The Joy Of Joysticks: 12 Joysticks Compared

# COMPUTE!

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1983
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Vol. 5, No. 2
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The Leading Magazine Of Home, Educational, And Recreational Computing

## All New Games Issue

How The Pros Write Computer Games

*Slalom:* 3-D Simulation Game For Atari And PET

*A Day At The Races:* Game With Excellent Graphics And Sound Tutorial For VIC And Atari

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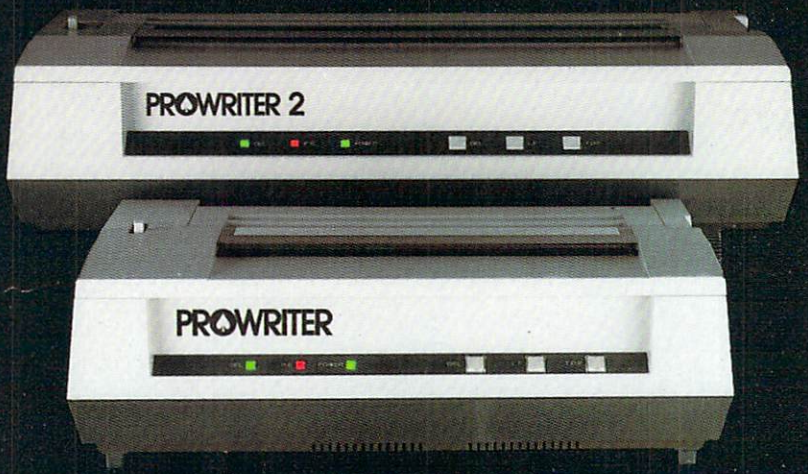


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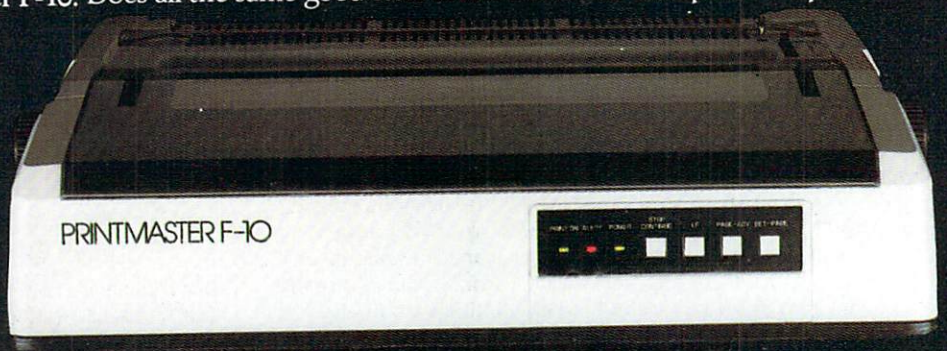


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Where can you find educational games that your kids will really enjoy playing?

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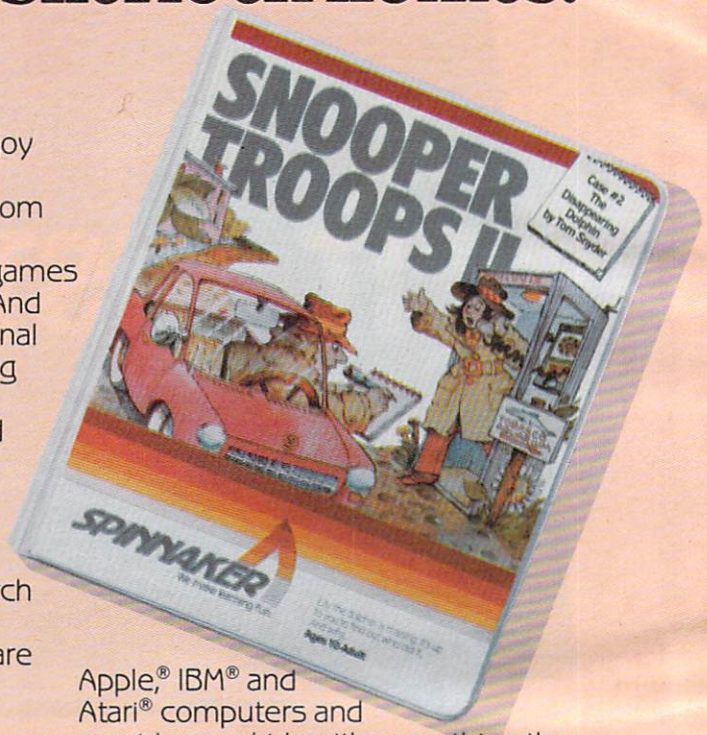


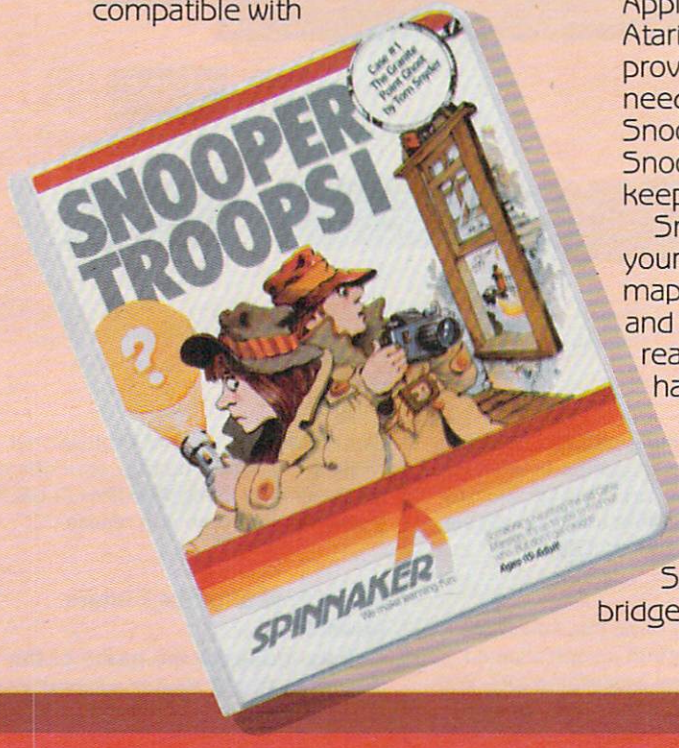


Snooper Troops detective games help your children learn to take notes, draw maps, organize and classify information and they help develop vocabulary and reasoning skills. All while your kids are having a good time.

So if you want to find educational games that are really fun, here's a clue: Snooper Troops games are available at your local software store, or by writing to: Spinnaker Software, 215 First Street, Cambridge, MA 02142.

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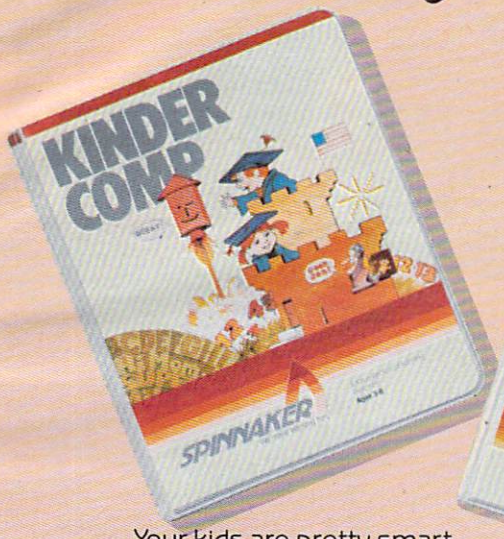


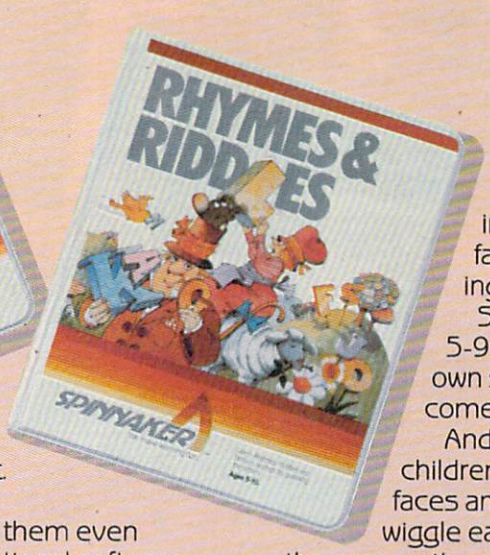


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And Spinnaker games are compatible with the most popular computers: Apple,® Atari® and IBM.®

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And FACEMAKER™ lets your children create their own funny faces and make them wink, smile, wiggle ears (not your kids' ears, the ears on the screen), etc.

And we're introducing new games all the time.

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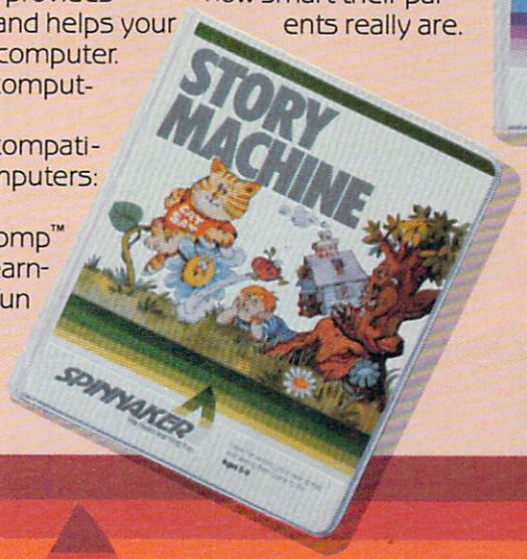


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February 1983 Vol. 5, No. 2

## FEATURES



## EDUCATION AND RECREATION



## REVIEWS



## COLUMNS AND DEPARTMENTS



## THE JOURNAL



**NOTE: See page 248 before typing in programs.**

### GUIDE TO ARTICLES AND PROGRAMS

**AP** Apple, **AT** Atari, **P** PET/CBM, **V** VIC-20, **O** OSI, **C** Radio Shack Color Computer, **64** Commodore 64, **ZX** Sinclair ZX-81, * All or several of the above.

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**New Z-80 VIDEO PAK brings CP/M® compatibility to your 64.** This exciting package gives you all the VIDEO PAK 80 features described above. Equally important, our built-in microprocessor and software give you CP/M compatibility for any programs formatted for the Commodore 1541® Disk Drive. The possibilities are truly awesome! Suggested retail: $299.95

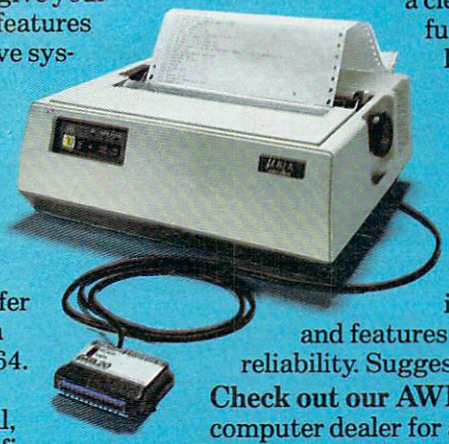


**New VIDEO CABLE completes the installation.** Here's the easy way to connect the monitor on your VIC-20 or CBM 64 system to our VIDEO PAK. A must for 80 column use! Suggested retail: $12.95

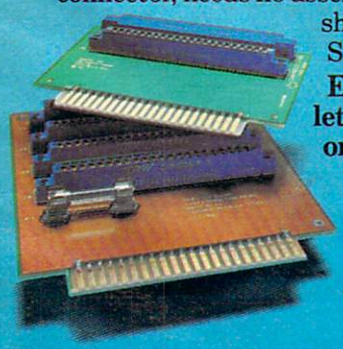
**New WORD MASTER—most cost-effective word processing system going.** Use

# FOR BOTH COMMODORES

WORD MASTER with our VIDEO PAKS to give your VIC-20 or Commodore 64 features found only in the most expensive systems. These include a full-function status display, up and down scrolling, and advanced on-the-screen editing features. All this and more for an exceptionally low price. Suggested retail: $89.95



**SERIAL PRINTER INTERFACE is simple, yet sophisticated.** Flexibility, continuous visual monitoring of data transfer functions, and easy installation make this a smart buy for your VIC-20 or Commodore 64. A glance at the status lights tells if the printer is hooked up, if the data buffer is full, and if data is being transmitted. Easily configured DIP switches match your computer to most popular printers. Our interface comes with cable and connector, needs no assembly, and virtually troubleshoots its own installation. Suggested retail: $69.95



**EXPANSION CHASSIS lets you use 4 cartridges at once.** Run a series of compatible memory, software or game cartridges of any make on your VIC-20. Just pop in any cartridge with the standard 22-pin edge connector. And don't worry about your computer's power supply—we protect it with a built-in 500ma fuse. Suggested retail: $49.95

**New MICRO EXPANSION CHASSIS for VIC-20.** Team this with our video expansion products and software cartridges. It's a neat two-slot board with one 22-pin edge connector in the normal vertical configuration and another at a right angle. This design keeps the VIDEO PAK in its normal position and gives a clean, functional layout for your hardware. Suggested retail: $34.95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# EDITOR'S NOTES

*Warner Communications* stock has been taking it on the chin during recent weeks on Wall Street. The problems started when Atari apparently fessed up to substantially slower sales of home video game cartridges than expected. This announcement promptly caused Warner (Atari's parent company) to plunge to a new twelve month low. Not only did the announcement of diminishing video cartridge sales clobber Warner stockholders, but tremors were promptly dispatched into the stock of Mattel and Commodore, among others.

We'd like to suggest the panic was cathartic in nature, inasmuch as anyone should have foreseen a diminishing share of the video game business in the Atari corner, given that their competition in the market has increased from just a couple of companies a couple of years ago to several dozen at present. Perhaps the real problem was that Atari itself didn't appear to take the competitive horizon into account in their own forecasts, and the rug was pulled out from under the stock with Warner's sudden announcement.

No one ever quite seemed to say that the video games weren't selling. From the commentary we read, it appeared they were simply saying that Atari was selling fewer video game cartridges. Part of this decline must be attributed to increased competition from the personal computer market. When you can buy a relatively sophisticated home computer with full color graphics capabilities for anywhere from $170 to $225, it again seems reasonable to foresee a bit of encroachment taking place. From all points, we're hearing that the Atari 400, the VIC-20, and the TI-99/4A are doing quite well, thank you.

So, in one sense, Atari's doing a good job of competing with itself, albeit in a morass of tight competition with the other personal computer vendors.

Now that we've raised the spectre of competition with self, we'd like to take a look at the new Atari 1200XL. An impressive name, but we're hard pressed to figure out what Atari is up to. The XL is destined to be formally introduced at the January Consumer Electronics Show in Las Vegas with a planned price point of less than $1000. One of the better attributes of the new unit, according to initial press releases, seems to be that it's a "breakthrough in attractive styling." Would you like me to repeat that for those of you clamoring for enhancements?

*We're concerned about the emperor's new clothes* because the actual features of the XL seem off base when compared to the competition. For example, the Atari 800. Here's a quick comparison, gleaned from the Atari announcement on the 1200XL:

| | Atari 800 | Atari 1200XL |
|---|---|---|
| Memory | 48K | 64K |
| User Programmable Function Keys | No | 4 |
| Cartridge Slots | 2 | 1 |
| Colors | 256 | 256 |
| Voices | 4 | 4 |
| Controller Ports | 4 | 2 |
| Price | Less than $700 | Less than $1000 |

Tom Halfhill will have a hands-on review of the 1200XL in our March issue. We're hopeful that additional capabilities and features will turn up. Right now, we're concerned that the 1200 has been introduced to fill a nonexistent hole in Atari's product line. Unless Atari plans a set of price decreases for the family of products (e.g., the 400 at less than $200, the 800 at less than $500, and the 1200XL at less than $800 or so), we fail to see the significance of the new introduction, or its competitive niche in the marketplace.

*Random Bits... The Commodore™ Gazette* (for the VIC-20 and Commodore 64) will premiere as a monthly with a May issue. For full details see page 245. As we noted last issue, *The Commodore Gazette* will not alter the current scope of **COMPUTE!** for VIC and 64 readers... we see the new magazine as a product geared even more to beginners than **COMPUTE!**.

We're moving. By the time this issue reaches you, we'll be in larger facilities. The growth of **COMPUTE!** and **COMPUTE! Books** has necessitated our expansion into new quarters. Our post office box remains the same, but our new street address is: 505 Edwardia Drive, Greensboro, NC 27407.

A Call For Articles: We're still looking for beginning and intermediate level applications and tutorials for TI, Atari, VIC-20, Commmodore 64, etc.

Robert Lock


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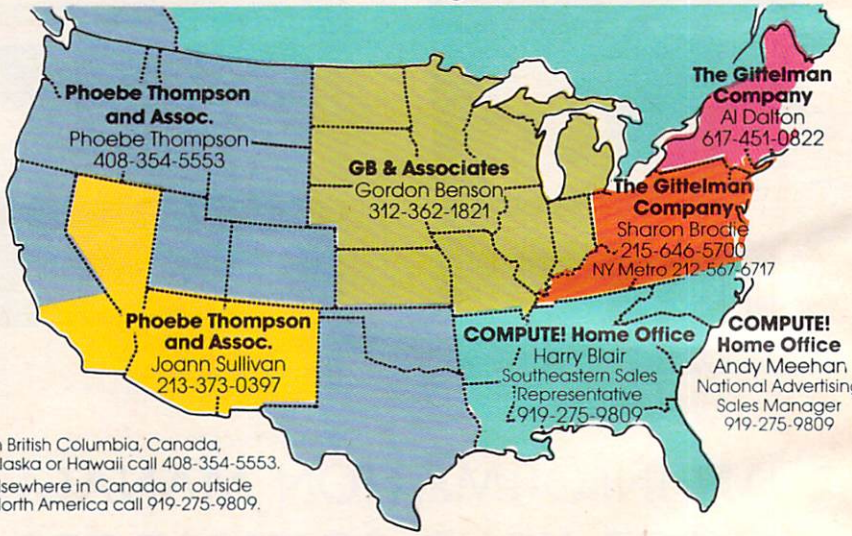


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# ASK THE READERS

The Editors and Readers of COMPUTE!

## Using VIC's Function Keys

Is it possible to use the special function keys on the Commodore VIC-20 while not under the control of a program? I have tried many ways and have not come up with a solution yet.

Brian A. Cohen

*See "Programming VIC's Function Keys" in* **COMPUTE!**, *November 1982, #30, pp. 196-198.*

## Commodore 64 Add-ons

Could you tell me if the following are available, forthcoming, or possible for the Commodore 64, and, if so, how (and from whom) I may obtain them?

1. 80-column display monitor
2. external RAM expansion
3. languages: Logo, FORTRAN, FORTH, COBOL, APL, or a language text editor
4. indexed sequential disk files
5. random access files
6. 132-column dot-matrix printer

Carleton B. Bass

*To answer your questions in order:*

**1.** *Commodore has no plans to provide hardware for an 80-column display. However, a number of other vendors already make peripherals which produce 40- or 80-column displays for the VIC-20 (look for their ads in this issue), so it seems quite likely that such products will soon become available for the 64. One reason Commodore has for not developing an 80-column display is that 40 columns is about the maximum resolution capability of the average home TV set. Anything greater than that requires a separate video monitor.*

**2.** *The 64K of memory built into the computer represents the maximum amount the Commodore 64's microprocessor can address. Thus, any external RAM would have to be "bank switched," and Commodore has no plans to provide such an expansion.*

**3.** *Versions of Logo and PILOT for the 64 are under development, and FORTH is almost certain to become available from an outside vendor. The optional Z-80 microprocessor add-on card will provide CP/M capability, and thus access to versions of FORTRAN, COBOL, and other languages. Each language has its own text editor, but there are no plans to provide a text editor separate from a language.*

**4. & 5.** *The standard VIC-1541 disk drive for the 64 provides the capability for both sequential and random access files.*

**6.** *A planned serial-to-IEEE interface will make it possible to use the Commodore 8023 132-column dot-matrix printer with the 64.*

## Pausing Atari Printer

Why does the Atari 825 printer stop for an extended period of time every once in a while? Is it from overheating?

Marshall Lake

*Sometimes, the printer will "time out" and will halt for several seconds. This is due to a bug in the 10K ROM operating systems, not the printer. This bug, and several others, has been fixed in the new Revision B operating system.*

*Contact your local authorized Atari service center for information on making a minor repair to solve this problem.*

## A Bevy Of New Commodore Drives

I own a VIC-20. I am also contemplating a purchase of a Commodore-64. As of this date I have not purchased a disk drive for my machine primarily for two reasons. The most important of these reasons is that I haven't seen the VIC-1540 disk drive subjected to any critical evaluation in the pages of **COMPUTE!** magazine. I am sure that many of your readers would be as interested in this information as I am. Although one might argue that this information could be obtained from the manufacturer, I would feel much more confident of the objectivity of the information and evaluation if it came from one of your expert writers (perhaps Jim Butterfield?).

Todd Oldham

*Jim replies:*

*Briefly, there's a whole flock of new Commodore disks.*

*The 2031 is a single disk unit suitable for use with PET/CBM; it uses an IEEE interface. The 1540 is a single disk unit suitable for the VIC; it uses a serial bus interface. The 1541 is a single disk unit suitable for either VIC or Commodore 64; again, it uses a serial bus interface.*

*All three disks are completely compatible with the 4040 dual disk in terms of format and transferability of programs and files. The 1540 and 1541 documentation hints that relative files cannot be used: in fact, they can; you'll need to do a little more programming on your VIC or 64 to get there, but the disk has all the features built in.*

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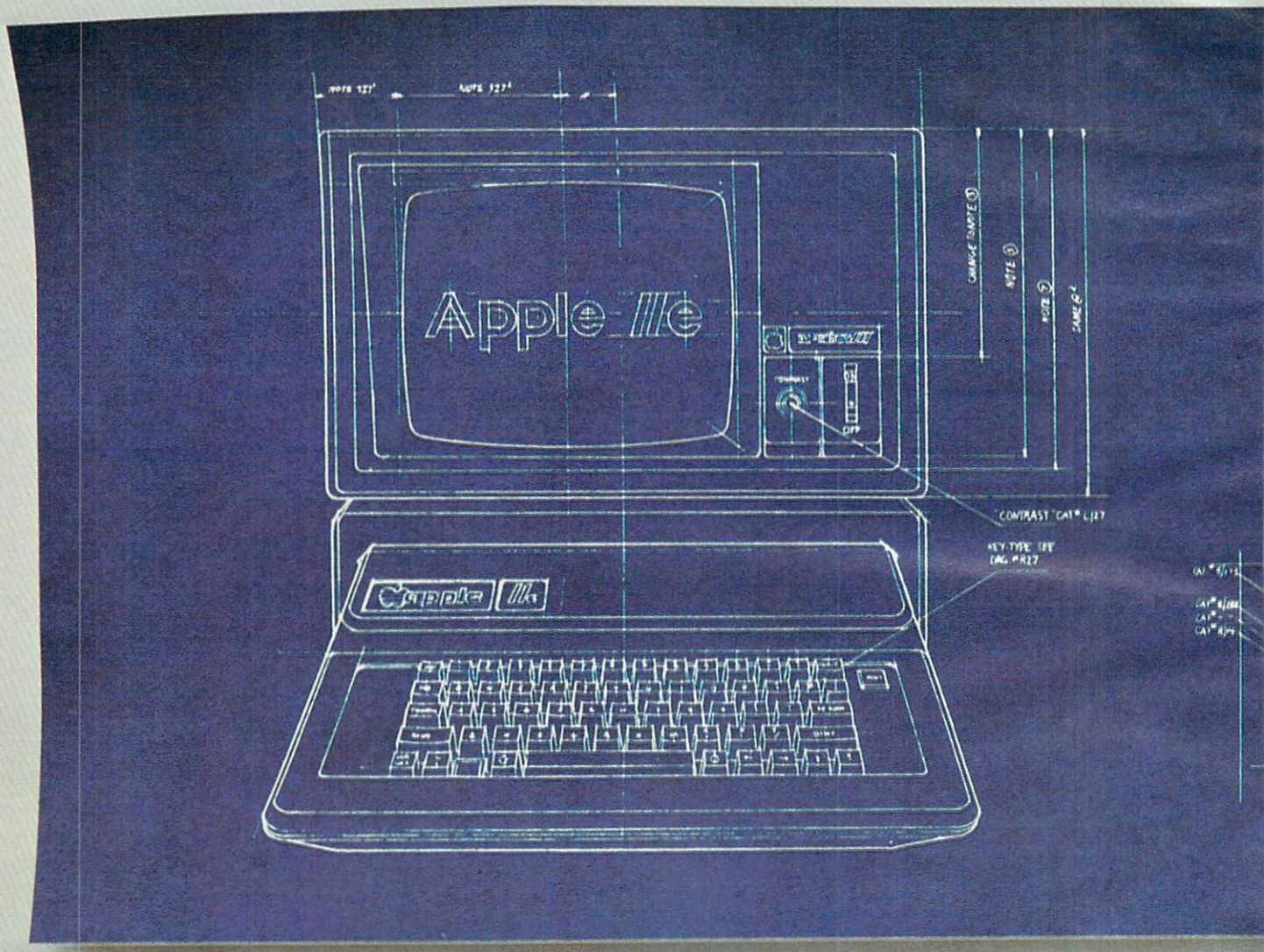


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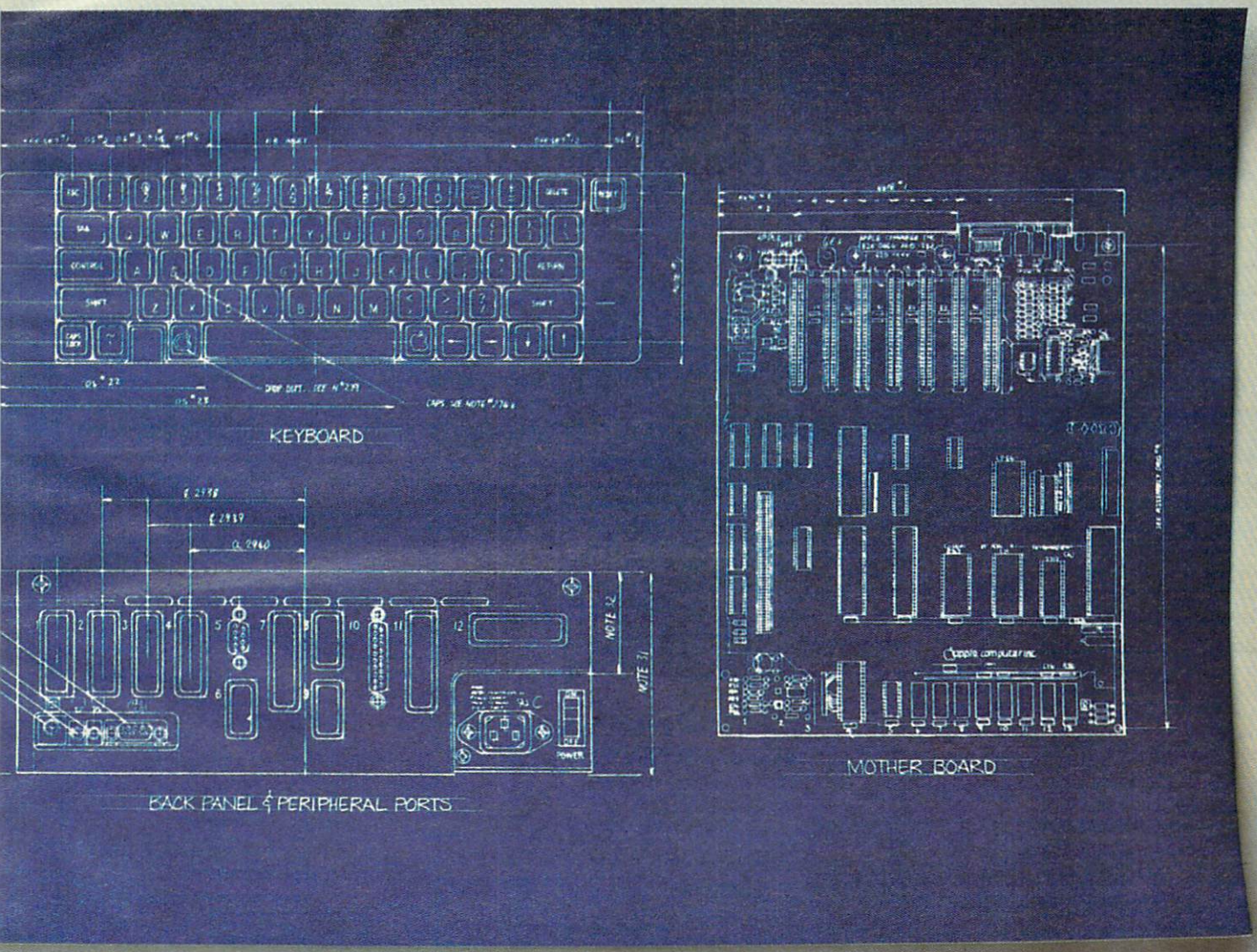


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*Also, all three disks have identical command protocols to the 4040 and 8050 disks, except that Copy and Duplicate won't do anything useful on a single disk. If the programs are compatible with the connected computer (this usually means no BASIC 4.0 commands), they will run regardless of which disk is connected. One limitation: the dual 4040 can have more files open simultaneously – up to six files – than the single units, which seem to be limited to about three at a time.*

*Now for the differences: the three disks are almost identical internally. Externally, the 2031 has a metal housing, but the 1540 and 1541 streamlined plastic enclosures. The 2031 communicates with the PET/CBM over the IEEE-488 bus, which means that it transfers information fast. The 1540 and 1541, by contrast, use the relatively slow serial bus. The 1541 is a little slower than the 1540; it may be used with either the VIC or 64. The 1540 is slightly faster, but can't be used with the Commodore 64 unless the computer is POKEd to blank the screen (POKE 53265,11 will blank the screen; after the Load, POKE 53265,27 will restore it). The 1540 can be changed to a 1540 by replacing a ROM chip.*

*A number of manufacturers offer adapters which interface the VIC and Commodore 64 to the IEEE bus. With such a device, you can get higher speed disk action, or use a dual disk if you wish.*

*Commodore is rumored to be retiring the 2031 single disk; their intention seems to be to re-announce it in a new form with a streamlined plastic housing similar to the 1540 and 1541.*

*Commodore has recently announced two high-capacity IEEE-488 disks. The 8250 is a dual disk unit with the capability of writing on both sides of a disk surface. It has about double the capacity of an 8050 unit: that is, one disk can now hold about 1.2 megabytes (million bytes) of information, which allows the 8250 to have 2.4 megabytes on line with both drives in use.*

*The 8250 has partial compatibility with the 8050 unit, allowing data to be transferred from 8050 format to 8250. The 8250 is said to have some problems, mostly involving files which continue from side one to side two. In switching sides, the disk often has to move its head over a considerable distance to find the proper track on the second side; this may result in time-out problems.*

*The D9000-series disks are high capacity "hard" disks. There are two versions, with capacities of about 5 megabytes and 7.5 megabytes. These disks are very fast internally; but their transfer rates are limited because of IEEE-488 speed limitations. Since the disks themselves are permanently installed within the drive, these units play a somewhat different role than that of floppy disks, which are user changeable. A hard disk tends to be more closely integrated into the computer system: its data and programs are viewed more as "built-in" rather than "plug-in." Because of the lack of replaceable media, the hard disk needs close attention on the questions of data security and backup.*

*Both the 8250 and the D series are generally compatible with other Commodore disks in terms of command sets. The D series, being a single drive unit, does not have backup or copy facilities. Both disk systems have substantially extended relative file capability: the size of a relative file is not limited as it was in the 8050 and previous disk models.*

*In general, all Commodore disks have a high degree of data compatibility within the 35-track (2040, 3040, 2031 and 4040) units and the 77-track (8050 and 8250) units. The computer-to-disk commands for reading and writing files and doing special jobs such as cataloguing or scratching files are completely consistent between units. It's easy to switch from one system to another.*

## Fuzzy VIC TV Picture

I am getting a poor TV picture when the VIC-20 is hooked up and activated. I believe it is RF interference. Is there any way to eliminate this so that I can obtain a clearer picture?

D. Murphy

*Early VICs caused severe interference problems, a feature which Commodore has made efforts to correct. For more information on solving your particular problem, call Commodore's technical assistance hotline, (215) 687-4311.*

## Apple DOS Toolkit on ROM

What I would like to know is if there is a ROM equivalent to Apple's "DOS Toolkit"? If one exists, I would like to know what company makes it, who or where I can get it from, and how much it costs. If it does not exist or you don't think it will in the near future, I would like to know if I could encode the existing Toolkit on an EPROM chip, put it on an interface card, and place it into any slot in an Apple's backplane? If this is possible, I would like to know if it could be used under Applesoft without disabling the Apple's firmware ROM. I know that this seems like a rather large request, but any information that you could provide would be most helpful.

Paul Lucas

*Apple does not manufacture such a ROM and knows of no one who does. Since most of the utilities provided in the Toolkit are stored as binary files, they could be transferred to EPROMs. However, a substantial amount of programming would likely be necessary to modify and relocate these machine language routines so they would work from ROM.*

## VIC Artifacting

I purchased a 16K RAM cartridge made by Commodore for my VIC-20 and noticed some strange effects on my TV screen. As the program is run-

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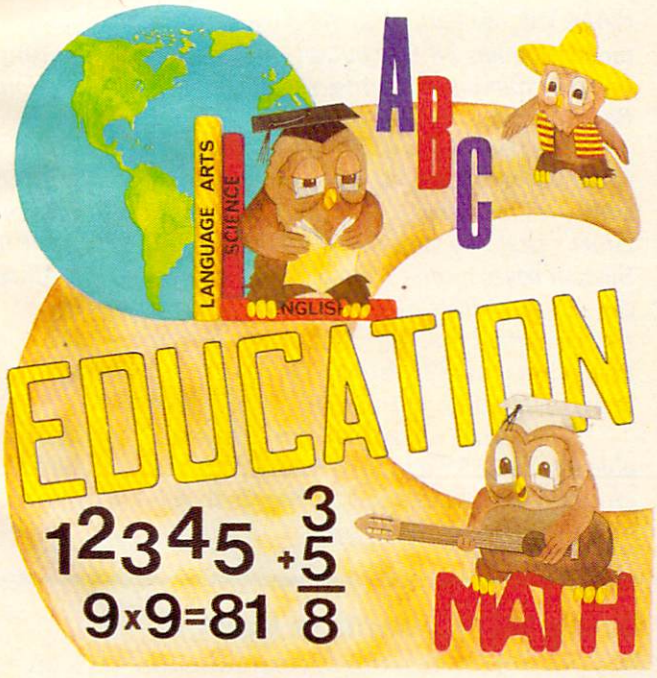


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ning the printing on the screen changes color, not the full word but individual letters, giving the screen a rainbow display. Also, it seems that the width of the letter changes. When the letters become the same color as the screen, it is impossible to read the words. I have tried two cartridges and both did the same. Can anyone help?

C. V. Lorigo

*This "effect" is known as artifacting, and is sometimes produced intentionally on other computers. However, Commodore has had no previous reports of their RAM cartridge producing such results. Have other readers with 16K cartridges experienced this phenomenon?*

## Upgrading The Original PET

We have an old PET 2001-8 which has been underutilized since we purchased a 32K machine with dual floppies. Of course, we are now over-utilizing the new machine. Does anybody know how we can upgrade the old PET to run our VisiCalc on it (32K and one floppy)?

Joe Ormond

*To get your PET to handle the extra memory and disk drives, you must first upgrade it to at least BASIC 3.0. For this you must take it to a Commodore service center and have some of the ROMs replaced. If your PET is an early model with 28 pin ROMs, you will need to ask for the Type 6540 Upgrade set. If yours is a later model with 24 pin ROMs, then you will need the Type 2316B Upgrade set.*

## Can The VIC Become A Commodore 64?

I am a VIC-20 owner contemplating selling my VIC and buying a Commodore 64. I have heard rumors that Commodore was going to manufacture a cartridge which would turn the VIC into a 64. I know a few other VIC owners who are also interested in such a conversion. If you have any knowledge of such a cartridge or expansion board in either the drawing or finished stages (from Commodore or other vendors), could you please share it? I'm sure that I and many other VIC owners would appreciate it.

