF
Ø52Ø FØ 17 2Ø E4 FF C9 ØD FØ
Ø528 11 2Ø C4 Ø5 BØ Ø3 4C 1D
Ø53Ø Ø5 A9 3F 2Ø D2 FF 4C ØØ
Ø538 Ø5 6Ø A9 2Ø 2Ø D2 FF A9
Ø54Ø 14 2Ø D2 FF A2 Ø7 BD 5Ø
Ø548 Ø3 DØ Ø5 CA DØ F8 FØ E1
Ø55Ø A9 Ø2 2Ø 7A Ø6 9Ø 4B A9
Ø558 Ø3 2Ø 7A Ø6 9Ø 44 A9 Ø5
Ø56Ø 2Ø 7A Ø6 9Ø 3D A2 ØØ 8E
Ø568 4C Ø3 2Ø E1 FF FØ CA AC
Ø57Ø 4C Ø3 C8 CØ Ø8 9Ø 12 AØ
Ø578 ØØ 18 A9 1E A2 Ø3 7D 6Ø
Ø58Ø Ø3 9D 6Ø Ø3 A9 ØØ CA 1Ø
Ø588 F5 8C 4C Ø3 B9 65 Ø7 18
Ø59Ø A2 Ø3 7D 6Ø Ø3 9D 68 Ø3
Ø598 A9 ØØ CA 1Ø F5 2Ø 7D Ø6
Ø5AØ BØ C8 AE 57 Ø3 CA DØ ØC
Ø5A8 A2 Ø6 BD 5Ø Ø3 DØ Ø5 CA
Ø5BØ 1Ø F8 3Ø Ø3 2Ø B9 Ø6 4C
Ø5B8 ØØ Ø5 A9 23 2Ø D2 FF A9
Ø5CØ 9D 4C D2 FF C9 3Ø 9Ø 42
Ø5C8 C9 3A BØ 3D 2Ø D2 FF 29
Ø5DØ ØF A8 2Ø BA Ø5 2Ø ØB Ø6
Ø5D8 BØ 3Ø 2Ø ØB Ø6 BØ 2B A2
Ø5EØ Ø7 18 BD 5Ø Ø3 7D 58 Ø3
Ø5E8 9D 5Ø Ø3 CA 1Ø F4 BØ 1A
Ø5FØ 2Ø ØB Ø6 BØ 15 A2 Ø7 98
Ø5F8 18 7D 5Ø Ø3 9D 5Ø Ø3 9D
Ø6ØØ 58 Ø3 A9 ØØ CA 1Ø F2 BØ
Ø6Ø8 Ø1 18 6Ø A2 Ø7 18 3E 5Ø
Ø61Ø Ø3 CA 1Ø FA 6Ø A9 ØØ A2
Ø618 ØB 9D 6C Ø3 CA 1Ø FA A2
Ø62Ø ØØ AØ ØØ 8E 48 Ø3 BD 5Ø
Ø628 Ø3 DØ Ø6 E8 DØ F8 BD 5Ø
Ø63Ø Ø3 99 7Ø Ø3 E8 C8 EE 48
Ø638 Ø3 EØ Ø8 9Ø F1 ØE 48 Ø3
Ø64Ø ØE 48 Ø3 ØE 48 Ø3 18 A2
Ø648 ØB 3E 6C Ø3 CA 1Ø FA A2
Ø65Ø Ø3 38 BD 6C Ø3 FD 68 Ø3
Ø658 CA 1Ø F7 9Ø ØF A2 Ø3 38
Ø66Ø BD 6C Ø3 FD 68 Ø3 9D 6C
Ø668 Ø3 CA 1Ø F4 CE 48 Ø3 DØ
Ø67Ø D6 A2 Ø7 3E 7Ø Ø3 CA 1Ø
Ø678 FA 6Ø 8D 6B Ø3 A9 ØØ 8D
Ø68Ø 49 Ø3 2Ø 15 Ø6 A9 ØØ A2
Ø688 Ø3 1D 6C Ø3 CA 1Ø FA AA
Ø69Ø DØ 1Ø EE 49 Ø3 A2 Ø7 BD
Ø698 7Ø Ø3 9D 5Ø Ø3 CA 1Ø F7
Ø6AØ 3Ø EØ A2 Ø7 38 BD 7Ø Ø3
Ø6A8 FD 64 Ø3 CA 1Ø F7 Ø8 AE
Ø6BØ 49 Ø3 FØ Ø3 2Ø DØ Ø6 28
Ø6B8 6Ø AD 4A Ø3 2Ø D2 FF 2Ø
Ø6CØ Ø4 Ø7 A2 Ø7 BD 5Ø Ø3 9D
Ø6C8 7Ø Ø3 CA 1Ø F7 4C ØF Ø7
Ø6DØ AD 4A Ø3 2Ø D2 FF A9 2A
Ø6D8 8D 4A Ø3 2Ø Ø4 Ø7 A2 Ø3
Ø6EØ BD 68 Ø3 9D 74 Ø3 CA 1Ø
Ø6E8 F7 2Ø ØF Ø7 AE 49 Ø3 CA
Ø6FØ FØ 11 2Ø Ø4 Ø7 AE 49 Ø3
Ø6F8 8E 77 Ø3 A9 5E 2Ø D2 FF
Ø7ØØ 2Ø ØF Ø7 6Ø A2 Ø7 A9 ØØ
Ø7Ø8 9D 7Ø Ø3 CA 1Ø FA 6Ø A2
Ø71Ø Ø9 A9 ØØ 9D 78 Ø3 CA 1Ø
Ø718 FA AØ 3F A2 Ø7 18 3E 7Ø
Ø72Ø Ø3 CA 1Ø FA A2 Ø9 78 F8
Ø728 BD 78 Ø3 7D 78 Ø3 9D 78
Ø73Ø Ø3 CA 1Ø F4 D8 58 88 1Ø
Ø738 E2 A2 ØØ 8E 4B Ø3 BD 78
Ø74Ø Ø3 48 4A 4A 4A 4A 2Ø 55
Ø748 Ø7 68 29 ØF 2Ø 55 Ø7 E8
Ø75Ø EØ ØA 9Ø EA 6Ø DØ Ø6 CD
Ø758 4B Ø3 DØ Ø1 6Ø EE 4B Ø3
Ø76Ø Ø9 3Ø 4C D2 FF Ø1 Ø7 ØB
Ø768 ØD 11 13 17 1D AA AA AA
```

Program 2: Factors—VIC/64 Version

```
12ØØ ØØ 24 12 64 ØØ 99 22 5Ø
12Ø8 52 49 4D 45 2Ø 46 41 43
121Ø 54 4F 52 53 2Ø 4F 46 2Ø
1218 41 4E 2Ø 49 4E 54 45 47
122Ø 45 52 22 ØØ 44 12 6E ØØ
1228 99 22 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø
123Ø 2Ø 2Ø 2Ø 4A 49 4D 2Ø 42
```

```
1238 55 54 54 45 52 46 49 45
124Ø 4C 44 22 ØØ 5D 12 78 ØØ
1248 99 22 55 5Ø 2Ø 54 4F 2Ø
125Ø 31 39 2Ø 44 49 47 49 54
1258 53 2E 2E 22 ØØ 7D 12 82
126Ø ØØ 99 22 4C 41 52 47 45
1268 2Ø 4E 55 4D 42 45 52 53
127Ø 2Ø 54 41 4B 45 2Ø 54 49
1278 4D 45 21 22 ØØ 8C 12 8C
128Ø ØØ 97 39 3Ø 3Ø 2C C2 28
1288 34 36 29 ØØ 9A 12 96 ØØ
129Ø 97 2Ø 34 36 2C 32 31 3A
1298 9C ØØ BC 12 AØ ØØ 54 B2
12AØ 28 C2 28 39 3Ø 3Ø 29 AB
12A8 32 31 29 AC 32 35 36 3A
12BØ 8B 2Ø 54 B2 3Ø 2Ø 89 2Ø
12B8 32 3Ø 3Ø ØØ D5 12 AA ØØ
12CØ 81 2Ø 4A B2 35 34 38 34
12C8 2Ø A4 2Ø 34 38 36 34 2Ø
12DØ A9 2Ø AB 31 ØØ E8 12 B4
12D8 ØØ 97 2Ø 4A 2C C2 28 4A
12EØ AA 54 29 3A 82 2Ø 4A ØØ
12E8 F3 12 C8 ØØ 9E 2Ø 34 38
12FØ 36 34 ØØ ØØ ØØ AA AA AA
12F8 AA AA AA AA AA AA AA AA
13ØØ A9 ØD 2Ø D2 FF 2Ø BA 13
13Ø8 A9 3D 8D 4A Ø3 A2 ØF A9
131Ø ØØ 9D 5Ø Ø3 9D 58 Ø3 9D
1318 6Ø Ø3 CA 1Ø F4 2Ø E1 FF
132Ø FØ 17 2Ø E4 FF C9 ØD FØ
1328 11 2Ø C4 13 BØ Ø3 4C 1D
133Ø 13 A9 3F 2Ø D2 FF 4C ØØ
1338 13 6Ø A9 2Ø 2Ø D2 FF A9
134Ø 14 2Ø D2 FF A2 Ø7 BD 5Ø
```


```
1348 Ø3 DØ Ø5 CA DØ F8 FØ E1
135Ø A9 Ø2 2Ø 7A 14 9Ø 4B A9
1358 Ø3 2Ø 7A 14 9Ø 44 A9 Ø5
136Ø 2Ø 7A 14 9Ø 3D A2 ØØ 8E
1368 4C Ø3 2Ø E1 FF FØ CA AC
137Ø 4C Ø3 C8 CØ Ø8 9Ø 12 AØ
1378 ØØ 18 A9 1E A2 Ø3 7D 6Ø
138Ø Ø3 9D 6Ø Ø3 A9 ØØ CA 1Ø
1388 F5 8C 4C Ø3 B9 65 15 18
139Ø A2 Ø3 7D 6Ø Ø3 9D 68 Ø3
1398 A9 ØØ CA 1Ø F5 2Ø 7D 14
13AØ BØ C8 AE 57 Ø3 CA DØ ØC
13A8 A2 Ø6 BD 5Ø Ø3 DØ Ø5 CA
13BØ 1Ø F8 3Ø Ø3 2Ø B9 14 4C
13B8 ØØ 13 A9 23 2Ø D2 FF A9
13CØ 9D 4C D2 FF C9 3Ø 9Ø 42
13C8 C9 3A BØ 3D 2Ø D2 FF 29
13DØ ØF A8 2Ø BA 13 2Ø ØB 14
13D8 BØ 3Ø 2Ø ØB 14 BØ 2B A2
13EØ Ø7 18 BD 5Ø Ø3 7D 58 Ø3
13E8 9D 5Ø Ø3 CA 1Ø F4 BØ 1A
13FØ 2Ø ØB 14 BØ 15 A2 Ø7 98
13F8 18 7D 5Ø Ø3 9D 5Ø Ø3 9D
14ØØ 58 Ø3 A9 ØØ CA 1Ø F2 BØ
14Ø8 Ø1 18 6Ø A2 Ø7 18 3E 5Ø
141Ø Ø3 CA 1Ø FA 6Ø A9 ØØ A2
1418 ØB 9D 6C Ø3 CA 1Ø FA A2
142Ø ØØ AØ ØØ 8E 48 Ø3 BD 5Ø
1428 Ø3 DØ Ø6 E8 DØ F8 BD 5Ø
143Ø Ø3 99 7Ø Ø3 E8 C8 EE 48
1438 Ø3 EØ Ø8 9Ø F1 ØE 48 Ø3
144Ø ØE 48 Ø3 ØE 48 Ø3 18 A2
1448 ØB 3E 6C Ø3 CA 1Ø FA A2
145Ø Ø3 38 BD 6C Ø3 FD 68 Ø3
1458 CA 1Ø F7 9Ø ØF A2 Ø3 38
146Ø BD 6C Ø3 FD 68 Ø3 9D 6C
1468 Ø3 CA 1Ø F4 CE 48 Ø3 DØ
147Ø D6 A2 Ø7 3E 7Ø Ø3 CA 1Ø
1478 FA 6Ø 8D 6B Ø3 A9 ØØ 8D
148Ø 49 Ø3 2Ø 15 14 A9 ØØ A2
1488 Ø3 1D 6C Ø3 CA 1Ø FA AA
149Ø DØ 1Ø EE 49 Ø3 A2 Ø7 BD
1498 7Ø Ø3 9D 5Ø Ø3 CA 1Ø F7
14AØ 3Ø EØ A2 Ø7 38 BD 7Ø Ø3
14A8 FD 64 Ø3 CA 1Ø F7 Ø8 AE
14BØ 49 Ø3 FØ Ø3 2Ø DØ 14 28
14B8 6Ø AD 4A Ø3 2Ø D2 FF 2Ø
14CØ Ø4 15 A2 Ø7 BD 5Ø Ø3 9D
14C8 7Ø Ø3 CA 1Ø F7 4C ØF 15
14DØ AD 4A Ø3 2Ø D2 FF A9 2A
14D8 8D 4A Ø3 2Ø Ø4 15 A2 Ø3
14EØ BD 68 Ø3 9D 74 Ø3 CA 1Ø
14E8 F7 2Ø ØF 15 AE 49 Ø3 CA
14FØ FØ 11 2Ø Ø4 15 AE 49 Ø3
14F8 8E 77 Ø3 A9 5E 2Ø D2 FF
15ØØ 2Ø ØF 15 6Ø A2 Ø7 A9 ØØ
15Ø8 9D 7Ø Ø3 CA 1Ø FA 6Ø A2
151Ø Ø9 A9 ØØ 9D 78 Ø3 CA 1Ø
1518 FA AØ 3F A2 Ø7 18 3E 7Ø
152Ø Ø3 CA 1Ø FA A2 Ø9 78 F8
1528 BD 78 Ø3 7D 78 Ø3 9D 78
153Ø Ø3 CA 1Ø F4 D8 58 88 1Ø
1538 E2 A2 ØØ 8E 4B Ø3 BD 78
154Ø Ø3 48 4A 4A 4A 4A 2Ø 55
1548 15 68 29 ØF 2Ø 55 15 E8
155Ø EØ ØA 9Ø EA 6Ø DØ Ø6 CD
1558 4B Ø3 DØ Ø1 6Ø EE 4B Ø3
156Ø Ø9 3Ø 4C D2 FF Ø1 Ø7 ØB
1568 ØD 11 13 17 1D AA AA AA
```

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INSIGHT: Atari

Bill Wilkinson

Well, it's the new year and, even though I am writing this months before New Year's Eve, I'm going to make at least one resolution right now: I hereby resolve to write the articles which I have promised. (Except, of course, if I...naw, that's not fair. I'll even try to avoid those exceptions.)

So, in the spirit of that resolution, I'm going to deliver the fourth part of my series on writing self-relocatable machine language right now. This month. Immediately. After I feed you some tidbits first.

Keep Those Cards And Brickbats Coming

Recently, I have received several letters ("several" means more than four—I am seldom exactly deluged with mail) which all bear on one or two topics. Since there appears to be some interest in these two areas, I would like to touch on them this month. Normally, I acknowledge my readers by name when I answer letters. This time, however, several asked the same questions, and I am hesitant to single out any one letter. If you recognize, in this column, a response to a letter you wrote me, I offer my thanks for the ideas you have given me.

Machine Language

The questions about this topic ranged all the way from "How about a section for machine language beginners?" to "Are you planning any more about graphics from machine language?"

To begin, let me say that I do not intend to teach a tutorial machine language class through this column. A good tutorial would take about 200 magazine pages, minimum. That's about what COMPUTE! allots me for two years' writing. By the time the series were finished, I would hope that you would have been experienced programmers for over a year!

On the other hand, I will try to take the spirit of the questions to heart and include a little more material for those who are just beginning to learn machine language. (Unfortunately, that does not include this month's article, but I feel committed to finishing the series.)

Several of you have asked me if I will write on how to do I/O and graphics from machine language. Unfortunately, I have already written a lot about these subjects (primarily from November 1981 to February 1982, but with many additions through the summer of 1982).

Alas, there is no beginner-level book which treats these subjects. Most of what I discussed in my articles is thoroughly explored in Atari's Technical Notes and Operating System documentation or *De Re Atari*, but you need to be well-versed in 6502 machine language before tackling either.

Probably the most popular books about the 6502 are those by Rodnay Zaks. My personal opinion is that they are good, but not great books. So, *after* you have digested Richard Mansfield's *Machine Language for Beginners* (COMPUTE! Books), you probably should be very careful about what book you pick up from your dealer's shelves. Pick one which appears appropriate to your level. But keep watching: More books are on their way.

The 1050 Disk Drive And DOS 3

I had promised that I would say no more on these topics, since there is obviously something of a conflict of interest for me here. (Atari hasn't bought our DOS XL, but some of the other disk drive manufacturers have.) But I have received several cogent questions and comments, and I will try to answer them as honestly as possible.

First, I heard from a couple of people that the 1050 drive does *not* support 32 sectors per track in its pseudo-double-density mode. The claim is that it only supports 26 sectors per track, a substantial reduction in capacity. Since I don't have a 1050 drive or the final version of DOS 3, I cannot directly verify or dispute this claim. (Is it possible that this claim is a result of an opinion which I myself expressed to a users group last spring?) I can only reiterate that it was an examination of a preliminary copy of DOS 3 which resulted in my comments.

The other letters I received either chided me for not giving more details on DOS 3 or simply asked whether it would work with...well, almost anything (Atari 810 drives, RAMDISKs, Mosaic boards, etc.). First, let me state that I have not been able to exhaustively test DOS 3. The preliminary version works on an Atari 800 with an 810 drive. Beyond that, I cannot say.

DOS 3 achieves its random access file capability by segmenting the disk into 128 blocks of 1K each. Obviously, with so few blocks, one can keep a pointer to each block in memory at all times. In fact, the VTOC (which is a bitmap on DOS 2) is also the file block map (which doesn't exist on DOS 2, hence no random files), all nicely packed into only 128 bytes of your computer's memory per drive.

And that is beginning to get more technical than I meant to get in this section, but let me close by noting that expanding this scheme to a 5 megabyte drive would imply either 40,000 bytes per block on the disk (and remember, a block is the smallest possible file size) or 10,000 bytes of VTOC and file map per drive in your main memory (in order to maintain the 1K block size). And that is why I said in my previous articles that DOS 3 does not expand well.

Anyway, I found it surprising that Atari would introduce the double-sided drives of the 1450XLD with DOS 3. But maybe I'm going to be surprised again.

A Tidbit

Once again, I am indebted to Steve Lawrow, the author of our MAC/65 assembler for telling me of another discovery about Atari BASIC which I shall share with you.

I have been traveling around demonstrating our new BASIC XL to various user groups; and, quite naturally, I have found several quick and easy programs which show off the language. One of my favorites is the following little gem:

```
1 REM
2 REM
3 REM
...
99 REM
100 POKE 20,0
101 IF I<200 THEN I=I+1 : GOTO 101
102 PRINT PEEK(20)
```

The object of this little gem is to get a bunch of do-nothing lines (in fact, 99 REMarks) in a program and then see how much they slow down the loop in line 101. Location 20 is the 1/60 second clock tick (1/50 second in countries using 50Hz power systems), so the result of lines 100 and 102 is to print out the elapsed time in clock ticks.

Well, I usually run this programette in Atari BASIC first, Atari Microsoft BASIC second, BASIC XL in slow mode third, and BASIC XL in FAST mode last. (See the chart for timings.)

Steve mentioned to me, though, that the timings of Atari BASIC (and slow-mode BASIC XL) were dependent on the line numbers chosen. Skeptically, I renumbered the program to look like this:

```
1 REM
2 REM
3 REM
...
99 REM
4000 POKE 20,0
5000 IF I<200 THEN I=I+1 : GOTO 5000
6000 PRINT PEEK(20)
```

Sure enough, all the BASICs (except, naturally, BASIC XL in FAST mode) speeded up a little (again, see the chart). Why?

I know the answer for Atari BASIC and BASIC XL, and I suspect it is the same answer for Microsoft BASIC. When these BASICs need to make a line number search, they place the line number being searched for in a particular memory location. Then they search through the program, a line at a time, looking for a match on the numbers. As they search, though, they always check the high bytes of the line numbers first. If the high bytes do not match, they don't bother to check the low bytes.

In our first example, since all the line numbers were less than 256, all the high bytes were the same, so the search took slightly longer. In the second example, though, the GOTO statement caused a search for line number 5000, whose high byte is *never* the same as those of any of the other lines. Bingo, fast search speed.

What does this mean? When writing in BASIC, it might be a good idea to modify the old traditional line-numbering-by-10. Purposely break your program up into sections so that the target lines of GOTOs and GOSUBs all differ by at least about 300, and you will help BASIC do its searching a bit faster. (And even though BASIC XL in FAST mode is not affected by these foibles when working with absolute line numbers, even it will be helped when in slow mode or when you use variable names or expressions as GOTO/GOSUB targets.)

And, incidentally, you might remember that the Microsoft version of this program must be typed exactly as shown to get these timings. Using longer variable names, more spaces in a line, more variable names, etc., will significantly slow down Microsoft BASIC. Often to the point where it is slower than Atari BASIC.

Anyway, here is the chart of timings. The Microsoft BASIC Integer version timings were obtained by appending a % to all variable and constant usage in lines 101 and 5000. Try some timings like this yourself. You'll be amazed.

Timings For The 99 REM Benchmark

	Atari BASIC	Microsoft Fltg Pt.	Microsoft Integer	BASIC XL Slow	BASIC XL Fast
GOTO 101	178	169	155	125	35
GOTO 5000	162	160	145	110	35

Self-Relocatable Machine Language, Part 4 (At Last)

Since it has been three months since Part 3 of this sort-of series appeared (COMPUTE!, September 1983), let me briefly summarize why self-relocatable machine language (ML) is desirable:

1. If all your ML is self-relocatable, you can load as many (or as few) modules as desired without worrying about where to put them in memory.
2. If you are using ML within Atari BASIC strings, remember that the strings can be moved by BASIC, so the ML virtually *has* to be self-relocatable.
3. Various pieces of systems software (for example, Atari BASIC, Pascal, Microsoft BASIC, some compilers) insist on using certain portions of memory. Since the pieces they insist on are not consistently the same, it is an advantage to be able to load your ML (especially device drivers, utilities, etc.) wherever the systems software leaves you a hole.

Also, let me summarize some of the rules for "Safe Relocatable Techniques," as presented in September:

1. Change JMPs to branches.
2. Save register values in the stack, not in fixed memory.
3. From BASIC, pass the address of a string as a location (or series of locations) to load from or store to. Note that Part 3 discussed how the ML string itself could be used for this purpose.
4. Move ML from relocatable memory to fixed memory temporarily.
5. Avoid load, store, and transfer instructions which refer to locations within your own module.

Finally, let me remind you that I promised to tell you how to utilize more than 255 bytes of relocatable storage and how to generate pointers to such storage without the "benefit" of help from a calling BASIC program. I shall attempt to fulfill my promise.

The techniques I will discuss here require a very small segment of nonrelocatable ML as well as one or (better) several zero page pointers. If you are in really dire straits, you can make do with temporary locations for both those requirements, but if possible you should find a way to preserve the required memory exclusively for your routine. In fact, the rest of this discussion assumes that you *have* managed to preserve the locations.

First Requirement: Find Yourself

You must have a subroutine, located at a fixed location, which looks like this:

```
BASE    =    $CE
        *=   $680
FINDME
        PLA
        STA  BASE+1
        PLA
        STA  BASE
        PHA
        LDA  BASE+1
        PHA
        RTS
```

Note that I have placed this routine in the infamous Page 6 and have used a fixed zero page location. These choices are for convenience, for illustration. Feel free to make your own choice of locations.

And just what does this routine *do*? How does it work? Quite simply, it finds the address of the program which called it. More precisely, it finds the address of the last byte of the three-byte JSR instruction with which a relocatable program calls it. An illustration of the calling program will help:

```
         *=    ????
START
         JSR   FINDME
BASEPT1  =     *-1
         ...
         LDY   #DATABYTE-BASEPT1
         LDA   (BASE),Y
         ...
DATABYTE .BYTE 99
```

Do you follow this? When FINDME is called via the JSR, it places the address of BASEPT1 into the zero page location called BASE. Then the Y register is loaded with the offset from BASEPT1 to DATABYTE and used an index for the LDA instruction. (This is similar to the technique discussed in Part 3, but it could only be used from BASIC USR calls.)

The limitation of this technique is that the data location (for example, DATABYTE above) must be located no more than 255 bytes away from the JSR (for example, BASEPT1). If you are writing a package of several small routines, this may not prove to be a limitation. After all, each routine could call FINDME if needed, and each routine could thus have its own storage areas, located no more than 255 bytes from the respective call to FINDME. If you are writing a subroutine library or a device driver, this might prove to be a very worthwhile option.

Note the side "benefit" to the scheme: If you call FINDME each time you enter a routine, then BASE may prove to be a really very temporary location and can be shared with other routines.

So far, so good. But suppose that you really do need a large data area or program, all self-relocatable. Well, then, your program might have to do this:

```
          *=     ????
DATABASE  =      $CC

START
          JSR    FINDME
BASEPT1   =      *-1
OFFSET1   =      DATABYTES-BASEPT1
          ...
          CLC
          LDA    BASE
          ADC    #OFFSET1&255
          STA    DATABASE
          LDA    BASE+1
          ADC    #OFFSET1/256
          STA    DATABASE+1
          ...
          LDY    <some offset in DATABYTES>
          LDA    (DATABASE),Y
          ...
DATABYTES .BYTE  1,2,3,4,5,6,7,8,9,10
```

Even more confused? You have a right to be. Here, we actually develop the base address of a data area and place it in a new zero page location. Now we can access the data area from anywhere in our self-relocatable ML by simply placing an offset within that data area into the Y register. Again, this limits the size of access to 256 bytes (the range of values the Y register can take on), but now the program can be as large as desired.

Finally, what happens if you actually do have a data area larger than 256 bytes? There are several possible solutions, none of them easy. If no "array" within the data area is larger than 256 bytes, you could simply develop several zero page pointers—one for each group of 256 bytes or less—using the ADC #OFFSET technique presented above.

If you have a single array or table which is larger than 256 bytes, the chances are that you have already developed some method of addressing into it (since the 6502 limits you to index sizes of 0 through 255, unless you play with indirect-Y addressing and calculated zero page pointer values). You need only use the contents of DATABASE, as generated above, in place of an absolute address for the start of the array or table, and your address calculations will be similar or even identical.

If you are lost at this point, don't worry. Much of what I just said will suddenly be meaningful as you write more and more advanced machine language programs. Just keep this article for handy reference.

Second Requirement: Calling Yourself

Suppose you want to call subroutines within your self-relocatable ML. How do you do it?

Of course, if the subroutine is at a fixed location (in ROM somewhere), you need do nothing special. The JSR instruction insists on an absolute address, and you simply supply one. But what happens if the routine you want to call is itself part of the self-relocatable ML?

Advice: Avoid doing what I am about to describe if you possibly can. However, if you need to write ML which *must* use these techniques, read on.

First, you could simply write some self-modifying ML. An example:

```
START
          JSR    FINDME
BASEPT    =      *-1
ROUTINE1  =      ROUTINE-BASEPT
CALL1     =      CALL+1-BASEPT
          ...
          LDY    #CALL1
          CLC
          LDA    BASE
          ADC    #SUB1&255
          STA    (BASE),Y
          INY
          LDA    BASE+1
          ADC    #SUB1/256
          STA    (BASE),Y
          ...
CALL      JSR    0 ; ADDRESS WILL BE GENERATED
          ...
          ...
ROUTINE
          ...
          RTS
```

Simply, did he say? Well, it's not as bad as it looks. After all, if we could generate the address of a table and place it in zero page, why can't we place a subroutine's address directly into our ML? Of course, we must do the placing indirectly, since even the address of the JSR instruction is self-relocatable. Did you note that CALL1 is an offset to the first address byte in the instruction? It wouldn't do to modify the instruction byte!

Another way of doing JSRs like this might be to place yet another small routine in nonrelocatable memory. You could (1) load the A and X registers with the offset to the desired subroutine, then (2) JSR to the nonrelocatable routine which would calculate the actual address you desired, and (3) JMP to that location. When the subroutine returned, execution would continue at the instruction after your JSR. ©

Larry Isaacs

Printing Graphics

I've been receiving a number of letters asking for more information about printers and printer interfaces. Possibly last month's article helped some. Several people asked about graphics.

Most printers implement their graphics capabilities differently. Fortunately, there are enough similarities so that they can be discussed as a class, somewhat generally. I have used the graphics on a number of different printers, so I will try to share what experience I have accumulated. You should be able to apply this information to your own printer.

Dot-Matrix Characters

Before getting into the graphics, let's take a quick look at how a printer forms its dot-matrix characters. The characters are placed on paper by the printhead, which travels horizontally back and forth across the paper. This printhead contains a number of print needles. These needles can be pushed out to strike the printer ribbon against the paper to form a dot. Most dot-matrix printers have eight to ten needles, though there are some with more. Usually the needles are arranged in a straight vertical line. Those with more needles will typically arrange the needles in two rows which are offset vertically:

```
0
 0
0
 0
0
 0
0
 0
```

Since the vertical spacing between the needles is very small, the dots resulting from the dual-row printhead will actually overlap. The advantage of the dual-row printhead is that better, more fully formed characters can be printed. However, this advantage may not serve graphics. It depends on the printer.

Printing is accomplished as the printhead traverses the paper. At certain intervals, a set of print needles are "fired," printing a group of vertical dots on the paper. Characters are formed by printing these vertical dots in a pattern appropriate for the character. So, during normal printing, each byte or character sent to the printer will result in the printing of a number of vertical groups of dots. Typically, enabling the graphics feature of the printer means that each byte or character sent to the printer will print only one vertical group of dots. The dots in the group are specified, of course, by the character which was sent. In the remainder of this article, I will use the term "graphics character" to refer to characters sent to the printer while the printer's graphics mode is enabled. As you will see, while in graphics mode, you have control over each dot that is printed.

Since each byte sent to the printer contains eight bits, up to eight dots can be controlled by each graphics character. In all printers that I've seen, a bit which is a one will cause the corresponding dot to be printed. Bits which are zero indicate that no dot should be printed. Most printers print eight dots per graphics character, but there are some which print six or seven. A printer which prints eight dots per graphics character will work out best for use with the 64 since eight dots is also the height of a character cell on the display.

Now let's start looking at what it takes to print graphics. First, we'll restrict ourselves to printing graphics on a single line. Afterwards we can go over how to visualize printing a graphics image which is more than one line high.

Entering The Graphics Mode

The first step in trying to print graphics is to determine how to enter and exit the graphics printing mode. In general, two methods are used to accomplish this. The first method sends the printer an "escape sequence" which includes the number of graphics characters that are intended to be sent. With this method, the only way to exit the graphics mode is to send the specified number of characters, at which point the printer automatically exits the graphics mode. The second method uses one escape sequence to enter the graphics mode, and another to exit graphics mode. This method implies that there will be some way to distinguish the escape sequences from the graphics characters. For printers which print eight dots per graphics character, all I've seen, including my NEC-8023, use the first method. (Escape is a "key," like the SHIFT key, which alerts a machine that the following number is special. ESC is the number 27. So, 27 24 could mean italics mode to a printer. Consult your printer's manual for the correct escape sequences to activate special modes.)

The escape sequence to put my NEC-8023 into graphics mode is

ESC,S,"nnnn"

and "nnnn" is a four-digit string giving the number of graphics characters that will be sent. To illustrate how this is output to the printer, here is a subroutine to output the proper escape sequence for N graphics characters to channel 4:

```
N$=STR$(N)
N$=RIGHT$(N$,LEN(N$)-1):REM DROP SPACE
N$=LEFT$("ØØØØ",4-LEN(N$))+N$
PRINT#4,CHR$(27);"S";N$;
RETURN
```

The second line of the routine is needed to remove the leading space from STR$(N). The third line places the required number of leading zeros to N$.

Preparing Graphics Characters

Once you know how to enter and exit the graphics mode, the next step is to determine how the graphics characters need to be prepared. The first consideration is which bit in the graphics character controls which dot. On some printers, the least significant bit controls the uppermost dot, and on others it controls the lowest dot. I've seen both used many times, so you will have to check your printer manual to determine which applies to you.

A second consideration for preparing the graphics characters is how the dots of the graphics image are activated. Usually a graphics image is accessed a byte at a time, just as it is printed a byte at a time.

You must first obtain some bytes from the graphics image which are displayed vertically. The number of bytes to fetch is the same as the number of dots printed per graphics character. Since my NEC prints eight dots per graphics character, I will need to fetch eight bytes. Once these bytes have been obtained, the next step is to begin removing a single bit from each of these bytes and combining the bits to form a graphics character. Eight graphics characters may be formed from the bytes fetched from the graphics image.

An important consideration at this point is which bit of the graphics image byte represents the leftmost dot. In every computer I've encountered, the most "significant" bit is displayed on the left. This means the bits should be extracted from our graphics image bytes starting with the most significant bit (that is, bit 7) first. We can extract bit 7 of a byte by ANDing it with 128. This will leave us a byte with bit 7 the same as the original byte, but all other bits set to zero. By shifting the remaining bits in the graphics image byte toward bit 7, we can extract each bit of the byte in sequence. To shift the bits toward bit 7, we simply multiply by 2.

Since any bit we extract is bit 7, it would be easier if we put it into the graphics character at bit 7 also. This can be done by ORing the extracted bit with the graphics character. Successive bits can be put into the graphics character by shifting the bits in the graphics character toward the least significant bit (bit 0) then ORing in the next bit. Shifting the bits toward bit 0 is accomplished by dividing by 2.

By using this procedure, we establish that the first bits placed in the graphics character will end up at the least significant bit positions. Now we need to determine if these first bits should be the top dots or the bottom dots. On my NEC, the least significant bits should be the top dots. To illustrate the process, here is a short subroutine that would accomplish the rearrangement for the NEC. It assumes that the eight bytes from the graphics image are contained in the array SA( ), with SA(0) containing the top dots. The resulting graphics characters will be output to channel 4.

```
FOR J=1 TO 8:GC=Ø:REM DO 8 GR. CHARS
FOR I=Ø TO 7:REM 8 DOTS PER GR. CHAR
GC=GC/2 OR (SA(I) AND 128)
SA(I)=SA(I)*2
NEXT I: PRINT#4,CHR$(GC);: NEXT J
RETURN
```

If you need the least significant bits of the graphics characters to be the bottom dots, just place the bytes in the SA( ) array so that SA(0) contains the bottom dots. If you are using a printer interface, you must also make sure that the interface is in a mode where it will not do any character translations, such as most do for color control codes, etc. On my printer interface, secondary address 4 or 5 is specified for graphics printing, with 4 including auto linefeed. Thus I might use OPEN 4,4,4 or OPEN 4,4,5 to open a channel to the printer.

Printing Graphics

If you wanted to print a line of graphics, the following routine shows how it could be done. This routine would output a line 320 graphics characters long.