Robert Pilat

*Despite their external similarities, the VIC and Commodore 64 have many internal differences. As a result, Commodore has no plans to produce any sort of add-on which would allow the VIC to mimic a 64. Whether an independent vendor will attempt such a project remains to be seen.*

## Missing Memory

I've had an Atari 800 computer for over a year now and have an 8K and a 16K RAM module for a total of 24K of memory. Just recently I purchased a 32K RAM module to increase the memory of the computer.

I know that the maximum free RAM that I can get is 37,902 by using the 16K and 32K memory modules, so out of a possible 49,152 (1024 x 48), I lose 11,250 bytes of memory.

In experimenting with various configurations of the three modules that I have, I came up with some interesting yet unexplainable (to me) totals for free RAM available. Listed below are my results:

| RAM Module | Total Possible RAM | Actual FRE(0) | Missing |
|---|---|---|---|
| 8K | 8192 | 5131 | 3061 |
| 8K + 16K | 24,576 | 21,518 | 3058 |
| 8K + 32K | 40,960 | 37,902 | 3058 |
| 16K | 16,384 | 13,326 | 3058 |
| 32K | 32,768 | 13,326 | 19,442 |
| 16K + 32K | 49,152 | 37,902 | 11,250 |

What I would like to know is why, when I put the 32K module in the computer alone, I have only 13,326 bytes of memory available and lose 19,442 bytes?

Thomas Bruton

*The memory discrepancies you have noticed are common to all computers and are known as* overhead. *All computers consume some "user" memory for various purposes when they're switched on. For example, a 5K RAM VIC-20 really has 3583 bytes free, and a Commodore 64 has 38,911 bytes (for BASIC programming). For an explanation of this, see this month's "Questions Beginners Ask" column.*

*The reason your 32K board does not yield 32K when plugged in alone has to do with the way the Atari addresses memory. The memory board plugged into the Atari's first slot (not counting the 10K ROM Operating System board) must have certain circuitry so the Atari can address all its memory. Atari RAM boards have this circuitry, but your 32K board does not. That's why you get the full 32K from your board only when using it in combination with the 8K or 16K boards.*

*There are "companion" or "loopback" boards available for about $5 which fit into the first slot, adding the circuitry to allow some 32K boards to operate alone and still yield 32K.*

## Using VIC's Function Keys

Is it possible to use the special function keys on the Commodore VIC-20 while not under the control of a program? I have tried many ways and have not come up with a solution yet.

Brian A. Cohen

*See "Programming VIC's Function Keys" in* **COMPUTE!**, *November 1982, #30, pp. 196-198.* ©

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# Questions Beginners Ask

Tom R. Halfhill, Features Editor

*Are you thinking about buying a computer for the first time, but don't know anything about computers? Or maybe you just purchased a computer and are still a bit baffled. Each month,* **COMPUTE!** *will tackle some of the most common questions that we are asked by beginners.*

**Q:** When I'm experimenting with player/missiles on an Atari 400/800 or with sprites on a Commodore 64, why don't the objects disappear when I press the CLEAR key to clear the screen?

**A:** To explain why, we'll briefly describe what "player/missiles" and "sprites" are. They're both the same thing, except that different manufacturers call them by different names. Sprites are an advanced feature of Atari computers, the Commodore 64, and the Texas Instruments TI-99/4A. Sprites are small screen objects which you can design in various shapes and colors as part of a program. Once defined, these shapes can be moved around on the screen very smoothly and quickly, using special features of the computer. Sprites are most often used for animation in games.

Although to users sprites look like just another image on the TV screen, they appear much differently to the computer. Computers display images on a TV screen by setting aside some memory which contains the information displayed on the screen. Everything seen on the screen is contained in this *screen memory* – except sprites. The information which describes the shapes and colors of sprites is contained in another part of memory. In fact, it is even contained in a separate microprocessor chip.

When the sprite memory is overlaid upon the regular screen memory, we see the sprite on the TV screen. This system allows sprites to move independently from other screen objects. In fact, it's possible for a sprite to pass behind or in front of another screen object without disturbing it. Look closely at a game to see this feature used to advantage.

Since the CLEAR key wipes out only the screen memory, the sprite is not erased. To get rid of the sprite without destroying the program, try pressing the SYSTEM RESET key on an Atari, or the RUN/STOP and RESTORE keys simultaneously on a Commodore 64.

**Q:** I'm shopping for a computer and comparing memory, among other features. Someone told me that a 5K RAM Commodore VIC-20 really has only 3.5K, and a 16K RAM Atari 400 has only 13K, and so on for other computers. I'm confused by these numbers. What do they mean? How can I tell how much memory a computer really has available?

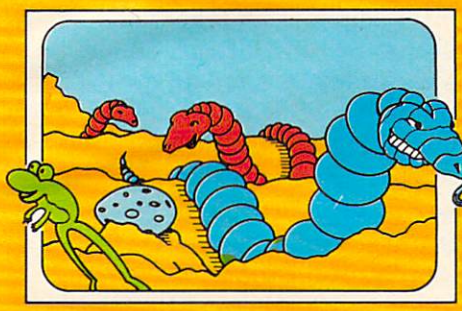
**A:** First, a brief explanation of RAM. Computers have two general types of memories: *RAM* (Random Access Memory) and *ROM* (Read Only Memory). ROM is permanent memory which cannot be altered by the user. ROM is used to store information which the computer needs every time it is turned on, such as the character set (the characters the computer displays), the BASIC programming language, the operating system (which governs the computer's internal operations), and so forth. ROM retains this information even when the computer is turned off.

RAM, on the other hand, is memory available to users to temporarily store information and programs. Data stored in RAM can be changed or erased as often as you want. It erases itself when the power is turned off. Both RAM and ROM are measured in *kilobytes*. A *byte* stores one character. A kilobyte is 1,024 bytes, abbreviated "K." Thus, "16K RAM" means the computer has about 16,000 characters of user-available memory.

But how much of that is really available to you? To some degree, all computers commandeer some RAM when they are switched on. This is called *overhead*. That's why all computers have less free memory than advertised. This is not considered deceptive advertising; the total amount of RAM has become a standard for comparison purposes, sort of like EPA gas mileage ratings for new cars.

On some computers, you can determine the amount of free memory by typing PRINT FRE(0) and pressing RETURN or ENTER. An unexpanded (5K) VIC-20 has about 3500 bytes; a 16K Atari 400, about 13,300; a Commodore 64, about 38,900; a 48K Atari 800, about 36,000. On other computers, you may be able to discover the amount of free memory by checking the manual or asking a salesperson. ©

# VIC-20 ?



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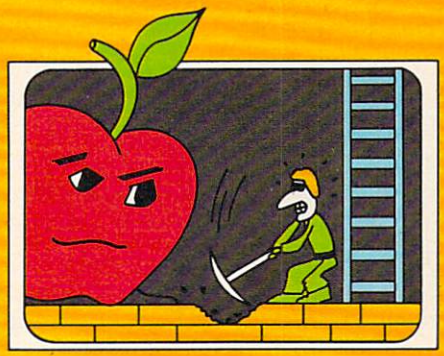

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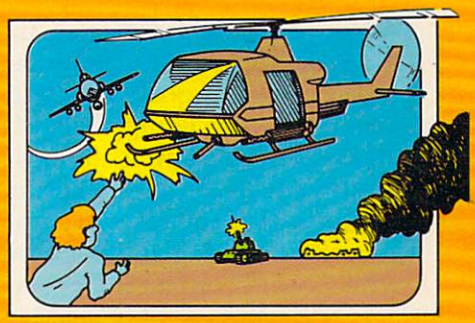

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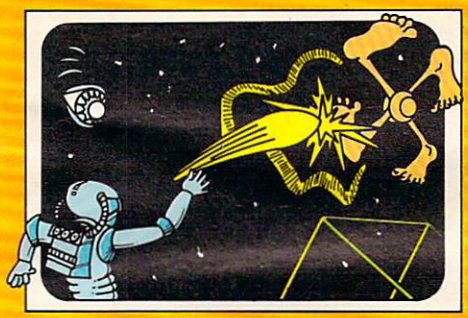

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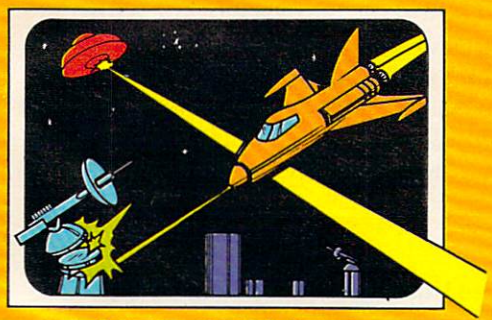

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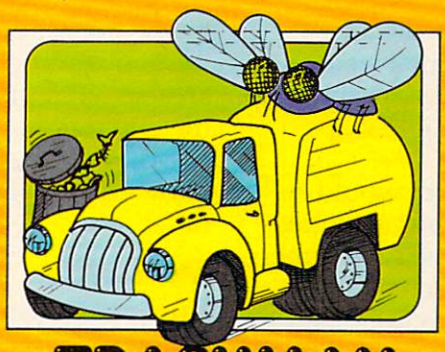
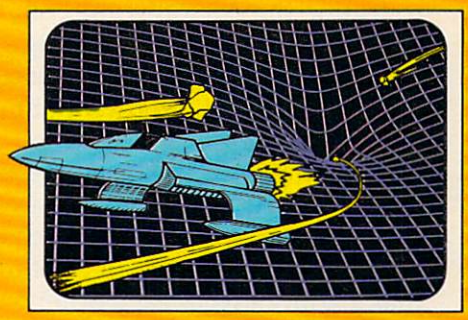


TRASHMAN



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CREATIVE SOFTWARE
201 San Antonio Circle • Mountain View, CA 94040

David D. Thornburg, Associate Editor

# Artificial Reality

A few years ago I designed an environment called the Kaleidophonic Experience. This exhibit consisted of an octagonal room about 20 to 30 feet across that was equipped with projection screens on each of the eight walls and loudspeaker columns at each of the eight corners. Each projection screen was illuminated by a programmable light source containing 16 filter wheels. Each filter wheel could contain images, polarizers, colored gels, etc., and could be used in conjunction with other color wheels to selectively control the illumination of each panel.

The speaker columns and light projectors were controlled by eight Atari 800 computers running in parallel (one for each projector and speaker column). The input for this room came from an instrumented tile floor in which each title sent position information to each of the eight computers. The software was designed to illuminate the room in a uniform glow if no one was present.

If a participant entered the room, the colors and sounds in the vicinity of the person were to be influenced by that person's activity level. If the participant just stood quietly, the region surrounding the person would fill with a warm orange light, and soft bubbling sounds would come from the speakers. If the user started to skip around the room, brighter lights would skip around as well.

In other words, the environment would respond differently to the user's various activities. If two people were in the room at the same time, they could send swirls of light to each other by making motions in each other's direction. Unfortunately, the Kaleidophonic Experience was never funded, so it was never built.

I have always wondered how people would react to responsive environments, and whether these environments might be useful laboratories for examining ways that people can convey information to computer systems. It was thus with great pleasure that I saw a copy of *Artificial Reality* by Myron Krueger. This book, recently published by Addison-Wesley, describes the results of Krueger's work over the past thirteen years, testing the idea that humans can interact positively with technology.

If you think that interactions that take place in highly instrumented rooms are artificial, consider that our present world has created an artificial reality for us that started with the industrial revolution. Most of our life is lived in a highly artificial environment. We transport ourselves with machines, we use machines to adjust our environment's temperature, we use machines to artificially enhance our communication – we seem to be totally captivated by an artificial reality. In fact, one has a hard time imagining our survival without the environmental modifications created by the industrial age.

Just as the industrial revolution (starting with the steam engine, perhaps) completely changed our relationship with our planet, our workplace, our homes, and each other, we can expect no less change to come from the information revolution, or whatever we will end up calling the computer age. The popularity of video game arcades shows one view of the electronic version of the artificial reality. Is a video game arcade anything more than an electronic version of a (principally mechanical) movie theater? Perhaps we should examine how people felt about the first commercial movie houses and compare that viewpoint with the concerns being expressed about the game arcades. Except for the change in the nature of the entertainment medium (both from the standpoint of technology and the level of user participation), I don't think there is much difference.

## Metaplay

Krueger recognizes that our artificial reality is going to change and, for aesthetic reasons, he decided to build some environments that could be controlled by the user. These environments generally consisted of rooms equipped with different types of display technologies and sensor systems. One of Krueger's environments was called Metaplay and was constructed in 1970. The focus in this environment was on the participant's awareness of his or her interaction with the environment itself.

Metaplay was constructed in an empty, square dark room with one wall dominated by an 8′ x 10′ projection screen. This translucent screen


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allowed the video projector to be placed outside the environment and to project its image from the rear. The remaining walls were painted with a phosphorescent paint. A large polyethylene sheet on the floor concealed 800 pressure sensitive switches. A computer in a separate building could generate responses to the participant's motion, or to both the participant's motion and the whims of a facilitator who was located in the same room as the computer.

Because the participants were being monitored by a TV camera, the projection screen could contain combinations of the video images of the participants along with computer generated graphics. This marriage of the computer and video images turned out to be a significant step in the development of the responsive environment. I will say more about the home applications of this marriage later.

Krueger's book describes some of the things people did in this and similar environments, as well as covering some of the technological issues associated with the creation of such technological artworks as Glowflow and Psychic Space. From his experiments with these environments, Krueger went on to develop Videoplace. Videoplace resulted from the premise that telecommunication between two places creates a third place, consisting of the information that is available to both communicating parties simultaneously.

The concept of a communication space separate from existing physical spaces has influenced Krueger's aesthetic thinking and has provided focus for hardware development. The original insight for Videoplace came when Krueger was in the gallery talking over the phone with a colleague at the computer center who was looking at an image on his display screen that was supposed to be similar to the one Krueger was seeing. In Krueger's words,

> *At first we talked over the phone about the displays we each had in front of us. However, after a few minutes of frustrating discussion, we realized that we had a far more powerful means of communication available. Using the two-way video link from Metaplay, we turned the gallery camera on the PDP-12 screen. The computer center camera was already aimed at the Adage. Both of us could now see a composite image juxtaposing the information being sent with that being received.... It was exactly as if we were sitting together at a table with a piece of paper between us.*
>
> *After a while, I realized that I was seeing more than an illusion. As I moved my hand to point to the data my friend had just sent, the image of my hand briefly overlapped the image of his. He moved his hand.... when it happened again I was struck by the thought that he was uncomfortable about the image of my hand touching the image of his.... The inescapable conclusion was that the same etiquette of personal space and avoidance of touching that exists in the real world was operating at that moment in this purely visual experience.*

Krueger goes on to describe his continuing work in this new area of artistic expression.

His book is a personal espousal of a humanism that accepts technology as part of nature – a most interesting thesis.

Those of us who don't have access to Krueger's environments can do some interesting experiments on our own. I am finishing a book on computer art and animation in which I suggest that the home VCR is a most valuable computer peripheral. Home video tape equipment, when used in conjunction with inexpensive special effects generators such as those made by Sony and Panasonic, allows computer users to mix personal computer graphics with realtime video images in some spectacular ways. The results are likely to be far more exciting than pure computer graphics (which tend to be almost too precise and static at times) and pure home-generated video.

One can see that this marriage of technology, much of it in the home already, will let people take greater control over a video medium that seemed, a few short years ago, to have us at its mercy. And personal control of technology is something we can all believe in. ©


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# THE BEGINNER'S PAGE

Richard Mansfield, Senior Editor

# Writing An Arcade Game

When you bring home your computer, usually the first thing everyone expects you to do is to write an arcade game. Who's "everyone"? It could be your children, your friends, even you – anybody who is tired of spending lots of money and wants you to program a game to play at home for free.

The best defense is to politely point out that:

1. Arcade games are among the hardest types of software to write.
2. Professionals, working in teams, can take a year to write one.

However, it is well worth trying to write action games. You might not be able to duplicate the speed or complexity of professional games, but you can create very entertaining games of your own. After you've spent a few weeks getting familiar with BASIC and have typed in a few games from **COMPUTE!**, you are ready to take up the challenge. This is one of the best ways to learn some important programming techniques and to explore the graphics and sound capabilities of your computer.

## Ten Million IF/THENs

Your main problem is going to be speed. BASIC, though fast enough for most jobs, is pretty slow when it has to keep track of ten aliens, two mother ships, torpedoes, stars, and the player's position. All these things are in motion at once. You need to have a way to control players, to detect collisions, to score points, etc. We recently received a letter from reader John Anderson which touches on these problems:

> *In order to make a fast, effective "arcade-style" game, I would like to know how to let my computer know where a large number of things are on the screen (like the walls in a maze) without 10,000,000 IF/THEN statements. I would also like to know how to keep things, like the little figures racing around during a game, from plowing through walls and wiping them out or coming back onto the other side of the screen.*

As John points out, the first solution that comes to mind is to use an IF/THEN test for every possible event in the game. IF the ball hits the target, THEN raise the score. IF the ball misses the target, THEN let it move one more space. And on and on. This quickly slows the action down to a crawl.

## POKE Ping Pong

One of the simpler arcade games is a simulation of Ping Pong. You need to keep track of only three things: two paddles and one ball. Let's start off by solving the hardest problem. How can we bounce a ball around the screen both quickly and accurately?

The key to the problem is the fact that many computers have an area set aside in RAM which is an *image* of what you see on screen. This is called *memory-mapped video* and most computers have it. It means that if you POKE into that area of RAM, a character will appear on screen. The next RAM byte address is the next space on screen, and so on. You can use this built-in "map" to tell what is where by using the fast "PEEK" command, and you can move things quickly with POKEs.

The example program will work as is on 5K VIC, Atari, or PET/CBM computers. Owners of other computers will need to make changes to the following variables:

**SCR** = The address where screen RAM memory starts.
**LN** = The length of one screen line.
**WALL** = A solid square that appears when this number is POKEd anywhere into SCR.
**BLANK** = A blank space character that returns the screen to normal if POKEd into SCR on top of a WALL or FIGURE.
**FIGURE** = A character that, when POKEd into SCR, looks like a ball.

The memory cells holding the screen image are located in different places in different computers. The Atari screen location itself can move, so you determine where it starts by using the formula in line 100. For VIC and PET/CBM, the numbers are given in line 100. First, draw a border around your screen like a picture frame. Perhaps print reversed spaces all around. (See lines 250-310.) This border is very useful. It will let you know when your ball has hit the edge.

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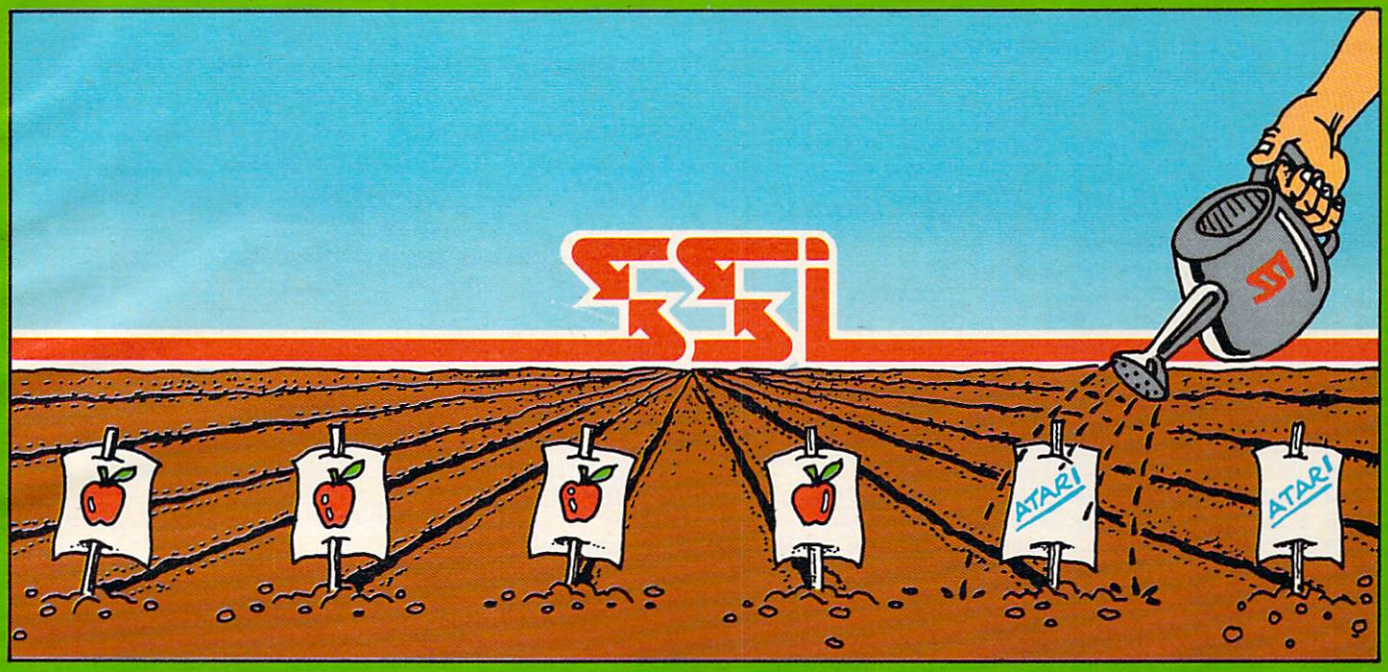


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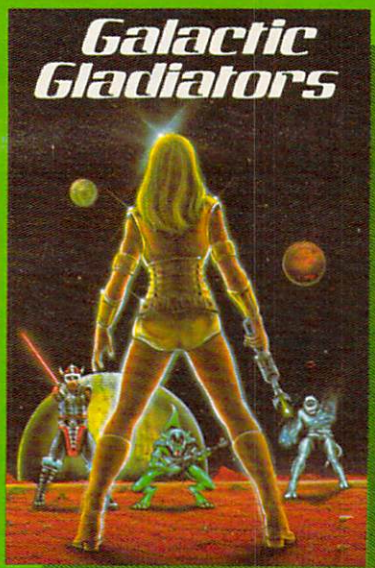


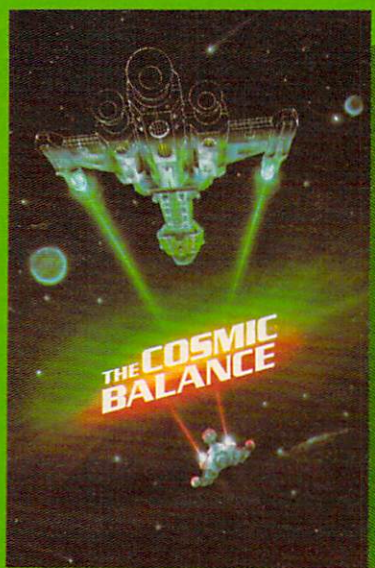


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## Program 1: PET, Atari, VIC, and 64 Version

```
100 SCR=PEEK(88)+256*PEEK(89):REM ADDRESS OF
    SCREEN MEMORY
105 REM USE SCR=32768 FOR PET/CBM,SCR=7680
    FOR 5K VIC
110 WALL=128:REM WALL CHARACTER, SOLID
    SQUARE.TRY OTHER CHARACTERS.
115 REM WALL=160 FOR PET/CBM/VIC
120 LN=40:REM LENGTH OF A LINE. USE LN=22
    FOR VIC,LN=80 FOR CBM 8032
130 GOSUB 260:REM DRAW BORDER
140 LOC=SCR+LN*10+LN/2:REM LOCATION OF BALL
    ON SCREEN AT FIRST
150 VECTR=LN:REM ALSO TRY -1,+1,LN-1,LN+1,
    ETC.
160 BLANK=0:REM BLANK=32 FOR PET/CBM/VIC
170 FIGURE=84:REM "BALL" CHARACTER. USE
    FIGURE =81 FOR PET/CBM/VIC
180 IF PEEK(LOC+VECTR)<>WALL THEN 200
190 VECTR=-VECTR:REM REVERSE DIRECTION
200 POKE LOC,BLANK:REM ERASE OLD BALL
210 LOC=LOC+VECTR:REM CALCULATE NEW POSITION
220 POKE LOC,FIGURE:REM PLACE BALL
230 GOTO 180
240 END
250 REM BORDER SUBROUTINE
260 PRINT CHR$(125);:REM CLEAR SCREEN. USE
    PRINT CHR$(147) FOR PET/CBM/VIC
270 FOR I=0 TO LN-1:POKE SCR+I,WALL:NEXT I:
    REM TOP
280 FOR I=0 TO LN-1:POKE SCR+LN*22+I,WALL:
    NEXT I:REM BOTTOM
290 FOR I=0 TO 22:POKE SCR+I*LN,WALL:NEXT I:
    REM LEFT
300 FOR I=0 TO 22:POKE SCR+LN-1+I*LN,WALL:
    NEXT I:REM RIGHT
310 RETURN
```

LOC is a variable in the program that's always changing whenever the ball changes. It keeps track of the current location of the ball. What you do is keep another variable (VECTR, in this example) which holds the direction and distance of the ball's current motion. When VECTR is added to LOC, we know where to move the ball next.

There are four possible directions to go in the simplest kind of animated games. Traveling up, VECTR = -LN since you subtract the number of spaces in one screen line to move the ball to the line above. Going down is +LN, right is +1, left is -1.

Notice line 180. That is how the computer tells if the ball has reached a border. The next position the figure is supposed to be POKEd into is checked to see if the WALL variable is sitting there. If not, the figure is moved (lines 200-220). If there is a wall, line 190 reverses the figure's direction.

If you type in the example program, you'll be on your way to making a Ping Pong game that will be as fast as you could want. What's left is to play around with VECTR to get different angles of bounce off walls so the ball can go anywhere. Then add two movable pieces of wall (paddles) and score-keeping.

## Other Computers

Some computers, the Apple for example, do not have standard memory-mapped video. There are usually provisions for moving objects, however. If your computer has a PLOT command, you can draw the walls in one color and then use another color for the ball. You will also need to use a LOCATE, POINT, or SCRN command to "read" (PEEK) the screen to check for collisions or a bounce off a wall.

## Program 2: Apple Version

```
100 GR : REM LO-RES GRAPHICS
110 GOSUB 1000: REM DRAW BORDER
120 X = 20:Y = 20
130 XVECTR = 1:YVECTR = - 1: REM START WITH
    UPPER DIAGONAL RIGHT DIRECTION
140 PT = SCRN( X + XVECTR,Y + YVECTR): REM
    LOOK AT POINT
150 IFPT=15 THEN XVECTR=-XVECTR:YVECTR=-YVE
    CTR:REM IF WALL HIT,REVERSE DIRECTION
160 COLOR= 0: PLOT X,Y: REM ERASE OLD BALL
170 X = X + XVECTR:Y = Y + YVECTR: REM
    UPDATE X,Y
180 COLOR= 1: PLOT X,Y
190 GOTO 140
999 END
1000 COLOR= 15
1010 FOR I = 0 TO 39: PLOT I,0: NEXT : REM
     YOU COULD USE HLIN 0,39 AT 0
1020 FOR I = 0 TO 39: PLOT I,39: NEXT
1030 FOR I = 0 TO 39: PLOT 0,I: NEXT
1040 FOR I = 0 TO 39: PLOT 39,I: NEXT
1050 RETURN
```

Since PLOT uses X, Y coordinates to locate things, it might be a good idea to keep changing the X, Y coordinates separately. Instead of using a single vector (VECTR in Program 1), use an X vector and a Y vector. For instance, the Y would be +1 and the X would be 0 if you wanted to move the ball downward. Program 2 is an example of this approach on the Apple II.

*If there is a topic that you would like to see discussed in this column, send a card or letter to: The Beginner's Page,* **COMPUTE!** *Magazine, P.O. Box 5406, Greensboro, NC 27403.*

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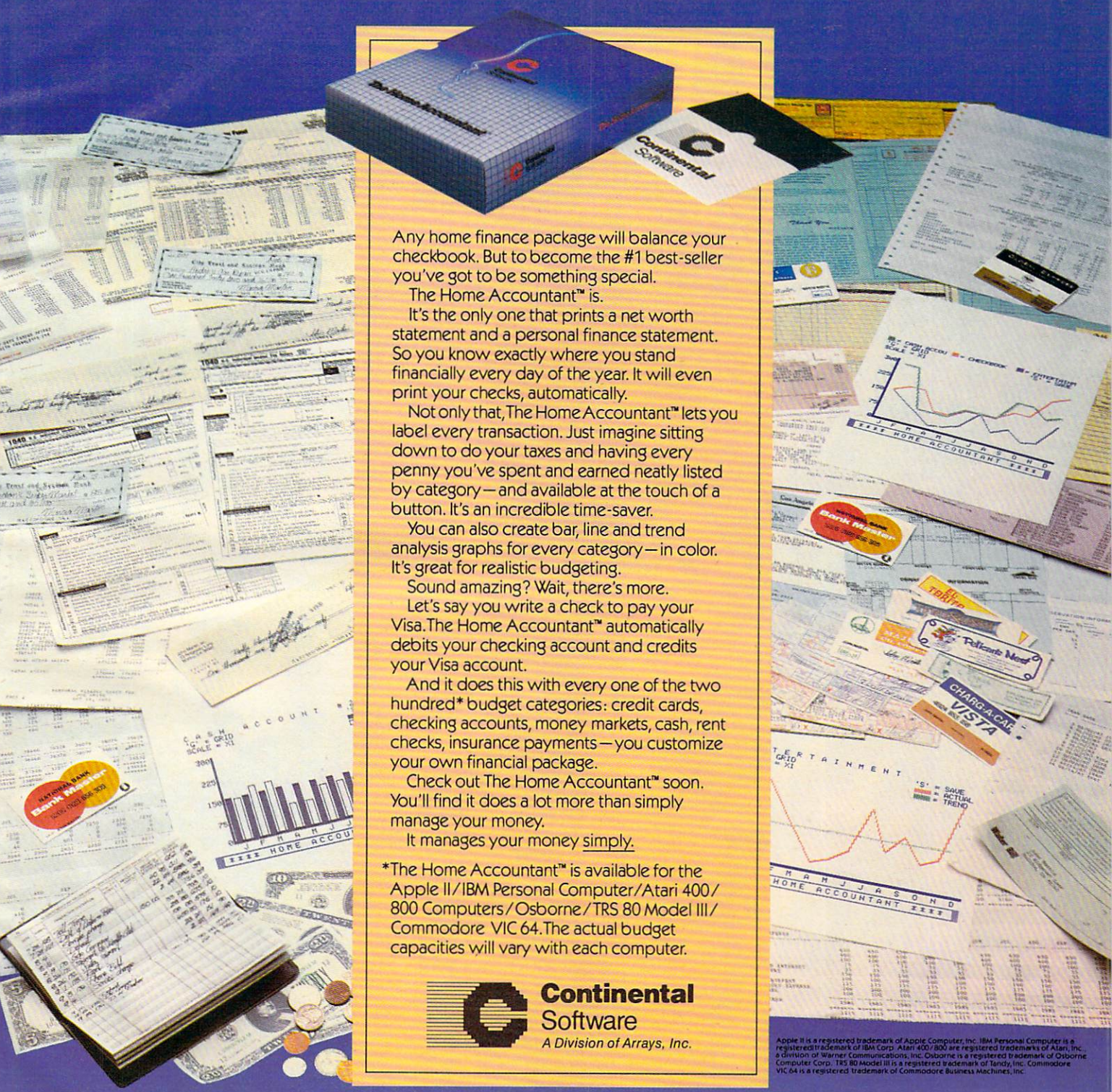


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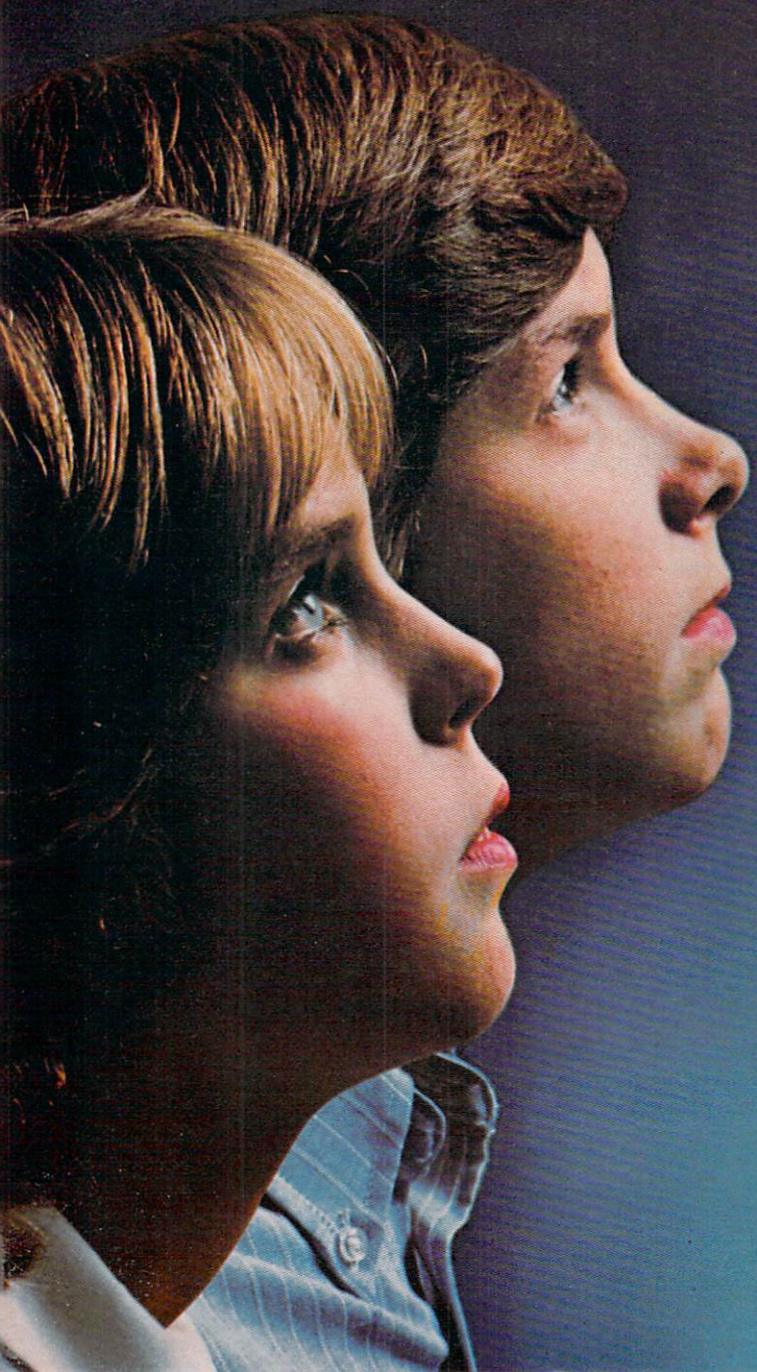

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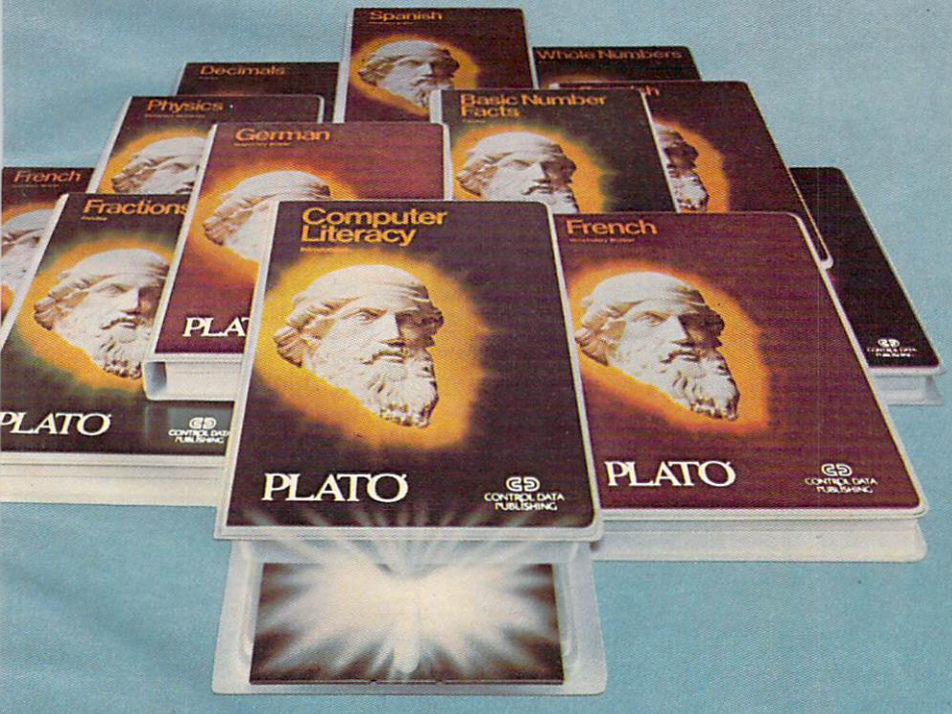


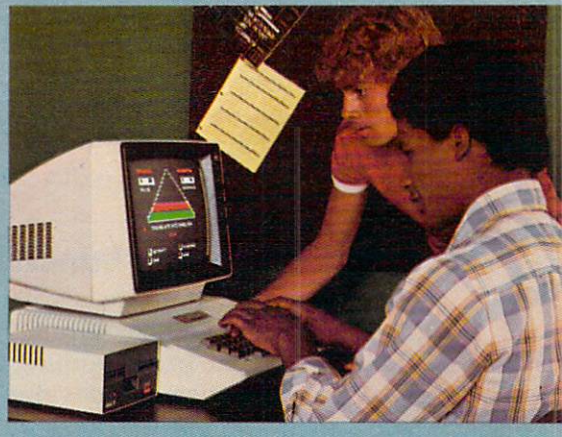

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# PLATO®

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# How The Pros Write Computer Games

Tom R. Halfhill, Features Editor

*Have you ever admired a computer game, and wondered how it was programmed? Where the programmer got the idea or what programming tools were used? Or how long it took? Here's the inside story on how professional game programmers work.*

So there you are at one o'clock in the morning, nodding over your computer keyboard with bloodshot eyes, trying to program your first computer game in BASIC. "Space Weirdos" seemed like a good idea at first, but it isn't turning out that way. The Weirdos keep flying off the screen and causing errors. Even when the Weirdos are on the screen, they move so slowly that they could be zapped by a sleeping zombie. And now you realize that there's no way for the game to keep track of scores.