```
N=320:GOSUB     <enable graphics mode>
FOR NC=1 TO N STEP 8
GOSUB           <fill the SA( ) array>
GOSUB           <print SA( ) array>
NEXT NC
```

I haven't covered any specifics about how to "fill the SA( ) array." This will depend somewhat on the graphics image you are trying to print. However, it turns out that the way the 64 stores its graphics images in memory is ideal for graphics printing (provided the printer prints eight dots per graphics character). The bytes needed to fill the SA( ) array are found right next to each other in memory. An example of a "fill SA( )" routine may be found in the demo program at the end of this article.

If you need to print only one line of graphics, you can continue with text immediately after the last graphics character. You could also output a carriage return and continue with text on the next line. With normal line spacing there will be a gap between your graphics line and the previous and following lines of text. If you want to print multiple lines of graphics, and have them print next to each other, there's an additional step to take.

This involves getting the printer to feed a distance less than the normal line spacing. On some printers, there is a special code or escape sequence to do this. However, on most printers, this is done with an escape sequence which allows you to change the linefeed distance. Once it is changed appropriately for graphics, the usual carriage return and linefeed may be used to move to the next graphics line. This is how it is done on my NEC. The escape sequence to change the linefeed distance on the NEC-8023 is:

ESC,T,"nn"

where "nn" is a two-digit string which indicates how many 144ths of an inch the linefeed distance should be. Since the vertical distance between the centers of the needles is 1/72 inch, eight dots would require 16/144 inch. Therefore, the appropriate sequence would be:

ESC,T,"16"

Normal line spacing (1/6 inch) can be restored by selecting 24/144 inch, or by the escape sequence: ESC,A.

To bring all this together, here is a demo program which will print a copy of the 64 Character Generator ROMs on a NEC. Try to determine what changes are necessary to make it work with your printer. Since the program is accessing the character ROMs, keyboard interrupts and the I/O registers must be disabled in order to read the data. The required POKEs and PEEKs are found in the subroutine at lines 250 and 260. You can refer to the section on Character Memory which starts on page 106 of the *Commodore 64 Programmer's Reference Guide* for details. This program is intended strictly as a demonstration. Written entirely in BASIC, it is rather slow when printing an image of any size. In next month's column I will try to provide some machine language routines to accomplish the same thing much faster.

Example Of ROM Character Printout

Print Character ROM Image

```
10 REM PROGRAM TO PRINT CHAR ROM IMAGE
20 OPEN 4,4,5
30 GOTO 1000
100 REM ENABLE GR. MODE FOR N CHARS
110 N$=STR$(N):N$=RIGHT$(N$,LEN(N$)-1)
120 N$=LEFT$("0000",4-LEN(N$))+N$
130 PRINT#4,CHR$(27);"S";N$;
140 RETURN
200 REM FILL SA() FROM 8 BYTES AT CP
210 POKE 56334,PEEK(56334) AND 254
220 POKE 1,PEEK(1) AND 251
230 FOR I=0 TO 7
240 SA(I)=PEEK(CP+I):NEXT
250 POKE 1,PEEK(1) OR 4
260 POKE 56334,PEEK(56334) OR 1
270 RETURN
300 REM PRINT SA() ARRAY
310 FOR J=0 TO 7: GC=0
320 FOR I=0 TO 7
330 GC=GC/2 OR (SA(I) AND 128)
340 SA(I)=SA(I) * 2
350 NEXT I:PRINT#4,CHR$(GC);:NEXT J
360 RETURN
1000 REM THE MAIN ROUTINE
1010 PRINT#4,CHR$(27);"T16";
1020 N=16*8:CP=53248
1030 FOR L=1 TO 32:REM PRINT 32 LINES
1040 GOSUB 100
1050 FOR G=1 TO 16:REM 16 GROUPS/LINE
1060 GOSUB 200:GOSUB 300:CP=CP+8:NEXT G
1070 PRINT#4:NEXT L
1080 PRINT#4,CHR$(27);"A";
1090 CLOSE 4
```

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Atari Autorun BASIC

Michael E Hepner

The Atari DOS makes it possible to automatically run a machine language program. This program shows you how to automatically run a BASIC program—a technique especially helpful when you're writing programs for novice users.

The Atari Disk Operating System (DOS 2.0S) provides the capability to automatically run a user-written machine language program whenever the computer is turned on. This article will show you how to use this feature to automatically run a program which is written in BASIC.

The need to automatically run a BASIC program arose as I was writing a program for a friend's business. Most of the employees who would have to run the program were unfamiliar with computers. I wanted to make the program easy for them to use. I knew that once the program gained control, I could help the user make inputs through menus and prompts. But the user still had to remember the syntax of the RUN command to make the program run, and had to cope with looking up the meaning of an error code if he or she made a mistake.

To solve these problems, I wrote a machine language program which tells the BASIC cartridge to run a BASIC program named AUTORUN.BAS from disk. I stored the machine language program output from the assembler onto disk as AUTORUN.SYS.

When the computer is turned on, the operating system loads DOS from disk and then runs an AUTORUN.SYS program if it finds it on the disk. My AUTORUN.SYS program then causes the BASIC program to be run. In this way, the user only needs to turn the computer on, reply to questions from the BASIC program, and turn the computer off.

The machine language program uses a trick that was documented in *De Re Atari* to run the BASIC program. The program writes two BASIC instructions on one line on the screen, tells BASIC to accept its input from the screen editor, and gives control to the BASIC cartridge.

When the BASIC cartridge takes control, it processes the two commands on the screen. The first command is POKE 842,12. This command tells BASIC to get its next input from the keyboard after it has finished processing all the commands in the current line. The second command is RUN "D1:AUTORUN.BAS". This command loads the BASIC program named AUTORUN.BAS from disk number one and runs it. You should SAVE the BASIC program you wish to have automatically RUN on the disk with the filename AUTORUN.BAS.

The BASIC program here will write the machine language program to your disk as AUTORUN.SYS. It reads data from DATA statements and creates the machine language program with the necessary load and run information with it.

Line 10 opens the disk for output. The output goes to a program on disk named AUTORUN.SYS.

Lines 20 and 50 set up a loop to read 94 bytes of data.

Line 30 reads the integer data from the DATA statement into the variable A.

Line 40 writes one byte to the disk. This byte is the ATASCII code that corresponds to the number in variable A.

Line 60 closes the disk.

Lines 80–100 contain the integer representation of the machine language program, including the load and run information.

Atari BASIC AUTORUN.SYS

```
10 OPEN #4,8,0,"D1:AUTORUN.SYS"
20 FOR I=1 TO 94
30 READ A
40 PUT #4,A
50 NEXT I
60 CLOSE #4
70 END
80 DATA 255,255,0,6,81,6,216,24,173,4
   8,2,105,4,133,204,173,49,2,105,0,1
   33,205,24,160,0,177,204,105,162,13
   3,212
90 DATA 160,1,177,204,105,0,133,213,1
   60,32,185,49,6,145,212,136,208,248
   ,169,13,141,74,3,96,0,48,47,43,37,
   0,24
100 DATA 20,18,12,17,18,26,50,53,46,0
    ,2,36,17,26,33,53,52,47,50,53,46,
    14,34,33,51,2,226,2,227,2,0,6
```

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Commodore Files For Beginners
Part 3

Jim Butterfield, Associate Editor

Part 3 continues the discussion of files appearing in the two previous issues of COMPUTE!. *This month, Butterfield explains how to handle files that fit within or are larger than RAM, and how to change or delete files.*

We've set up our file of data. So we know how to write it. We've written a reading program. So we know how to read it. In fact, we know how to do everything: additions, deletions, and corrections, since these are just reading and writing with a little computing in between.

Sizing

Can you handle a file of 100,000 characters when you have only a 5K machine? The answer is yes, but it's a qualified yes.

There are a few difficulties, but in principle you can handle a big file with a small computer. Ultimately, you may have to. Even if your computer were fitted with a million bytes of memory, somebody would dream up a two-million byte file—which could not be held entirely within the computer's RAM.

There are techniques for handling big files. The main idea is to handle an item and then get rid of it. If you had a list of a million customers on a disk (it would be a big disk), you could print out all the customers' names without trouble. Read a name, print it, and then loop back and read the next one. The names don't have to stay in the computer's memory: Once they have been printed, they are no longer needed.

Even when we are updating a big file, we won't have too much trouble provided we have a disk unit. Read a record from the input file; change or delete it if necessary; write it to the output file; and then go back and repeat. A little computer can handle big files.

Cassette tape is a special problem. To use this "big file" approach, we'd need to have two tape drives. That's not possible on VIC-20 or Commodore 64, and it's impractical on most PET/CBMs. So where cassette files are concerned, you'd better plan to have files that will fit entirely within memory.

And there are bonus things you can do when a file fits into RAM. For example, sorting records within memory is a snap. In contrast, special techniques are called for when files don't fit.

Let's confine this discussion to files that do fit entirely within the computer's memory space. But don't let your thinking freeze—you can do the bigger ones. It's just more work.

Bringing It In

First, we must make space for the number of records we expect. We set up the arrays with a DIM statement:

```
100 DIM A$(50),B$(50),M(50)
```

This leaves room for up to 50 students. To work out memory space, allow three bytes plus the average length for each string, plus seven bytes for each numeric. Here, we have a table of student names (A$), of student numbers (B$), and marks (M). Let's calculate, using previous data.

We estimate memory space with:

Surname:	**50 × (3 plus 8 characters)**
Student number:	**50 × (3 plus 4 characters)**
Mark:	**50 × 7 bytes**

This gives us a rough estimate of 1250 bytes for storage. It is not highly accurate—we haven't allowed for the zero elements, for example—but it will give us an idea whether things will fit. The program itself will need extra storage, of course.

Note that we're simply allocating space. We can provide for 50 students, but only need space for 30; that's quite OK.

Now we can read our file into memory:

```
110 INPUT "NAME OF INPUT FILE";N$
```

For disk, we use:

```
120 OPEN 1,8,2,N$
```

And for tape, we code:

```
120 OPEN 1,1,0,N$
```

or simply:

```
120 OPEN 1
```

Now we read the data into our memory tables. The coding is quite similar to our previous example, except that this time we need to give each record a code number:

```
130 J=0
140 J=J+1
150 INPUT#1,A$(J)
160 INPUT#1,B$(J)
170 INPUT#1,M(J)
```

We'll look for the last record in the usual (ST) way, and log the number of records as variable N:

```
190 IF ST=0 GOTO 140
200 N=J
210 CLOSE 1
220 PRINT "THERE WERE";N;"RECORDS"
```

At this moment, our whole file is parked neatly in memory. Record 1 contains a surname in A$(1), a student number in B$(1), and a mark in M(1).

Deciding What To Do

Let's give the user a series of options:

```
230 PRINT
240 PRINT "ADD - DELETE - CHANGE - WRITEF
    ILE"
250 INPUT "ACTION";X$
260 X$=LEFT$(X$,1)
270 IF X$="A" GOTO 400
280 IF X$="D" GOTO 600
290 IF X$="C" GOTO 700
300 IF X$<>"W" GOTO 250
```

Writing It Out

If we get to line 310, the user has selected the "writefile" option. Let's write the code; it will be similar to what we have done before:

```
310 INPUT "NAME OF OUTPUT FILE";N$
320 OPEN 1,8,2,"0:"+N$+",S,W
330 FOR J=1 TO N
340 PRINT#1,A$(J);CHR$(13)
350 PRINT#1,B$(J);CHR$(13)
360 PRINT#1,M(J);CHR$(13)
370 NEXT J
380 CLOSE 1
390 END
```

For tape, change line 320 to:

```
320 OPEN 1,1,2,N$
```

Adding A Record

Line 400 is reached if the user wishes to add a record. Since we haven't sorted our records, we can stick the new record on the end:

```
400 INPUT "NAME";A$
410 INPUT "NUMBER";B$
420 INPUT "MARK";M
430 INPUT "OK";X$
```

As before, we'll give the user a chance to back out:

```
440 IF X$<>"Y" AND X$<>"YES" GOTO 230
450 N=N+1
460 A$(N)=A$
470 B$(N)=B$
480 M(N)=M
490 GOTO 230
```

Finding A Record

To change or delete a record, we'll need to find that record. Let's save time by writing a subroutine to search for a student number:

```
500 INPUT "NUMBER";B$
510 E=0:FOR J=1 TO N
520 IF B$<>B$(J) GOTO 560
530 PRINT A$(J);" ";B$(J)," ";M(J)
540 INPUT "IS THIS THE RECORD";X$
550 IF X$="Y" OR X$="YES" GOTO 590
560 NEXT J
570 PRINT "RECORD NOT FOUND"
580 E=1
590 RETURN
```

Deleting A Record

Line 600 is for deletion of a record. First, we call the subroutine at 500, noting if the record was not found:

```
600 GOSUB 500:IF E GOTO 230
```

Now we have found the record; close up the space:

```
610 N=N-1
620 FOR K=J TO N
630 A$(K)=A$(K+1)
640 B$(K)=B$(K+1)
650 M(K)=M(K+1)
660 NEXT K
670 PRINT "RECORD DELETED"
680 GOTO 230
```

Changing The Record

Finally, line 700 starts the sequence to change a record. Again, we locate the record with the subroutine at 500:

```
700 GOSUB 500:IF E GOTO 230
710 INPUT "NEW NAME";A$
720 INPUT "NEW NUMBER";B$
730 INPUT "NEW MARK";M
740 INPUT "OK";X$
750 IF X$<>"Y" AND X$<>"YES" GOTO 230
760 A$(J)=A$
770 B$(J)=B$
780 M(J)=M
790 PRINT "DONE!":GOTO 230
```

Other Projects

That's all. We might add to this program:

- A LIST option to allow the current file to be listed to the screen;
- A PRINT option to output the file to the printer;
- An UPDATE option to allow new marks to be entered for all students;
- Where disk is used, disk error checking.

At this point, we're starting to achieve a small but effective sequential filing system.

Next month, we'll deal with "keys," sorted files, and merges. ©

MLX

Machine Language Entry Program For Commodore 64

Charles Brannon, Program Editor

Remember the last time you typed in the BASIC loader (a group of DATA statements) for a long machine language program? You typed in hundreds of numbers and commas. Even then, you couldn't be sure if you typed it in right. So you went back, proofread, tried to run the program, crashed, went back and proofread again, corrected a few typing errors, ran again, crashed again, rechecked your typing. Frustrating, wasn't it?

Until now, though, that has been the best way to get machine language into your computer. Unless you happen to have an assembler and are willing to wrangle with machine language on the assembly level, it is much easier to just type in a BASIC program that reads DATA statements and then POKEs the numbers into memory.

Some of these "BASIC loaders" will use a *checksum* to see if you've typed the numbers correctly. The simplest checksum is just the sum of all the numbers in the DATA statements. If you make an error, your checksum will not match up with the total. Some programmers make your task easier by including checksums every few lines, so you can locate your errors more easily.

Now, MLX comes to the rescue. MLX is a great way to enter all those long machine language programs with a minimum of fuss. MLX lets you enter the numbers from a special list that looks similar to DATA statements. It checks your typing on a line-by-line basis. It won't let you enter illegal characters when you should be typing numbers. It won't let you enter numbers greater than 255. It will prevent you from entering the numbers on the wrong line. In short, MLX will make proofreading obsolete.

Tape Or Disk Copies

In addition, MLX will generate a ready-to-use copy of your machine language program on tape or disk. You can then use the LOAD command to read the program into the computer, just like a BASIC program. Specifically, you enter:

LOAD "program name",1,1 (for tape)

or

LOAD "program name",8,1 (for disk)

To start the program, you need to enter a SYS command that transfers control from BASIC to your machine language program. The starting SYS will always be given in the article which presents the machine language program in MLX format.

Using MLX

Type in and SAVE MLX (you'll want to use it in the future). When you're ready to type in the machine language program, RUN MLX. MLX will ask you for two numbers: the starting address and the ending address.

You'll then get a prompt showing the specified starting address.

The prompt is the current line you are entering from the MLX-format listing. Each line is six numbers plus a checksum. If you enter any of the six numbers wrong, or enter the checksum wrong, the 64 will sound a buzzer and prompt you to reenter the entire line. If you enter the line correctly, a pleasant bell tone will sound and you may go on to enter the next line.

A Special Editor

You are not using the normal Commodore 64 BASIC editor with MLX. For example, it will only accept numbers as input. If you need to make a correction, press the INST/DEL key; the entire number is deleted. You can press it as many times as necessary, back to the start of the line. If you enter three-digit numbers as listed, the computer will automatically print the comma and go on to accept the next number in the line. If you enter less than three digits, you can press either the comma, space bar, or RETURN key to advance to the next number. The checksum will automatically appear in inverse video.

MLX is an extremely easy way to enter long listings. With the audio cues provided, you don't even have to look at the screen if you're a touch-typist.

Done At Last!

When you get through typing, assuming you type your machine language program all in one session, you can then save the completed and bug-free program to tape or disk. Follow the instructions displayed on the screen. If you get any error messages while saving, you probably have a bad disk, or the disk was full, or you made a typo when entering the MLX program. (MLX can't check itself.)

Command Control

What if you don't want to enter the whole program in one sitting? MLX lets you enter as much as you want, save the completed portion, and then reload your work from tape or disk when you want to continue. MLX recognizes these few commands:

SHIFT-S: Save
SHIFT-L: Load
SHIFT-N: New Address
SHIFT-D: Display

Hold down SHIFT while you press the appropriate key. You will jump out of the line you've been typing, so I recommend you do it at a new prompt. Use the Save command to store what you've been working on. It will write the tape or disk file as if you've finished. Remember what address you stop on. The next time you RUN MLX, answer all the prompts as you did before, then insert the disk or tape containing the stored file. When you get to the entry prompt, press SHIFT-L to reload the file into memory. You'll then use the New Address command (SHIFT-N) to resume typing.

New Address And Display

After you press SHIFT-N, enter the address where you previously stopped. The prompt will change, and you can then continue typing. Always enter a New Address that matches up with one of the line numbers in the special listing, or else the checksums won't match up. You can use the Display command to display a section of your typing. After you press SHIFT-D, enter two addresses within the line number range of the listing. You can stop the display by pressing any key.

Tricky Stuff

The special commands may seem a little confusing, but as you work with MLX, they will become valuable. For example, what if you forgot where you stopped typing? Use the Display command to scan memory from the beginning to the end of the program. When you reach the end of your typing, the lines will contain a random pattern of numbers. When you see the end of your typing, press any key to stop the listing. Use the New Address command to continue typing from the proper location.

You can use the Save and Load commands to make copies of the completed machine language program. Use the Load command to reload the program from tape or disk, then insert a new tape or disk and use the Save command to create a new copy.

One quirk about tapes made with the MLX Save command: When you load them, the message "FOUND program" may appear twice. The tape will load just fine, however.

Programmers will find MLX to be an interesting program which protects the user from most typing mistakes. Some screen formatting techniques are also used. Most interesting is the use of ROM Kernal routines for LOADing and SAVEing blocks of memory. To use these routines, just POKE the starting address (low byte/high byte) into memory locations 251 and 252 and POKE the ending address into locations 254 and 255. Any error code for the SAVE or LOAD can be found in location 253 (an error would be a code less than ten).

Be sure to save MLX; it will be used for future applications in COMPUTE! Magazine, COMPUTE!'s GAZETTE, and COMPUTE! Books.

Machine Language Editor (MLX)

```
100 PRINT"{CLR}{CYN}";CHR$(142);CHR$(8);:
    POKE53281,1:POKE53280,1
101 POKE 788,52:REM DISABLE RUN/STOP
110 PRINT"{RVS}{40 SPACES}";
120 PRINT"{RVS}{15 SPACES}{RIGHT}{OFF}
    E*3£{RVS}{RIGHT} {RIGHT}{2 SPACES}
    E*3{OFF}E*3£{RVS}£{RVS}
    {13 SPACES}";
130 PRINT"{RVS}{15 SPACES}{RIGHT} EG3
    {RIGHT} {2 RIGHT} {OFF}£{RVS}£E*3
    {OFF}E*3{RVS}{13 SPACES}";
140 PRINT"{RVS}{40 SPACES}"
200 PRINT"{2 DOWN}{PUR}{BLK}{3 SPACES}A F
    AILSAFE MACHINE LANGUAGE EDITOR
    {5 DOWN}"
210 PRINT"E53{2 UP}STARTING ADDRESS?
    {8 SPACES}{9 LEFT}";:INPUTS
215 F=1-F:C$=CHR$(31+119*F)
220 IFS<256OR(S>40960ANDS<49152)ORS>53247
    THENGOSUB3000:GOTO210
```

```
225 PRINT:PRINT:PRINT
230 PRINT"{5}{2 UP}ENDING ADDRESS?
    {8 SPACES}{9 LEFT}";:INPUTE:F=1-F:C$=
    CHR$(31+119*F)
240 IFE<256OR(E>40960ANDE<49152)ORE>53247
    THENGOSUB3000:GOTO230
250 IFE<STHENPRINTC$;"{RVS}ENDING < START
    {2 SPACES}":GOSUB1000:GOTO 230
260 PRINT:PRINT:PRINT
300 PRINT"{CLR}";CHR$(14):AD=S:POKEV+21,0
310 PRINTRIGHT$("0000"+MID$(STR$(AD),2),5
    );":";:FORJ=1TO6
320 GOSUB570:IFN=-1THENJ=J+N:GOTO320
390 IFN=-211THEN 710
400 IFN=-204THEN 790
410 IFN=-206THENPRINT:INPUT"{DOWN}ENTER N
    EW ADDRESS";ZZ
415 IFN=-206THENIFZZ<SORZZ>ETHENPRINT"
    {RVS}OUT OF RANGE":GOSUB1000:GOTO410
417 IFN=-206THENAD=ZZ:PRINT:GOTO310
420 IF N<>-196 THEN 480
430 PRINT:INPUT"DISPLAY:FROM";F:PRINT,"TO
    ";:INPUTT
440 IFF<SORF>EORT<SORT>ETHENPRINT"AT LEAS
    T";S;"{LEFT}, NOT MORE THAN";E:GOTO43
    0
450 FORI=FTOTSTEP6:PRINT:PRINTRIGHT$("000
    0"+MID$(STR$(I),2),5);":";
451 FORK=0TO5:N=PEEK(I+K):PRINTRIGHT$("00
    "+MID$(STR$(N),2),3);",";
460 GETA$:IFA$>""THENPRINT:PRINT:GOTO310
470 NEXTK:PRINTCHR$(20);:NEXTI:PRINT:PRIN
    T:GOTO310
480 IFN<0 THEN PRINT:GOTO310
490 A(J)=N:NEXTJ
500 CKSUM=AD-INT(AD/256)*256:FORI=1TO6:CK
    SUM=(CKSUM+A(I))AND255:NEXT
510 PRINTCHR$(18);:GOSUB570:PRINTCHR$(20)
515 IFN=CKSUMTHEN530
520 PRINT:PRINT"LINE ENTERED WRONG : RE-E
    NTER":PRINT:GOSUB1000:GOTO310
530 GOSUB2000
540 FORI=1TO6:POKEAD+I-1,A(I):NEXT:POKE54
    272,0:POKE54273,0
550 AD=AD+6:IF AD<E THEN 310
560 GOTO 710
570 N=0:Z=0
580 PRINT"{+}";
581 GETA$:IFA$=""THEN581
585 PRINTCHR$(20);:A=ASC(A$):IFA=13ORA=44
    ORA=32THEN670
590 IFA>128THENN=-A:RETURN
600 IFA<>20 THEN 630
610 GOSUB690:IFI=1ANDT=44THENN=-1:PRINT"
    {LEFT} {LEFT}";:GOTO690
620 GOTO570
630 IFA<48ORA>57THEN580
640 PRINTA$;:N=N*10+A-48
650 IFN>255 THEN A=20:GOSUB1000:GOTO600
660 Z=Z+1:IFZ<3THEN580
670 IFZ=0THENGOSUB1000:GOTO570
680 PRINT",";:RETURN
690 S%=PEEK(209)+256*PEEK(210)+PEEK(211)
691 FORI=1TO3:T=PEEK(S%-I)
695 IFT<>44ANDT<>58THENPOKES%-I,32:NEXT
700 PRINTLEFT$("{3 LEFT}",I-1);:RETURN
710 PRINT"{CLR}{RVS}*** SAVE ***{3 DOWN}"
720 INPUT"{DOWN} FILENAME";F$
730 PRINT:PRINT"{2 DOWN}{RVS}T{OFF}APE OR
    {RVS}D{OFF}ISK: (T/D)"
740 GETA$:IFA$<>"T"ANDA$<>"D"THEN740
750 DV=1-7*(A$="D"):IFDV=8THENF$="0:"+F$
760 T$=F$:ZK=PEEK(53)+256*PEEK(54)-LEN(T$
    ):POKE782,ZK/256
762 POKE781,ZK-PEEK(782)*256:POKE780,LEN(
    T$):SYS65469
763 POKE780,1:POKE781,DV:POKE782,1:SYS654
    66
765 POKE254,S/256:POKE253,S-PEEK(254)*256
    :POKE780,253
766 POKE782,E/256:POKE781,E-PEEK(782)*256
    :SYS65496
770 IF(PEEK(783)AND1)OR(ST AND191)THEN780
775 PRINT"{DOWN}DONE.":END
780 PRINT"{DOWN}ERROR ON SAVE.{2 SPACES}T
    RY AGAIN.":IFDV=1THEN720
781 OPEN15,8,15:INPUT#15,E1$,E2$:PRINTE1$
    ;E2$:CLOSE15:GOTO720
790 PRINT"{CLR}{RVS}*** LOAD ***{2 DOWN}"
800 INPUT"{2 DOWN} FILENAME";F$
810 PRINT:PRINT"{2 DOWN}{RVS}T{OFF}APE OR
    {RVS}D{OFF}ISK: (T/D)"
820 GETA$:IFA$<>"T"ANDA$<>"D"THEN820
830 DV=1-7*(A$="D"):IFDV=8THENF$="0:"+F$
840 T$=F$:ZK=PEEK(53)+256*PEEK(54)-LEN(T$
    ):POKE782,ZK/256
841 POKE781,ZK-PEEK(782)*256:POKE780,LEN(
    T$):SYS65469
845 POKE780,1:POKE781,DV:POKE782,1:SYS654
    66
850 POKE780,0:SYS65493
860 IF(PEEK(783)AND1)OR(ST AND191)THEN870
865 PRINT"{DOWN}DONE.":GOTO310
870 PRINT"{DOWN}ERROR ON LOAD.{2 SPACES}T
    RY AGAIN.{DOWN}":IFDV=1THEN800
880 OPEN15,8,15:INPUT#15,E1$,E2$:PRINTE1$
    ;E2$:CLOSE15:GOTO800
1000 REM BUZZER
1001 POKE54296,15:POKE54277,45:POKE54278,
     165
1002 POKE54276,33:POKE 54273,6:POKE54272,
     5
1003 FORT=1TO200:NEXT:POKE54276,32:POKE54
     273,0:POKE54272,0:RETURN
2000 REM BELL SOUND
2001 POKE54296,15:POKE54277,0:POKE54278,2
     47
2002 POKE 54276,17:POKE54273,40:POKE54272
     ,0
2003 FORT=1TO100:NEXT:POKE54276,16:RETURN
3000 PRINTC$;"{RVS}NOT ZERO PAGE OR ROM":
     GOTO1000
```

©

CAPUTE!

Modifications Or Corrections To Previous Articles

Modem Save And Download For The VIC-20

For Program 1 of this telecommunications utility from the November 1983 issue (p. 215) to run properly, the following line must be changed:

```
40 CK=0: FOR A=10496 TO 10751: READ D: CK
   =CK+D: POKE A,D: NEXT A
```

In Program 2, line 190 should read THEN 220 instead of THEN 210.

The Filer For TI

The program in "The Beginner's Page" (October 1983, p. 32) will not run in standard TI console BASIC. In console BASIC there can be only one statement per line, and the THEN in IF-THEN statements can be followed only by a line number. Also, TI BASIC requires that spaces be left between BASIC commands and variables. The GETK$ in line 30 must be replaced on the TI with an appropriate CALL KEY command.

Moving Maze For The 64

When "Shuttle Escape," the 64 version of this game from the October 1983 issue (Program 3, p. 82), is run for the first time, the program will stop with an ILLEGAL QUANTITY ERROR IN 500 message. If you then hit the RUN/STOP and RESTORE keys and run the program again, it will function properly. To prevent this error message, make the following changes:

```
10020 CK=CK+A:POKE I,A:I=I+1:GOTO 10005
10025 IF CK<>34430 THEN PRINT "DATA ERROR
       IN LINES 10030-11120":STOP
50040 CS=CS+A:POKE I,A:I=I+1:GOTO 50010
50045 IF CS<>188431 THEN PRINT "DATA ERRO
      R IN LINES 50050-52010":STOP
```

Spelling Quiz For VIC

To prevent a BAD SUBSCRIPT ERROR IN 165 message when this program from the October 1983 issue (p. 127) is run, change the DIMension of W$(20) in line 10 to W$(21).

Runway 180 For TI

As presented, this game from the October 1983 issue (p. 208) requires that the ALPHA LOCK key be down to read the instructions. Since this key must be up to use the joystick in the game, Gordon Millham suggests the following changes so that ALPHA LOCK can be left up throughout the program: Change the value for K to 103 in line 190 and to 105 in line 200, and change the word ON in line 210 to OFF. He also suggests the following additional line, which creates a delay so that you can admire your skill when you land the plane successfully.

```
1895 FOR DELAY=1 TO 800 :: NEXT DELAY
```

Also in this program, note the stray zero at the end of line 1850. That line should end with GOTO 1870.

High Speed Mazer For The 64

In the "Munchmaze" game (Program 6) with this article (October 1983, p. 254), there is a spurious question mark in line 13752 which should be removed. Since this game is written entirely in machine language, any errors in the DATA lines will prevent it from functioning properly.

Protector For The 64

In the table for this VIC-20 article from the October 1983 issue (p. 272), several values for disabling certain functions on the 64 were given. In particular, the article stated that POKE 808,225 could be used to disable STOP, RESTORE, and LIST on the 64. This works for most programs, but could cause problems since it scrambles the value in the jiffy clock. A safer way is to POKE 808,234. If you wish to disable only the STOP key, you can use POKE 808,239. ©

How To Type COMPUTE!'s Programs

Many of the programs which are listed in **COMPUTE!** contain special control characters (cursor control, color keys, inverse video, etc.). To make it easy to tell exactly what to type when entering one of these programs into your computer, we have established the following listing conventions. There is a separate key for each computer. Refer to the appropriate tables when you come across an unusual symbol in a program listing. If you are unsure how to actually enter a control character, consult your computer's manuals.

Atari 400/800

Characters in inverse video will appear like: INVERSE VIDEO
Enter these characters with the Atari logo key, {⅄}.

When you see	Type	See	
{CLEAR}	ESC SHIFT <	↖	Clear Screen
{UP}	ESC CTRL -	↑	Cursor Up
{DOWN}	ESC CTRL =	↓	Cursor Down
{LEFT}	ESC CTRL +	←	Cursor Left
{RIGHT}	ESC CTRL *	→	Cursor Right
{BACK S}	ESC DELETE	◀	Backspace
{DELETE}	ESC CTRL DELETE		Delete character
{INSERT}	ESC CTRL INSERT		Insert character
{DEL LINE}	ESC SHIFT DELETE		Delete line
{INS LINE}	ESC SHIFT INSERT		Insert line
{TAB}	ESC TAB	▶	TAB key
{CLR TAB}	ESC CTRL TAB		Clear tab
{SET TAB}	ESC SHIFT TAB		Set tab stop
{BELL}	ESC CTRL 2		Ring buzzer
{ESC}	ESC ESC		ESCape key

Graphics characters, such as CTRL-T, the ball character ● will appear as the "normal" letter enclosed in braces, e.g. {T}.

A series of identical control characters, such as 10 spaces, three cursor-lefts, or 20 CTRL-R's, will appear as {10 SPACES}, {3 LEFT}, {20 R}, etc. If the character in braces is in inverse video, that character or characters should be entered with the Atari logo key. For example, {♥} means to enter a reverse-field heart with CTRL-comma, {5▥} means to enter five inverse-video CTRL-U's.

Commodore PET/CBM/VIC/64

Generally, any PET/CBM/VIC/64 program listings will contain words within braces which spell out any special characters: {DOWN} would mean to press the cursor down key. {5 SPACES} would mean to press the space bar five times.

To indicate that a key should be *shifted* (hold down the SHIFT key while pressing the other key), the key would be underlined in our listings. For example, S would mean to type the S key while holding the shift key. If you find an underlined key enclosed in braces (e.g., {10 N}), you should type the key as many times as indicated (in our example, you would enter ten shifted N's). Some graphics characters are inaccessible from the keyboard on CBM Business models (32N, 8032).

For the VIC and 64, if a key is enclosed in special brackets, ⌈ ⌉, you should hold down the *Commodore key* while pressing the key inside the special brackets. (The Commodore key is the key in the lower left corner of the keyboard.) Again, if the key is preceded by a number, you should press the key as many times as indicated.

Rarely, you'll see in a Commodore 64 program a solitary letter of the alphabet enclosed in braces. These characters can be entered by holding down the CTRL key while typing the letter in the braces. For example, {A} would indicate that you should press CTRL-A.

About the *quote mode*: you know that you can move the cursor around the screen with the CRSR keys. Sometimes a programmer will want to move the cursor under program control. That's why you see all the {LEFT}'s, {HOME}'s, and {BLU}'s in our programs. The only way the computer can tell the difference between direct and programmed cursor control is the quote mode.

Once you press the quote (the double quote, SHIFT-2), you are in the quote mode. If you type something and then try to change it by moving the cursor left, you'll only get a bunch of reverse-video lines. These are the symbols for cursor left. The only editing key that isn't programmable is the DEL key; you can still use DEL to back up and edit the line. Once you type another quote, you are out of quote mode.

You also go into quote mode when you INSerT spaces into a line. In any case, the easiest way to get out of quote mode is to just press RETURN. You'll then be out of quote mode and you can cursor up to the mistyped line and fix it.

Use the following tables when entering special characters:

When You Read:	Press:		See:	When You Read:	Press:		See:
{CLEAR}	SHIFT	CLR/HOME		{GRN}	CTRL	6	
{HOME}		CLR/HOME		{BLU}	CTRL	7	
{UP}	SHIFT	↑ CRSR ↓		{YEL}	CTRL	8	
{DOWN}		↑ CRSR ↓		{F1}	f1		
{LEFT}	SHIFT	← CRSR →		{F2}	f2		
{RIGHT}		← CRSR →		{F3}	f3		
{RVS}	CTRL	9		{F4}	f4		
{OFF}	CTRL	0		{F5}	f5		
{BLK}	CTRL	1		{F6}	f6		
{WHT}	CTRL	2		{F7}	f7		
{RED}	CTRL	3		{F8}	f8		
{CYN}	CTRL	4		←	←		
{PUR}	CTRL	5		↑	SHIFT	↑	

All Commodore Machines

Clear Screen	{CLR}	Cursor Left	{LEFT}
Home Cursor	{HOME}	Insert Character	{INST}
Cursor Up	{UP}	Delete Character	{DEL}
Cursor Down	{DOWN}	Reverse Field On	{RVS}
Cursor Right	{RIGHT}	Reverse Field Off	{OFF}

Apple II / Apple II Plus

All programs are in Applesoft BASIC, unless otherwise stated. Control characters are printed as the "normal" character enclosed in brackets, such as {D} for CTRL-D. Hold down CTRL while pressing the control key. You will not see the special character on the screen.

Texas Instruments 99/4

The only special characters used are in PRINT statements to indicate where two or more spaces should be left between words. For example, ENERGY {10 SPACES} MANAGEMENT means that ten spaces should be left between the words ENERGY and MANAGEMENT. Do not type in the braces or the words 10 SPACES. Enter all programs with the ALPHA LOCK on (in the down position). Release the ALPHA LOCK to enter lowercase text.

COMPUTE! Back Issues

Here are some of the applications, tutorials, and games from available back issues of COMPUTE!. Each issue contains much, much more than there's space here to list, but here are some highlights:

Home and Educational COMPUTING! (Fall 1981 and Summer 1981 — count as one back issue): Exploring The Rainbow Machine, VIC As Super Calculator, Custom Characters On The VIC, Alternative Screens, Automatic VIC Line Numbers, Using The Joystick (Spacewar Game), Fast VIC Tape Locater, Window, VIC Memory Map.

May 1981: Named GOSUB/GOTO in Applesoft, Generating Lower Case Text on Apple II, Copy Atari Screens to the Printer, Disk Directory Printer for Atari, Realtime Clock on Atari, PET BASIC Delete Utility, PET Calculated Bar Graphs, Running 40 Column Programs on a CBM 8032, A Fast Visible Memory Dump, Cassette Filing System, Getting To A Machine Language Program, Epidemic Simulation.

June 1981: Computer Using Educators (CUE) on Software Pricing, Apple II Hires Character Generator, Ever Expanding Apple Power, Color Burst for Atari, Mixing Atari Graphics Modes 0 and 8, Relocating PET BASIC Programs, An Assembler In BASIC for PET, Quadra PET: Multitasking?, Mapping Unknown Machine Language, RAM/ROM Memory, Keeping TABs on a Printer.

July 1981: Home Heating and Cooling, Animating Integer BASIC Lores Graphics, The Apple Hires Shape Writer, Adding a Voice Track to Atari Programs, Machine Language Atari Joystick Driver, Four Screen Utilities for the PET, Saving Machine Language Programs on PET Tape Headers, Commodore ROM Systems, Using TAB, SPC, And LEN.

August 1981: Minimize Code and Maximize Speed, Apple Disk Motor Control, A Cassette Tape Monitor for the Apple, Easy Reading of the Atari Joystick, Blockade Game for the Atari, Atari Sound Utility, The CBM "Fat 40," Keyword for PET, CBM/PET Loading, Chaining, and Overlaying, Adding A Programmable Sound Generator, Converting PET BASIC Programs To ASCII Files.

October 1981: Automatic DATA Statements for CBM and Atari, VIC News, Undeletable Lines on Apple, PET, and VIC; Budgeting on the Apple, Atari Cassette Boot-tapes, Atari Variable Name Utility, Atari Program Library, Train Your PET to Run VIC Programs, Interface a BSR Remote Control System to PET, A General Purpose BCD to Binary Routine, Converting to Fat-40 PET.

December 1981: Saving Fuel $$ (multiple computers), Unscramble Game (multiple computers), Maze Generator (multiple computers), Animating Applesoft Graphics, A Simple Atari Word Processor, Adding High Speed Vertical Positioning to Atari P/M Graphics, OSI Supercursor, A Look At SuperPET, Supermon for PET/CBM, PET Mine Maze Game, Replacing The INPUT# Command, Foreign Language Text on The Commodore Printer, File Recovery.

January 1982: Invest (multiple computers), Developing a Business Algorithm (multiple computers), Apple Addresses, Lowercase with Unmodified Apple, Cryptogram Game for Atari, Superfont: Design Special Character Sets on Atari, PET Repairs for the Amateur, Micromon for PET, Self-modifying Programs in PET BASIC, Tinymon: a VIC Monitor, VIC Color Tips, VIC Memory Map, ZAP: A VIC Game.

May 1982: VIC Meteor Maze Game, Atari Disk Drive Speed Check, Modifying Apple's Floating Point BASIC, Fast Sort For PET/CBM, Extra Atari Colors Through Artifacting, Life Insurance Estimator (multiple computers), PET Screen Input, Getting The Most Out Of VIC's 5000 Bytes.

August 1982: The New Wave Of Personal Computers, Household Budget Manager (multiple computers), Word Games (multiple computers), Color Computer Home Energy Monitor, A VIC Light Pen For Under $10, Guess That Animal (multiple computers), PET/CBM Inner BASIC, VIC Communications, Keyprint Compendium, Animation With Atari, VIC Curiosities, Atari Substring Search, PET and VIC Electric Eraser.

September 1982: Apple and Atari and the Sounds of TRON, Commodore Automatic Disk Boot, VIC Joysticks, Three Atari GTIA Articles, Commodore Disk Fixes, The Apple Pilot Language, Sprites and Sound on the Commodore 64, Peripheral Vision Exerciser (multiple computers), Banish INPUT Statements (multiple computers),

COMPUTE! Back Issues

Charades (multiple computers), PET Pointer Sort, VIC Pause, Mapping Machine Language, Commodore User-defined Functions Defined, A VIC Bug.

January 1983: Sound Synthesis And The Personal Computer, Juggler And Thunderbird Games (multiple computers), Music And Sound Programs (multiple computers), Writing Transportable BASIC, Home Energy Calculator (multiple computers), All About Commodore WAIT, Supermon 64, Perfect Commodore INPUTs, VIC Sound Generator, Copy VIC Disk Files, Commodore 64 Architecture.

March 1983: An Introduction To Data Storage (multiple computers), Mass Memory Now And In The Future, Games: Closeout, Boggler, Fighter Aces, Letter And Number Play (all for multiple computers), VIC Music, Direct Atari Disk Access, Automatic Commodore Program Selector, PET Quickplot, A Commodore Gotcha, VIC and Atari Memory Management, Friendly VIC INPUTs.

April 1983: Selecting The Right Word Processor, Air Defense (multiple computers), Commodore Structure BASIC, Retirement Planner (multiple computers), Dr. Video For Commodore, Atari Filefixer, Video 80:80 Columns For The Atari, VIC-word, Magic Commodore BASIC, A BASIC Hex Editor For VIC, VIC Music Theory.

May 1983: The New Low Cost Printer/Plotters, Jumping Jack (multiple computers), Deflector (multiple computers), VIC Kaleidoscope, Graphics on the Sinclair/Timex, Bootmaker For VIC, PET and 64, VICSTATION: A "Paperless Office," The Atari Musician, Puzzle Generator (multiple computers), Instant 64 Art, 64 Odds And Ends, Versatile VIC Data Acquisition, POP For Commodore.

June 1983: How To Buy The Right Printer, The New, Low-cost Printers, Astrostorm (multiple computers), The Hawkmen Of Dindrin (multiple computers), MusicMaster For The Commodore 64, Commodore Data Searcher, Atari Player/Missile Graphics Simplified, VIC Power Spirals, Un NEW For The VIC and 64, Atari Fast Shuffle, VIC Contractor, Commodore Supermon Q & A.

July 1983: Constructing The Ideal Computer Game, Techniques For Writing Your Own Adventure Game, SpeedSki And Time Bomb (VIC), Castle Quest And Roadblock (Atari), RATS! And Goblin (64), How To Create A Data Filing System (multiple computers), How To Back Up Disks For VIC And 64, Atari Artifacting, All About The Commodore USR Command, TI Mailing List.

August 1983: Weather Forecaster (multiple computers), First Math And Clues (multiple computers), Converting VIC And 64 Programs To PET, Atari Verify, Apple Bytechanger, VIC And 64 Escape Key, Banish Atari INPUT Statements, Mixing Graphics Modes On The 64, VICplot, VIC/64 Translations: Reading The Keyboard, Musical Atari Keyboard, VIC Display Messages.

September 1983: Games That Teach, Caves Of Ice, Diamond Drop, Mystery Spell, and Dots (multiple computers), VIC Pilot, Ultrasort (VIC, 64, PET), Easy Atari Page Flipping, Computer Aided Design On The TI, Relative Files On the VIC/64, Atari Fontbyter, TI Sprite Editor, All About Interrupts (multiple computers), Cracking The 64 Kernal, Making Change On The Timex/Sinclair, Build Your Own Random File Manager (multiple computers).

October 1983: Computer Games By Phone, Coupon File (multiple computers), Dragon Master And Moving Maze (multiple computers), Merging Programs From Commodore Disks, Atari Master Disk Directory, Sprites In TI Extended BASIC, Commodore EXEC, Multicolor Atari Character Editor, High Speed Commodore Mazer, Apple Sounds, Extra Instructions (multiple computers), Commodore DOS Wedges, Invisible Disk Directory For VIC And 64.

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A Beginner's Guide To Typing In Programs

What Is A Program?