Obviously, there must be some trick to programming games that you don't know about. How did that guy ever program *Raster Blaster*, anyway? That fellow who did *Space Eggs* must've taken ten years....

## An Individualistic Bunch

Actually, of course, there is no "trick" to programming a top-notch computer game. Like most other skills, game programming is an art which usually requires years to develop (although a few have done it in months).

Good game programming requires a high level of mastery of the computer, and the ability to constantly push the machine to its limits – or even beyond established limits. It is safe to say that some of the most innovative microcomputer programming going on today is in the field of entertainment. Techniques discovered and sharpened by game programmers spread to educational programs and even business software (witness how high-resolution graphics are becoming as standard a feature on high-end personal computers as 80-column screens).

Not only is there no "trick" to game programming, but there is also no single style. Although many people think of programming as a primarily technical task, it is really a highly creative pursuit. As a result, professional programmers tend to be a very individualistic bunch. The game programmers we contacted advocate several different styles. And it's a good thing they usually work alone on projects, because some of their styles are totally incompatible with each other. For example, some programmers work everything out on paper before they ever touch a keyboard. Others sit down at the keyboard and start hacking away without ever touching paper.

On the other hand, professional game programmers also have some characteristics in common. Nearly all are men in their 20s who have been working with computers for several years. Many were introduced to computing as teenagers. They tend to specialize on one particular computer, often the one on which they learned. Surprisingly, few professional game programmers have computer-related college degrees, or even any formal education in programming. Virtually all of them write their games 100 percent in machine language.

## Start With An Idea

Computer games have a lot in common with novels. They begin life as an idea in someone's mind, an idea that is then developed into a "scenario," or plot. When the idea has matured or solidified to a certain point, work begins. As things progress, parts of the original idea may be dropped, and subplots may be added. After much revision, the work finally approaches completion. Often, the work is declared "done" only because the author is too spent to carry it any further, or because a deadline looms. Then, like a novel, the computer game hits the market and lives or dies on the effectiveness of its promotion, the reactions of reviewers, and the response of consumers. Only a few rise to the top and become best sellers.

Obviously, the first critical step is coming up with an idea. Video game designers are being criticized these days for copying each other's work, but the better ones spend lots of time racking their brains for original concepts. How do they go about it?

"That's a real tough one," says Mike Branham, manager of software development for Synergistic Software in Bellevue, Washington. "First of all, we decide what type of game we want to do – such as an adventure game, another space game, a general arcade-type game, or whatever.... The programming staff here provides a

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by Mark Kuzyk

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lot of creativity. We'll start with an idea and develop it as the game progresses. Usually the scenario has changed by the time the game is finished, because of certain limitations and so forth."

Sometimes, says Branham, instead of building a program around a scenario, a scenario is built around a programming technique.

"*Procyon Warrior*, for example, is a game we released just to show off the capabilities of the Fast Draw portion of our *Game Animation Package* [a collection of graphics utilities sold by Synergistic]. We started with that technique and built the whole game around it."

At Synergistic, multiple minds are involved in shaping a game concept on paper before a programmer even approaches a computer. An important part of Branham's job is supervising this process, and later, helping the programmers out if they get stuck on certain routines. "We'll start by writing a list of all the things that will happen in the game. We'll write page after page of 'what-ifs' – what if this happenns or what if that happens. Then we pare it down, eliminating those things not valid to the game or possible on the machine."

One of Synergistic's staff programmers is David Kampschafer, who wrote *Planetary Guide* and parts of the *Game Animation Package*, both for the Apple. Kampschafer searches for inspiration from such diverse sources as "TV, magazines, talking to people, going to arcades, reading a story in a book. It's just a matter of looking around and seeing what people enjoy, what they want, what they think is fun."

Dropping by the local arcade, it turns out, is the most common way professional programmers generate ideas for new games. They gravitate toward the machine which attracts the largest crowd, and try to figure out what makes the game so popular. Is it the scenario, or a certain graphics technique? Often they can find out only by playing the game themselves, perhaps hundreds of times.

"I wouldn't call myself a game fanatic, but I do go to the arcades now and then," says Jack Verson of JV Software in Santa Clara, California. Verson programmed *Ghost Encounters*, *Action Quest*, and JV's latest release, *Journey To The Planets* – all combination arcade/adventure games.

Verson says a few programmers still visit arcades to find a new game to copy. "I know some people who try to copy the arcade games almost verbatim, changing it just enough to avoid problems with the legal staff."

However, more copycat programmers are abandoning this practice because of vigorous prosecution by companies such as Atari, Inc., as well as increasing competition. Still, incentive remains to quench the game-playing public's thirst for home computer replicas of arcade-style games.

## That's How The Ball Bounces

Some games are conceived as accidents. Or, as programmer Nasir Gebelli admits, "Some games come from mistakes. I'm experimenting with something and a good image comes up, and I think it might be good in a game, so I develop the game around it. The image would come first and the story would come later."

Gebelli, almost legendary among Apple gamesters for such works as *Space Eggs*, *Cyber Strike*, and *Gorgon*, started programming for Sirius Software several years ago before splitting off to form his own company in Sacramento, California, Gebelli Software, Inc. He's one of those programmers who disdain paperwork; 95 percent of an idea is formulated in his head before he starts programming, he says, and only five to ten percent of the original concept changes during the course of work.

In Gebelli's case, his entire career came about by accident. "Programming games wasn't something I always wanted to do, it was just something that happened," he explains. "I got an Apple and was interested in the color and graphics, and then wrote a graphics package. And the routines in the graphics package weren't for anything, really, except to show off."

Gebelli showed the package to a Computerland salesman, who offered to buy it. Realizing he was on to something, Gebelli wrote a game called *Star Cruiser*. It was marketed by Sirius, and his career was launched.

Lots of games have been hatched from graphics experiments. Among these are two from Datamost in Northridge, California. "*Pandora's Box* and *Guardian* were both totally original concepts which I came up with just to do some graphics which had never been done before," says Datamost programmer Bob Flanagan.

"The Apple game market is so crowded that you have to do something really different to stand out. My ex-girlfriend actually suggested the name *Pandora's Box*, and I built the whole game around that name. It uses multidirectional full-screen scrolling, much like what you commonly see on the Atari. That had never been done before on the Apple because it's so much harder to do."

Another accidental game is the popular *Pool 1.5*, sold by IDSI of Las Cruces, New Mexico.

"I'll tell you what happened with *Pool*," says Howard de St. Germain, who wrote the game with his partners, Don Hoffman and David Morock. "Before I got involved in microcomputers, I was working on a Remtek system [a large minicomputer] and became interested in the idea of simulating the interaction between two


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balls – just that aspect of it, not even thinking about pool."

While contemplating how the ball bounces, de St. Germain mentioned his idea to Hoffman, who was experienced with Apple graphics. Hoffman suggested that with the proper mathematics, they could develop the concept into an entire pool simulation. They got to work, and, after three or four months of part-time labor, emerged with the first Apple version of *Pool*. Then they formed IDSI and started making money. Since then, they've translated the game to work on the Atari, and have written two variants: *Pool 400*, a stripped-down version that fits into an Atari cartridge, and *Trick Shot*.

Next, one of the partners attended an Atari workshop to learn Atari programming techniques, and developed a fast top-to-bottom, fine-scrolling routine. Without any clear idea of how the game would end up, the three spent six months of part-time work shaping the scrolling routine into *Freeway Blast*.

*Freeway Blast* also is proving successful. But does that mean IDSI will continue to take the dartboard approach to game concepts? No way, not in today's market, says de St. Germain.

"To tell you the truth, when we first started in this business, we didn't begin with solid ideas for games. But we do now. From experience now we know what elements a game needs to be successful."

These elements include a two-player alternating-play option, high score tabulation so players have a larger goal to aim for, a pause option in case of ringing telephones or other interruptions, and multiple difficulty levels.

Like IDSI, virtually all the software houses are taking a more studied approach to game programming. Where once a programmer would write a game on his own and drop it in a company's lap, now marketing considerations are determining the nature of games before they ever leave the planning stages. Because of hotter competition, putting a new game on the market requires an ever-larger commitment on the part of a software company, so marketing minds rule where once only lone programmers trod.

"I am not the person who knows what the market is like," explains Datamost's Flanagan. "I mean, I know what I like, but I don't know what the market likes. They [the marketing experts] do, because they're out there dealing with it every day, so I go to them to see what they want."

As an illustration, the last game Flanagan dropped in his boss's lap was *Pandora's Box*. His latest work, *Spectre*, was developed only after careful planning and consultation with Bob Gordon, owner of Datamost.

## The Paper Chase

Once everyone is satisfied that the basic idea is solid enough to warrant a programmer's valuable time, work begins. But this stage – the most critical to a game's development – is where the programmer's individual style still rules supreme. You can divide programmers into two general groups: those who work everything out carefully on paper first, and those who don't. Of course, there is a range of styles in between. The two extremes are represented by Nasir Gebelli and Synergistic's David Kampschafer.

Gebelli does it all in his head. He just sits down at the keyboard, usually an Apple, and starts programming. "Theoretically, you can program anything in your head that you can program on a computer," he says.

Gebelli doesn't use a printer, and he programs the machine language with a mini-assembler so sparse that he cannot even go back and insert a line of code. Any revisions must be made by relocating the entire program in another area of memory. What's more, sometimes he doesn't even bother to save the source code after the program is assembled into machine language.

"If I wanted to change something in *Space Eggs* right now," says Gebelli, "I'd have to look at it the same way I'd look at anybody else's program – figure out what the routines are doing and then change them."

Nor does Gebelli have a predetermined goal to work toward. "I never really finish a program," he says. "I just stop working on it." Gebelli takes anywhere from one week to one and a half months to complete a game, which is less time than most of the other programmers interviewed by **COMPUTE!**. He says *Space Eggs* took seven or eight days, working eight hours a day, and that *Gorgon* took five weeks.

Still, Gebelli admits that sometimes his methods slow him down – such as when he decides to change all the shapes on the screen when the game is nearly done – but it's his style, so he sticks to it. As the saying goes, who can argue with success? But Gebelli is definitely the exception; few programmers are comfortable with these methods. Kampschafer is Gebelli's opposite.

"I'm a paper programmer," says Kampschafer. "I write everything on paper first – flowcharts, outlines, everything. I even write the assembly code on paper first before going to the computer.

"In writing any kind of program, whether it be a game or educational program or business software, you should plan it all out ahead of time so you know exactly what you're doing as you write the program. If you force yourself to work it out on paper first, you'll find that it will cause

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you less work in the long run. You'll actually get done in less time. Of course, I do it that way because I was trained and taught to do it that way, but it really does work."

## Parlez-vous 6502?

One of the things to be decided during the planning stage is what computer language to use to write the program. In most cases, there's no question: machine language. There's a good reason for this: speed.

Although BASIC and similar high-level languages are easy to use, they are also relatively slow, since their rather abstract instructions must be translated (or *interpreted*) line-by-line into the computer's own binary code *while the program runs*.

The computer interprets the instructions so fast that the delay isn't noticed in most programs. But games are a different story. Animating a multicolored object – or many objects – across a TV screen at high speed requires thousands of calculations per second, and often the only answer is to write the program in the computer's own language so it doesn't have to do any interpreting. Ergo, machine language.

Here again, programmers' styles vary widely. In the old days of computer programming (the real old days, the 1950s), programmers had to hand-assemble their code, laboriously coding the instructions directly in binary (a base 2 numbering system), octal (base 8), or hexadecimal (base 16).

Nowadays, virtually all machine language programmers use an *assembler*, a programming utility which is often flexible enough to be called a language itself. Assemblers vary in their features, but in general they make the coding process easier and more abstract. Some programmers, like Gebelli, use stripped-down assemblers with almost no extra features. Others use very advanced *macro assemblers*. Still others, like Synergistic's Kampschafer, find it easier to write programs or parts of programs in a high-level language and then translate them to machine language.

"I do this," explains Kampschafer, "to get an idea of how the action is going to happen, and how the program looks. I like to use structured languages such as Pascal because I like the structure; it helps me to organize my thoughts."

Programmers such as Kampschafer, who was formally trained in programming and is working toward a degree, also prefer to write their programs in modules, small sections. This also helps at the debugging stage.

"For example, you might have a little guy running, and monsters moving, and hazards happening, and scores updating, so you write these parts as separate modules and try them out first to make sure they're working properly before joining them together."

Some game programmers carry this even further by maintaining a library of routines for animation, scoring, initializing, and other functions common to nearly all computer games. They build a new game by modifying these tried-and-true routines to fit the task at hand. But other programmers write each game from scratch, arguing that the more specific the machine code, the faster the execution. If you haven't already guessed, that's Nasir Gebelli's method.

Flanagan, of Datamost, prefers to start most of his programming on paper. The exceptions are simple routines such as sound effects, joystick reading loops, and routines for printing characters on the screen. "The first thing I do once I've come up with the actual idea is to grab some graph paper with a 20 by 40 grid and plot out exactly what the screen is going to look like, what's going to be in each square."

Then he sits down at his Apple and boots up Microsoft's *Assembly Language Development System* with CP/M. "I can usually get a sample screen working for a game within a couple of hours."

Next, Flanagan starts on the animation. "I use the 'top-down' programming approach that they talk about in all the books. I break the task down into a series of simple problems, and sometimes those simple problems can be broken down even further to be solved one by one. That's better than just writing a huge mess of a program and then sitting back and saying, 'Now, what's wrong with this program, which routine is messing up?' "

At Synergistic Software, the programming staff invested lots of time developing a package of utilities to streamline the game-writing process. Synergistic has a bit-mapped graphics editor and a block-draw routine running on all its machines, and its own integer BASIC compiler for the Apple (a *compiler* automatically translates a program from a high-level language into code which is very close to machine language). Branham, the software development manager at Synergistic, says one of his programmers can sit down at an unfamiliar machine and, with these utilities, begin writing an advanced game almost immediately.

"Tools are a most important part of a programmer's cache of programming skills," says Branham. "The programmer who doesn't have tools and who wants to hard-code everything from scratch is going to be in for a lot of headaches, and is going to take a lot of time. These are the type of programmers who will spend two years writing a brilliant game that becomes a bestseller and makes them a million dollars a month and everything, but then when you say, 'Translate it over to the Apple,' they answer, 'Give me another year.' They're lost because they have to re-do everything from scratch."

Although Branham encourages his program-

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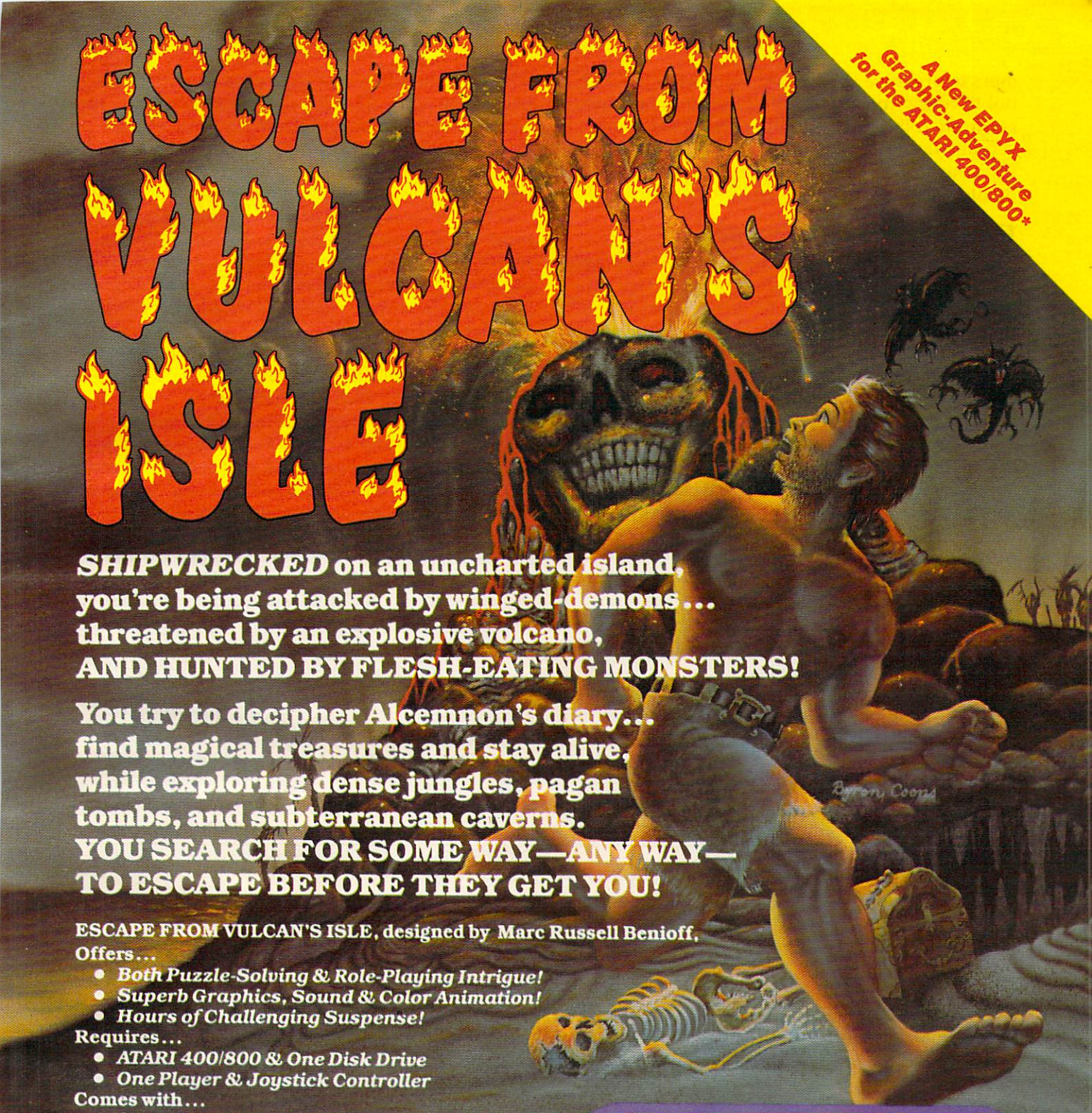

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mers to organize their work, he says he is careful not to cramp their style. "We let our programmers retain their individuality. If we tried to force a certain way of doing things on our programmers, then our programmers would get unhappy and would go somewhere else, to Sirius or wherever."

## The Difficulty Of Difficulty

Most of the programmers we talked to say it takes them a couple of months to complete a typical game program. Polishing the program is sometimes the hardest part of all. Many programmers say the final ten percent of the program causes 90 percent of the heartache. That's because errors have to be weeded out, rough edges smoothed, and the game's final "character" molded.

"You have to spend a lot of time watching other people play it," says JV Software's Jack Verson. "Especially adventure-type games where there are many objects to be picked up or cropped or moved around. There are many possible permutations.... You've got to watch the person explore all those permutations, because they'll always do things you didn't anticipate, things I would never do myself and didn't account for in the program. That's when bugs show up. You've got to cover all the possibilities."

Verson's testing stage usually takes about a month. When he "finishes" a game, he gives it to friends to test – including some who work at Atari. Other testers include teen-agers and his children, aged eight and ten. If he works on a game part-time, it requires about four months from start to finish. If he works on it full-time, he can do it in about two months.

The other software developers also spend weeks debugging and testing their new games, making sure they are ready for the marketplace. A common problem they all face is adjusting the game's difficulty.

"A lot of the difficulty in writing a game is making sure that a beginner is not going to be able to master it at the first sitting and move up to advanced levels, or that they're not going to get so frustrated that they'll throw it away," explains Flanagan.

Verson adds, "You're selling games to real young kids, maybe eight or nine, and also to people in their 20s who might spend $50 a week in the arcades, and who need something that's really challenging."

The most common solution to the "difficulty" issue is trying out the game on a variety of people, and building in features such as multiple difficulty levels. The other alternative is to aim the game at a certain age group, but that restricts sales.

## For The Love Of It

Once the program is finally honed to perfection – or at least as close to perfection as patience and marketing demands allow – the game is ready to be packaged and sold. Advertising and promotional campaigns are geared up, copies are sent to key magazines and users groups in hopes of favorable reviews, and the payoff presumably follows.

Those "marketing demands" might include a deadline, such as the Christmas season. Or perhaps the software company has another assignment for the programmer. Or maybe the company has decided to maximize its investment by translating the game to work on several popular computers. When things get really hectic toward the end of a project, a company might put extra programmers on the job to finish it up in time. One programmer might be coding the sound effects while another is completing the animation.

Although software firms are far from Detroit assembly lines, they are becoming more organized and efficient as the industry grows and big consumer dollars are at stake. The days when crude games could survive and even prosper are approaching their end. As the overall level of quality increases, and competition multiplies, only the best games will satisfy the more sophisticated gamesters who make up the buying public.

But don't fear that something as inherently creative as writing games will ever become too serious. After all, the best games throughout history were invented by people who were simply out to have fun. Did it take a marketing expert with an MBA to invent baseball? Or chess? No way. That's why Verson, of JV Software, believes that one of the most important qualities a computer game programmer can possess is a love of computer games.

"It's probably important to be able to enjoy playing the types of games you're trying to program. You couldn't, for example, go into an arcade and watch people playing arcade games and say, 'Well, I don't care much for these types of games, but other people seem to, so I'll go home and write one.' You have to like what you're doing." ©

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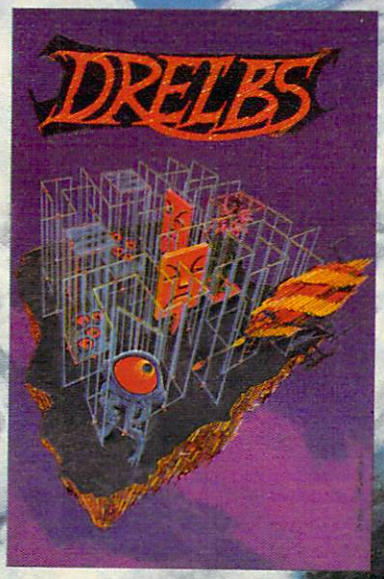



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# A Day At The Races

Robert B. Ferree

*This simulation of a racetrack, complete with animation and color, can serve as an effective model for beginners interested in programming their own games on the VIC or Atari. What's more, it's fun to play.*

An occasional complaint heard about game playing on personal computers is the lack of the high-resolution graphics of arcade machines. In the direct or program modes, the basic VIC with 5K has a resolution of 22 x 23. This makes the mechanics of arcade games possible, but the movement is rather jerky. The VIC can be improved to a resolution of 176 x 184 through BASIC with programmable characters.

## VIC Game Techniques

First, the programmer needs to know about programmable characters. An in depth explanation is found in the *VIC Programmers Reference Guide.* Briefly, the unexpanded VIC has memory locations from 7168 to 7679 for programmable characters. Each programmable character is made up of eight bytes. By POKEing numbers from 0 to 255 into these locations, a character is programmed. To shift into the programmed character mode, you POKE 36869,255. POKEing 36869,240 will return you to the direct, or program, mode. To find the memory location of a character, use:

```
10 INPUT"CHARACTER";A$
20 A=ASC(A$)
30 IFA>=64THENML=(A-64)*8+7168:PRINTML;"-";ML
   +7:GOTO50
40 ML=A*8+7168:PRINTML;"-";ML+7
50 GOTO10
```

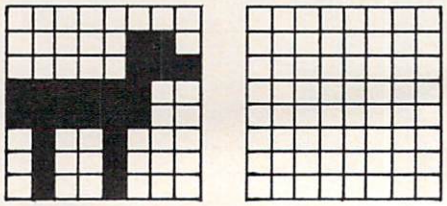
INPUTing "A" into the above program should give a reading of 7176-7183, which is the location of the character A.

The eight bytes of memory for a character each have eight digits in binary If you place these eight bytes in binary, each under the previous one, and imagine the 1's are pixel dots and 0's are spaces, you can decide what eight numbers should go into these locations. For example, type:

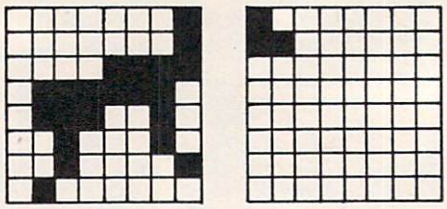
```
100 FORC=7432TO7439:READA:POKEC,A:NEXTC
110 DATA0,6,7,252,252,72,72,72
```

Now RUN. Nothing happens! Now type POKE 36869,255 and everything will turn to garbage. Type a few !'s and you should see a horse. The character ! has been reprogrammed to be a horse. Try your own, remembering to figure from the top to the bottom, or the character will appear upside down.

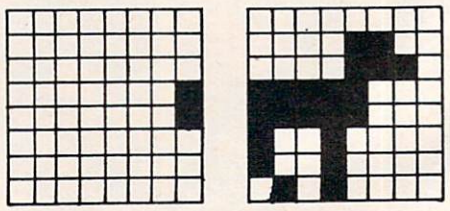
The next trick is to move these programmable characters. Most programs for personal computers in BASIC move their graphics by drawing a character and then erasing it while drawing it again in the next space. This can cause a rather jerky motion. By programming a series of characters, each just one pixel dot farther in the direction you wish to go, and then erasing the previous character, you can improve your resolution to 176 x 184. For example, your first two characters might be:



The space character is the area that you are heading for. The next two characters might be:



This would continue until:



Now you are ready to do the series over again in the next two character spaces.

For a demonstration of how this can work, try Program 1. Before RUNning, take out line 330. We will use it later in preparation for the game. RUN the program, and if the horses look funny, check your DATA lines (50-210). If it all works right, add line 330 and SAVE. This information

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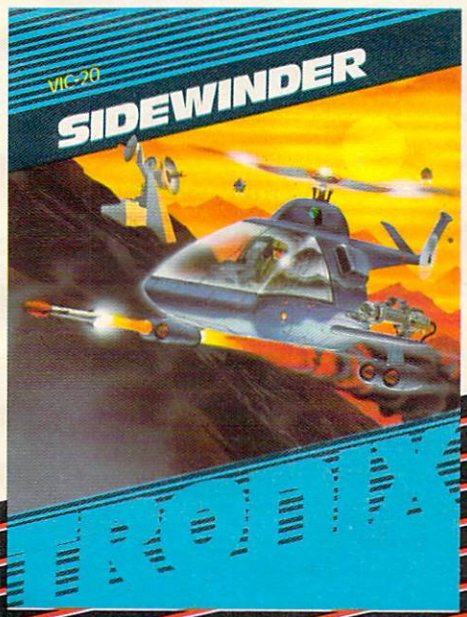
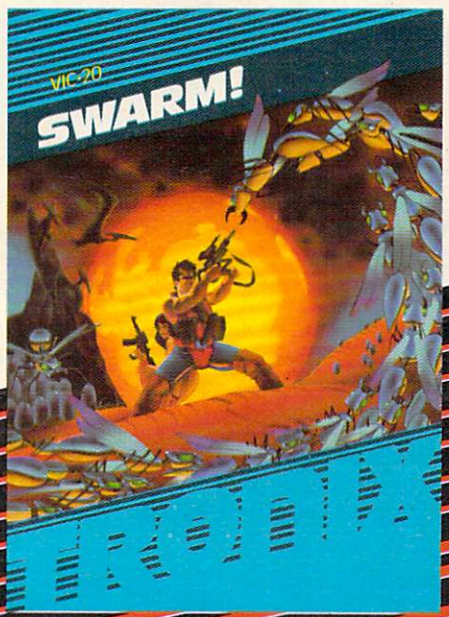
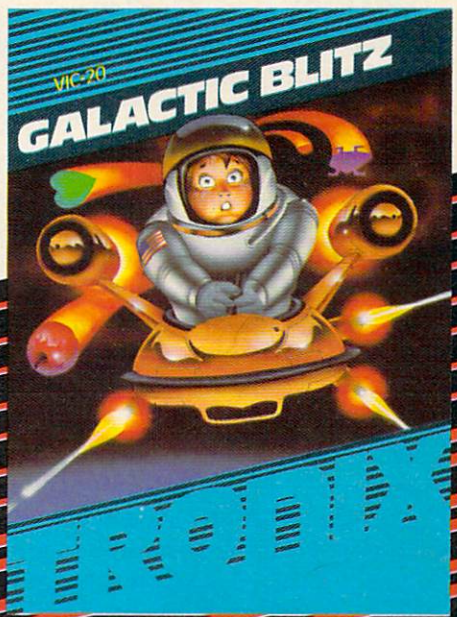


will provide the programmable characters for the game. All programmable character information will remain in memory until the machine is turned off or the memory location information is changed. The latter can be intentional or it can happen accidentally if these locations are not protected. To protect all programmable character locations, you will need to POKE 52,28 and POKE 56,28. For this game, only the upper half is protected, leaving more program space.

After debugging the game (Program 2), be sure to SAVE it right after the already SAVEd Program 1. RUNning Program 1 will automatically LOAD/RUN Program 2 (the game).

## The Rules Of The Game

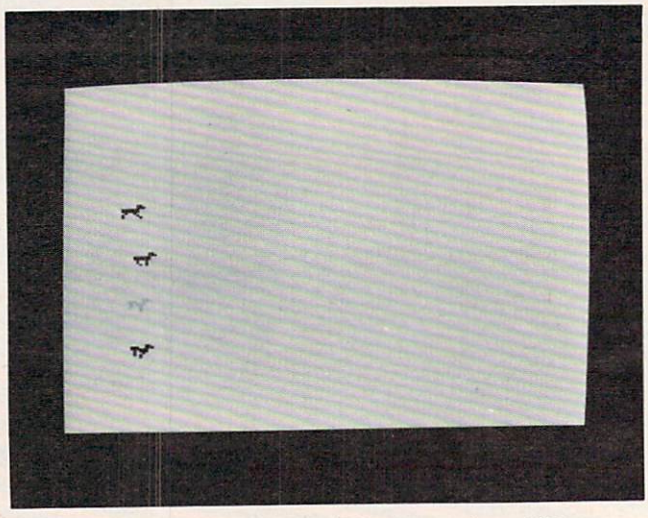
"A Day At The Races" is a game for one to six players. It consists of five races on random track conditions. Each horse is given odds for a particular track in the initialization. These odds are kept throughout the five races. Try to avoid long names for people or horses; they may cause an OUT OF MEMORY error. Five letters work nicely. Each win pays three-to-one while each loss costs you the amount you bet.

## A Major Hint

Remember each horse's performance on the different track conditions. They may run the same way the next time that track condition comes up.

The game sections are marked with REM statements. Changing the denominators in lines 80-100 will change the difference between each horse's odds. You can change the number of races in line 680, the payoff in line 620, and the losses in line 630.

You will notice that one horse moves nicely when it is alone, but things slow down considerably when four horses are involved. Still, I think the programmed characters enhance the movement of the game (it was originally written with the character π as the horses and they were moving one space at a time).



*Charging out of the gate in the VIC-20 version of "A Day At The Races."*

## Atari Notes

Instructions are included in the Atari version of Horse Race and are presented in a unique fashion. As many people can play as memory permits (at least 16K is required). Redefined characters and various screen colors add extra fun. Unlike many games, Horse Race is straightforward enough for a beginner to follow. It might be helpful as a guide when making your own games.

Character graphics are used for the horse. The two pairs of characters used for each horse show two "frames" of a horse's gallop. For more realistic motion, you could add more characters to show more views. The technique used in the VIC version could also be employed to provide smoother animation. The speed of the horses is due to the simplicity of the racing routine. Each horse is randomly selected when allowed to move. Therefore, the "odds" for the horses are not very telling. An improved race algorithm could make the game more realistic, albeit slower.

## Program 1: VIC Version

```
10 PRINT"{CLEAR}":POKE36879,8:S=7856:Z=33
20 PRINT"{04 DOWN}{RIGHT}WELCOME TO VIC DOWNS
   "
30 FORX=1TO2500:NEXT
40 FORF=7424TO7559:READA:POKEF,A:NEXT
50 DATA0,0,0,0,0,0,0,0:REM DATA FOR HORSE
60 DATA0,6,7,252,252,7 ,72,72
70 DATA0,0,0,0,0,0,0,0
80 DATA3,3,14,126,116,36,34,32
90 DATA0,128,0,0,0,0,0,0
100 DATA1,1,7,63,58,17,16,32
110 DATA128,192,0,0,0,0,0,0
120 DATA0,0,31,31,9,16,16,0
130 DATA192,224,128,128,0,128,64,0
140 DATA0,0,15,15,4,8,8,0
150 DATA96,112,192,192,128,64,64,0
160 DATA0,0,7,7,2,2,4,0
170 DATA0,48,56,224,224,64,64,64
180 DATA0,0,3,3,1,1,1,0
190 DATA0,24,156,240,112,32,64,64
200 DATA0,0,0,1,1,0,0,0
210 DATA0,12,14,248,248,144,144,80
220 PRINT"{CLEAR}"
230 POKE36869,255:REM SWITCH TO PROGRAMMABLE C
    HARACTERS
240 POKES+C-2,32:POKES+C-1,32:REM ERASE OLD HO
    RSE
250 POKES+C,Z:POKES+C+1,Z+1:REM DRAW NEW HORSE

260 Z=Z+2:REM COUNT HORSES IN THIS SERIES
270 IFZ=49THENC=C+1:Z=33:REM IF SERIES IS FINI
    SHED MOVE TO NEXT SERIES
280 H=H+1:REM]COUNT HORSES
290 IFH<169THENGOTO240:IF NOT THE END OF THE L
    INE, CONTINUE
300 PRINT"{CLEAR}":POKE36869,240:PRINT"{04
    DOWN}EACH PLAYER STARTS      WITH $50
```

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```
    0.":REM SWITCH BACK
310 PRINT"{02 DOWN}A WINNING BET PAYS      3 T
    O 1."
320 PRINT"{02 DOWN}PRESS PLAY AND WAIT."
330 PRINT"{BLK}":POKE631,131:POKE198,1:REM LOA
    D AND RUN NEXT PROGRAM
```

## Program 2: VIC Version

```
40 REM INITIALIZATION
50 POKE52,29:POKE56,29:REM PROTECT MEMORY LOC
    ATIONS ABOVE 7424
60 PRINT"{CLEAR}{WHT}":POKE36879,8
70 Z=33:Z1=Z:Z2=Z:Z3=Z:Z4=Z
80 POKE36878,15:SO=36877
90 S1=7856:S2=7922:S3=7988:S4=8054
100 REM GIVE ODDS
110 D1=RND(1)/12:D2=RND(1)/12:D3=RND(1)/12:D4=
    RND(1)/12
120 D1=RND(1)/12:D2=RND(1)/12:D3=RND(1)/12:D4=
    RND(1)/12
130 T1=RND(1)/12:T2=RND(1)/12:T3=RND(1)/12:T4=
    RND(1)/12
140 REM NAME PLAYERS AND HORSES
150 INPUT"{CLEAR}{02 DOWN}HOW MANY PLAYERS";PL

160 IFPL>6ORPL<1THENGOTO150
170 FOR X=1TOPL:W(X)=500
180 INPUT"{02 DOWN}NAME OF PLAYER";N$(X):NEXT
190 PRINT"{CLEAR}{DOWN}NAME THE FOUR HORSES:":
    FORX=1TO4:INPUTA$(X):NEXT
200 REM SETS TRACK CONDITIONS
210 TR=RND(1)*10:PRINT"{BLK}{CLEAR}"
220 IFTR<3THENCO$="DRY":O1=D1:O2=D2:O3=D3:O4=D
    4:POKE36879,248:GOTO260
230 IFTR<6THENCO$="TURF":O1=T1:O2=T2:O3=T3:O4=
    T4:POKE36879,216:GOTO260
240 CO$="MUDDY":POKE36879,200
250 O1=U1:O2=U2:O3=U3:O4=U4
260 R=R+1:PRINT"{CLEAR}{DOWN}RACE #"R:PRINT"TH
    E TRACK IS ";CO$
270 FORY=1TO4:PRINTTAB(5)A$(Y):NEXT
280 FORX=1TOPL:PRINTN$(X);W(X):NEXT:PRINT
290 FOR Q=1 TO PL:IF W(Q)=0 THEN B(Q)=0:GOTO 2
    98
292 PRINTN$(Q);:INPUT" BETS";B(Q):IF B(Q)<=W(Q
    ) THEN 296
294 PRINT"CAN'T BET THAT MUCH!":GOTO 292
296 INPUT"  ON";B$(Q)
298 NEXT
300 PRINT"{CLEAR}"
310 PRINT"{02 DOWN} ALL BETS ARE DOWN!!!"
320 REM SETS COLOR OF TRACK (PATHS)
330 FORX=S1TOS1+22:POKEX+30720,0:NEXT
340 FORX=S2TOS2+22:POKEX+30720,4:NEXT
350 FORX=S3TOS3+22:POKEX+30720,5:NEXT
360 FORX=S4TOS4+22:POKEX+30720,6:NEXT
370 READP:IFP=-1THENPRINT"{UP}
        ":GOTO390
380 READD:POKE36876,P:FORX=1TOD:NEXT:POKE36876
    ,0:FORX=1TO50:NEXT:GOTO370
390 POKE36869,255:REM PROGRAMMABLE CHARCTER MO
    DE
400 REM MOVE HORSES AND HORSES SOUND
410 M1=RND(1)+O1:IFM1>.9THEN440
420 POKES1+C1-1,32:POKES1+C1-2,32:POKES1+C1,Z1
    :POKES1+1+C1,Z1+1:Z1=Z1+2:H1=H1+1
430 POKESO,200:POKESO,0:IFZ1=49THENC1=C1+1:Z1=
    Z
440 M2=RND(1)+O2:IFM2>.9THEN470
450 POKES2+C2-1,32:POKES2+C2-2,32:POKES2+C2,Z2
    :POKES2+1+C2,Z2+1:Z2=Z2+2:H2=H2+1
460 IFZ2=49THENC2=C2+1:Z2=Z
470 M3=RND(1)+O3:IFM3>.9THEN500
480 POKES3+C3-1,32:POKES3+C3-2,32:POKES3+C3,Z3
    :POKES3+1+C3,Z3+1:Z3=Z3+2:H3=H3+1
490 POKESO,130:POKESO,0:IFZ3=49THENC3=C3+1:Z3=
    Z
500 M4=RND(1)+O4:IFM4>.9THEN530
510 POKES4+C4-1,32:POKES4+C4-2,32:POKES4+C4,Z4
    :POKES4+1+C4,Z4+1:Z4=Z4+2:H4=H4+1
520 IFZ4=49THENC4=C4+1:Z4=Z
530 REM FIND WINNER
540 IFH1>168THENJ$=A$(1):GOTO590
550 IFH2>168THENJ$=A$(2):GOTO590
560 IFH3>168THENJ$=A$(3):GOTO590
570 IFH4>168THENJ$=A$(4):GOTO590
580 GOTO400
590 FORC=1TO10:FORX=150TO250STEP7:POKE36876,X:
    NEXT:NEXT:POKE36876,0
600 POKE36869,240:PRINT"{CLEAR}"J$" WINS"
610 FORX=1TOPL
620 IFB$(X)=J$THENW(X)=W(X)+B(X)*3:GOTO640
630 W(X)=W(X)-B(X):IFB$(X)<>J$THENPRINT"{DOWN}
    "N$(X)" LOSES $";B(X):GOTO650
640 PRINT"{DOWN}"N$(X)" WINS $";B(X)*3
650 NEXT
660 REM READY FOR NEXT RACE
670 H1=0:H2=0:H3=0:H4=0:Z1=Z:Z2=Z:Z3=Z:Z4=Z:C1
    =0:C2=0:C3=0:C4=0
680 IFR=5THENGOTO710
690 FORX=1TO5500:NEXT
700 RESTORE:GOTO200
710 REM ENDING
720 FORX=1TO2500:NEXT
730 PRINT"{04 DOWN}   HAVE A GOOD DAY!{02
    DOWN}":FORX=1TOPL:PRINTN$(X);"$";W(X)
    :NEXT
740 REM SONG DATA
750 DATA195,50,209,50,219,50,225,50,225,50,225
    ,50
760 DATA219,50,219,50,219,50,209,50,219,50,209
    ,50,195,300
770 DATA195,50,209,50,219,50,225,50,225,50,225
    ,50
780 DATA195,50,195,50,195,50,209,300,-1
```

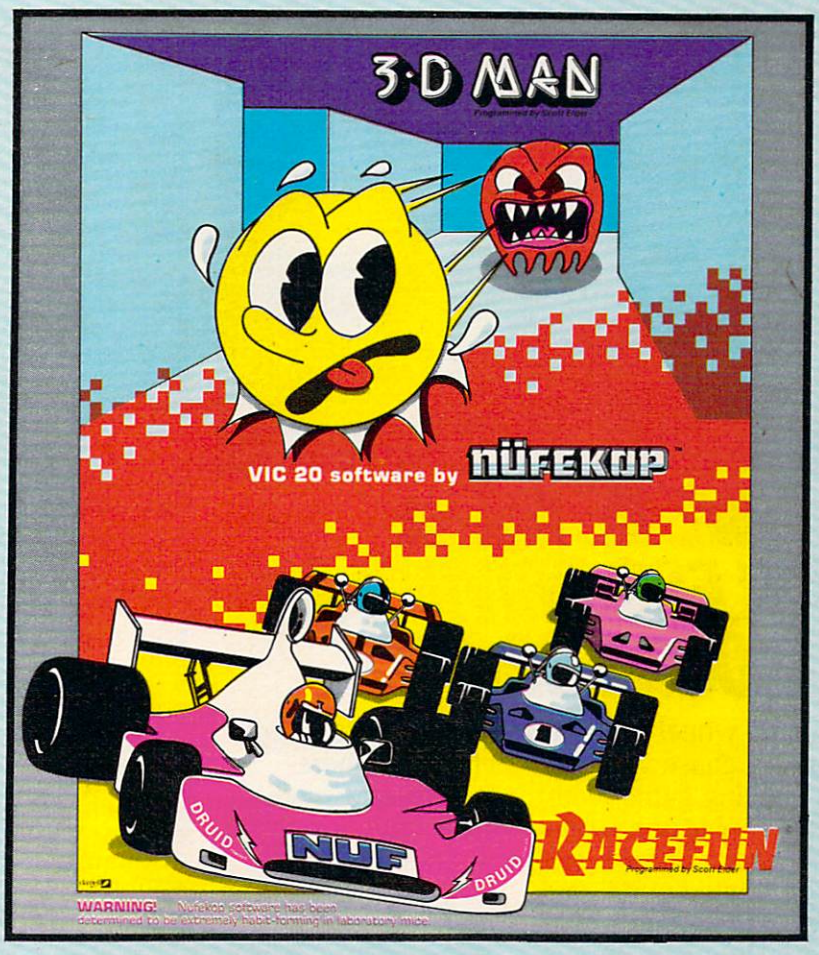
## Program 3: Atari Version

```
100 RAM=PEEK(106)-8:ROM=57344
105 REM {CLEAR} IS ESC SHIFT CLEAR
107 REM {BELL} IS ESC CTRL 2
108 REM {A}{B} IS CTRL-A, CTRL-B
109 REM {C}{D} IS CTRL-C, CTRL-D
110 GRAPHICS 0
120 POKE 756,RAM:RAM=RAM*256
130 IF PEEK(RAM+522)=192 THEN 210
140 FOR I=520 TO 551:READ A:POKE RAM+
    I,A:NEXT I
150 FOR I=656 TO 663:POKE RAM+I,PEEK(
    ROM+I):NEXT I
160 DATA 0,0,192,63,63,48,97,131
170 DATA 48,252,48,192,192,192,128,0
180 DATA 0,0,192,63,63,48,24,12
190 DATA 48,252,48,192,192,192,96,24
200 FOR I=0 TO 471:POKE RAM+I,PEEK(RO
    M+I):NEXT I
210 POSITION 15,0:? "■HORSERACE■":? :
    ? :SETCOLOR 2,0,10:SETCOLOR 1,0,2
220 DIM T$(40)
230 ? "WANT INSTRUCTIONS";:INPUT T$:I
    F T$>"" THEN T$=T$(1,1)
240 IF T$="Y" THEN GOSUB 1070
250 TRAP 250:? "HOW MANY PLAYERS";:IN
    PUT NP:TRAP 40000
260 DIM NAME$(20*NP),LN(NP),BET(NP),C
    ASH(20),ODDS(5),HORSE$(2),R(5),X(
    5),HORSE(NP)
270 FOR I=1 TO 5:ODDS(I)=5:NEXT I
280 SETCOLOR 2,4,2:SETCOLOR 1,0,14
290 ? "ALL PLAYERS PLEASE ENTER YOUR
    NAME"
300 FOR I=1 TO NP
310 ? "PLAYER #";I;:INPUT T$
320 IF T$="" OR LEN(T$)>20 THEN 310
330 NAME$(I*20-19,I*20)=T$
340 LN(I)=LEN(T$)
```

**Exterminator** **By Ken Grant**
Just about as action-packed and complex as is nufisically possible in your standard 5K VIC 20. This extremely well-written, machine code game is invariably praised by customers and has been called the second best tape game made for the VIC of 1982 (oh, no, not by us, we don't agree with that opinion). Rapidfire from the bottom of the screen at moving insects and creatures . . . anything that moves, and even anything that doesn't. Just don't be overrun by any or all. It's as much fun the hundredth time you play it as it was the first. This game plays stick or key and runs in standard 5K VIC 20.

**3-D Man** Not just another eat-the-dots-in-a-maze game, this! Though you find yourself in an edible dot-littered floor plan that may seem vaguely familiar, we guarantee you have never looked at it from this perspective (eye level) before. The dots diminish into the distance as you race down a hallway eating them one after the other. The dot-remaining counter on the right clicks downward. Race through a 4-way intersection and whoops! Head to head with one of the ghosts that haunt these halls! Back quickly on the stick puts you facing the dotless hall you just cleaned out when . . . another ghost! A quick left turn into that junction saves you, but in the confusion you've lost direction momentarily and must check the miniature radar plotting screen to set things straight. . . . Definitely, an ordinary maze game this one is *not*. 3-D Man requires a joystick and at least 3K extra memory.

**Racefun** Extensive use of multi-color character graphic capabilities of the VIC make this game very appealing to the eye. Fast all-machine language action, quick response to the stick or keyboard-controlled throttle, combine with the challenge of driving in ever-faster traffic to make it appeal to the rest of the body. Plays joystick or keyboard.




**Antimatter Splatter!** A more dastardly alien could scarcely be found than one who would wipe out an entire civilization by dropping anti-matter anti-canisters, right? If your opinion of this alien troublemaker is the same as ours, probably your first thought was, get some matter! We say calm down! All is not lost. A mobile rapid splatter cannon capable of both breaking through his standard alien moving force fields and laying waste to the ever-increasing number of anti-canisters is even now hovering above us. If only our cannoneer hadn't called in sick...say, what are you doing today? *Anti-Matter Splatter* is 100% machine language and runs in standard 5K VIC.

**Defender on Tri** As pilot of the experimental Defender-style ship "Skyes Limited," you are the only hope for an advance party of scientists trapped in ancient alien sphere which suddenly (heat from collision course with sun presumably—G.E.) came to life. Four screens worth of unique defenses, on-off shields, fuel deposits, alien treasures, running timer, energy, score and very nice graphics display make this one that does not quickly wax old. *Defender on TRI* requires at least 3K memory expander, but will run with any memory add-on (8K, 16K, 24K, etc.) we have come across.

**Alien Panic** Standard 5K VIC 20/combination stick & keyboard. This arcade-type game pits you against time and an alien on a six level construction sight with ladders and pitfalls, but *not to worry!* You have a shovel.

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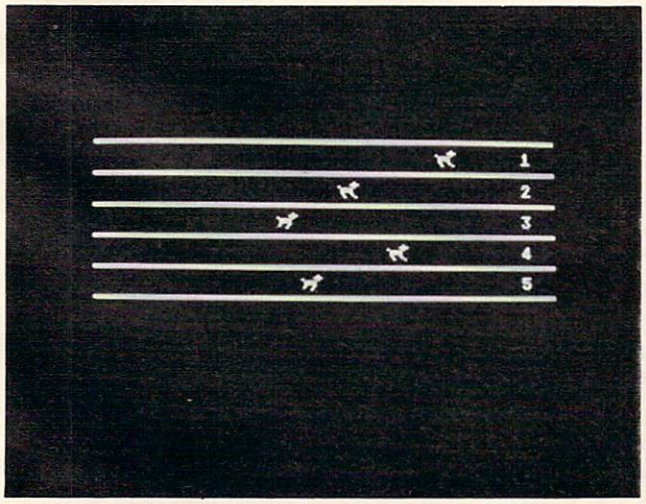
```
350 CASH(I)=500
360 NEXT I
370 REM GET BETS
380 ? "{CLEAR}{BELL} BETTING TIME!":?
     :SETCOLOR 2,12,10:SETCOLOR 1,0,0
390 FOR I=1 TO NP:T=I-1
400 IF CASH(I)=0 THEN 510
410 GOSUB 750
420 ? NAME$(T*20+1,T*20+LN(I)),
430 ? " CASH $";CASH(I);" BET";
440 BET=0:TRAP 450:INPUT BET:TRAP 400
    00
450 IF BET=0 THEN ? "PASS":GOTO 470
460 IF BET<1 OR BET>CASH(I) THEN ? "
    {BELL}TRY AGAIN.":GOTO 420
470 BET(I)=BET:IF BET=0 THEN 510
480 ? "WHICH HORSE? (1-5)";
490 TRAP 510:INPUT T:TRAP 40000:IF T<
    1 OR T>5 THEN ? :? "ONE TO TEN!":
    GOTO 480
500 HORSE(I)=T:? "{CLEAR}"
510 NEXT I
520 REM START RACE
530 SETCOLOR 2,6,0:SETCOLOR 1,0,12
540 POKE 752,1:? "{CLEAR}";:FOR I=1 T
    O 6
550 COLOR 18:PLOT 2,I*2:DRAWTO 39,I*2
560 NEXT I:PLOT 39,12
570 RESTORE 580
580 DATA 237,100,177,100,140,100,117,
    200,140,100,117,200,140,100,117,2
    00
590 DATA 140,100,177,300,177,500,-1,-
    1
600 READ N,P:IF N=-1 THEN 640
610 SOUND 0,N,10,8
620 FOR C=1 TO P/4:NEXT C
630 GOTO 600
640 POSITION 2,0:? "{3 SPACES}*** THE
    Y'RE OFF !! ***"
650 FOR I=1 TO 50:SOUND 0,I*5,12,8:NE
    XT I:SOUND 0,0,0,0
660 POSITION 2,0:? "{29 SPACES}"
670 FOR I=1 TO 5:POSITION 2,I*2+1:? "
    {C}{D}":POSITION 37,I*2+1:? I;:X(
    I)=0:R(I)=0:NEXT I
680 WHICH=INT(5*RND(0)+1)
690 X(WHICH)=X(WHICH)+1
700 HORSE$="{C}{D}":R(WHICH)=1-R(WHIC
    H):IF R(WHICH) THEN HORSE$="{A}
    {B}"
710 POSITION 1+X(WHICH),WHICH*2+1:? "
     ";HORSE$
720 IF X(WHICH)=34 THEN 830
730 POKE 53279,1
740 GOTO 680
750 REM PRINT HORSE NAMES, ODDS
760 ? ,"{3 SPACES}HORSE",,"ODDS{DOWN}
    ":RESTORE 820
770 FOR J=1 TO 5
780 READ T$
790 ? J,T$,ODDS(J);" TO 1"
800 NEXT J:?
810 RETURN
820 DATA GREASED LIGHTNING,CERTAIN SA
    M,JUDGEMENT JACK,SLY SAXON,DEALIN
    ' DAN
830 REM WIN
840 FOR I=1 TO 30:POKE 710,255*RND(0)
    :SOUND 0,I,12,15-I/2:NEXT I:SETCO
    LOR 2,9,4
850 POSITION 2,0:RESTORE 820:FOR I=1
    TO WHICH:READ T$:NEXT I:? " #";WH
    ICH;", ";T$;", WON!"
860 FOR I=1 TO 500:NEXT I
```

```
870 ? "{CLEAR}  BETTING RESULTS  {DOWN}
    "
880 SETCOLOR 2,1,10:SETCOLOR 1,0,0
890 FOR I=1 TO NP
900 IF CASH(I)=0 THEN 960
910 ? NAME$((I-1)*20+1,(I-1)*20+LN(I)
    );
920 IF HORSE(I)=WHICH THEN ? " WON $"
    ;:CASH(I)=CASH(I)+ODDS(WHICH)*BET
    (I):? BET(I)*ODDS(WHICH);:GOTO 94
    0
930 ? " LOST $";:CASH(I)=CASH(I)-BET(
    I):? BET(I);
940 POKE 85,30:IF CASH(I)<=0 THEN CAS
    H(I)=0:? "  BUSTED  ":Q=Q+1:GOTO 96
    0
950 ? "$";CASH(I)
960 NEXT I:POKE 752,0:IF Q=NP THEN ?
    "YOU ALL BUSTED!!!":? :GOTO 1010
970 FOR I=1 TO 5:IF I<>WHICH THEN ODD
    S(I)=ODDS(I)+1
980 NEXT I:ODDS(WHICH)=ODDS(WHICH)-(O
    DDS(WHICH)>1)
990 IF Q=NP-1 AND NP>1 THEN 1030
1000 ? :? "ANOTHER ROUND";:INPUT T$:I
     F T$<>"N" THEN 370
1010 ? :? "SEE YOU ALL LATER!"
1020 SETCOLOR 2,9,4:SETCOLOR 1,12,10:
     POKE 756,224:END
1030 FOR I=1 TO NP:IF CASH(I)=0 THEN
     NEXT I
1040 ? NAME$((I-1)*20+1,(I-1)*20+LN(I
     ));" WON!!"
1050 ? "YOU BEAT THEM ALL!"
1060 GOTO 1010
1070 GRAPHICS 0:POKE 752,1
1080 DATA HORSERACE is a simple simul
     ation
1090 DATA of the entertaining sport o
     f horse
1100 DATA racing.  There are 5 horses
1110 N=3:RESTORE 1070:GOSUB 1300
1120 RESTORE 820:FOR I=1 TO 5:READ T$
     :? I;" ";T$:NEXT I
1130 ? :? "  PRESS ANY KEY TO CONTINU
     E "
1140 IF PEEK(764)=255 THEN 1140
1150 POKE 764,255:? "{CLEAR}":RESTORE
      1160
1160 DATA Each horse starts out with
     odds
1170 DATA of 10 to 1.  When you bet o
     n a horse
1180 DATA the amount you win is your
     bet multi-
1190 DATA plied by the odds for that
     horse.
1200 DATA If a horse wins a race  his
      odds go
1210 DATA down by one and all the los
     ers'
1220 DATA odds are increased by one.
1230 DATA ,  PRESS ANY KEY TO BEGIN
1240 N=9:GOSUB 1300
1250 IF PEEK(764)=255 THEN 1250
1260 POKE 764,255:? "{CLEAR}"
1270 POSITION 15,0:? "  HORSERACE  ":?
     :?
1280 POKE 756,RAM/256
1290 POKE 752,0:RETURN
1300 FOR I=1 TO N
1310 POSITION 2,22:READ T$:? T$
1320 POSITION 2,I:FOR J=1 TO 22-I:? "
     {DEL LINE}";:FOR W=1 TO I:NEXT W
     :NEXT J
1330 FOR J=1 TO 50:NEXT J
1340 NEXT I:? :? :RETURN
```




*A close contest in "Horse Race" for the Atari 400/800.*

# Spectra Video's New Home Computer

Tom R. Halfhill, Features Editor

If you had any doubts that 1983 would be the Year of the Home Computer, prepare to put them to rest. We're only a couple of months into the year, and already it looks as if more home computers will be introduced than in any previous 12-month period. Besides the market debut of Commodore's Max Machine and P Series, it appears that long-rumored new models from Apple, Atari, and IBM are on their way, as well as Mattel's Aquarius (see "Mattel's New Home Computer," **COMPUTE!**, January 1983).

Now there's another contender. Spectra Video, Inc., of New York, maker of the Spectravision line of video game cartridges and the Quick Shot joystick, is entering the home computer market for the first time with its new SV-318. The computer was to be shown at the winter Consumer Electronics Show in Las Vegas in January, and is expected to be available by March 1 with a full line of peripherals and software.

At $299.95 suggested retail, the basic SV-318 can be described as a low-end computer, but it also offers enough expandability to compete against higher-end machines. With its low initial price, plus color and sound, it will compete head-on with the Atari 400, Commodore VIC-20, Mattel Aquarius, and Texas Instruments TI-99/4A. But its large memory expansion, 80-column conversion, and CP/M capability will also pit it against more expensive computers such as the Atari 800 and 1200XL, Apple II, Commodore 64, and Commodore P Series. Since Spectra Video intends to market the SV-318 through department stores and other mass retail outlets instead of computer shops, the company seems most interested in the burgeoning low-end home market.

Here's a rundown of features, according to Spectra Video:

The standard $299.95 SV-318 will come with 32K of Random Access Memory (RAM). Half of that is dedicated screen memory, leaving 16K RAM for BASIC programming. The 16K dedicated screen memory is controlled by a Texas Instruments video controller chip and is accessible with the BASIC commands PEEK and POKE. RAM is expandable to 144K (including the 16K screen memory). In addition, there is 32K of Read Only Memory (ROM), expandable to 96K.

An extended Microsoft BASIC is built-in. The full-size keyboard is the "calculator" type, with flat partial-stroke keys, similar to the Radio Shack Color Computer. There are 71 keys, upper- and lowercase, including 10 definable function keys and 52 graphics symbols (similar to the Commodore VIC-20 and PET). There's a built-in text editor for editing BASIC programs, and the cursor is controlled with a built-in, but detachable, joystick to the right of the keyboard. The joystick also functions as a game controller, and two external joysticks (with standard Atari plugs) can be added. The screen format is 40 columns by 24 lines for text, and 32 columns by 24 lines for the graphics symbols.

*Spectra Video's new SV-318 computer and the optional Super Expander. Note the computer's topside slot, which accepts a $49.95 adapter for Colecovision game machine cartridges. Other adapters may also be available.*

## Advanced Sound And Graphics

The SV-318 has some advanced graphics and sound features. It displays 16 colors with a maximum graphics resolution of 256 by 192 dots. The character set can be redesigned by the programmer, much like the Atari, VIC-20, Commodore 64, and TI computers. Another impressive feature is the SV-318's ability to display up to 32 sprites. Sprites (known as player/missiles to Atari users) are screen shapes which can be designed by the programmer and animated very quickly and smoothly. Sprites are most often used in games, and the only other home computers that have this powerful feature are the Ataris, Commodore 64, and TI-99/4A.

For music and sound effects, the SV-318 has three sound channels, each capable of eight octaves. As on the Commodore 64, the *envelope*, or shape of the sound wave, is programmable (attack, decay, sustain, and release). There is 12-bit fre-

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quency resolution, which means the tuning accuracy of the notes will fall midway between the Atari's eight-bit resolution and the Commodore 64's 16-bit resolution.

The Central Processing Unit is a Z-80A eight-bit microprocessor with a fast clock speed of 3.6 megahertz. This makes it possible to run CP/M 2.2 and CP/M Plus. CP/M (Control Program for Microcomputers) is a standardized operating system that is compatible with thousands of programs, mostly business-oriented. CP/M capability on the SV-318 requires a plug-in 80-column card and a disk drive. Accessory cards, boards, and peripherals plug into expander boxes which attach to the SV-318.

The Single Slot Expander costs $29.95, and a seven-slot Super Expander is $175. The disk drive (256 capacity, unformatted) sells for $525 and requires a controller board ($175). Memory boards are priced at $99.95 for 16K and $160 for 32K. Other add-ons include printer interface boards, a Dual Channel Data Cassette at $89.95, an 80-column dot-matrix printer at $499, the Sensor Touch Graphic Tablet at $129.95, and a 300/1200 baud phone modem at $175.

Besides delivering all the peripherals with the computer by March 1, Spectra Video also promises more than 100 software packages for the SV-318. ©

# Computer Talk Show

Tom R. Halfhill, Features Editor

*As microcomputers penetrate the average American home, the popular appeal of computing spreads to everyday consumers. Here's another indication that home computing is gaining mass appeal.*

It's 9 o'clock on a Saturday morning in Dayton, Ohio. All over town, hundreds of people are tuning their radios to WAVI-AM. To catch the morning news? To get last night's sports scores? To hear the Top 40 or a talk show?

Nope. The latest rage in Dayton is a new sort of talk show, the first of its kind in the nation. It's called *Computer Talk* – an hour-long, call-in talk show devoted exclusively to home computing.

Since taking to the air last summer, *Computer Talk* has become one of WAVI's most popular programs. "It's been a real success, and frankly no one was more surprised than me," says A. J. Austin, the deejay who hosts the show. "I figured it would be a fad for a few weeks and then go out of style, but it's proven so popular that we're considering expanding the show to two hours."

The advertising is sold out for virtually every program, a steady stream of guests has kept the discussions alive, and listeners have responded with plenty of input/output – tying up the phone lines almost constantly every week.

## Vacuum Cleaner Ruminations

Not bad for what started as a tentative experiment. Although Austin is a dedicated microcomputer enthusiast – he's owned an Apple for two and a half years – it didn't occur to him that a computer talk show could have wide popular appeal. At least, not until an engineer at the station brought up the idea.

Knowing that Austin owned an Apple, engineer Kurt Farmer suggested last April that it might be interesting to air a computer-oriented talk show. At first, Austin says he was skeptical. Would there be enough people out there to support a talk show on such a narrow topic? Wouldn't the technical jargon scare away casual listeners? What could he talk about every week? Who would sponsor the show?

Austin soon had his answers. *Computer Talk* hit the airwaves on June 1, originally only a half-hour long. Within two weeks it was expanded to an hour. Austin says the incoming lines on his telephone light up when the show starts and stay lit almost constantly until the show ends. Regular sponsors include local computer stores and other computer-related businesses.

At first, Austin experimented with all kinds of ideas. At one point, he was actually broadcasting programs over the air by playing data cassettes so people could tape-record the signals off their radios. But the squealing static of digitally encoded data – described by a local magazine as "vacuum cleaner ruminations" – is no longer heard on *Computer Talk*. "The results weren't worth the three minutes of noise," explains Austin, "and the technical problems of AM radio just didn't make it practical."

## Explaining The RAMifications

Instead, a more or less standard format has evolved. "I'll start off with five or ten minutes of news – you know, who's ripped off IBM this week, or so-and-so's new machine, news like that. Then we'll go to our guests and discuss whatever topics we have decided on, and I'll usually finish off with a few software reviews. During this whole time, of course, the phone lines are open for anyone to call in about anything."

Austin is encouraged because many beginners and non-computerists are calling in with questions and comments. Lots of them want advice on which computer to buy. One week his guests were TRS-80 and Atari owners who responded to a caller by discussing the relative merits of their machines. Austin tries to keep the discussions as general and as easy to understand as possible, but often a beginner will phone in with a seemingly simple question, such as asking what "RAM" means. Austin then takes a minute to explain the concept of Random Access Memory, and returns to the discussion.

"We know that the show has sold at least one computer.... This lady called in and told us she got so interested in computers by listening to our show that one day she went out and bought a TI 99/4A for her family, and she's just delighted with it. Before she heard the show, she had never even considered buying a computer."

As word about *Computer Talk* spreads, Austin says he is getting inquiries from other radio stations around the country about airing similar shows. He still can hardly believe the show is really thriving.

"I thought it would run for a few weeks and then I'd get my Saturdays off again. But no way." ©

## Part II:

# Writing Transportable BASIC

Edward Ordman

*This concludes a two-part article on writing BASIC programs so that they are more easily read, revised, or translated to run on different computer brands. Though not everyone will agree with the goal (general-purpose BASIC), or the approach (structured programming), many of these suggestions are potentially useful to those programmers who later revise and improve their own programs. For contrast, see the views of some of the programmers quoted in "How The Pros Write Computer Games," elsewhere in this issue.*

## Structure

The major tool in making a program transportable is careful attention to program structure. This does not mean slavish adherence to "structured programming." It does mean using common sense and some of the important tools available to keep programs from becoming "spaghetti bowls" of GOTOs. This can include "structured programming" when applicable.

To consider a concrete example, suppose we have two branches in our code governed by a GOTO. A simple version might be:

```
500 IF X>2 THEN T=T+Y : C=C+2 ELSE T=T+Z :
    C=C+1
```

There is certainly no objection to writing this in one line if your BASIC allows it; the intent is clear. Remember that you should leave space for new lines, since someone may have to rewrite this as:

```
500 IF X>2 THEN 504
501 T = T+Y
502 C = C+2
503 GOTO 507
504 T = T+Z
505 C = C+1
507 REM ENDIF
```

Even this is still quite readable. It is clear where the IF starts and where its effect ends. A far worse example (but painfully common in beginners' programs) would have IF X>2 THEN 4000 and then down at line 4000 would have:

```
4000 T=T+Z: C=C+1 : GOTO 510
```

This is hard to read: how, when checking line 4000, can you know where it relates to the rest of the program? Reading lines 500-510, how can you understand the options of the other path?

My own practice, incidentally, is to avoid GOTOs over long distances, avoid upward GOTOs unless they are part of a fairly formal structure, and have GOTOs go to REM statements in a great many cases. Suppose, in the example above, line 510 was PRINT TAB(C);X;TAB(C+5); Y and some variation in the new machine meant that this had to be expanded to two lines to get the right spacing. A GOTO 510 in line 503 means that a line 509 cannot be introduced without other changes; the 507 REM means changes in the PRINT do not require changes in the IF.

A similar situation arises in programs where there is a large loop (PLAY AGAIN in a game) and some initialization before it. If you start

```
1 PRINT "WELCOME TO THE GAME"
2 T = 0
3 X = RND(1)
4 Y = 1
```

the person rewriting this may type 2 T=0: X=RND(1): Y=1, and be in big trouble when he discovers that at line 5560 you have GOTO 4. He will be in more trouble when he revises the program and needs to add another statement within the main loop, but before Y=1. Compare the program:

```
10 PRINT "WELCOME TO THE GAME"
20 T = 0:X = RND(1):REM INITIALIZE,0<
   X<1
30 REM  ENTER MAIN LOOP HERE
40 Y = 1 :REM  COUNT NUMBER OF ATTEMP
   TS
5560 GOTO 30 :REM REPEAT MAIN LOOP
```

In this version, the rewriter will not confuse line 20 and line 40; a line 35 can be added; and there is no confusion as to exactly where the GOTO is leading, even after several program revisions. In general, do not GOTO "the middle" of a line of reasoning without clearly labeling why and providing an easy way to make changes without extensive rewriting.

If you really want to avoid upward GOTOs in as many cases as possible (and it *does* make programs easier to read!), there are two alternative structures that are important: GOSUB ... RETURN and the DO ... WHILE. First, let us consider the DO...WHILE.

DO...WHILE can be regarded as an extension of FOR...NEXT. A typical form is:

```
1000 DO WHILE X>10
1010 PRINT X
1020 T = T+X
1030 X = X/2
1040 ENDWHILE
```

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Suppose X is 50 when this is entered. Lines 1010-1030 will be done for X = 50, for X = 25, for X = 12.5; then X will become 6.25, the test will fail, and the program will go on after line 1040. This is a remarkably useful *thinking* tool, even if your BASIC does not have these statements (many do not). But, for transportability, I would argue *against* using these statements even if you have them. There is, however, no reason at all not to *think* in terms of DO...WHILE and then to write an imitation of it:

```
1000 IF X<=10 THEN 1040 :REM DO WHILE
     X>10 TO LINE 1040
1010 PRINT X
1020 T = T+X
1030 X = X/2
1035 GOTO 1000
1040 REM  END WHILE
```

Again, this is easy to read, the upward GOTO is clearly explained, and the reader is in no doubt as to the scope of the loop and where you enter and leave it.

## Subroutines Are Best

Subroutines – the facility provided by GOSUB and RETURN – are the single most important feature in providing transportability. There is a strong case to be made for dividing every program of more than a few dozen lines, and many shorter ones, into subroutines. Ideally, each subroutine should have a purpose that you can describe in one or two lines, and that explanation should be given in remarks at the head of the subroutine. The subroutine should *not* interact with the rest of the program except as provided in the leading remarks. An example:

```
6000 REM  SUBROUTINE TO CONVERT TO PO
     LAR COORDINATES
6001 REM  GIVEN X,Y COORDINATES.  RET
     URN R=RADIUS,T=ANGLE.
6002 REM  X,Y UNCHANGED.  RETURN T=0
     IF R=0.
6003 REM
6010 R=SQR(X*X + Y*Y)
6020 IF R = 0 THEN T = 0 : RETURN
6030 IF X<>0 THEN T = ATN(Y/X) : RETU
     RN : REM ARCTANGENT, RADIANS
6040 IF Y > 0 THEN T = 3.14159/2
6050 IF Y < 0 THEN T = -3.14159/2
6090 RETURN
```

It is entirely appropriate for subroutines to call other subroutines, or for a main program to consist primarily of subroutine calls, with all the real work done in the subroutines. But when this is done, it is even more important to make sure that the subroutines can be debugged separately – that they do not, for instance, change the variable used elsewhere, but not mentioned in the headnote.

Where you are using a feature that you know is particular to your computer – for instance, disk input/output – it is especially important to isolate it in a subroutine, and label it as machine-dependent. This means that it can be rewritten later with a minimum of change to the main program logic.

## Make Input/Output General

It is very likely that anyone rewriting a program for another machine will have to revise input/output statements. This applies to PRINT and INPUT for keyboards, terminals, CRTs, and printers; to cassette and disk storage; to game controllers and joysticks; and to all other peripherals. Essentially the only "minimal" features that all machines have in common are INPUT X and PRINT X,Y,Z, and even these are not as standard as one might like. The usual solution is to stick to minimal formatting, if you consider transportability of prime importance; or to place fancy input/output in subroutines and indicate your intention clearly, if it is essential to the program. Here we can give only a quick guide to some of the tricks and pitfalls.

**INPUT** Some computers allow you to cue the user (prompt) as desired, e.g., INPUT "YOUR NEXT GUESS?";N while others do not. The others can fake it by PRINT "YOUR NEXT GUESS";:INPUT N getting the question mark on the same line as the printout. Many BASICs will not allow suppression of the question mark. Inputting string variables, particularly with embedded spaces or commas, also differs dramatically from system to system, as mentioned earlier. If your program depends heavily on a precise form of string input, place the input routine in a subroutine and explain the purpose carefully. For example:

```
2000 REM  STRING S$ WILL BE ALL CHARA
     CTERS TYPED (PRINTABLE OR NOT)
2001 REM  UNTIL ENTER IS HIT (EXCLUDI
     NG THE ENTER)
2010 S$ = ""
2020 K$ = INKEY$ :REM  GETS SINGLE KE
     Y FROM KEYBOARD
2030 IF K$ = "" THEN 2020
2040 IF ASC(K$) = 13 THEN 2090 :REM
     CARRIAGE RETURN, OR ENTER
2050 S$ = S$ + K$
2060 GOTO 2020
2090 RETURN
```

Of course, other machines may require substantial rewriting of this subroutine, if the special word INKEY$ is not available or works differently. In some microcomputers, the implementation may be as easy as INPUT LINE S$. Still, having this in a single subroutine, rather than scattered throughout the program, will simplify the job of rewriting for a new machine.

**PRINT** Some computers allow statements like PRINT "$"X"000", without commas or semicolons, and produce the output $4000 when X is 4. Others require PRINT "$";X;"000" and produce $ 4 000 or something similar. Usually, a

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clear indication (in a REMark) of what you want is far more helpful than an ingenious trick to achieve it on your machine. The exact meanings of comma and semicolon differ from one machine to another: it is universal that comma means "wide space; arrange in columns" and semicolon means "short space, or no space," but the details differ. In many configurations, TAB will not work properly (this is common when using a printer attached to an Apple, for instance).

If you must engage in any fancier spacing than use of commas and semicolons, explain yourself in REMarks and leave it to the reader to implement it on his machine. Many microcomputers do not have PRINT USING; if you use it, an example output line contained in a remark is very helpful. If you use a fancy PRINT statement repeatedly in your program, consider placing it to a subroutine where the reader will have to translate it only once.

**CLEAR** There are a number of special commands whose implementation differs from one computer to another. Some examples are Clear Screen, Go to top-of-page, and similar ones. (Varying print character width, for instance, is usually a function of the printer model, not of the BASIC.) If at all possible, place these functions on a line by themselves and remark clearly; it will then be easy for the reader to translate them, or delete them if inapplicable to the new system.

**Joysticks** These also differ dramatically from one system to another. Again, place them in a clearly labeled section of the program, preferably a subroutine, and label what they do. In particular, avoid repeating these statements numerous places within the program. Example:

```
1050 GOSUB 5000 : REM  READ PADDLES
2300 GOSUB 5000
5000 REM  READ PADDLES X,Y -- VALUES
     ARE 0 - 255, SCALE TO 0 - 100
5010 X = PDL(0)/2.55
5020 Y = PDL(1)/2.55
5030 RETURN
```

Clearly, someone whose paddle-reading commands are different, or give values in a different range, can easily rewrite this subroutine.

**Tape/Disk** While the particular statements involved in tape and disk input/output differ for almost every system, the general functions to be performed are almost identical. Typically, one must specify a file name and number by which it will be referred, and whether it will be for input (READ or INPUT), or output (WRITE or PRINT), or both. A typical statement is something like OPEN "DATAFILE" AS 1 FOR INPUT. If your BASIC allows omitting some of this, include it in a REMark. For example,

```
1050 PRINT D$; "OPEN INPUT";F$ :REM OPEN F$,
     SEQUENTIAL, INPUT ONLY
```

is acceptable if you only have one file open at a time; the reader can insert an AS #1 if the new system requires it. Once you have opened a file, you must read from it or write to it, typically by a statement such as READ #1, A,B,C or PRINT #3,A;C$;B;C$;X :REM C$=",".

Notice that if your system does not require a specific indication in the statement that it refers to a file, you should include one in a REMark. It is an excellent idea to write commas as field dividers to a file, even if your system will permit a space as a divider on input. Enough systems insist on the comma that it decreases portability to omit it. A statement such as

```
1060 REM A TYPICAL LINE OF FILE IS 4 , 5 ,
     DEBITS , 2.95 (CR)
```

will often make the program much clearer to the reader than it is from just the line

```
INPUT#3 P(K),Z(K),D$,A(I)
```

In the case of a direct access file, most systems also need to know the record length and record number for each read or write. If a direct access file is opened for updating, you should read a record before you write it. Finally, on any type of file, you should remember to close it explicitly (usually CLOSE #3 or some variant). Even if your BASIC does not insist on this, someone else's will; and it can be hard to figure out *when* to do the closing in a strange program.

A program using no files is more easily transportable than one using files; the fewer the files, the more transportable. (Avoid opening more files than needed at one time.) Sequential files are easier to move than direct access files; files read or written "all-at-once" are more transportable than ones that are read or written only intermittently. If at all possible, structure a program like this:

```
1000 GOSUB 7500 : REM READ WHOLE FILE
       INTO AN ARRAY
 .... :REM  MAIN PROGRAM ACTS ON THE
ARRAY
4000 GOSUB 7700 : REM WRITE WHOLE ARR
     AY BACK OUT TO FILE
4010 GOTO 9999
```

so that all file-handling is confined to specific subroutines and the files can be kept on a cassette tape even without fancy automatic stop-start features.

## Graphics

If we view BASIC as something almost geological, something that has had layers added over time, graphics capabilities are the last layer, and the layer least solidified. Graphics differ more from machine to machine than any other feature. Fancy graphics tricks are the very hardest thing to transport from one system to another. Still, it is possible to do some graphics work and still limit the problems when moving them to another system.

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Generally, it is easiest to transport a program that uses only "character" graphics. If we view the screen as consisting of a fixed number of rows and a fixed number of columns, then each position can be occupied by one letter or "character." If we confine ourselves to commonly available characters, our program *should* be capable of being rewritten for most systems. If it does not involve moving pictures, it should even be possible to run it on a printer-oriented system in many cases.

As you know, common systems *do* differ in screen size (in number of characters in a row or column). The first thing we must do is let the reader know what assumptions we have made:

```
50 M1=16 :REM NUMBER OF LINES ON SCREEN
60 M2=40 :REM NUMBER OF CHARACTERS PER
   LINE
```

From this point on, we should place everything in terms of the numbers M1 and M2, *not* 16 and 40. Further, to position a given character C$ at coordinates X,Y (that is, X across and Y down: position X of row Y), we should set X, Y, and C$ and then call a subroutine. On the IBM Personal Computer, we print an "A" in the center of the screen by

```
100 X=INT(M2/2) :Y=INT(M1/2) :C$="A"
110 GOSUB 7000
 ....
7000 REM  SUBROUTINE TO WRITE C$ AT
     POSITION X OVER, Y DOWN ******
7010 LOCATE Y,X : PRINT C$;
7020 RETURN
```

Again, the user of any given computer can rewrite this subroutine as a whole far more easily than he can rewrite statements like LOCATE 12,40: PRINT "A"; which are scattered throughout the program.

Sometimes a screen is built up by "jumping around," rather than line-by-line. If you wish to get hard copy of such a screen, and lack a built-in operating system procedure to do so, you can have the subroutine just mentioned build an array by 7015 S(X,Y)=ASC(C$) (or 7015 S$(X,Y)=C$) and later print the entire array. This may be as easy as:

```
8000 REM  PRINT THE SCREEN STORED IN
     ARRAY S(M2,M1) **************
8010 FOR I = 1 TO M2
8020 FOR J = 1 TO M1
8030 PRINT CHR$(S(J,I)); :REM ; LEAVE
     S NO SPACE ON IBM PERSONAL COMP
8040 NEXT J
8050 PRINT :REM  GO TO NEXT LINE - DE
     LETE IF IT CAUSES DOUBLE SPACING
8060 NEXT I
8070 RETURN
```

Note that this program must contain a line such as

```
70 DIM S(80,24) :REM SAVE SCREEN. NOTE DIM
   S(M2,M1)
```

so that a person changing M1 and M2 will know how it changes the DIM statement.

A remarkable assortment of graphics effects may be achieved just by the skillful use of standard characters: minus signs or underscores for horizontal lines, ones or a special symbol for verticals, and so on. It is not hard to generate pictures by hand: hold a piece of window screen over a picture, judge the amount of darkness as best you can (most people can rate "darkest, dark, middle, light, clear") and use characters such as M I : . and space to represent them. Some scaling may be needed; in many systems the space allocated for a character is 1 2/3 to 2 times as tall as it is wide. Fill-in-the-blanks effects, on screen or paper, may be achieved by using minus signs as underscores:

```
SOCIAL SECURITY NUMBER ? ___-__-____
```

Turning now to "high-resolution" graphics, or other extended graphics features, we find that most of them still can be expressed in terms of X-Y coordinates and making a specific mark at specific coordinates, although the mark is now usually "on" or "off" or "COLOR 7" instead of a letter. The same principle as before applies: specify the maximum size involved; if at all possible give dimensions as fractions of M1 and M2 rather than absolute numbers; and keep the actual writing in as few subroutines as possible.

In general, have one subroutine that draws a point; another that draws a line by making repeated GOSUBs to the subroutine to mark points; and so on. Even if your computer has built-in line-drawing commands, place them in subroutines (instead of HLIN 20,50 TO 30,40 write X1=50: Y1=20: X2=40: Y2=30: GOSUB 2600 where 2600 has the line HLIN Y1,X1 TO Y2,X2), so that a person whose computer lacks them can try to write a reasonable imitation.

If you write carelessly, or depend too heavily on features of a particular machine, you can have a program that is very hard to translate to any other machine. If you want to be able to move your programs to a new, different machine, or have them run on a friend's machine or on a machine at school, you must plan ahead when you first write the program.

It takes relatively little extra effort to write a transportable program, and there are many fringe benefits. You yourself will find the program easier to test, debug, or reread a few months later. A little avoidance of particular machine "special features," a little use of good structuring practices, and some care to isolate likely-to-change features in labeled subroutines, can pay off in far easier maintenance and rewriting. And if it means that some published programs will run on a larger variety of machines than they used to, it will pay off for all of us. ©

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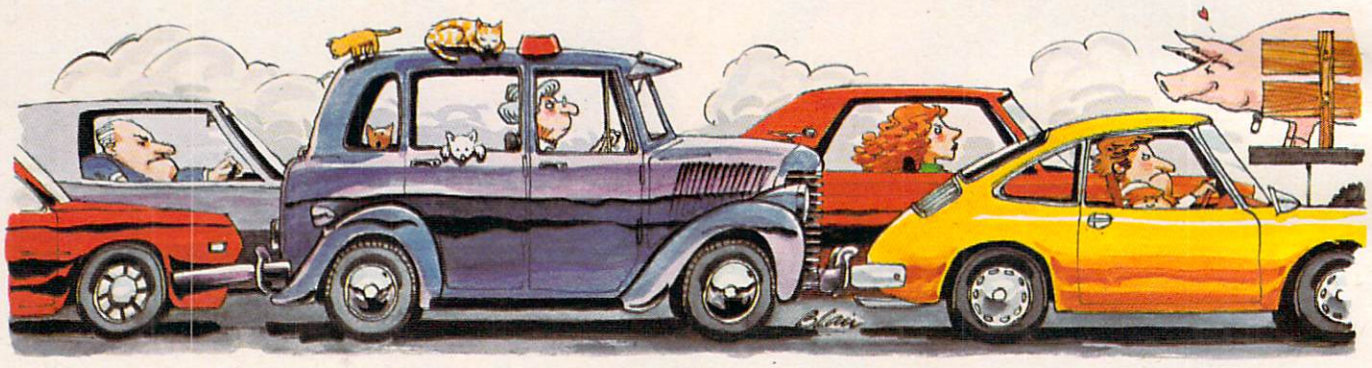


*Want to program a new computer game but find yourself stuck for ideas? Maybe you could try one of these tongue-in-cheek suggestions.*

Let's face it, computer and home video games seem to be stuck in a rut. Our senses and joystick elbows are endlessly assaulted by what seem to be repetitions of the same old themes.

*Space Invaders* spin-offs keep descending upon us as relentlessly as...well, as *Space Invaders*. We're lost in a maze of *Pac-Man* imitations, pursued by the ghosts of programmers whose most difficult task was not the coding, but evading the wrath of copyright attorneys. Almost overnight, it seems, each new arcade hit spawns litters of look-alike offspring. *Missile Command* clones multiply as if by fission. *Zaxxon* is Xeroxed. *Donkey-Kong* is aped.

Perhaps it's time for a change. As a public service to home video game addicts everywhere, we're presenting a list of ideas for a new generation of games, in the hope that game designers from here to Silicon Valley will leave their hot tubs and stop cashing their royalty checks long enough to consider something different.

To tackle the problem, we had to come up with a new approach. What makes a game fun? It occurred to us that the game designers, by and large, are hopelessly trapped in their spaced-out, paranoid fantasies. Fantasies are fine, but they have their limits. After all, how often have you been called upon in real life to defend Earth against alien invaders?

On the other hand, we quite frequently find ourselves in one of those amusing little situations that make everyday life such a lark. You know, like the time you emerged from that midnight movie when it was 22 degrees below zero and discovered your car's battery was dead. There are thousands of these situations to choose from. Can 25 years' worth of *I Love Lucy* reruns be wrong?

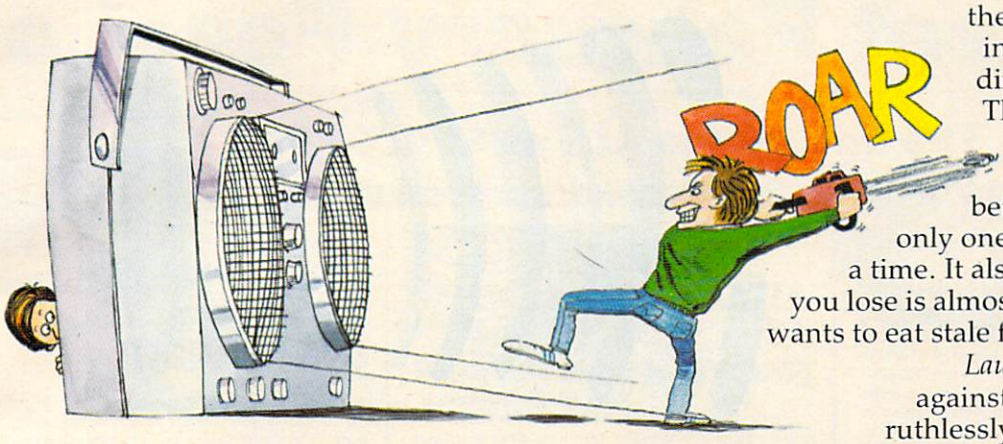
So crank up your computer and get ready to start programming....

## Rush Hour Madness

A game for one to 32,768 players, *Rush Hour Madness* is an ideal project for the beginning programmer who is limited to the relatively slow BASIC language. Although *Rush Hour Madness* involves large numbers of screen objects, the animation need not be fast. In fact, animation is nearly nonexistent.

Players start by driving onto the expressway at 5:15 p.m., controlling their car with a joystick. The "fire" button honks your horn. Immediately after entering the expressway, players are entangled in a massive traffic jam. Scoring is straightforward: one point for each minute the player endures the game without going stark raving mad.

A 50-point Good Samaritan bonus is awarded for parting ranks to allow another player to join




the game from the expressway entrance ramp. Every 10,000 points (roughly 166 hours of play), players can manipulate their joysticks to move their cars a few feet. This might not seem like much to those who've been spoiled by the cheap thrills of so-called "action" games. However, our test panel reports that after hours of waiting, the moment when you move your car is very close to ecstasy.

The object of *Rush Hour Madness* is simple – reach "home" before the game re-initializes itself and starts over again the next morning.

## Check-out Tribulation

If *Rush Hour Madness* is a hit, it might well give birth to numerous look-alikes. *Check-out Tribulation*, which traps the player in a supermarket check-out line, is but one example. Others might include *License Renewal Ordeal* or *Airport Inspection* ...you get the idea. The possibilities are as endless as the lines themselves.

Each version, of course, would feature its unique variations. Players of *Check-out Tribulation* would face battle with such creatures as the Sticky-Fingered Imp, who lunges from the seat of his grocery cart to squash your tomatoes, and the Absent-Minded Peruser, who forgets the line is moving while reading tabloid articles such as "Lost In Desert: Eats Own Briefcase."

## Laundromat Invaders

The theme of this game suggests an answer to one of our most perplexing unsolved mysteries. Ever notice how you always go to a laundromat with an even number of dirty socks, and return home with an odd number of clean socks? Somehow, no matter how careful you are, you always seem to end up with a lonely sock.

*Laundromat Invaders* explains why. You see, there's a planet in another dimension, a planet populated by humanoids much like ourselves. The main difference is that these humanoids subsist entirely on a diet of socks. Their survival has been threatened by a severe sock shortage caused by a recent blight on their Orlon crop. So, they've built robots which invade laundromats in our dimension to steal socks. This explains why only *one* sock turns up missing; the portal between dimensions allows only one sock to pass through at a time. It also explains why the sock you lose is almost always a new one: who wants to eat stale food?

*Laundromat Invaders* pits you against these interlopers. You ruthlessly hunt down the robots and clobber them with your Prolific Family Size box of Tide as they pull their favorite tricks, i.e., making the socks cling to the insides of the washer, surreptitiously snatching them with static electricity as you empty the dryer, etc. You get 100 points for each robot you clobber (500 if it's carrying off a sock), and 1000 points if you wind up with an extra sock from somebody else's laundry.

## Boom Box Blasters

This game is for those commuters who forego *Rush Hour Madness* (see above) in favor of our urban mass transit systems. *Boom Box Blaster* is a fast-action arcade game which pits the player against hordes of inconsiderate adolescents armed with those giant portable radio/tape players.

It starts off deceptively easy. Using the joystick, you maneuver your commuter down the sidewalk toward the bus stop, studiously avoiding such minor obstacles as Hare Krishnas and Moonies hawking incense and flowers. Suddenly, your ears are assaulted by the 85-decibel roar of the Shrill Sisters' latest hit, "Nerve Erosion." It's a teen-ager carrying a boom box! Pressing the joystick fire button to activate your Tri-Proton Chainsaw, you blast the noisy box to bits as the terrified teen flees in panic.

But the game gets much harder. Players soon find themselves trapped with whole gangs of boom box-wielding hoodlums inside the acoustic confines of a bus. Survivors advance to even more difficult levels, finally winding up on the subway. Other obstacles encountered in *Boom Box Blaster* include sticky gum-encrusted seats (which momentarily disable your joystick movements) and rude transit personnel (who ignore your opponents, but hassle you for exact change).

*Programming Hints:*

*Naturally, writing these games will require some special techniques. We recommend programming languages such as BASIC (Beginner's Algorithms for Seemingly Infinite Confusion), LOGO (Logical Order for the Gobbledygook-Oriented), and PILOT (Programmer's Instruction Language for Oddball Tasks).* ©

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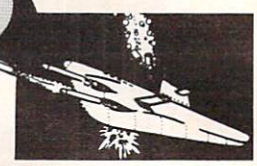

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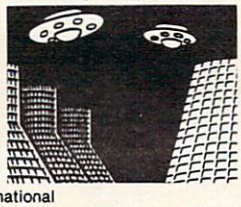

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By Tom Snyder from Spinnaker

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### ALIENCOUNTER & FACE FLASH

From EduFun!

**ALIENCOUNTER:** A flying saucer appears on the screen, with a number. You must try to land that number of Aliens by pressing the + or – keys, trying for a perfect encounter.

**FACE FLASH:** A set of smiling faces flashes on the screen. You must remember how many there were. Each correct answer gets another screen—but the "flash" gets shorter. One wrong answer, and the game is over.

**16K Tape, $29.95** **32K Disk, $32.95**

### BATTLING BUGS & CONCENTRATION

From EduFun!

**BATTLING BUGS:** A column of red bugs (negative numbers) and a column of black bugs (positive numbers) march toward each other. Each pair of colliding bugs disappears; the remaining bugs continue marching. You must add a new column of bugs to wipe out the survivors.

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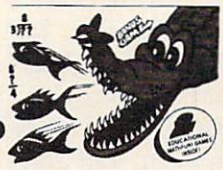

### FRENZY & FLIP FLOP

From EduFun!

**FRENZY:** Choose subtraction or division, and level of difficulty before starting. Answer 20 problems before the hungry alligator eats 10 fish. With Bonus Game.

**FLIP FLOP:** The computer shows you 2 designs. You must decide if the left figure can be moved to look exactly like the right figure. You can slide, flip or turn the figure to make it fit.

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From Atari

**JUGGLES** the Clown helps children learn to recognize spatial relationships such as: above, below, left, right—while having lots of fun. JUGGLES also helps develop skills for recognizing alphabet, reading and writing. While working with line and circles, children will learn some of the hardest letters, like p, d, b and q.

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# Copy Cat

Mark and Dan Powell

*Copy Cat is an entertaining, musical, and colorful "match-me" game. It exercises pattern recognition, short-term memory and hand-eye coordination, making it an excellent game for all ages. Versions are included for the VIC-20, Atari 400/800, TRS-80 Color Computer, Apple II, and PET/CBM.*

Copy Cat picks a random pattern for you to copy. Each time you correctly copy the pattern, you acquire a point.

In line 5 there is a REM in front of the POKEs. These POKEs disable the STOP key. Do not take off the REM until you've finished typing in the program (or don't put it in at all).

## VIC Note

Note also that line 2020 reads "IF PEEK (653)›3THEN END". What this does is test for the VIC's CTRL key. To test for the SHIFT key, "IF PEEK (653) = 1THEN END", and to test for the Commodore key, it should read "IF PEEK(653) = 2THEN END. For combinations of these keys, just add them together (the value for CTRL is 4).


*A flubbed response ends a game of "Copy Cat," VIC-20 version.*

## Program 1: VIC-20 Version

```
5 REM:POKE809,242:POKE808,199
10 DIML%(100):POKE36879,27
20 PRINT"{CLEAR}{04 DOWN}{BLK}      COPY CAT"
   :PRINT"{02 DOWN} PRESS 1-4 TO COPY TH
   E"
30 PRINT"      COMPUTER":PRINT"{02 DOWN} YOU ~
   CAN ONLY MISS":PRINT" THREE TIMES A G
   AME"
32 PRINT"{03 DOWN}{BLU}PRESS 'SPACE' TO START
   "
35 GETA$:IFA$<>" "THEN35
40 POKE36879,8:C=38400:SC=256*PEEK(648):IFSC=
   4096THENC=37888
50 PRINT"{CLEAR}{06 DOWN}{WHT}   1    2    3 ~
      4   {DOWN}  {REV}    {OFF} {REV}  ~
     {OFF} {REV}    {OFF} {REV}    {OFF}
   "
55 FORT=1TO2
60 PRINT"{WHT}  {REV} {OFF}  {REV} {OFF} {
   REV} {OFF}  {REV} {OFF} {REV} {OFF}  ~
   {REV} {OFF} {REV} {OFF}  {02 REV} {
   OFF}"
70 NEXTT
80 PRINT"  {REV}    {OFF} {REV}    {OFF} {
   REV}    {OFF} {REV}    {OFF}"
82 PRINT"{HOME}{15 DOWN}"SPC(10)"000"
85 FORLA=0TO3
87 LC(LA)=INT(RND(1)*4)+2:IFLC(LA)=3THENLC(LA
   )=6
90 FORLB=1TO4:CN=LC(LA):IFLC(LA)=LC(LB)ANDLB<
   >LATHEN87
95 NEXT:POKEC+201+5*LA,CN:POKEC+202+5*LA,CN:P
   OKEC+223+5*LA,CN:POKEC+224+5*LA,CN:NEXT

99 FORT=1TO300:NEXT
100 LF=LF+1:IFLF=100THEN2000
110 L%(LF)=INT(RND(1)*4)
120 FORLL=1TOLF:S=L%(LL):Q=160:GOSUB1000
130 FORT=1TO300:NEXT:Q=32:GOSUB1000:POKE36878,
   0:FORT=1TO200:NEXT:NEXT
135 FORLG=1TOLF:TA=TI
140 GETA$:A=VAL(A$)-1:IFTI-TA>200THENS=L%(LG):
   GOTO160
150 S=A:IFA=-1ORA>3THEN140
152 LF$=STR$(LF)
160 Q=160:GOSUB1000:FORT=1TO200:NEXT:Q=32:GOSU
   B1000:POKE36878,0
162 IFA=L%(LG)THENFORT=1TO50:NEXT:NEXT
165 IFLG=LF+1THENPRINT"{HOME}{15 DOWN}{WHT}"TA
   B(14-LEN(LF$))RIGHT$(LF$,LEN(LF$)-1):
   GOTO99
170 PRINT"{HOME}{02 DOWN}"TAB(9)"{YEL}MISS":PO
   KE36878,15:POKE36875,128:R=R+1:FORT=1
   TO400:GETA$:NEXT
175 IFR=3THENFORT=1TO100:NEXT:GOTO2000
180 FORT=1TO600:NEXT:PRINT"{HOME}{02 DOWN}    ~
          ":POKE36878,0:FORT=1TO500:NEXT

190 GOTO120
1000 POKESC+201+5*S,Q:POKESC+202+5*S,Q:POKESC+2
   23+5*S,Q:POKESC+224+5*S,Q
1010 POKE36878,15:POKE36875,7*S+217:RETURN
2000 PRINT"{HOME}{16 DOWN}{WHT}     *GAME OVER*
   ":PRINT"{DOWN}    TO PLAY AGAIN":POKE
   36878,0
2005 PRINT"     PRESS SPACE":PRINT"{02 DOWN} PR
   ESS 'CTRL' TO STOP"
2010 GETA$:IFA$=" "THENRUN40
2020 IFPEEK(653)>3THENEND
2030 GOTO2010
```

## Program 2: Atari Version

```
100 REM [ATARI "COPY-CAT" WITH
110 REM [JOYSTICKS
120 REM
130 GOSUB 670:REM Instructions
140 GRAPHICS 18:DIM WHICH$(100)
150 REM Use page four for character s
    et.
160 CHSET=1024
170 FOR I=0 TO 7:POKE CHSET+I,0:NEXT
    I
180 REM Only character in set (other
```

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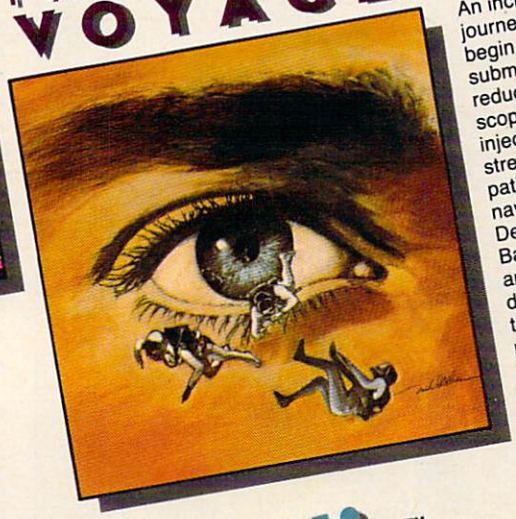

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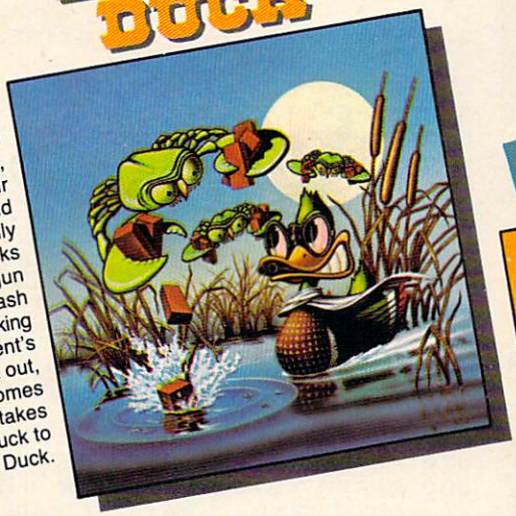
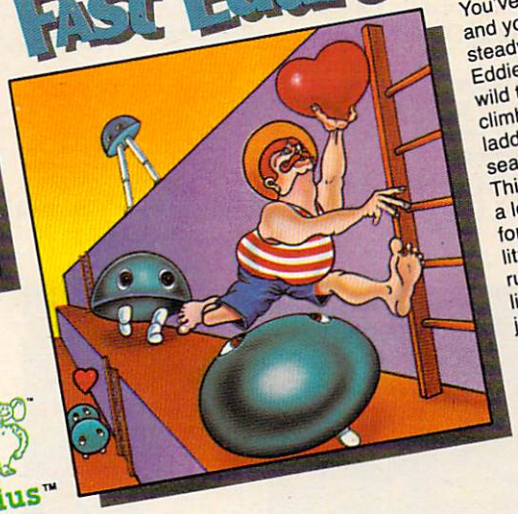


Those cranky crabs are trying to drive the ducks from their once quiet pond. Imagine, crabs taking to the air armed with bricks and bombs! Luckily, Deadly Duck has a few tricks of his own. His gun barrel bill can unleash a bevy of crab cracking bullets at a moment's notice. Look out, Deadly, here comes another brick! It takes more than luck to play Deadly Duck.

## Fast Eddie™



You've got to be cool and you've got to be steady to play Fast Eddie. Eddie is on a wild treasure hunt, climbing up and down ladders everywhere in search of prizes. Things would sure be a lot easier if it weren't for all of those pesky little Sneakers™ running around. They literally keep him jumping!

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# Notes For Other Machines

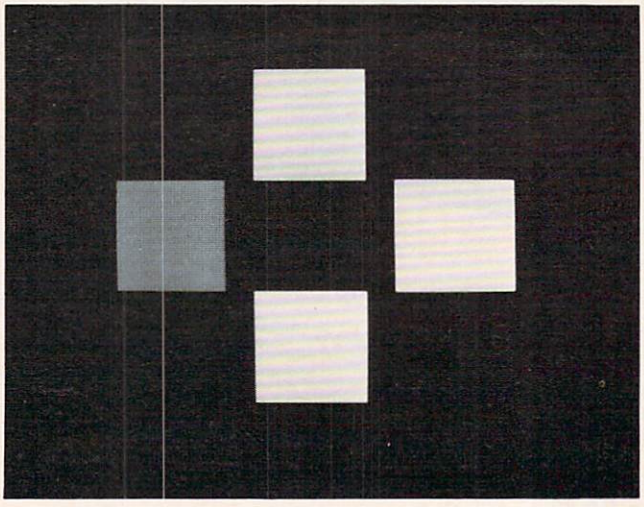
Charles Brannon, Editorial Assistant

Programs 2-5 are customized versions for the Atari, TRS-80 Color Computer, Apple II and PET/CBM. All games will run on each computer's minimum memory size. The Atari version requires one joystick plugged into the first port. Instructions are included in the program.

## Special Atari Note

You can easily get four simultaneous colors in GRAPHICS 2, but there is no suitable "solid" character. This is solved by defining a solid box character (8x8 pixels), using a custom character set. It would seem wasteful to reserve 512 bytes just for one custom character, but a sneaky trick is used here: the character is stored on *page four*! ($0400) is on an even 1K boundary, and is unused most of the time by the Operating System. It's an excellent place to store just a few characters, and it doesn't consume any user RAM. Remember to clear the first eight bytes, which is the pattern used by the SPACE character.