A computer cannot perform any task by itself. Like a car without gas, a computer has *potential*, but without a program, it isn't going anywhere. Most of the programs published in **COMPUTE!** are written in a computer language called BASIC. BASIC is easy to learn and is built into most computers (on some computers, you have to purchase an optional BASIC cartridge).

BASIC Programs

Each month, **COMPUTE!** publishes programs for many machines. To start out, type in only programs written for your machine, e.g., "TI Version" if you have a TI-99/4. Later, when you gain experience with your computer's BASIC, you can try typing in and converting certain programs from one computer to yours.

Computers can be picky. Unlike the English language, which is full of ambiguities, BASIC usually has only one "right way" of stating something. Every letter, character, or number is significant. A common mistake is substituting a letter such as "O" for the numeral "0", a lowercase "l" for the numeral "1", or an uppercase "B" for the numeral "8". Also, you must enter all punctuation such as colons and commas just as they appear in the magazine. Spacing can be important. To be safe, type in the listings *exactly* as they appear.

Brackets And Special Characters

The exception to this typing rule is when you see the curved bracket, such as "{DOWN}". Anything within a set of brackets is a special character or characters that cannot easily be listed on a printer. When you come across such a special statement, refer to the appropriate key for your computer. For example, if you have an Atari, refer to the "Atari" section in "How to Type COMPUTE!'s Programs."

About DATA Statements

Some programs contain a section or sections of DATA statements. These lines provide information needed by the program. Some DATA statements contain actual programs (called machine language); others contain graphics codes. These lines are especially sensitive to errors.

If a single number in any one DATA statement is mistyped, your machine could "lock up," or "crash." The keyboard, break key, and RESET (or STOP) keys may all seem "dead," and the screen may go blank. Don't panic – no damage is done. To regain control, you have to turn off your computer, then turn it back on. This will erase whatever program was in memory, so always SAVE a copy of your program before you RUN it. If your computer crashes, you can LOAD the program and look for your mistake.

Sometimes a mistyped DATA statement will cause an error message when the program is RUN. The error message may refer to the program line that READs the data. *The error is still in the DATA statements, though.*

Get To Know Your Machine

You should familiarize yourself with your computer before attempting to type in a program. Learn the statements you use to store and retrieve programs from tape or disk. You'll want to save a copy of your program, so that you won't have to type it in every time you want to use it. Learn to use your machine's editing functions. How do you change a line if you made a mistake? You can always retype the line, but you at least need to know how to backspace. Do you know how to enter inverse video, lowercase, and control characters? It's all explained in your computer's manuals.

A Quick Review

1) Type in the program a line at a time, in order. Press RETURN or ENTER at the end of each line. Use backspace or the back arrow to correct mistakes.

2) Check the line you've typed against the line in the magazine. You can check the entire program again if you get an error when you RUN the program.

3) Make sure you've entered statements in brackets as the appropriate control key (see "How To Type COMPUTE!'s Programs" elsewhere in the magazine.)

We regret that we are no longer able to respond to individual inquiries about programs, products, or services appearing in **COMPUTE!** *due to increasing publication activity. On those infrequent occasions when a published program contains a typo, the correction will appear on the CAPUTE! page, usually within eight weeks. If you have specific questions about items or programs which you've seen in* **COMPUTE!**, *please send them to Readers Feedback, P.O. Box 5406, Greensboro, NC 27403.* ©

NEWS&PRODUCTS

Terminal Emulator For VIC And 64

Versaterm, a terminal emulator package for the VIC-20 and Commodore 64, is available from Electrosharp Technologies.

The program features UPLOAD, DOWNLOAD, PRINTER DUMP, SAVE, and CONVERT commands. Data can be SAVEd on tape or disk to reduce connect time. Data is stored in a receive buffer which holds 36K on the Commodore 64 and up to 26K on the VIC-20.

The PROGRAM mode searches through the receive buffer for a program file and automatically converts it into program form so it can be SAVEd and RUN normally.

Versaterm is available on tape for $24.95 or disk for $27.95. The VIC version requires at least 8K memory expansion.

Electrosharp Technologies
1981 Sandalwood Drive
Santa Maria, CA 93455
(805) 922-4095

Atari Printer Interface

Microbits has developed a printer interface that is compatible with all Atari computers and serves as a replacement for the Atari 850 Interface Module.

The MPP-1150 Printer Interface, which connects to the computer's serial bus and daisy-chains with other Atari peripherals, is compatible with all existing software. It includes a three-foot cable with a Centronics plug.

The Microbits MPP-1150 Parallel Printer Interface is compatible with all Atari computers.

The interface sells for $99.95.

Microbits Peripheral Products
225 West Third St.
Albany, OR 97321
(503) 967-9075

On The Road With The Apple

Columbia Software has introduced *Roadsearch-Plus*, a computerized road atlas for the Apple II and Apple IIe computers.

The program contains a data base of 406 cities and road intersections and about 70,000 miles of major highways throughout the United States and Canada. With the companion *Roadmap Development System*, users can customize the data base with up to 50 additional cities and 100 additional road segments, including local roads, favorite shortcuts, and new destinations.

When run, the program determines and prints the shortest practical route between any cities in the data base. If desired, the program can choose routes that avoid toll roads. Printed output from the program includes driving route, distances, travel times, and estimated fuel usage.

Roadsearch-Plus with the *Roadmap Development System* is available for $74.95. A version without the *Roadmap Development System* is available for $34.95.

Columbia Software
P.O. Box 2235A
5461 Marsh Hawk
Columbia, MD 21045
(301) 997-3100

Joysticks For Atari, Commodore, TI

Coin Controls has developed the Competition Pro 3000 joystick, a new game controller for Atari, Commodore, and TI computers.

The Competition Pro 3000 includes a trigger atop the joystick and a "fire-bar" on the controller's base. The joystick incorporates arcade-style, eight-way directional leaf switches,

The TI version of the Competition Pro 3000 joystick includes an adapter for the TI-99/4A computer.

and is backed by a two-year warranty.

Atari and Commodore models are available for $16.95. The TI version is available for $18.95.

Coin Controls, Inc.
2609 Greenleaf Ave.
Elk Grove Village, IL 60007
(800) 323-8174

Pascal For The 64

Zoom Pascal 64, from Abacus Software, is a fast-running Pascal package for the Commodore 64.

The program includes an editor to create, save, or modify Pascal source statements, a compiler to translate source statements into intermediate code, and a translator to translate the intermediate code into 6502 machine language.

The package, which sells for $39.95, also includes several sample programs.

Other new programs available from Abacus include: *Chartpak-64*, which allows construction of charts and graphs in high-resolution graphics without programming, $42.95; *Assembler/Monitor 64*, a utility for the development of machine language programs, $32.95; and *Graphics Designer 64*, which lets you design architectural, engineering, or artistic graphics, $34.95.

Abacus Software
P.O. Box 7211
Grand Rapids, MI 49510

Grammar Tutorial For Apple And Atari

English Grammar is a program designed to teach the parts of speech to students at any grade or age level. The two-disk Apple or Atari program, produced by T.H.E.S.I.S., can create specialized exercises for use in a variety of settings.

Drills on individual parts of speech, or any combination of parts of speech, are available. The material in the drills is easily modified to match the reading level of the student.

The program is available for $45 plus $3 for shipping and handling.

Another new offering from T.H.E.S.I.S. is *Weights and Measures*, a two-program package for the Atari, designed for children ages 4 to 10.

Weights teaches children how to read a scale in pounds and ounces, and includes exercises for converting pounds to ounces and ounces to pounds.

Linear Measures teaches children how to measure with a ruler and how to make conversions among inches, feet, and yards.

Weights and Measures is available for $20 on tape or $25 on disk.

T.H.E.S.I.S.
P.O. Box 147
Garden City, MI 48135
(800) 354-0550

Color Computer Games And Graphics

Radio Shack has released two new games and a disk graphics package for the TRS-80 Color Computer.

The games, *Color Baseball* and *Star Blaze*, are both available in Program Paks for computers with at least 16K. In *Color Baseball*, you can play a human opponent or the computer. Features include user selectable batting averages, base stealing, and control of all defensive players. The game sells for $24.95.

Star Blaze is a space exploration adventure. The player must defend the 64 sectors of the galaxy against a fleet of aliens. *Star Blaze* is available for $19.95.

Color Disk Graphics includes formats to plot vertical or horizontal bar charts, pie charts, and line charts. Charts produced by the program can be saved on disk, displayed on either a high- or low-resolution computer screen, or printed out on a dot-matrix printer that has graphics capabilities.

Color Disk Graphics sells for $49.95.

Tandy Corporation/Radio Shack
1800 One Tandy Center
Fort Worth, TX 76102

TI Cartridge Software

Texas Instruments has released five new cartridge games for the TI-99/4A home computer. The games sell for $29.95 each and can be played from the keyboard, though some games may perform better with joysticks.

The games are:

BurgerTime, a single-player chase game in which Peter Pepper has to avoid the nasty pickles and hot dogs.

Treasure Island, in which the player must gather treasure before rising waters engulf the island.

Return to Pirate's Isle, a Scott Adams adventure with multiple screens.

Hopper, a ten-level chase game for one or two players. The action takes place in the cargo hold of an ocean liner.

Slymoids, a single-player game in which you control a sharpshooting cowboy who uses scanners and laser fireballs to eliminate the alien Slymoids.

Texas Instruments
Consumer Relations
P.O. Box 53
Lubbock, TX 79408
(800)842-2737

Thinking Game For Commodore 64

Omnipotus is a Commodore 64 game in which the player assumes the role of a computer and the computer assumes the role of Professor Omnipotus, the computer's creator.

The scenario is this: The professor sent you out into the world to "compare and categorize." You have returned from your task and the professor is questioning you about what you have observed. Your dialogue with the professor introduces you to the basics of philosophical thinking.

The program, produced by The Wizards, is available on tape or disk for $13.95.

Also available from The Wizards is a computer aided instruction program titled *Course I: How to Make Good Investments*. The course covers material traditionally covered in business schools, with some practical street techniques added in. The program, which comes with a 75-page text, is available on tape for $39.95 or disk for $44.95.

The Wizards
P.O. Box 7118
The Woodlands, TX 77387

CALENDAR

January 14–15, Northland Mall, Sterling, IL. Fourth Annual Computer Fair. Sponsored by the Sauk Valley Computer Club. For more information, contact Vinus Williams, Rt. 1, Milledgeville, IL 61051.

January 19–21, Pasadena Convention Center, 300 E. Green St., Pasadena, CA. Data West. This computer conference and exposition will offer a series of workshops and seminars, and will present an array of computer hardware and software for personal and business use. For more information, contact Cliff and Doug Mitchell, Information Processing Group, (213) 792-5111.

January 23–25, Hacienda Resort Hotel and Casino, Las Vegas, NV. Teaching Math With Microcomputers. Sponsored by the National Council of Teachers of Mathematics. A two-day program designed for introducing microcomputers to teachers and supervisors of mathematics education at the elementary, intermediate, and secondary school levels. Seminar topics include software, programming, hardware selection, and computers in the future. For more information, contact NCTM Seminar Series, 1906 Association Dr., Reston, VA 22091, (703) 620-9840.

New Product releases are selected from submissions for reasons of timeliness, available space, and general interest to our readers. We regret that we are unable to select all new product submissions for publication. Readers should be aware that we present here some edited version of material submitted by vendors and are unable to vouch for its accuracy at time of publication.

COMPUTE! *welcomes notices of upcoming events and requests that the sponsors send a short description, their name and phone number, and an address to which interested readers may write for further information. Please send notices at least three months before the date of the event, to: Calendar, P.O. Box 5406, Greensboro, NC 27403.* ©

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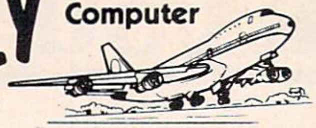

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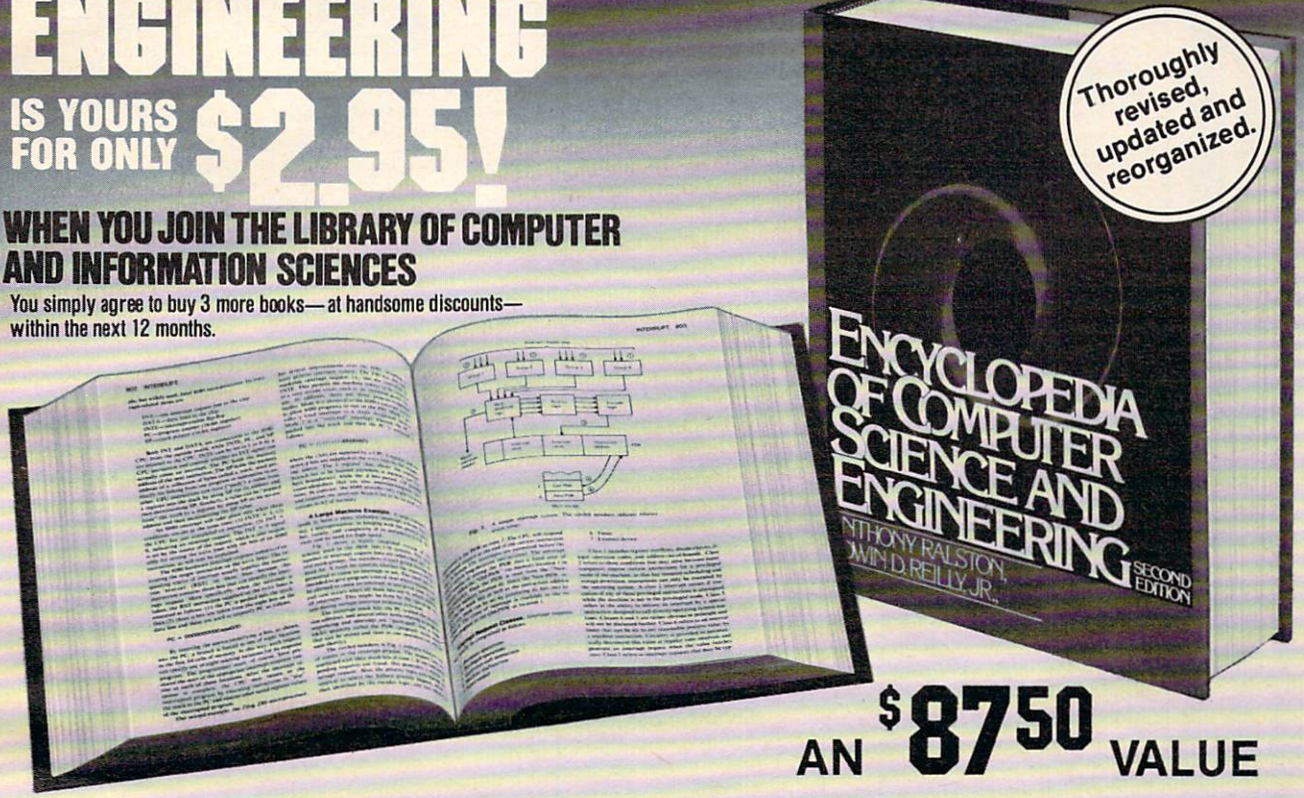

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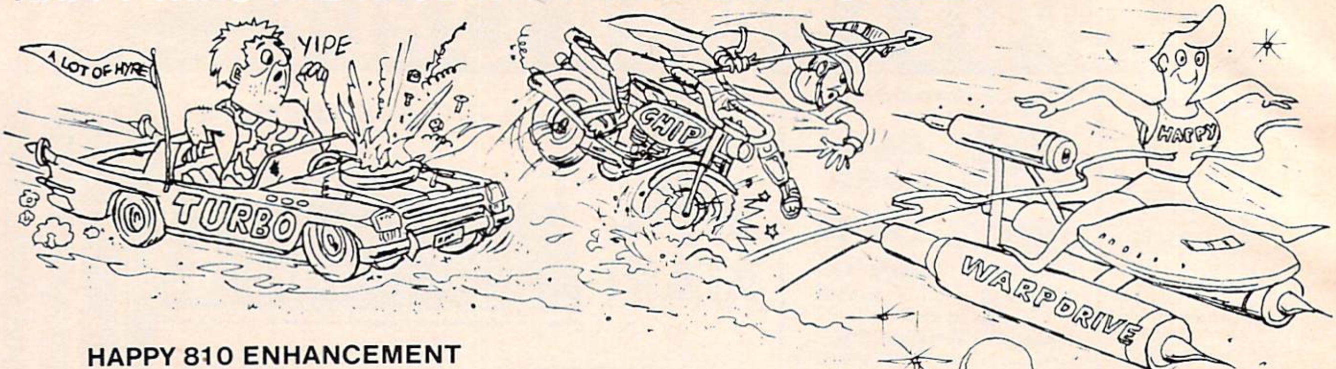

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