```
    than space) is a square:
190 FOR I=0 TO 7:POKE CHSET+8+I,255:N
    EXT I
200 POKE 756,4
210 ? #6;"{8 SPACES}!!!!"
220 ? #6;"{8 SPACES}!!!!"
230 ? #6;"{8 SPACES}!!!!"
240 ? #6;"{8 SPACES}!!!!"
250 ? #6;"{3 SPACES}{4 A}{6 SPACES}!!
    !!"
```



*Four colored blocks blink on and off in the Apple, Atari, and TRS-80 Color Computer versions of "Copy Cat."*

```
260 ? #6;"{3 SPACES}{4 A}{6 SPACES}!!
    !!"
270 ? #6;"{3 SPACES}{4 A}{6 SPACES}!!
    !!"
280 ? #6;"{3 SPACES}{4 A}{6 SPACES}!!
    !!"
290 ? #6;"{8 SPACES}{4 [F]}"
300 ? #6;"{8 SPACES}{4 [F]}"
310 ? #6;"{8 SPACES}{4 [F]}"
320 ? #6;"{8 SPACES}{4 [F]}"
330 INDEX=INDEX+1
340 WHICH$(INDEX)=CHR$(INT(4*RND(0)+1
    ))
350 GOSUB 610
360 FOR I=1 TO INDEX
370 ST=STICK(0):WHICH=(ST=14)+2*(ST=1
    1)+3*(ST=7)+4*(ST=13)
380 IF STRIG(0)=0 THEN GRAPHICS 0:END

390 IF WHICH=0 THEN 370
400 POKE 77,0:GOSUB 530
410 IF WHICH<>ASC(WHICH$(I)) THEN 450
420 NEXT I
430 FOR W=1 TO 100:NEXT W
440 GOTO 330
450 SOUND 0,100,12,8:SETCOLOR 4,3,10:
    FOR W=1 TO 200:NEXT W
460 GOSUB 610
470 GRAPHICS 18:SETCOLOR 4,0,14:POSIT
    ION 6,2:? #6;"[too bad]{F}"
480 POSITION 5,6:? #6;"[LENGTH]";INDEX
    -1
490 POSITION 3,8:? #6;"difficulty:";D
    IFF
500 POSITION 1,11:? #6;"  press [fire].
    .."
510 POKE 711,PEEK(53770):IF STRIG(0)
    THEN 510
520 RUN
530 P=PEEK(707+WHICH)
540 HUE=INT(P/16):LUM=P-HUE*16
550 SETCOLOR WHICH-1,HUE,14
560 FOR W=15 TO 0 STEP -1
570 SOUND 0,WHICH*10+50,10,W
580 NEXT W
590 POKE 707+WHICH,P
600 RETURN
610 FOR I=1 TO INDEX
620 WHICH=ASC(WHICH$(I))
630 GOSUB 530
640 FOR W=1 TO (9-DIFF)*5:NEXT W
650 NEXT I
660 RETURN
670 REM INSTRUCTIONS, SET-UP
680 GRAPHICS 17:POSITION 6,0:? #6;"[CO
    PY]{M}[CAT]":? #6:SETCOLOR 2,9,6
690 ? #6;"{3 SPACES}REPEAT MY NOTES"
700 ? #6;"{3 SPACES}BY PUSHING YOUR"
710 ? #6;"{3 SPACES}JOYSTICK IN THE"
720 ? #6;"{3 SPACES}RIGHT DIRECTION":
    ? #6
730 ? #6;"{3 SPACES}[I CAN PLAY THE]"
740 ? #6;"{5 SPACES}[NOTES FROM]"
750 ? #6;"{3 SPACES}[{1} SLOW TO]"
760 ? #6;"{3 SPACES}[{9} FAST ...]":? #
    6
770 ? #6;" [select difficulty]"
780 ? #6;" [with joystick{2}]"
790 ? #6
800 ? #6;" 1 2 3 4 5 6 7 8 9"
810 ? #6:? #6;"  THEN PRESS [fire]"
820 DIFF=5
830 COLOR DIFF+16:PLOT DIFF*2-1,15
840 ST=STICK(0):IF ST=15 THEN 890
850 IF ST=STICK(0) THEN 850
```

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*SSSD = Single Sided Single Density; SSDD = Single Sided Double Density; DSDD = Double Sided Double Density; SSQD = Single Sided Quad Density; DSQD = Double Sided Quad Density; TPI = Tracks per inch.*

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```
860 POKE 53279,0
870 COLOR DIFF+48:PLOT DIFF*2-1,15
880 DIFF=DIFF-(ST=11)*(DIFF>1)+(ST=7)
    *(DIFF<9)
890 IF STRIG(0) THEN 830
900 GRAPHICS 2+16:SETCOLOR 4,1,10:SET
    COLOR 0,7,6:SETCOLOR 2,3,4
910 POSITION 1,5:? #6;"PRESS FIRE TO
    QUIT"
920 FOR W=1 TO 200:NEXT W:RETURN
```

## Program 3: TRS-80 Color Computer Version

```
100 ' TRS-80 COLOR COMPUTER
110 ' COPYCAT
120 REM
125 CLS
130 GOSUB 670:' INITIALIZATION
140 CLS 0
250 DATA 1,2,3,6,4,8,7,5
260 FOR I=1 TO 4
270 READ A,B
280 FOR J=1 TO 10
290 DRK$(I)=DRK$(I)+CHR$(143+16*(A-1)
    )
300 LT$(I)=LT$(I)+CHR$(143+16*(B-1))
310 NEXTJ
320 NEXT I
325 FORI=1TO4:WHICH=I:GOSUB 530:NEXT
327 FOR W=1 TO200:NEXT
328 SO=1
330 INDEX=INDEX+1
340 WHICH$=WHICH$+CHR$(RND(4))
350 GOSUB 610
360 FOR I=1 TO INDEX
380 Z$=INKEY$:IFZ$=""THEN380
385 WHICH=-(Z$="I")-2*(Z$="J")-3*(Z$=
    "K")-4*(Z$="M")
390 IF WHICH<1 OR WHICH>4 THEN 380
400 GOSUB 530
410 IF WHICH<>ASC(MID$(WHICH$,I)) THE
    N 450
420 NEXT I
430 FOR W=1 TO100:NEXT
440 GOTO 330
450 FORI=1TO4:CLSI:SOUNDI*10,1:NEXT:S
    OUND1,10
455 CLSO:FORI=1TO4:SO=0:WHICH=I:GOSUB
    530:NEXT
460 SO=1:GOSUB610
470 CLS:PRINT@12,"TOO BAD!"
480 PRINT:PRINT:PRINTTAB(11);"LENGTH:
    ";INDEX-1
490 PRINT:PRINT:PRINTTAB(8);"DIFFICUL
    TY:";DIFF
500 PRINT:PRINT:PRINT:PRINT:PRINTTAB(
    9);"PRESS SPACE..."
510 IF INKEY$<>" " THEN 510
520 RUN
530 TM=10-DIFF
540 IF WHICH=1 THEN Z=10 ELSE IF WHIC
    H=2 THEN Z=160 ELSE IF WHICH=3 TH
    EN Z=180 ELSE Z=330
550 FOR L=0 TO 3:PRINT@Z+L*32,LT$(WHI
    CH);:NEXT
560 IF SO THEN SOUND WHICH*10+18,TM/2
    +.5
570 FOR L=0 TO 3:PRINT@Z+L*32,DRK$(WH
    ICH);:NEXT
580 RETURN
610 FOR I=1 TO INDEX
620 WHICH=ASC(MID$(WHICH$,I))
630 GOSUB 530
640 FOR W=1 TO(9-DIFF)*5:NEXT W
650 NEXT I
660 RETURN
670 ' INSTRUCTIONS
680 PRINT@12,"COPY-CAT":PRINT
690 PRINT"REPEAT MY NOTES BY PRESSING
700 PRINT"THE I,J,K,M KEYS...
710 PRINT"I=UP,M=DOWN,J=LEFT,K=RIGHT:
    "
720 PRINT TAB(16);"I":PRINTTAB(15);"J
    K":PRINTTAB(16);"M"
730 PRINT:PRINT"I CAN PLAY THE NOTES
    FROM":PRINT
740 PRINT"<1> SLOW TO <9> FAST":PRINT
750 PRINT:PRINT"ENTER SKILL LEVEL <1-
    9>"
760 Z$=INKEY$:IFZ$=""THEN760
770 DIFF=VAL(Z$)
780 IF DIFF<1 OR DIFF>9 THEN 760
820 RETURN
```

## Program 4: Apple II Version

```
100  REM  APPLE II COPYCAT
110  REM
120  GOSUB 670: REM  INITIALIZATION
130  GR
150  DATA  11,1,7,2,14,12,15,3
160  FOR I = 1 TO 4
170  READ LT(I),DRK(I)
180  NEXT
190 SO = 0: FOR I = 1 TO 4
200 WHICH = I: GOSUB 530: NEXT
210  FOR W = 1 TO 500: NEXT
220 SO = 1
330 INDEX = INDEX + 1
340 WHICH$ = WHICH$ +  CHR$ (4 *  RND (1) +
    1)
350  GOSUB 610
360  FOR I = 1 TO INDEX
370  IF  PEEK ( - 16384) < 127 THEN 370
380 A =  PEEK ( - 16384) - 128: POKE  - 1636
    8,0
385 WHICH = A - 72: IF WHICH = 5 THEN WHICH =
    4
390  IF WHICH < 1 OR WHICH > 4 THEN 370
400  GOSUB 530
410  IF WHICH <  > ASC ( MID$ (WHICH$,I)) THEN
    450
420  NEXT I
430  FOR W = 1 TO 100: NEXT
440  GOTO 330
450  FOR I = 1 TO 50: COLOR=  INT (16 *  RND
    (0))
451 S =  - 16336: POKE S,0:Z =  PEEK (S)
455  HLIN 40 *  RND (1),40 *  RND (1) AT 40 *
     RND (1)
457  VLIN 40 *  RND (1),40 *  RND (1) AT 40 *
     RND (1)
458  NEXT
460  GR : FOR I = 1 TO 4:SO = 0:WHICH = I: GOSUB
    530: NEXT :SO = 1: GOSUB 610
470  TEXT : HOME : INVERSE : PRINT  TAB( 16)
    ;"TOO BAD!"; TAB( 39): NORMAL : PRINT :
     PRINT : PRINT
480  PRINT : PRINT : PRINT  TAB( 15);"LENGTH
    :";INDEX - 1
490  PRINT : PRINT : PRINT  TAB( 12);"DIFFIC
    ULTY:";DF
495  POKE  - 16368,0
500  VTAB 23: HTAB 7: INVERSE : PRINT "PRESS
     ";: FLASH : PRINT "SPACE";: INVERSE : PRINT
    " TO PLAY AGAIN:";: NORMAL : GET A$
520  RUN
530 TM = 10 - DF
540 X = 5 + 10 * (WHICH = 1 OR WHICH = 4) +
    20 * (WHICH = 3)
550 Y = 5 + 10 * (WHICH = 2 OR WHICH = 3) +
    20 * (WHICH = 4)
560  COLOR= LT(WHICH): FOR L = 0 TO 9: HLIN
    X,X + 10 AT Y + L: NEXT
```

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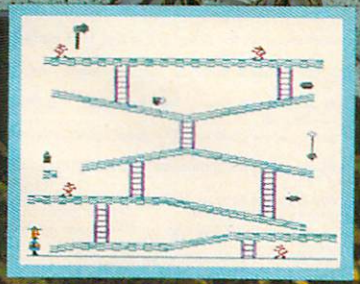
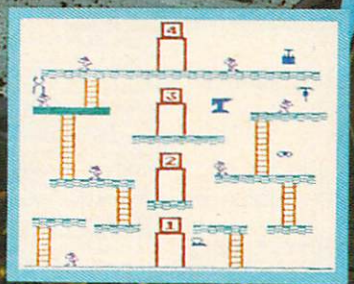
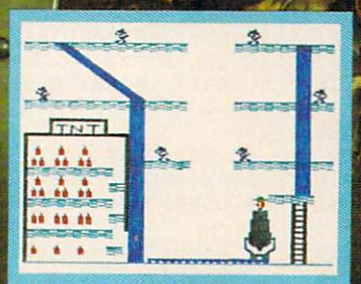


**Round 1: The Mine Shaft.**
Sharpen your miner's skill!



**Round 3: The Transporters.**
Beam yourself up!

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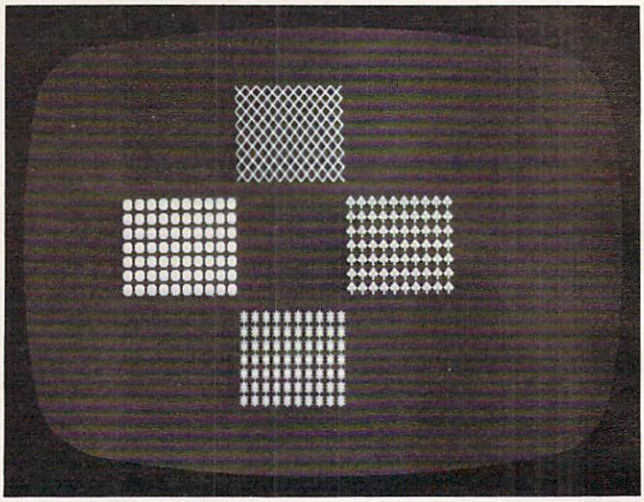
```
570 S =  - 16336: IF SO THEN  FOR L = 1 TO T
    M * 5:A =  PEEK (S): FOR W = 1 TO WHICH
    : NEXT : NEXT
580 COLOR= DRK(WHICH): FOR L = 0 TO 9: HLIN
    X,X + 10 AT Y + L: NEXT
590 RETURN
610 FOR I = 1 TO INDEX
620 WHICH =  ASC ( MID$ (WHICH$,I))
630 GOSUB 530
640 FOR W = 1 TO (9 - DF) * 5: NEXT W
650 NEXT I
660 RETURN
670 REM  INSTRUCTIONS
680 TEXT : HOME
685 INVERSE : PRINT  TAB( 16);"COPY-CAT"; TAB(
    39);""
687 NORMAL
690 PRINT : PRINT "REPEAT MY NOTES BY PRESS
    ING
700 PRINT : PRINT "THE I,J,K,M KEYS...": PRINT

710 PRINT  TAB( 20);"I": PRINT  TAB( 19);"J
     K": PRINT  TAB( 20);"M"
730 PRINT : PRINT "I CAN PLAY THE NOTES FRO
    M": PRINT
740 PRINT "<1> SLOW TO <9> FAST": PRINT : PRINT

750 PRINT "ENTER SKILL LEVEL <1-9>:";
755 GET A$
760 DF =  VAL (A$): IF DF < 1 OR DF > 9 THEN
    755
800 RETURN
```

## Program 5: PET/CBM Version

```
100 REM PET-CBM COPYCAT
110 GOSUB 5000:REM INSTRUCTIONS
115 PRINT"{CLEAR}";CHR$(142);:POKE59464,12
120 DATA "V","Q","X","*"
130 FORI=1TO4:READ DRK$
150 FORJ=1TO10:DRK$(I)=DRK$(I)+DRK$:NEXT
160 NEXT
170 SO=0:FORWHICH=1TO4:GOSUB1000:NEXT:SO=1
180 INDEX=INDEX+1
190 WHICH$=WHICH$+CHR$(4*RND(0)+1)
200 GOSUB 2000
210 FOR I=1 TO INDEX
220 GETA$:IFA$=""THEN220
230 WHICH=-(A$="8")-2*(A$="4")-3*(A$="6")-4*(A
    $="2")
240 IF WHICH=0 THEN 220
250 GOSUB 1000
260 IF WHICH<>ASC(MID$(WHICH$,I)) THEN 500
270 NEXT I
280 FOR W=1 TO 500:NEXT
290 GOTO 180
500 POKE59467,16:POKE59466,13
510 FOR I=0 TO 255 STEP 5:POKE 59464,I:POKE 32
    768+999*RND(0),255*RND(0):NEXT
520 POKE 59467,0
530 PRINT"{CLEAR}";:SO=0:FORWHICH=1TO4:GOSUB10
    00:NEXT:SO=1
540 GOSUB 2000
550 FOR W=1 TO 500:NEXT
560 PRINT"{CLEAR}{REV}";TAB(16);"TOO BAD!"
570 PRINT"{04 DOWN}";TAB(15);"LENGTH:";INDEX-1

580 PRINT"{04 DOWN}";TAB(12);"DIFFICULTY:";DF
590 PRINT"{HOME}{22 DOWN}";
600 PRINTTAB(7);"PRESS {REV}SPACE{OFF} TO PLAY
     AGAIN:"
610 GETA$:IFA$<>" "THEN610
620 RUN
1000 REM UPDATE A BOX
1010 TM=10-DF
1020 X=5-10*(WHICH=1ORWHICH=4)-20*(WHICH=3)
1030 Y=-8*(WHICH=2ORWHICH=3)-16*(WHICH=4)
1040 PRINTLEFT$("{HOME}{17 DOWN}",Y+1);
1050 FORL=1TO7:PRINTSPC(X);"{REV}";DRK$(WHICH):
    NEXT
```



*"Copy Cat" awaits a pattern-matching response, PET/CBM version.*

```
1060 IF SO THEN POKE 59467,16:POKE 59466,51
1065 PITCH=10*WHICH+100
1070 IF SO THEN FOR L=0 TO 4:POKE 59464,PITCH+L
    :NEXT:POKE59467,0
1075 PRINTLEFT$("{HOME}{17 DOWN}",Y+1);
1080 FORL=1TO7:PRINTSPC(X);DRK$(WHICH):NEXT
1090 RETURN
2000 FOR I=1 TO INDEX
2010 WHICH=ASC(MID$(WHICH$,I))
2020 GOSUB 1000
2030 FOR W=1 TO (9-DF)*20:NEXT
2040 NEXT I
2050 RETURN
5000 REM INSTRUCTIONS
5010 PRINT"{CLEAR}";TAB(16);"{REV}COPYCAT"
5020 PRINT"{04 DOWN}REPEAT MY NOTES BY PRESSING
    THE
5030 PRINT"{DOWN}8,4,6,2 KEYS:{DOWN}"
5040 PRINTTAB(15);" 8{DOWN}{02 LEFT}4 6{DOWN}{0
    2 LEFT}2"
5050 PRINT"{02 DOWN}I CAN PLAY THE NOTES FROM
5060 PRINT"{DOWN}<1> SLOW   TO   <9>  FAST"
5070 PRINT"{03 DOWN}ENTER SKILL LEVEL:";
5080 GETA$:IFA$<"1"ORA$>"9"THEN5080
5090 DF=VAL(A$):RETURN
```

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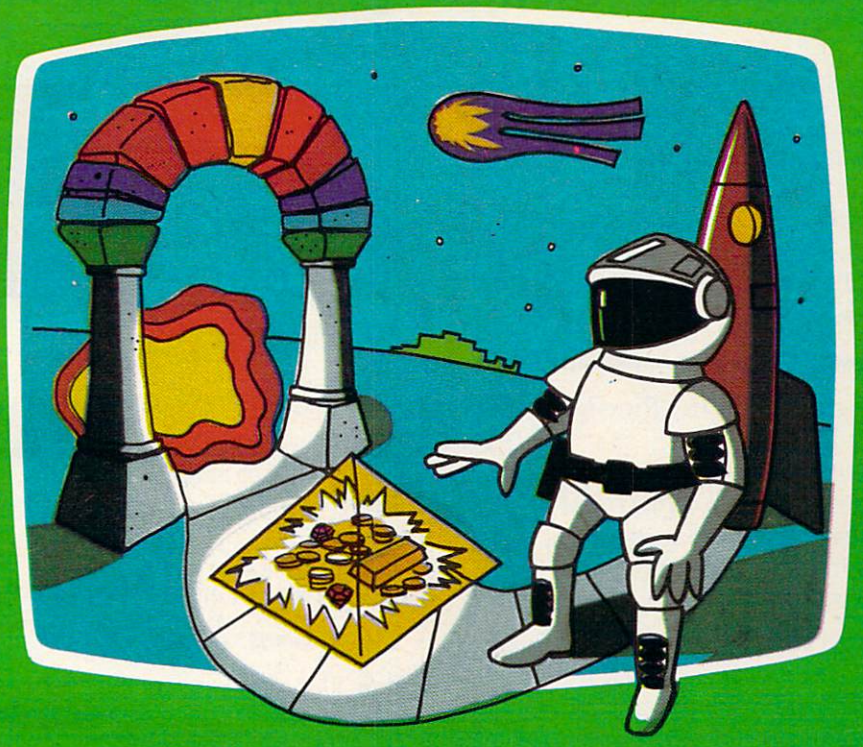

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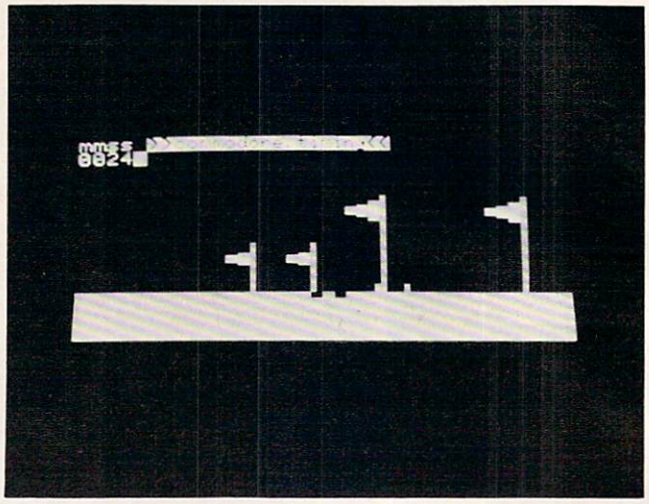
# Slalom

George Leotti

*This challenging skiing game, for PET/CBM and Atari, will test your skills and endurance as you try to maneuver through flags on a treacherous downhill race. Program versions for a 16K Atari and PET/CBM. Each version demonstrates some special programming technique, too. The PET version is in 3-D and the Atari version features fine scrolling.*



*Dodging oncoming flags in the PET version of "Slalom."*

You may want to stop off at the Pine Mountain Slalom course.

This newly constructed course is unique, in that you select the length, from 10 to 50 flags. You also select how fast you want to ski.

The object is to beat your best time. There are two things to keep in mind:

**1.** You must go between each set of flags. If you miss any, you will receive a five second penalty for each set missed.

**2.** If you hit any flag, it will slow you down. Try to get between them.

When the display starts, you will see your skis as two indentations in the snow. To steer, push the four key to go left and the six key to go right. Push the five key to stop ski motion.

To get the fastest times, do not have any wedge-type programs active such as Toolkit, DOS Support, etc.

If you do not feel like typing the program in (PET version only), I will be glad to make a copy. Just send $3, a blank cassette and a self-addressed, stamped mailer to:

*George Leotti*
*416 S. Elmwood Ave.*
*Glenolden, PA 19036*

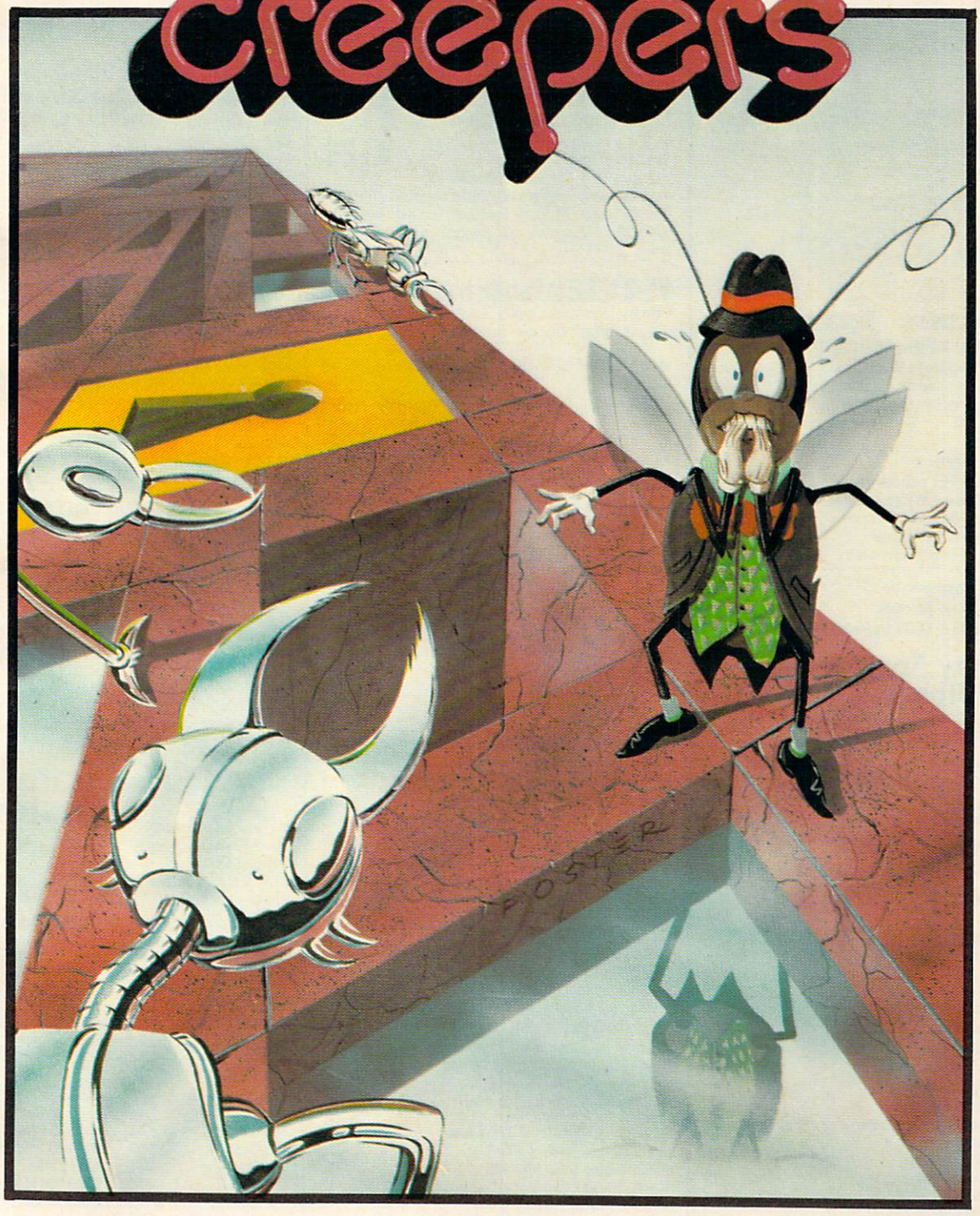
## Program 1: PET Version

```
100 GOTO440
110 TI$="000000":FORI=1TON:IFI<N-1THENPRINTR$(
    I)B$R$(I+1)M$R$(I+2)L$:GOTO140
120 IFI<NTHENPRINTR$(I)B$R$(I+1)M$:GOTO140
130 PRINTR$(I)B$
140 FORJ=1TOP:PRINT"{HOME}{DOWN}"RIGHT$(TI$,4)
    :NEXT:PRINTR$(I)G$
150 GETZ$:IFZ$>""THENT=ASC(Z$)
155 IFT<>52ANDT<>54THEN180
160 TZ=-((T<55)+(T<54)):S=S+D(TZ):IFS<0ORS>35T
    HENS=S-D(TZ):GOTO180
170 PRINTD$TAB(S)S$:GOTO150
180 IFS>R(I)-1ANDR(I)+9>STHEN210
190 T=TI:IFR(I)-3>SORS>R(I)+11THENM=M+5:GOTO21
    0
200 IFTI-T<120THENPRINT"{HOME}{DOWN}"RIGHT$(TI
    $,4):GOTO200
210 IFI<N-1THENPRINTR$(I)C1$R$(I+1)C2$R$(I+2)C
    3$:GOTO240
220 IFI<NTHENPRINTR$(I)C1$R$(I+1)C2$:GOTO240
230 PRINTR$(I)C1$
240 PRINT"{HOME}{DOWN}"RIGHT$(TI$,4):NEXT:T=TI

250 PRINTD$"{DOWN}{REV}            F  I  N  I ~
     S  H  "
260 R=R+1:PRINT"{DOWN}";:IFMTHENPRINT"{DOWN}PE
    NALTY OF"M"SECONDS;"M/5"FLAGS MISSED"

270 J=T
280 MT$=STR$(INT(T/3600)):MT$=RIGHT$(MT$,LEN(M
    T$)-1):T=T-VAL(MT$)*3600
290 IFLEN(MT$)=1THENMT$="0"+MT$
300 ST$=STR$(INT(T/60)):ST$=RIGHT$(ST$,LEN(ST$
    )-1):T=T-VAL(ST$)*60
310 IFLEN(ST$)=1THENST$="0"+ST$
320 JT$=MID$(STR$(T/60),3,2):IFLEN(JT$)=1THENJ
    T$=JT$+"0"
330 IFLEN(JT$)=0THENJT$="00"
340 IFJ=0THENRETURN
350 PRINT"{DOWN}THIS TIME/RUN: "MT$":"ST$"."JT
    $"  RUN#"R
360 PRINT"{DOWN}{REV}OFFICIAL TIME: ";:T=J+M*6
    0:J=0:GOSUB280
370 PRINTMT$":"ST$"."JT$"{OFF}   ↑ ↑ ↑"
380 IFR=1THEN400
390 IFVAL(MT$+ST$+JT$)>=VAL(LEFT$(BT$,2)+MID$(
    BT$,4,2)+RIGHT$(BT$,2))THEN410
400 BT$=MT$+":"+ST$+"."+JT$:BR=R
410 PRINT"{DOWN}BEST TIME/RUN: "BT$"  RUN#"BR:
    FORI=0TO9:GETI$:NEXT
420 INPUT"{DOWN}WANT TO SKI AGAIN  Y{03 LEFT}"
    ;I$:IFLEFT$(I$,1)="N"THENEND
430 GOTO630
440 DIMR$(50),R(50):I=0:N=0:J=0:P=0:T=0:K=151:
    S=0:D(1)=1:D(2)=-1
450 B$="":M$="":G$="":IFPEEK(50000)=0THENK=515

460 FOR Q=1 TO 69:READ BB:B$=B$+CHR$(BB):NEXT ~
    Q
470 FOR Q=1 TO 30:READ MM:M$=M$+CHR$(MM):NEXT ~
    Q
480 FOR Q=1 TO 66:READ GG:G$=G$+CHR$(GG):NEXT ~
    Q
490 L$=CHR$(172)+"{02 RIGHT}"+CHR$(187)
500 C1$=" {UP}{LEFT} {UP}{LEFT} {UP}{LEFT} {
    RIGHT}    {DOWN}{04 LEFT}    {DOWN}{
    LEFT} {DOWN}{LEFT} {DOWN}{LEFT} {DOWN}
    {LEFT} "
```

FOR THE
ATARI
400/800

by James Albanese

# jeepers creepers



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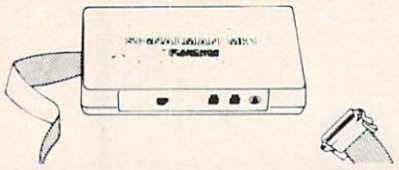

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| | |
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Subsort is an excellent general purpose machine language sort routine for PET/CBM computers. Sorts both one and two dimensioned arrays at lightning speed in either ascending or descending order. Other fields can be subsorted when a match is found, and fields need not be in any special order. Sort arrays may be specified by name, and fields are random length. Allows sorting by bit to provide 8 categories per byte. The routine works with all PET BASICs, adjusts to any memory size, and can co-exist with other programs in high memory.

# SuperGraphics 2.0

**NEW Version with TURTLE GRAPHICS**

SuperGraphics, by John Fluharty, provides a 4k machine language extension which adds 35 full featured commands to Commodore BASIC to allow fast and easy plotting and manipulation of graphics on the PET/CBM video display, as well as SOUND Commands. Animations which previously were too slow or impossible without machine language subroutines now can be programmed directly in BASIC. Move blocks (or rocketships, etc.), or entire areas of the screen with a single, easy to use BASIC command. Scroll any portion of the screen up, down, left, or right. Turn on or off any of the 4000 (8000 on 8032) screen pixels with a single BASIC command. In high resolution mode, draw vertical, horizontal, and diagonal lines. Draw a box, fill a box, and move it around on the screen with easy to use BASIC commands. Plot curves using either rectangular or polar co-ordinates (great for Algebra, Geometry and Trig classes.)

The SOUND commands allow you to initiate a note or series of notes (or even several songs) from BASIC, and then play them in the background mode without interfering with your BASIC program. This allows your program to run at full speed with simultaneous graphics and music.

Seven new TURTLE commands open up a whole new dimension in graphics. Place the TURTLE anywhere on the screen, set his DIRECTION, turn him LEFT or RIGHT, move him FORWARD, raise or lower his plotting pen, even flip the pen over to erase. Turtle commands use angles measured in degrees, not radians, so even elementary school children can create fantastic graphic displays.

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Volume discounts available on ROM version for schools.

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for PET/CBM Computers

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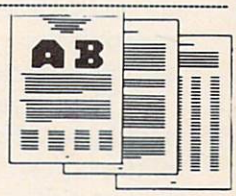
by Michael Riley




Paper-Mate is a full-featured word processor for CBM/PET by Michael Riley. Paper-Mate incorporates 60 commands to give you full screen editing with graphics for all 16K or 32K machines (including 8032), all printers, and disk or tape drives. Many additional features are available (including most capabilities of Professional Software's WordPro 3).

For writing text, Paper-Mate has a definable keyboard so you can use with either Business or Graphics machines. Shift lock on letters only, or use keyboard shift lock. All keys repeat.

Paper-Mate text editing includes floating cursor, scroll up or down, page forward or back, and repeating insert and delete keys. Text block handling includes transfer, delete, append, save, load, and insert.

All formatting commands are imbedded in text for complete control. Commands include margin control and release, column adjust, 9 tab settings, variable line spacing, justify text, center text, and auto print form letter (variable block). Files can be linked so that one command prints an entire manuscript. Auto page, page headers, page numbers, pause at end of page, and hyphenation pauses are included.

Unlike most word processors, CBM graphics as well as text can be used. Paper-Mate can send any ASCII code over any secondary address to any printer.

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# Atari Notes

Charles Brannon, Editorial Assistant

With the Atari version of Slalom, **COMPUTE!** presents its first fine-scrolling arcade style game. The Atari version, called "SKI!", lets you test your skill at electronic winter sports.

Use a joystick controller plugged into the first port to control the skier. The game will run in 16K if you remove the text from all REM statements. The mountain scenery smoothly moves down towards you, as you dodge rocks, trees, and flags and "gobble up" bonus points planted in the snow. You can move the joystick left or right to turn. You can also position your player up or down to change difficulty, points, and maneuverability.

The higher you go, the faster the scene scrolls, and the more points you win. The higher speeds necessitate fast response. The novice will want to position himself a little below midway up the screen. That way, you have room to pull back if you need to duck. If you hit a rock, tree, or flag, you crash, and start over at the bottom of the screen. You lose fifty points for every crash.

## Up The Hill

Every time you play the game, a random ski course is generated. The screen scrolls in reverse as it displays the course being laid out. If you want more of a surprise, turn off your TV while the course is being drawn. Your computer will buzz when the game is ready to play. Press FIRE to begin. While the pattern is being drawn, you can imagine you're on your way up the mountain on the ski lift, previewing the course.

## Fine Scrolling

Fine scrolling couples coarse scrolling (which moves the pointers to screen memory around) with a special feature of the ANTIC chip.

To fine-scroll, you set a special bit in every line of the display list you wish to scroll. You then scroll one scan line at a time by storing numbers from 0-15 in VSCROL. When you reach the limit of ANTIC's fine scrolling resolution (8 scan lines in GRAPHICS 1), you reset VSCROL and then coarsely scroll a full eight scan lines. Coarse scrolling is described in *COMPUTE!'s Second Book of Atari*. Machine language is required for fine scrolling, since you must reset VSCROL and perform the coarse scroll almost simultaneously, or else you get a jumpy, unpleasant display.

## Interfacing To BASIC

The fine scrolling routine could be written as a USR statement, but BASIC would have to call it every time a scroll was needed, and this would be too slow. We need to periodically update the screen in a way that's not dependent on BASIC.

The Vertical Blank Interrupt (VBI) is perfect for this task. Every 1/60th of a second, the scroll routine is called to update the screen. BASIC can control the speed with memory location zero. POKEing a number from 1-255 controls the speed from one (fastest) to 255. A zero will stop the scrolling, although the vertical blank routine will still be "hooked up." BASIC sets up the VBLANK scrolling routine by passing the address of the Load Memory Scan counter to change in the display list (which can be found on a normal screen with LMS = PEEK(560) + 256* PEEK(561) + 4) and the number of lines to scroll. BASIC can PEEK location 1 to see how many full lines still need to be scrolled.

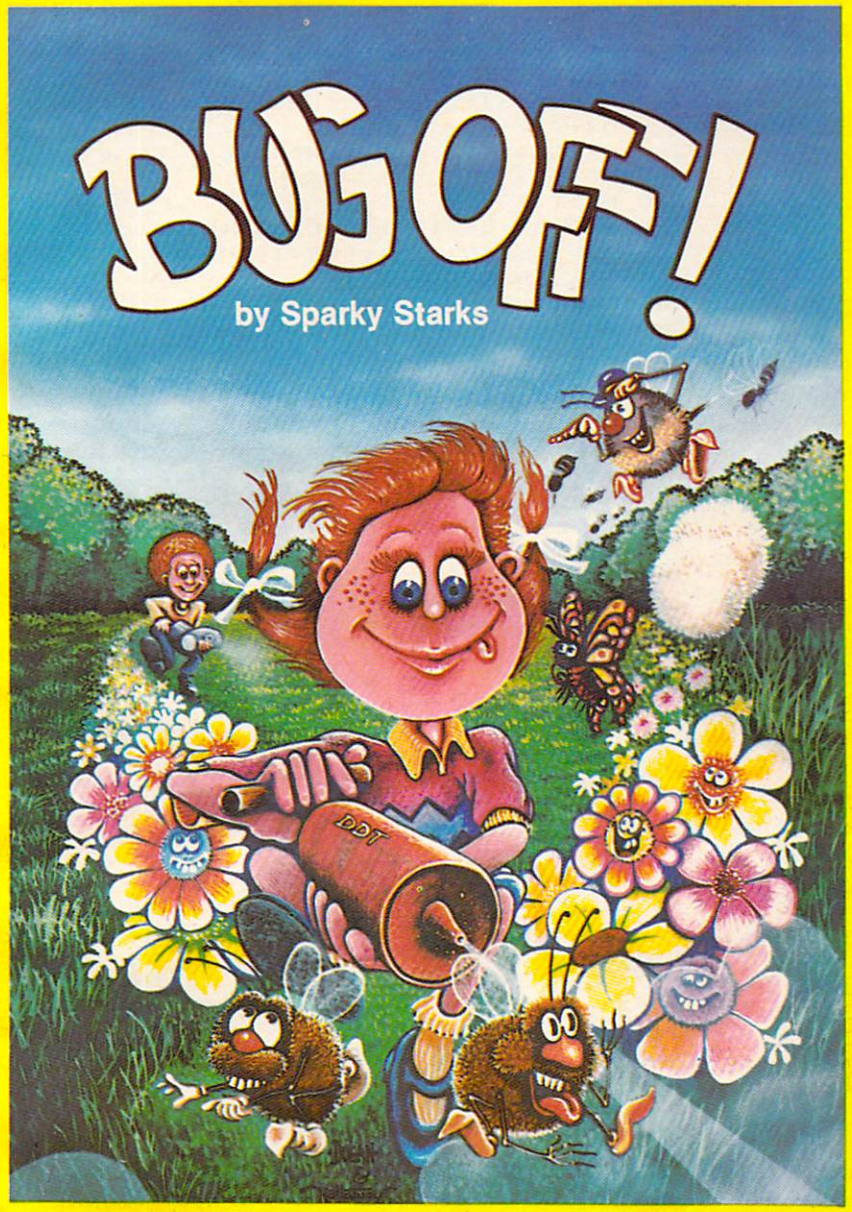
The VBLANK routine will stop scrolling when it runs out of lines, and memory location 1 will hold a zero. You could use the machine language routine in your own programs, but since it is not general-purpose, you will be limited to unidirectional scrolling in GRAPHICS 1. Be sure to use the "disable routine" (A = USR(1638)) to remove the VBI routine from the system.

## An ANTIC Anomaly

It's not mentioned anywhere as far as I know, but the address of the start of your screen memory for fine scrolling should start on a 4K boundary. ANTIC apparently cannot cross a 4K boundary, so if your screen buffer (that holds the rocks, trees, etc.) is too long, ANTIC can get confused and start displaying nonsense. Another thing to watch for: when using a vertical blank routine, be sure to include a CLD (Clear Decimal) at the start of the program. If you don't, your arithmetic will be foiled every time BASIC calls the floating point routines (which use BCD math).

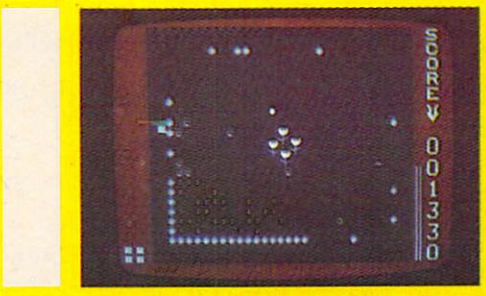
Strings are used extensively in the BASIC program, to prevent memory conflicts. A string is used to hold the display list, the screen memory area, the player/missile memory, and the shapes for the player. The screen memory area and the player/missile address are ensured to be on proper page boundaries by modification of the Variable Value Table. Because of this, line 100 must be typed first, in order for the program to work properly.

# YOU'RE GOING TO HAVE FUN WITH YOUR ATARI!!




## AND THE FUN GETS ROLLING WITH BUG OFF!

Yikes! The bugs are swarming here, there and everywhere and only a strong whiff of DDT can put 'em away. The object of the game is to control the seven different kinds of pests that are running helter-skelter over everything. The Army can airlift in more DDT to fill your bug sprayer . . . but will they make it in time?




**The action builds to a furious frenzy** as an awesome assortment of insects attack anything and everything in sight. A definite case of "spray first and ask questions later." All this and hi-res graphics, too!

| | | |
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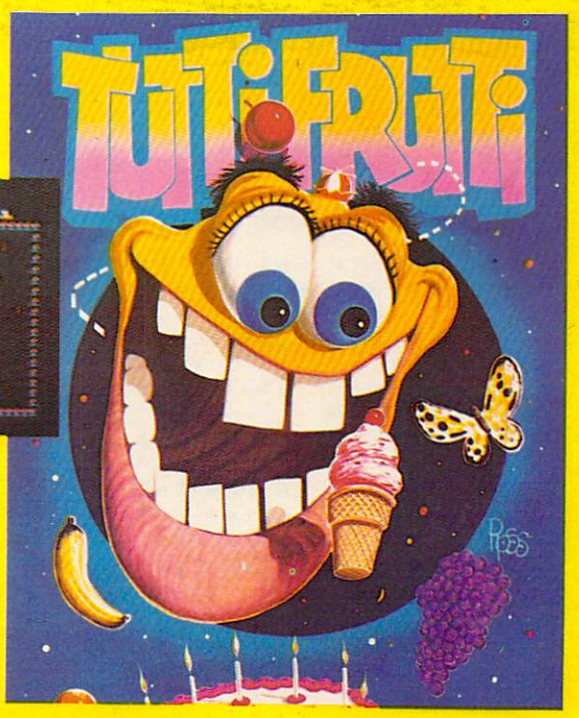
## TUTTI FRUTTI — by Alan Newman

**"GRAPE FUN" FOR THE WHOLE FAMILY!**

Somewhere between Never Never Land and next Thursday, there's a wild and wacky place where your joystick-controlled "Hungry" snacks on an orchard of goodies. But there are some nasty ol' bugs who'd just as soon snack on YOU, so look sharp and beware. Funtastic action for all ages!




**TUTTI FRUTTI** ... Wow! A crazy cast of characters in vivid hi-res color all performing in their natural habitat, otherwise known as TUTTI FRUTTI Land. Grape fun for ages 6 and up!

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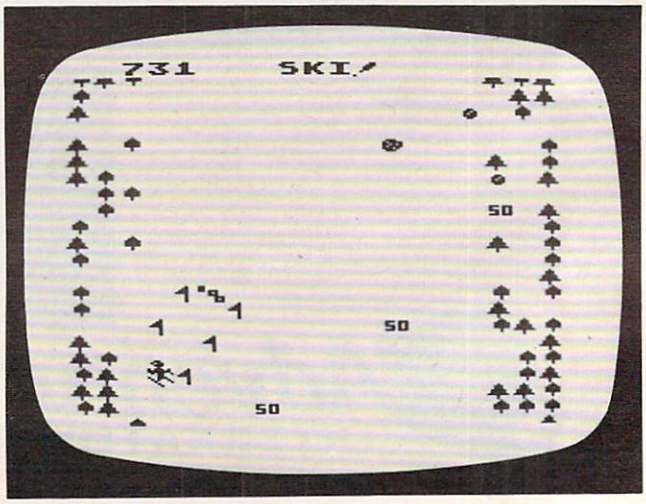
```
510 C2$="{RIGHT}{UP}{03 LEFT}   {UP}{03 LEFT}
    {02 RIGHT}   {DOWN}{03 LEFT}   {
    DOWN}{LEFT} "
520 C3$="{03 RIGHT} "
530 R$="{35 RIGHT}"
540 D$="{HOME}{09 DOWN}":S$="{REV} "+CHR$(184)
    +" "+CHR$(184)+" "
550 INPUT"{CLEAR}COURSE LENGTH (10-50)";N
560 IFN>50THENPRINT"{HOME}"LEFT$(R$,23)"50
    ":N=50
570 IFN<10THENPRINT"{HOME}"LEFT$(R$,23)"10
    ":N=10
580 INPUT"{DOWN}SPEED (1=FAST) TO (9=SLOW)";P
590 IFP>9THENPRINT"{UP}"LEFT$(R$,28)"9      ":
    P=9
600 IFP<1THENPRINT"{UP}"LEFT$(R$,28)"1      ":
    P=1
610 IFP>1THENP=P*5
620 FORI=1TON:READR(I):R$(I)=D$+LEFT$(R$,R(I))
    :NEXT:D$=D$+"{DOWN}"
630 PRINT"{CLEAR}"D$;:FORI=1TO30:PRINT"{REV}
    {OFF}";:NEXT
640 S=17:M=0:PRINTD$LEFT$(R$,S)S$"{HOME}{DOWN}
    {04 RIGHT}{REV}PRESS ANY KEY"
650 GETI$:IFI$=""THEN650
660 PRINT"{HOME}{DOWN}{04 RIGHT}            {
    HOME}MMSS {REV}>>COMMODORE TIMING<<":
    GOTO110
670 REM ** FLAG CHARACTERS (B$)
680 DATA 161,145,157,161,145,157;161,145
690 DATA 157,161,145,157,157,157,157,183
700 DATA 184,18,185,146,161,145,157,157
710 DATA 157,157,239,185,18,184,146,161
720 DATA 29,29,29,29,29,29,29,29
730 DATA 239,185,18,184,146,161,17,157
740 DATA 157,157,157,183,184,18,185,146
750 DATA 161,17,157,161,17,157,161,17
760 DATA 157,161,17,157,161
770 REM ** FLAG CHARACTERS (M$)
780 DATA 161,145,157,157,157,183,184,161
790 DATA 145,157,157,157,239,185,161,29
800 DATA 29,239,185,161,17,157,157,157
810 DATA 183,184,161,17,157,161
820 REM ** FLAG CHARACTERS (G$)
830 DATA 18,167,145,157,167,145,157,167
840 DATA 145,157,167,145,157,157,157,157
850 DATA 162,185,239,167,145,157,157,157
860 DATA 157,146,162,18,184,183,167,29
870 DATA 29,29,29,29,29,29,29,146
880 DATA 162,18,184,183,167,17,157,157
890 DATA 157,157,162,185,239,167,17,157
900 DATA 167,17,157,167,17,157,167,17
910 DATA 157,167
920 REM ** FLAG POSITIONS
930 DATA 14,6,24,27,15,13,23,15,8,25
940 DATA 19,11,14,5,3,18,24,4,19,5
950 DATA 24,13,23,4,7,10,13,24,27,20
960 DATA 23,4,25,24,3,27,8,6,9,4
970 DATA 11,14,3,7,10,13,16,19,22,25
```

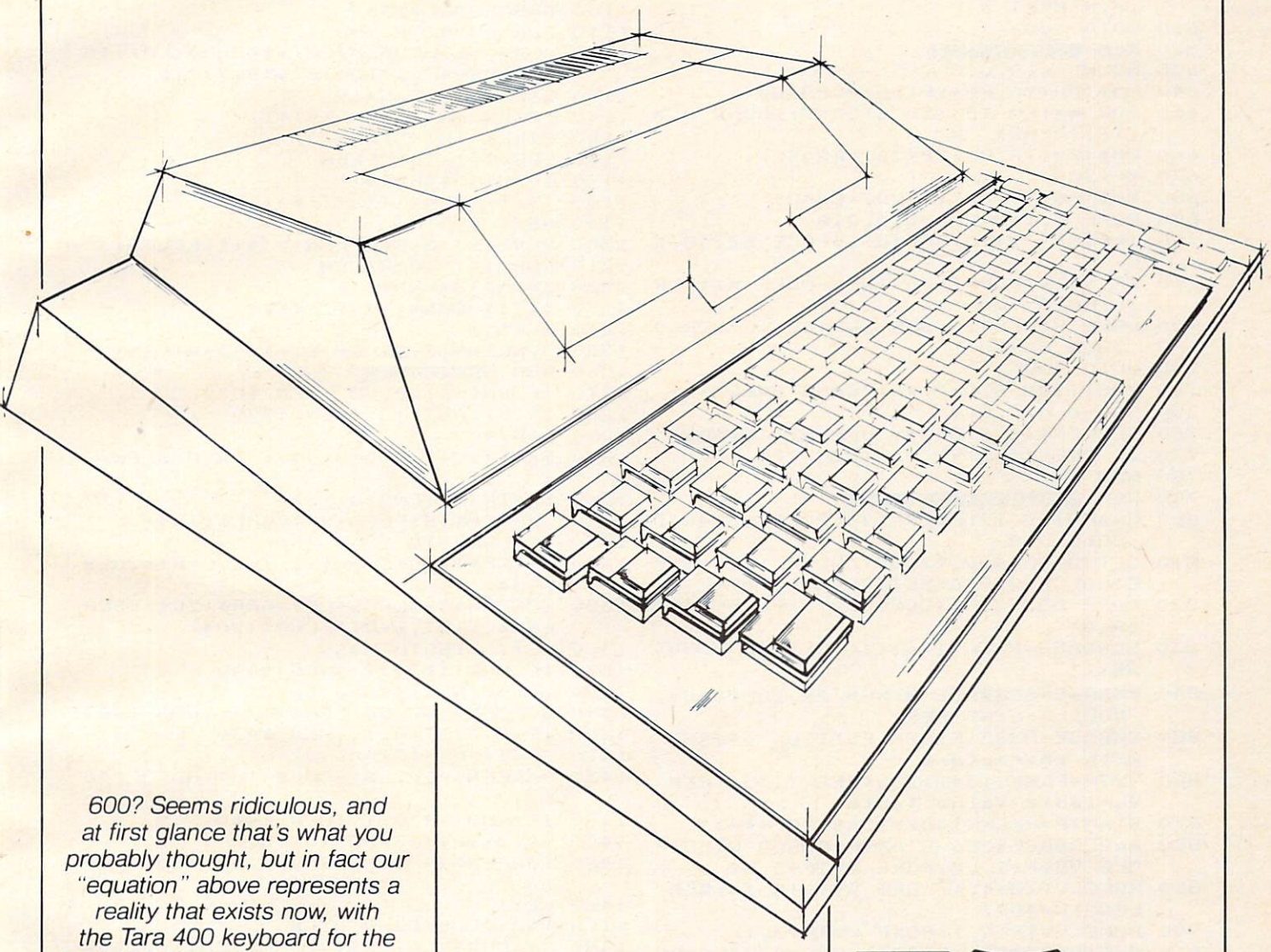
## Program 2: Atari Version

```
100 DIM SCREEN$(1),PM$(1):GOTO 130
110 REM * SKI * Line 100 must be type
    d in first!!!
120 HI=INT(A/256):LO=A-HI*256:RETURN
125 POKE 66,1:FOR W=1 TO 10:POKE 5327
    9,0:POKE 53279,8:NEXT W:POKE 66,0
    :RETURN
130 GOSUB 790:REM Initialization rout
    ines
140 REM PLAYER ROUTINE
150 POKE 559,62:POKE 54279,PMBASE
160 POKE 53277,3:POKE 704,2*16+6
170 PO=1024:YP=180:XP=128
180 PM$(PO)=CHR$(0):PM$(PO+254)=CHR$(
    0):PM$(PO+1)=PM$(PO)
190 DIM LEFT$(20),CENTER$(20),RIGHT$(
    20),CURR$(20),CRASH$(20),ERASE$(2
    0),DIR(8)
200 ERASE$=CHR$(0):ERASE$(20)=CHR$(0)
    :ERASE$(2)=ERASE$
210 LEFT$=ERASE$:CENTER$=ERASE$:RIGHT
    $=ERASE$:CRASH$=ERASE$
220 FOR I=0 TO 15
230 LEFT$(I+2,I+2)=CHR$(PEEK(CHSET+20
    8+I))
240 CENTER$(I+2,I+2)=CHR$(PEEK(CHSET+
    224+I))
250 RIGHT$(I+2,I+2)=CHR$(PEEK(CHSET+1
    04+I))
260 CRASH$(I+2,I+2)=CHR$(PEEK(CHSET+2
    40+I))
270 NEXT I
280 DIR(0)=0:DIR(1)=20:DIR(2)=19:DIR(
    3)=21:DIR(4)=1:FOR I=0 TO 3:DIR(I
    +5)=-DIR(I):NEXT I
290 CURR$=CENTER$
300 PM$(PO+YP,PO+YP+20)=CURR$
310 SCR=SCR+5-PEEK(0)
320 POSITION 2,0:? #6;SCR;"   ";
330 IF PEEK(1)=0 THEN 740
340 ST=STICK(0)
350 LEFT= NOT PTRIG(1):RIGHT= NOT PTR
    IG(0):LR=LEFT+2*RIGHT
360 CURR$=CENTER$:POKE 53248,XP
370 IF LEFT THEN CURR$=LEFT$:IF LR<>0
    LR THEN SV=2:TI=5
380 IF RIGHT THEN CURR$=RIGHT$:IF LR<
    >OLR THEN SV=4:TI=5
390 IF TI>0 THEN TI=TI-1:SOUND 0,SV,0
    ,TI
400 IF LR=0 THEN SOUND 0,0,0,0:TI=0
410 XP=XP+LEFT-RIGHT:OLR=LR
420 UP=(ST=14 OR ST=10 OR ST=6):DOWN=
    (ST=5 OR ST=9 OR ST=13)
430 YP=YP-2*UP+2*DOWN:IF YP>200 THEN
    YP=200
440 IF YP<40 THEN YP=40
450 POKE 0,(YP-48)/48+1
460 IF PEEK(POPF)=0 THEN 300
470 WHICH=INT(LOG(PEEK(POPF))/LOG(2)+
    0.1):POKE 0,0
480 PM$(PO+YP,PO+YP+20)=ERASE$
490 POKE HITCLR,0:IF WHICH<>2 THEN 62
    0
500 REM POINTS
510 PTR=ASC(DLIST$(8))+256*ASC(DLIST$
    (9))
520 LINE=INT((YP-39)/8)+1
530 COL=INT((XP-49)/8)+1
```




*A tricky maneuver between the flagpoles in "SKI!" for Atari computers.*

# 400 + 400 = 600?



*600? Seems ridiculous, and at first glance that's what you probably thought, but in fact our "equation" above represents a reality that exists now, with the Tara 400 keyboard for the Atari 400. Designed to provide the Atari 400 user with the hardware of tomorrow, today. Designed with an understanding of the essential superiority of a keyboard as a man–machine interface. Designed with the user in mind. For example, our keyboard does not attach to the 400 with a ribbon cable, but fits neatly into the original housing in 5 minutes, directly replacing the old membrane panel, and is styled to complement the lines of the computer itself. Sure, other keyboards have been sold, but who wants one that hangs off the computer, or whose keys fall off when you type on it? Our keys are actually gold-contact switches, offering increased reliability and performance, second to none. Coupled with the Tara 48K RAM expansion board, you can easily see how 400 + 400 = 600,* providing the user today with the hardware of tomorrow.*

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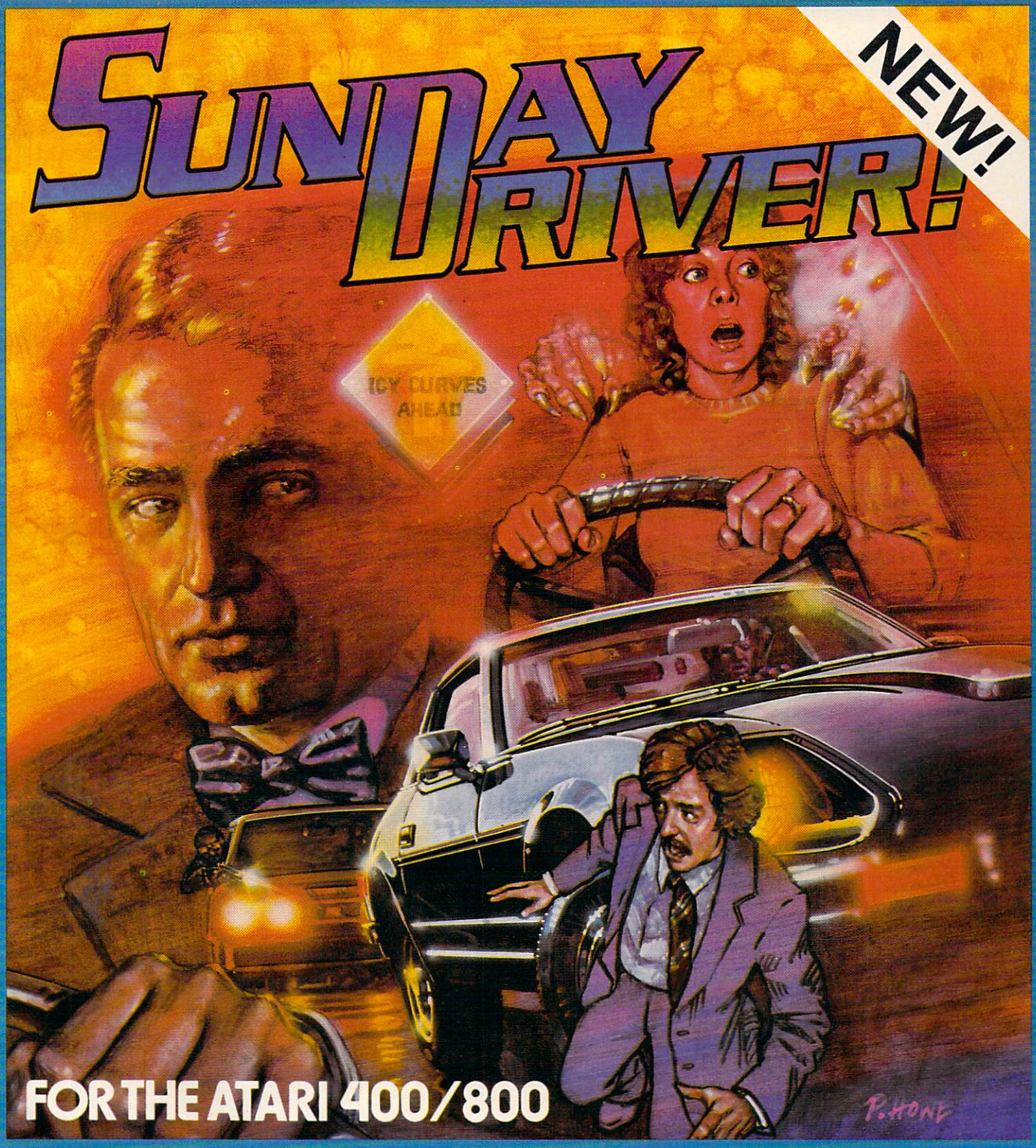
| • Apple 16K RAM | |

**600 – The Atari redesigned full keyboard version of the Atari 400.*

```
540 LOC=PTR+LINE*20+COL:SOUND 0,0,0,0
550 FOR I=0 TO 8:P=PEEK(LOC+DIR(I))
560 IF P<128 OR P>192 THEN 590
570 POKE LOC+DIR(I),0
580 SCR=SCR+(P=139)*50+(P=134)*100:I=
    8:NEXT I:GOTO 600
590 NEXT I:GOTO 300
600 FOR W=15 TO 0 STEP -1:SOUND 0,20,
    10,W:NEXT W
610 GOTO 300
620 REM CRASH ! !
630 SOUND 0,0,0,0
640 PM$(PO+YP,PO+YP+20)=CRASH$
650 FOR W=100 TO 150 STEP 2:SOUND 0,W
    ,12,10:NEXT W
660 PM$(PO+YP,PO+YP+20)=ERASE$
670 YP=200
680 PM$(PO+YP,PO+YP+20)=CURR$
690 POKE 0,1:SOUND 0,0,0,0
700 XP=INT(72+90*RND(0)):POKE 53248,X
    P
710 IF PEEK(POPF)<>0 THEN POKE HITCLR
    ,0:GOTO 700
720 POKE HITCLR,0:SCR=SCR-50:IF SCR<0
     THEN SCR=0
730 GOTO 300
740 POSITION 8,0:? #6;"GAME OVER"
750 SOUND 0,0,0,0
760 SCREEN$(326,336)="press(,)start"
770 IF PEEK(53279)<>6 THEN 770
780 RUN
790 REM Initialization
800 GRAPHICS 17:HILO=120:POKE 53248,0
    :POKE 0,0
810 SETCOLOR 4,0,12:SETCOLOR 1,12,8:S
    ETCOLOR 2,9,6:SETCOLOR 0,15,4
820 POPF=53252:HITCLR=53278:POKE HITC
    LR,0
830 SCRBASE=PEEK(106)-16:REM 4K BOUND
    ARY
840 PMBASE=SCRBASE-8:REM 2K BOUNDARY,
     DOUBLE-LINE RES
850 CHBASE=PMBASE:REM Fill up offset
    with characters
860 VVTP=PEEK(134)+256*PEEK(135):REM
    Variable Value Table
870 STARTP=PEEK(140)+256*PEEK(141)
880 A=SCRBASE*256-STARTP:GOSUB HILO:P
    OKE VVTP+2,LO:POKE VVTP+3,HI
890 POKE VVTP+4,1:POKE VVTP+5,16:REM
    LENGTH=4097
900 POKE VVTP+6,1:POKE VVTP+7,16
910 A=PMBASE*256-STARTP:GOSUB HILO:PO
    KE VVTP+10,LO:POKE VVTP+11,HI
920 POKE VVTP+12,1:POKE VVTP+13,8:REM
     LENGTH=2049
930 POKE VVTP+14,1:POKE VVTP+15,8
940 CHSET=CHBASE*256:IF PEEK(CHSET+9)
    <>6 THEN GOSUB 1510:GOSUB 1740
950 Z=USR(1638):REM DISABLE VBLANK
960 POKE 756,CHBASE:RESTORE 990
970 DIM T$(20),DLIST$(40),TOPLINE$(20
    )
980 A=ADR(DLIST$):GOSUB HILO:POKE 561
    ,HI:POKE 560,LO
990 DATA 112,112,112,70,0,0,102,0,0
1000 FOR I=1 TO 9:READ A:DLIST$(I)=CH
     R$(A):NEXT I
1010 FOR I=1 TO 20:DLIST$(I+9)=CHR$(6
     +32):NEXT I:DLIST$(30)=CHR$(6)
1020 DLIST$(31)=CHR$(65):DLIST$(32)=C
     HR$(PEEK(560)):DLIST$(33)=CHR$(P
     EEK(561))
1030 SCREEN$(1)=CHR$(0):SCREEN$(4095)
     =CHR$(0):SCREEN$(2)=SCREEN$:REM
     CLEAR OUT SCREEN
1040 TOPLINE$=SCREEN$
1050 A=ADR(TOPLINE$):GOSUB HILO
1060 DLIST$(5,5)=CHR$(LO):DLIST$(6,6)
     =CHR$(HI)
1070 POKE 88,LO:POKE 89,HI
1080 POSITION 8,0:? #6;"sked";
1090 SCREEN$(407,413)="finish"
1100 A=SCRBASE*256
1110 FOR L=24 TO 198
1120 A=A+20:GOSUB HILO:T$=CHR$(LO):T$
     (2)=CHR$(HI):DLIST$(8,9)=T$
1130 S=L*20+1:E=S+19
1140 LFLEN=INT(3*RND(0)+1)
1150 RTLEN=INT(3*RND(0)+1)
1160 FOR I=1 TO LFLEN
1170 Z=INT(3*RND(0))
1180 T$(I)=CHR$((72+Z)*(Z<2))
1190 NEXT I
1200 SCREEN$(S,S+LFLEN)=T$(1,LFLEN)
1210 FOR I=1 TO RTLEN
1220 Z=INT(3*RND(0))
1230 T$(I)=CHR$((72+Z)*(Z<2))
1240 NEXT I
1250 SCREEN$(E-RTLEN,E)=T$(1,RTLEN)
1260 REM obstacles
1270 IF RND(1)>0.05 THEN 1370
1280 IF L-LAST<10 THEN 1370
1290 LAST=L
1300 SKEW=1:IF RND(0)>0.5 THEN SKEW=-
     1
1310 SP=INT(7*RND(0)+5)
1320 SCREEN$(S+SP,S+SP)=CHR$(134)
1330 FOR I=0 TO 2
1340 RT=SP+I*40+SKEW*(I+1):LF=RT+20-S
     KEW*2
1350 SCREEN$(S+LF,S+LF)=CHR$(204):SCR
     EEN$(S+RT,S+RT)=CHR$(204)
1360 NEXT I:GOTO 1460
1370 IF RND(1)>0.1 THEN 1400
1380 SP=S+INT(13*RND(0)+5)
1390 SCREEN$(SP,SP)=CHR$(7):GOTO 1460
1400 IF RND(1)>0.1 THEN 1430
1410 SP=S+INT(13*RND(0)+5)
1420 SCREEN$(SP,SP)=CHR$(10):GOTO 146
     0
1430 IF RND(1)>0.1 THEN 1460
1440 SP=S+INT(13*RND(0)+5)
1450 SCREEN$(SP,SP)=CHR$(139):GOTO 14
     60
1460 NEXT L
1470 A=A+200:GOSUB HILO
1480 T$=CHR$(LO):T$(2)=CHR$(HI):DLIST
     $(8,9)=T$
1481 GOSUB 125:IF STRIG(0) THEN 1481
1490 A=USR(1536,ADR(DLIST$(8)),176)
1500 RETURN
1510 FOR I=0 TO 7:POKE CHSET+I,0:NEXT
      I
1520 FOR I=128 TO 471:POKE CHSET+I,PE
     EK(57344+I):NEXT I
1530 RESTORE 1570
1540 READ A:IF A=-1 THEN RETURN
1550 FOR J=0 TO 7:READ B:POKE CHSET+A
     *8+J,B:NEXT J
1560 GOTO 1540
1570 DATA 1,0,6,14,28,24,32,0,128
1580 DATA 6,192,192,220,20,28,7,5,7
1590 DATA 7,0,0,24,52,44,60,24,0
1600 DATA 8,16,56,56,124,124,254,16,1
     6
1610 DATA 9,8,28,62,62,62,8,8,0
1620 DATA 10,0,56,94,106,94,116,56,0
1630 DATA 11,0,119,69,117,21,119,0,0
1640 DATA 12,8,24,56,120,8,8,8,8
```




SUNDAY DRIVER gives you four scenarios to choose from. You must beat the clock as you drive along while avoiding pedestrians, other cars, and obstacles. In other versions it's winter and you're on ice-slicked roads. In game three it's nighttime (don't hit the ghosts). If this sounds too easy try the 007 option — it's you against **them** on twisty roads.

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```
1650 DATA 14,254,89,24,156,82,33,16,8
1660 DATA 13,0,0,0,48,88,56,16,186
1670 DATA 27,127,154,24,57,74,132,8,1
     6
1680 DATA 26,0,0,0,12,26,28,8,93
1690 DATA 29,186,89,24,154,170,198,65
     ,65
1700 DATA 28,0,0,24,60,60,24,24,60
1710 DATA 31,10,24,24,0,0,0,0,0
1720 DATA 30,1,18,36,74,161,18,156,77
1730 DATA -1
1740 RESTORE 1780:FOR I=1536 TO 1648:
     READ A:POKE I,A:NEXT I
1750 RETURN
1760 REM Following numbers are machin
     e language
1770 REM Type carefully!
1780 DATA 169,0,133,0,169,1
1790 DATA 141,99,6,169,8,141
1800 DATA 98,6,104,104,133,7
1810 DATA 104,133,6,104,104,133
1820 DATA 1,162,6,160,35,169
1830 DATA 7,32,92,228,96,216
1840 DATA 165,0,240,55,165,1
1850 DATA 240,51,206,99,6,173
1860 DATA 99,6,208,43,165,0
1870 DATA 141,99,6,206,98,6
1880 DATA 174,98,6,142,5,212
1890 DATA 208,27,160,0,56,177
1900 DATA 6,233,20,145,6,160
1910 DATA 1,177,6,233,0,145
1920 DATA 6,169,7,141,98,6
1930 DATA 141,5,212,198,1,76
1940 DATA 98,228,0,0,0,0
1950 DATA 104,162,228,160,98
1960 DATA 169,7,32,92,228,96
```

# Writing Effective Educational Programs

C. Regena

*When using the computer as a "teacher," you should consider several factors which are unique to this relatively new situation: how people best learn from machines. Computer tutorial programming techniques are illustrated with a geometry-teaching program for the TI-99/4A, the VIC, and the TRS-80 Color Computer (with 16K Extended BASIC).*

One of the most natural uses for a microcomputer is in education. A student may use a tutorial (teaching) program to learn at his or her own pace, or use a drill program to get practice and experience.

Two capabilities of the computer are useful in educational programs. First, a computer does not get tired of repetition. A teacher or parent may get frustrated or not have time for many repetitions, but a computer has as much time to run the program as the student wishes. Second, the randomness feature can be used to change numbers each time a drill is performed or to mix up the order of questioning or to individualize instruction and practice.

## Successful Tutorials

Either in programs you purchase or in programs you write yourself, several attributes should be incorporated.

*Color graphics.* Just a lot of words on a screen are hard to read and tiring. The program should not mimic a book. Graphics can be used appropriately to illustrate the concepts being taught.

*Music, sound, and speech.* Music can add variety and enhancement to a program to retain interest. Speech can be effective in reading, spelling, language programs, or in any programs for young children who may not yet be proficient in reading. Keep in mind the educational concept that the more senses the student uses (sight, sound, touch), the more efficient the learning process.

*Positive and negative reinforcement.* A short musical interlude, or perhaps a change in graphics, may be used for correct answers. A non-intimidating "uh-oh" tone or noise may be used for incorrect responses. Be careful that the incorrect answer doesn't result in an overly entertaining display, or the student will *want* to get the wrong answer. Avoid name-calling and "smart remarks" that are intended to be cute, but actually detract from educational programs.

*Remediation.* After correct answers the program should advance to higher levels of difficulty or to new concepts. After an incorrect response or two, the correct answer should be presented. Usually with a true-false or yes-no question, the student wouldn't need to be told the answer, but after an input answer which could be one of many answers, the answer is necessary.

*Flexibility.* The student should be able to advance quickly over sections she or he already knows and to repeat sections as needed (use menu screens or options). Also, any time the student needs to read something, she or he should be able to pause as long or as short a time as desired. It is frustrating to be reading when the program changes screens before you're ready – or to have to spend a certain length of time with a screen that you are already familiar with.

*Careful use of INPUT.* Keep in mind that any time a student needs to respond to an INPUT there is a greater chance of the program "crashing" or of graphics getting messed up. After an INPUT, be sure to check allowable limits. What happens if a string variable is entered when a numeric variable is expected, or vice versa? If you can arrange questions or choices to require a one-key-press response, your program will be easier for the student to use and have fewer chances for error.

If you must use INPUT, make sure the student knows what is expected, and ask for only one response at a time. Usually in scientific or higher mathematics programs you can assume the student will know what type of number is expected, but in elementary or beginning programs the student must be guided.

## Plotting Points

"Coordinate Geometry" is a tutorial program written for the TI-99/4A, TRS-80 Color Computer (16K and Extended BASIC), and VIC-20 that teaches how to locate points on a rectangular coordinate grid. The program includes a section for positive and negative coordinates.

First a random example point is given with the coordinates labeled. Next a random point is given, and the student must press the numbers for the x-coordinate and the y-coordinate. The third step is to locate the point, given the coordi-

nates. The TI-99/4A and TRS-80 CC have standard arrow keys. As an arrow key is pressed, the point moves in that direction. For the VIC-20 I chose to use the function keys since there are no standard arrow keys. F1 is up, F3 is left, F5 is right, and F7 is down.

To detect which key is pressed, the TI-99/4A uses CALL KEY (0,K,S), where K is the ASCII code of the key pressed. K is checked for (up), (left), D (right), and X (down), and any other key pressed is ignored. (Lines 1420-1690)

On the TRS-80 CC, INKEY$ is used to detect a key pressed. The character codes for the arrow keys are checked for the point to move. (Lines 1020-1180)

The VIC-20 needs the GET function to determine the key pressed. (Lines 57-72)

These programs use the graphics capabilities of the computers to illustrate the grid. A PRINT statement is used for the graphics because it is quicker than a series of CALL HCHAR or CALL VCHAR statements (TI-99/4A), SET commands (TRS-80 CC) or POKE commands (VIC-20). The grid is drawn several times in the program, so the instructions to draw it are in a subroutine.

A musical arpeggio is played for a correct answer, and an "uh-oh" is played for an incorrect answer. These procedures are also in subroutines and may be called from several places in the program.

After an incorrect answer, the correct answer is given. The student can study the problem, then press ENTER or RETURN, and another problem will be given. Numbers are chosen randomly. If the answer is correct, the student has the choice of another problem of the same type or of continuing the program.

Only key presses are necessary in the TRS-80 CC and VIC-20 versions and the first section of the TI-99/4A version. Later sections of the TI-99/4A program require INPUT for positive and negative coordinates and answers which may require a decimal.

If you wish to save typing time and effort and would like a copy of any of these programs, you may send $3, a blank cassette, and a self-addressed, stamped mailer. Be sure to specify which computer version.

*C. Regena*
*P.O. Box 1502*
*Cedar City, UT 84720*

### Explanation of the Program: TI-99/4A

Line Numbers

| | |
|---|---|
| 100 | Defines random function. |
| 110-460 | Print title screen and define graphics characters. |
| 490-510 | Subroutine for incorrect answer music. |
| 520-560 | Subroutine for correct answer music. |
| 570-610 | Subroutine to print grid. |
| 620-660 | Subroutine to print "PRESS ENTER" and wait for response. |
| 670-710 | Subroutine to draw graphics. |
| 720-870 | Give random example of a point with coordinates. |
| 880-910 | Print instructions. |
| 920-1240 | Exercise for giving coordinates for a point. |
| 1250-1280 | Print instructions. |
| 1290-1840 | Exercise for locating a point with given coordinates. |
| 1850-1900 | Subroutine to randomly choose point. |
| 1910-1940 | Subroutine to draw vertical red line from point to x-axis. |
| 1950-1980 | Subroutine to draw horizontal red line from point to y-axis. |

### Explanation of the Program: TRS-80 CC

Line Numbers

| | |
|---|---|
| 50 | Branch to title screen. |
| 60-180 | Subroutine to print grid. |
| 190-220 | Subroutine to print "PRESS ENTER" and wait for response. |
| 230-270 | Subroutine to choose point and calculate graphics print position. |
| 280-310 | Subroutine to calculate coordinates to SET point. |
| 320 | Subroutine to play music for incorrect answer. |
| 330 | Subroutine to play music for correct response. |
| 340-540 | Draw title screen. |
| 550-600 | Define string variables for grid graphics; pause. |
| 610-710 | Draw grid, show example point. |
| 720-900 | Present problem to find coordinates for given point. |
| 910-960 | Print instructions. |
| 970-1270 | Present problem to locate point with given coordinates. |
| 1280-1340 | Print choice to have another problem, start over, or end program; branch appropriately. |
| 1350 | End. |

### Explanation of the Program: VIC-20

Line Numbers

| | |
|---|---|
| 2 | Prints title screen. |
| 4 | Defines volume and sound. |
| 6-7 | Define string variables for grid; delay. |
| 8-26 | Draw grid; show example point. |
| 30-51 | Present problem to give coordinates for given point. |
| 52-54 | Print instructions. |
| 55-74 | Present problem to locate point with given coordinates. |
| 75-79 | Print choice to have another problem, start over, or end program; branch appropriately. |
| 80-83 | Subroutine to label point and draw yellow lines from point to axes. |
| 84 | Subroutine to calculate graphics memory location. |
| 86 | Subroutine to play music for incorrect answer. |
| 88 | Subroutine for correct answer. |
| 89 | Subroutine to delay for music. |
| 90-92 | Subroutine to print grid. |
| 94 | Subroutine to get rid of buffered keys in GET function. |
| 96-99 | Subroutine to print "PRESS RETURN" and wait for response. |
| 100 | End. |

## Program 1: TI-99/4A Version

```
100 DEF R(N)=INT(N*RND+1)
```

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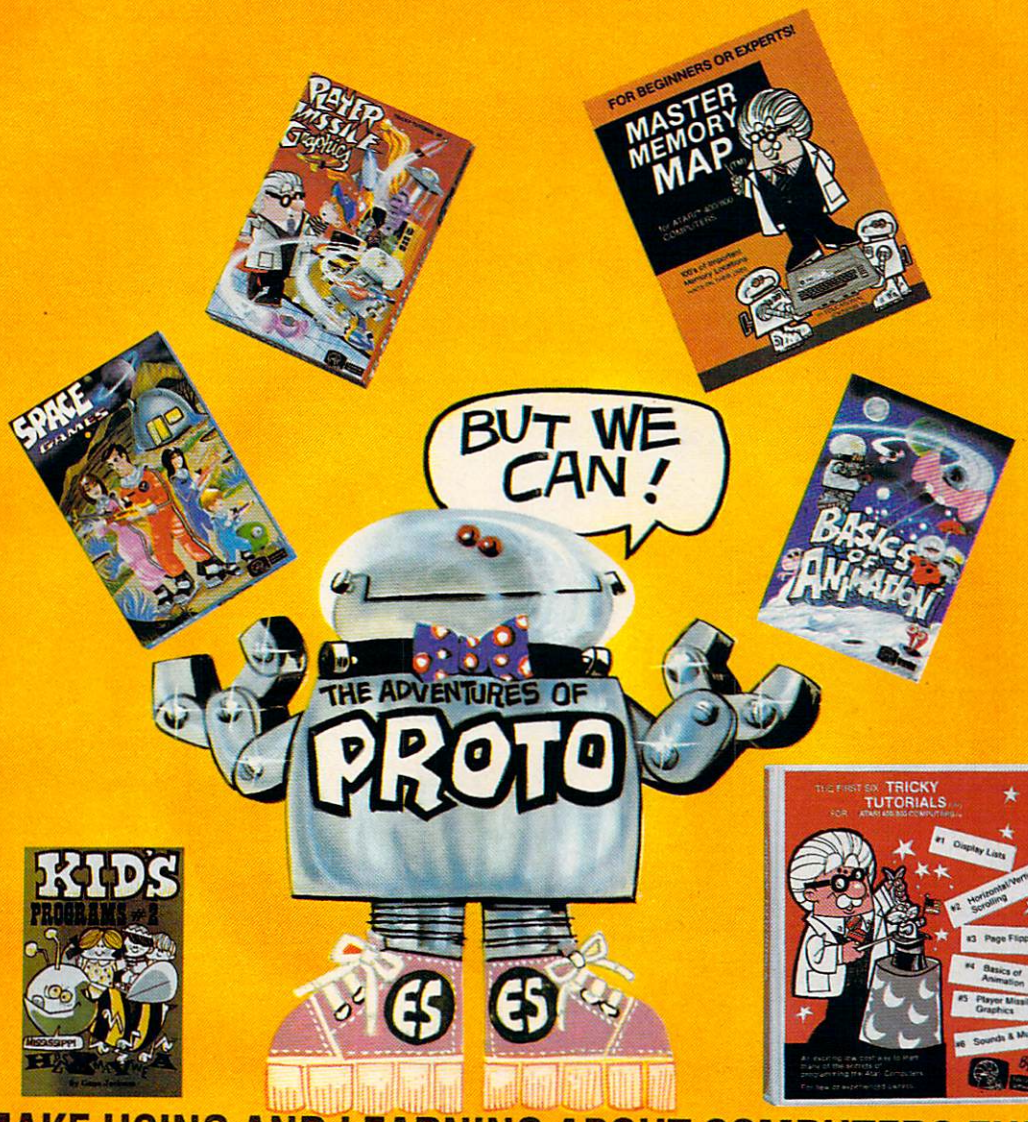


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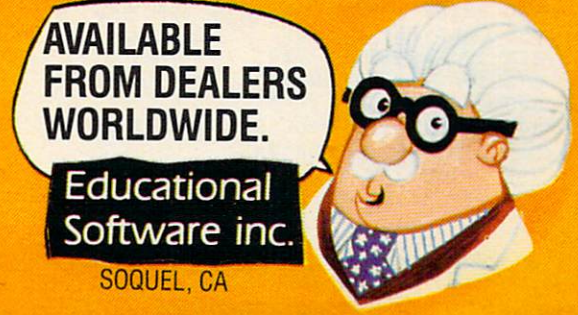


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```
110 CALL CLEAR
120 PRINT"  **********************":"  *";TAB
    (25);"*":"  * COORDINATE GEOMETRY  *"

130 PRINT "  *";TAB(25);"*":"  **************
    ********":::TAB(11);"POINTS":::
140 A$="1818181818181818"
150 B$="181818FFFF181818"
160 C$="000000FFFF"
170 FOR C=96 TO 112 STEP 8
180 CALL CHAR(C,A$)
190 CALL CHAR(C+1,B$)
200 CALL CHAR(C+2,C$)
210 NEXT C
220 CALL CHAR(120,"183C7EFFFF7E3C18")
230 CALL CHAR(128,"183C7EFFFF7E3C18")
240 CALL CHAR(129,"00000000030C30C")
250 CALL CHAR(130,"030C30C")
260 CALL CHAR(64,"3C4299A1A199423C")
270 CALL CHAR(94,"00102828444482FE")
280 CALL COLOR(10,5,1)
290 CALL COLOR(11,10,1)
300 CALL COLOR(12,11,1)
310 CALL COLOR(13,7,1)
320 CALL CHAR(140,"1010101010101010")
330 CALL CHAR(141,"000000FF")
340 CALL CHAR(142,"101010F")
350 CALL COLOR(14,13,1)
360 A$="`  h  h  h  h  h  h  h"
370 B$="ajjijjijjijjijjijjijji"
380 C$="abbabbabbabbabbabbabbabb"
440 CALL CLEAR
450 CALL COLOR(2,2,1)
460 GOTO 720
490 CALL SOUND(100,330,2)
500 CALL SOUND(100,262,2)
510 RETURN
520 CALL SOUND(100,262,2)
530 CALL SOUND(100,330,2)
540 CALL SOUND(100,392,2)
550 CALL SOUND(200,523,2)
560 RETURN
570 CALL CLEAR
580 PRINT "    Y":"    ";A$:"    ";A$:"   4";B
    $:"    ";A$:"    ";A$:"   3";B$
585 PRINT "    ";A$:"    ";A$:"   2";B$
590 PRINT "    ";A$:"    ";A$:"   1";B$:"    "
    ;A$:"    ";A$:"   0";C$
595 PRINT "    0  1  2  3  4  5  6  7":::
600 CALL HCHAR(20,31,88)
610 RETURN
620 PRINT TAB(16);"PRESS<ENTER>";
630 CALL KEY(0,K,S)
640 IF K<>13 THEN 630
650 CALL HCHAR(24,18,32,13)
660 RETURN
720 GOSUB 570
730 PRINT "THE LOCATION OF A POINT IS":"GIVEN ~
    BY ITS X-COORDINATE"
735 PRINT "AND Y-COORDINATE (X,Y)"
740 RANDOMIZE
750 X=R(5)
760 GOSUB 1850
770 GOSUB 1910
780 CALL HCHAR(Y1,X1+2,40)
790 CALL HCHAR(Y1,X1+3,48+X)
800 CALL HCHAR(Y1,X1+4,44)
810 GOSUB 1950
820 CALL HCHAR(Y1,X1+5,48+Y)
830 CALL HCHAR(Y1,X1+6,41)
840 PRINT :"WANT ANOTHER EXAMPLE? (Y/N)";
850 CALL KEY(0,K,S)
860 IF K=89 THEN 720
870 IF K<>78 THEN 850
880 CALL CLEAR
890 PRINT "YOU WILL BE SHOWN A POINT.":"PRESS
     THE NUMBER OF THE"
895 PRINT :"X-COORDINATE THEN THE"
900 PRINT :"NUMBER OF THE Y-COORDINATE."::::::
    :
910 GOSUB 620
920 CALL CLEAR
930 GOSUB 570
940 PRINT :::
950 RANDOMIZE
960 GOSUB 1850
970 CALL HCHAR(21,7,40)
980 CALL HCHAR(21,9,44)
990 CALL HCHAR(21,11,41)
1000 CALL KEY(0,K,S)
1010 CALL HCHAR(21,8,63)
1020 CALL HCHAR(21,8,32)
1030 IF S<1 THEN 1000
1040 CALL HCHAR(21,8,K)
1050 X2=K
1060 CALL KEY(0,K,S)
1070 CALL HCHAR(21,10,63)
1080 CALL HCHAR(21,10,32)
1090 IF S<1 THEN 1060
1100 CALL HCHAR(21,10,K)
1110 Y2=K
1120 IF X2<>X+48 THEN 1190
1130 IF Y2<>Y+48 THEN 1190
1140 GOSUB 520
1150 PRINT "PRESS":"1 FOR SAME TYPE PROBLEM":"2
     TO CONTINUE PROGRAM";
1160 CALL KEY(0,K,S)
1170 IF K=49 THEN 920
1180 IF K=50 THEN 1250 ELSE 1160
1190 GOSUB 490
1200 GOSUB 1910
1210 GOSUB 1950
1220 PRINT "THE CORRECT ANSWER IS (";STR$(X);",
    ";STR$(Y);")"
1230 GOSUB 620
1240 GOTO 920
1250 CALL CLEAR
1260 PRINT "NOW YOU WILL BE GIVEN THE"::"COORDI
    NATES."
1265 PRINT :"USE THE ARROW KEYS TO MOVE"::"THE ~
    POINT TO THE CORRECT"
1270 PRINT :"PLACE, THEN PRESS <ENTER>.":::::
1280 GOSUB 620
1290 CALL CLEAR
1300 GOSUB 570
1310 RANDOMIZE
1320 X=R(7)
1330 Y=R(4)
1340 X1=7+3*X
1350 Y1=17-3*Y
1360 PRINT :"PLOT (";STR$(X);",";STR$(Y);")"::
1370 C1=97
1380 A=17
1390 A1=A
1400 B=7
1410 B1=B
1420 CALL HCHAR(A,B,120)
1430 CALL KEY(0,K,S)
1440 IF S<1 THEN 1430
1450 IF K=13 THEN 1700
1460 IF K<>69 THEN 1510
1470 IF A=5 THEN 1430
1480 CALL GCHAR(A-3,B,C)
1490 A=A-3
1500 GOTO 1650
1510 IF K<>88 THEN 1560
1520 IF A=17 THEN 1430
1530 CALL GCHAR(A+3,B,C)
1540 A=A+3
1550 GOTO 1650
1560 IF K<>83 THEN 1610
1570 IF B=7 THEN 1430
1580 CALL GCHAR(A,B-3,C)
1590 B=B-3
1600 GOTO 1650
1610 IF K<>68 THEN 1430
1620 IF B=28 THEN 1430
1630 CALL GCHAR(A,B+3,C)
1640 B=B+3
1650 CALL HCHAR(A1,B1,C1)
```

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## The Smart 64

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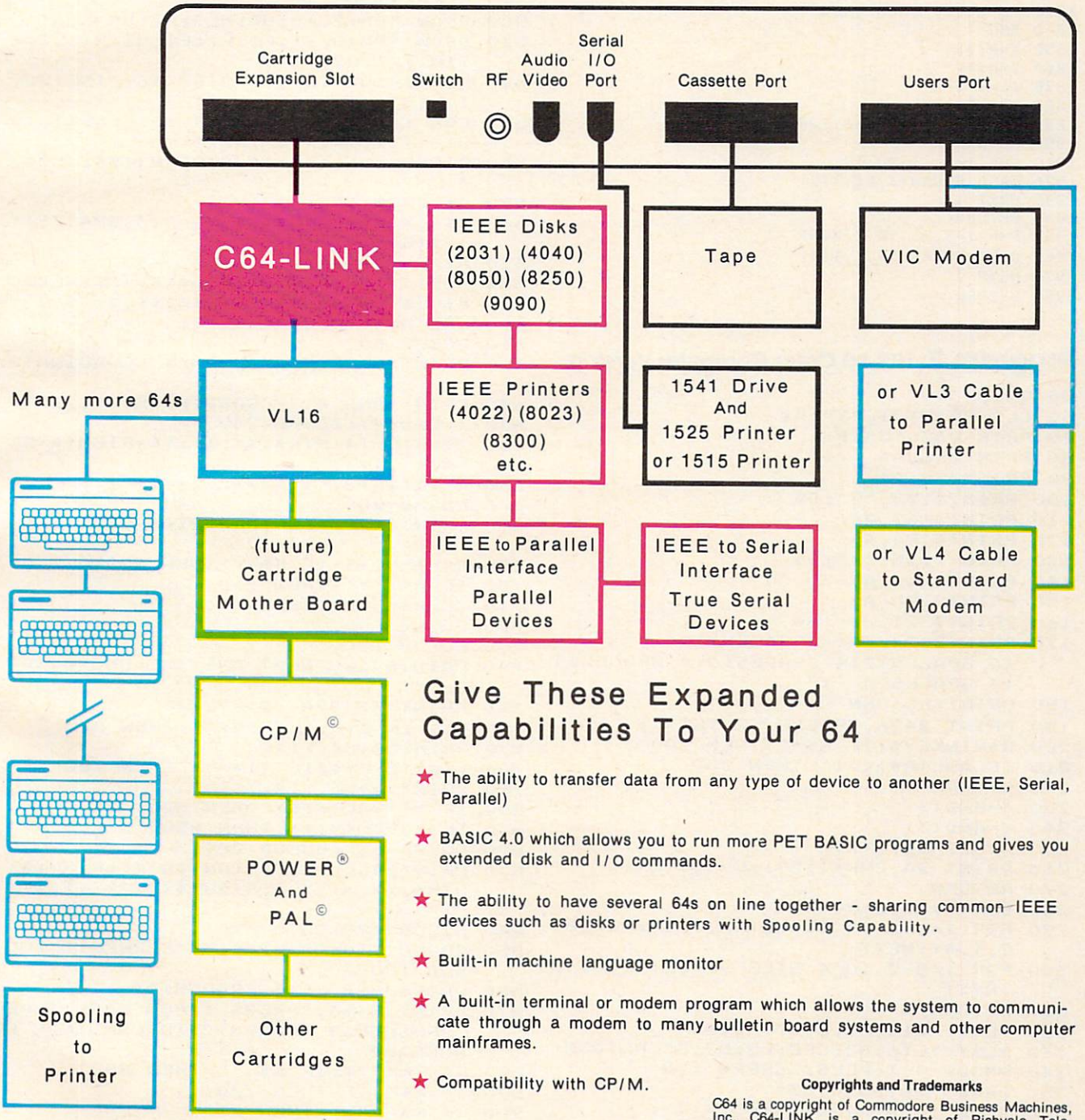


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- ★ A built-in terminal or modem program which allows the system to communicate through a modem to many bulletin board systems and other computer mainframes.
- ★ Compatibility with CP/M.

```
1660 A1=A
1670 B1=B
1680 C1=C
1690 GOTO 1420
1700 CALL SOUND(150,1397,2)
1710 CALL GCHAR(Y1,X1,C)
1720 IF C=120 THEN 1790
1730 GOSUB 490
1740 CALL HCHAR(Y1,X1,128)
1750 GOSUB 1910
1760 GOSUB 1950
1770 GOSUB 620
1780 GOTO 1290
1790 GOSUB 520
1800 PRINT "PRESS":"1 FOR SAME TYPE PROBLEM":"2
     TO CONTINUE PROGRAM";
1810 CALL KEY(0,K,S)
1820 IF K=49 THEN 1290
1830 IF K<>50 THEN 1810
1840 END
1850 X=R(7)
1860 Y=R(4)
1870 X1=7+3*X
1880 Y1=17-3*Y
1890 CALL HCHAR(Y1,X1,128)
1900 RETURN
1910 FOR I=Y1+1 TO 17
1920 CALL HCHAR(I,X1,112)
1930 NEXT I
1940 RETURN
1950 FOR I=X1-1 TO 7 STEP -1
1960 CALL HCHAR(Y1,I,114)
1970 NEXT I
1980 RETURN
```

## Program 2: TRS-80 Color Computer Version

```
50 GOTO 340
60 CLS:PRINT@1,"Y";A$
70 PRINT@33,"3";B$
80 PRINT@66,A$
90 PRINT@98,A$
100 PRINT@129,"2";B$
110 PRINT@162,A$
120 PRINT@194,A$
130 PRINT@225,"1";B$
140 PRINT@258,A$
150 PRINT@290,A$
160 PRINT@321,"0";B$
170 PRINT@354,"0{4 SPACES}1
    {4 SPACES}2{4 SPACES}3{4 SPACES}4
    {4 SPACES}5  X"
180 PRINT:RETURN
190 PRINT @496,"PRESS <ENTER>";
200 R$=INKEY$:IF R$=""THEN 200
210 IF ASC(R$)<>13 THEN 200
220 RETURN
230 X=RND(5)
240 Y=RND(3)
250 A=322-96*Y+X*5
260 PRINT @A,CHR$(159);CHR$(159);
270 RETURN
280 B=4+X*10:C=20-6*Y
290 FOR I=C+2 TO 20:SET(B,I,4):SET(B+
    2,I,4):NEXT
300 FOR I=B-2 TO 4 STEP -1:SET(I,C,4)
    :NEXT
310 RETURN
320 PLAY "L16;O2;E;C":RETURN
330 PLAY "L16;O2;CEG;L8;O3;C":RETURN
340 PMODE 4,1:PCLS:SCREEN 1,0
350 DRAW "S8;BM20,65"
360 DRAW "NU6;R4;U1;BM+3,+1"
370 DRAW "BM+1,0;H1;U4;E1;R2;F1;D4;G1
    ;L2;BM+6,0"
380 DRAW "BM+1,-0;H1;U4;E1;R2;F1"
390 DRAW "BM+0,+4;G1;L2;BM+6,0"
400 DRAW "U4;E2;F2;D2;NL4;D2;BM+3,0"
410 DRAW "BM+2,+0;U6;NL2;R2;BM+3,+6"
420 DRAW "BM+1,0;R1;NR1;U6;NL1;R1;BM+
    4,+6"
430 DRAW "U6;F1;D1;F2;D1;F1;NU6;BM+3,
    0"
440 DRAW "BM+1,-0;H1;U4;E1;R2;F1"
450 DRAW "BM+0,+2;NL1;D2;G1;L2;BM+6,0
    "
460 DRAW "BM+7,0;U6;R3;F1;D1;G1;L3;BM
    +7,3"
470 DRAW "BM+1,0;H1;U4;E1;R2;F1;D4;G1
    ;L2;BM+6,0"
480 DRAW "BM+1,0;R1;NR1;U6;NL1;R1"
490 DRAW "BM+4,+6;U6;F1;D1;F2;D1;F1;N
    U6;BM+3,0"
500 DRAW "BM+2,+0;U6;NL2;R2;BM+3,6"
510 DRAW "BM+0,-1;F1;R2;E1;U1;H1;L2;H
    1;U1;E1;R2;F1"
520 FOR I=104 TO 168 STEP 16:LINE(20,
    I)-(236,I),PSET:NEXT
530 FOR I=28 TO 220 STEP 16:LINE(I,10
    0)-(I,172),PSET:NEXT
540 CIRCLE(76,136),4:CIRCLE(156,152),
    4
550 C$=CHR$(175)
560 D$=C$+C$+C$+C$+C$:E$="{3 SPACES}"
    +C$+C$
570 A$=E$:B$=D$
580 FORI=1TO4:A$=A$+E$:B$=B$+D$:NEXT
590 A$=C$+C$+A$:B$=C$+C$+B$+C$+C$
600 FOR D=1 TO 5000:NEXT
610 GOSUB 60
620 PRINT"A POINT HAS AN X-COORDINATE
    "
630 PRINT"AND A Y-COORDINATE (X,Y)."
640 X=RND(4):GOSUB 240
650 X$=RIGHT$(STR$(X),1):Y$=RIGHT$(ST
    R$(Y),1)
660 PRINT@A+2,"("+X$+","+Y$+")";
670 GOSUB 280
680 PRINT@480,"ANOTHER EXAMPLE? (Y/N)
    ";
690 R$=INKEY$:IF R$=""THEN 690
700 IF R$="Y" THEN 610
710 IF R$<>"N" THEN 690
720 GOSUB 60
730 GOSUB 230
740 PRINT@416,"WHAT ARE THE COORDINAT
    ES?"
750 PRINT"{5 SPACES}(?,?)"
760 X1$=INKEY$:IF X1$="" THEN 760
770 PRINT @454,X1$;
780 Y1$=INKEY$:IF Y1$="" THEN 780
790 PRINT @456,Y1$;
800 IF X<>VAL(X1$) THEN 820
810 IF Y=VAL(Y1$) THEN 850
820 GOSUB 320:GOSUB 280
830 PRINT@460,"LOCATION IS (";RIGHT$(
    STR$(X),1);",";RIGHT$(STR$(Y),1);
    ")"
840 GOSUB 190:GOTO 720
850 GOSUB 330:PRINT@460,"CORRECT!":GO
    SUB 190
860 PRINT@496,"{13 SPACES}";
870 PRINT @416,"PRESS 1 FOR SAME TYPE
     PROBLEM{9 SPACES}2 TO CONTINUE P
    ROGRAM"
880 R$=INKEY$:IF R$="" THEN 880
890 IF R$="1" THEN 720
900 IF R$<>"2" THEN 880
910 CLS
920 PRINT@66,"YOU WILL BE GIVEN THE":
    PRINT"  COORDINATES."
```

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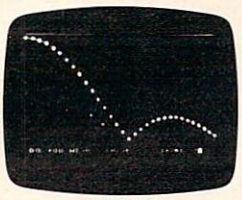
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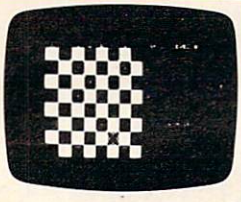
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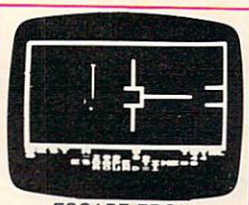
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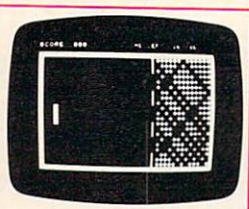
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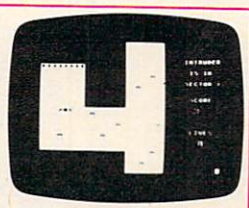
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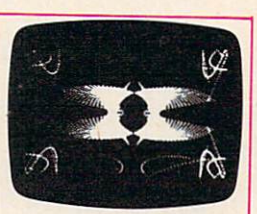
CRYSTALS

```
930 PRINT@162,"USE THE ARROW KEYS TO
    MOVE"
940 PRINT"  THE POINT TO THE CORRECT"
950 PRINT"  LOCATION, THEN PRESS <ENT
    ER>."
960 GOSUB 190
970 CLS:GOSUB 60
980 X=RND(5):Y=RND(3)
990 PRINT@416,"LOCATE (";RIGHT$(STR$(
    X),1);",";RIGHT$(STR$(Y),1);")"
1000 B1=4:C1=20
1010 B=4:C=20
1020 SET(B,C,2):SET(B+2,C,2)
1030 SOUND 227,2
1040 R$=INKEY$:IF R$=""THEN 1040
1050 IF ASC(R$)=13 THEN 1190
1060 IF ASC(R$)<>9 THEN 1090
1070 B1=B+10:IF B1>54 THEN B1=54
1080 GOTO 1170
1090 IF ASC(R$)<>8 THEN 1120
1100 B1=B-10:IF B1<4 THEN B1=4
1110 GOTO 1170
1120 IF ASC(R$)<>94 THEN 1150
1130 C1=C-6:IF C1<2 THEN C1=2
1140 GOTO 1170
1150 IF ASC(R$)<>10 THEN 1040
1160 C1=C+6:IF C1>20 THEN C1=20
1170 SET(B,C,3):SET(B+2,C,3)
1180 B=B1:C=C1:GOTO 1020
1190 BB=4+X*10:CC=20-6*Y:IF B<>BB THE
     N 1210
1200 IF C=CC THEN 1260
1210 GOSUB 320
1220 SET(BB,CC,4)
1230 SET(BB+2,CC,4)
1240 GOSUB 280
1250 GOSUB 190:GOTO 970
1260 GOSUB 330:PRINT @448,"CORRECT!":
     GOSUB 190
1270 PRINT@496,"{13 SPACES}";
1280 PRINT @416,"PRESS 1 FOR SAME TYP
     E PROBLEM"
1290 PRINT"{6 SPACES}2 TO START PROGR
     AM OVER"
1300 PRINT@486,"3 TO END PROGRAM";
1310 R$=INKEY$:IF R$=""THEN 1310
1320 IF R$="1" THEN 970
1330 IF R$="2" THEN 610
1340 IF R$<>"3" THEN 1310
1350 CLS:END
```

## Program 3: VIC-20 Version

```
2 PRINT"{CLEAR}{05 DOWN}    {BLK}L
    OCATING POINTS"
4 POKE36878,15:S=36876
6 A$="{GRN}  _  _  _  _  _  _":B$="{GRN}
  +**+**+**+**+**+***"
7 FORI=1TO3000:NEXT
8 GOSUB90
10 PRINT"A POINT IS LOCATED BY AN ~
    X-COORDINATE AND A Y-COORD
    INATE (X,Y)."
12 X=INT(4*RND(0))+1:Y=INT(3*RND(0
    ))+1
14 GOSUB84:POKEC,81:POKEC1,2
18 GOSUB80
22 PRINT:PRINT"{GRN}ANOTHER EXAMPL
    E? (Y/N){BLU}";:GOSUB94
24 GETR$:IFR$="Y"THEN8
26 IFR$<>"N"THEN24
30 GOSUB90:PRINT"WHERE IS THE POIN
    T?":PRINT:PRINT"{BLK}({
    RED}?{BLK},{RED}?{BLK})";
31 X=INT(6*RND(0)):Y=INT(5*RND(0))
    :GOSUB84:POKEC,81:POKEC1,2
32 GOSUB94
33 GETR$:IFR$=""THEN33
34 IFASC(R$)<48ORASC(R$)>57THEN33
35 POKE8099,ASC(R$):POKE38819,2:X$
    =R$
36 GETR$:IFR$=""THEN36
37 IFASC(R$)<48ORASC(R$)>57THEN36
38 POKE8101,ASC(R$):POKE38821,2:Y$
    =R$
39 IFVAL(X$)<>XTHEN42
40 IFVAL(Y$)=YTHEN48
42 GOSUB86:PRINT"  {BLK}(";RIGHT$(
    STR$(X),1);",";RIGHT$(STR$
    (Y),1);")":GOSUB80:GOSUB96
    :GOTO30
48 GOSUB88:PRINT"{GRN}PRESS":PRINT
    "1 SAME TYPE PROBLEM   2 C
    ONTINUE PROGRAM";:GOSUB94
50 GETR$:IFR$="1"THEN30
51 IFR$<>"2"THEN50
52 PRINT"{CLEAR}{BLU}YOU WILL BE G
    IVEN THE COORDINATES (X,Y)
     ":PRINT:PRINT"PRESS F1 TO
     MOVE UP"
53 PRINT:PRINTTAB(6);"F3 TO MOVE L
    EFT":PRINT:PRINTTAB(6);"F5
     TO MOVE RIGHT":PRINTTAB(6
    );"F7 TO MOVE DOWN"
54 PRINT:PRINT"MOVE THE POINT TO T
    HE CORRECT LOCATION,     T
    HEN PRESS <RETURN>.{03 DOW
    DOWN}":GOSUB96
55 GOSUB90:X=INT(6*RND(0)):Y=INT(5
    *RND(0)):A=0:B=0
56 PRINT"LOCATE (";RIGHT$(STR$(X),
    1);",";RIGHT$(STR$(Y),1);"
    )";:GOSUB94
57 POKES,231:GOSUB89:P=7990-B*66+3
    *A:POKEP,81:POKEP+30720,3
58 GETR$:IFR$=""THEN58
59 IFASC(R$)=13THEN73
61 IFASC(R$)<>133THEN64
62 B=B+1:IFB>4THENB=4
63 GOTO72
64 IFASC(R$)<>134THEN67
65 A=A-1:IFA<0THENA=0
66 GOTO72
67 IFASC(R$)<>135THEN70
68 A=A+1:IFA>5THENA=5
69 GOTO72
70 IFASC(R$)<>136THEN58
71 B=B-1:IFB<0THENB=0
72 POKEP,91:POKEP+30720,5:GOTO57
73 GOSUB84:IFP=CTHEN75
74 GOSUB86:POKEC,81:POKEC1,2:GOSUB
    96:GOTO52
75 GOSUB88:PRINT"{GRN}PRESS":PRINT
```

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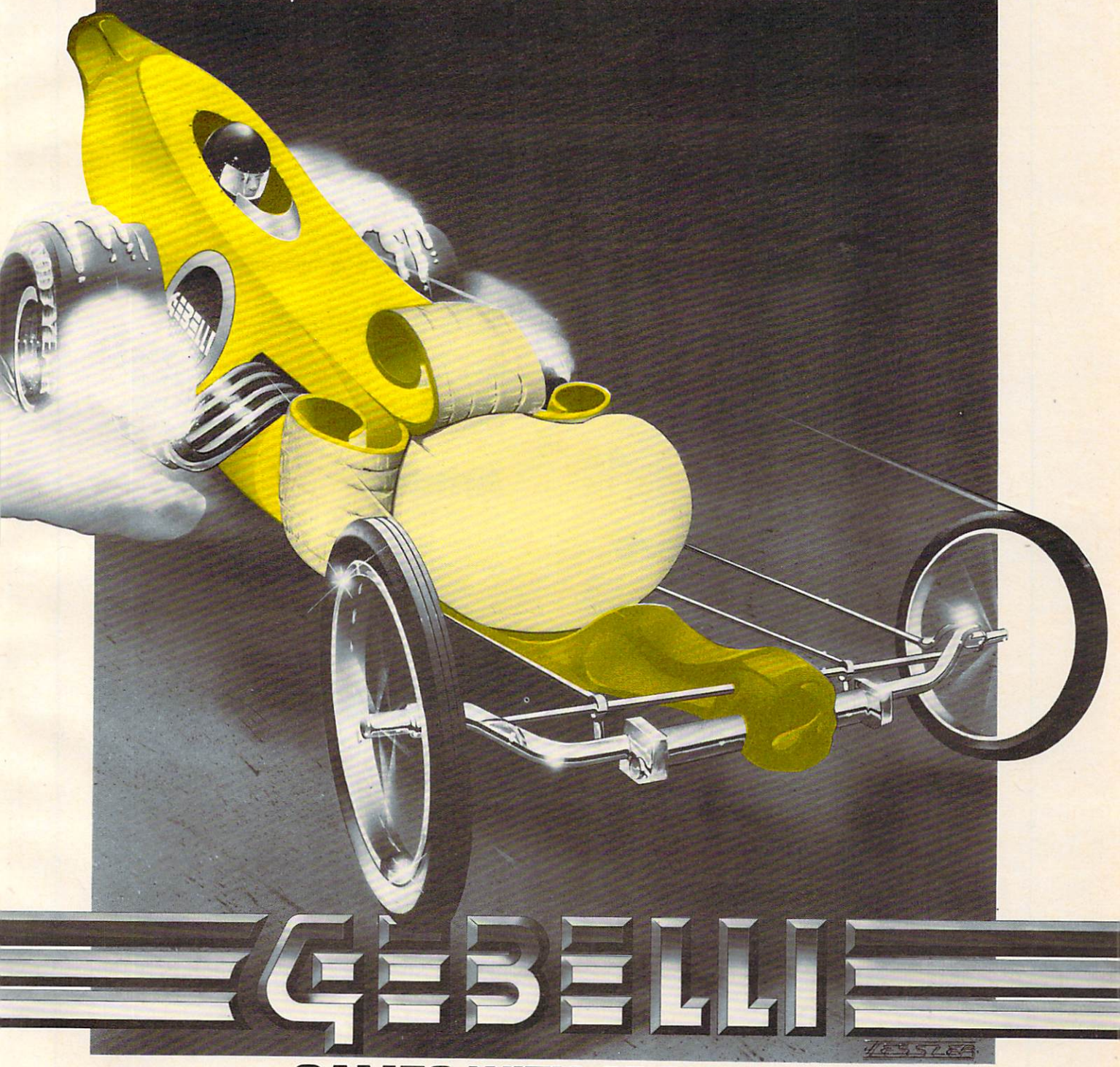

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```
    " 1 SAME TYPE PROBLEM   2 ~
    START PROGRAM OVER  3 END ~
    PROGRAM";:GOSUB94
76 GETR$:IFR$="1"THEN52
77 IFR$="2"THEN8
78 IFR$="3"THEN100
79 GOTO76
80 FORI=C1+1TOC1+5:POKEI,2:NEXT
81 POKEC+1,40:POKEC+2,X+48:POKEC+3
    ,44:POKEC+4,Y+48:POKEC+5,4
    1
82 FORI=C1+22TO38710+X*3STEP22:POK
    EI,7:NEXT
83 FORI=C1-1TOC1-X*3STEP-1:POKEI,7
    :NEXT:RETURN
84 C=7990-Y*66+3*X:C1=C+30720:RETU
    RN
86 POKES,159:GOSUB89:POKES,135:GOS
    UB89:RETURN
88 PRINT"{RED} CORRECT!":POKES,195
    :GOSUB89:POKES,207:GOSUB89
    :POKES,215:GOSUB89:POKES,2
    25:GOSUB89
89 FORI=1TO150:NEXT:POKES,0:RETURN

90 PRINT"{CLEAR}{BLK}  Y":PRINTA$:
    PRINT" {BLK}4";B$:PRINTA$:
    PRINTA$:PRINT" {BLK}3";B$:
    PRINTA$:PRINTA$:PRINT" {
    BLK}2";B$:PRINTA$:PRINTA$:
    PRINT" {BLK}1";B$:PRINTA$:
    PRINTA$
92 PRINT" {BLK}0";B$;"{BLK}X  0  1
     2  3  4  5{BLU}":PRINT:R
    ETURN
94 FORI=1TO10:GETR$:NEXT:RETURN
96 PRINT:PRINT:PRINT"{GRN}PRESS RE
    TURN";:GOSUB94
97 GETR$:IFR$=""THEN97
98 IFASC(R$)<>13THEN97
99 RETURN
100 PRINT"{CLEAR}{BLU}":END
```

©

Beginners: See special program typing instructions on page 249.

# MASTERMAZE

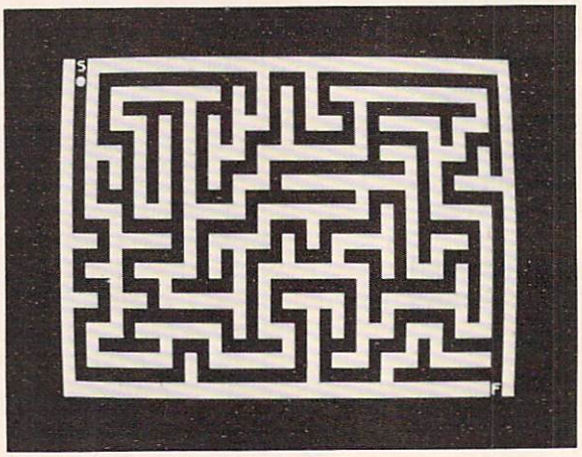
## Mazing In Three Dimensions

Kenneth S. Szajda

*MASTERMAZE, possibly the most challenging game ever printed in* **COMPUTE!**, *uses a special Atari technique, page-flipping, to create a maze with up to 32 levels. For VIC, 64, PET/CBM, and other Microsoft BASIC computers, we include the maze-generating subroutine which is at the heart of this spectacular game for the Atari. If you are of very sound mind, you can even struggle down through an invisible, multi-level maze, but the author cautions that you get the consent of a psychologist before attempting it.*

*Requires an Atari with 16K RAM memory.*

Almost everyone finds mazes an enjoyable challenge. If you are like me, however, you feel that mazes take only minutes to solve and can soon become monotonous. After I saw Charles Bond's maze generator routine (**COMPUTE!**, December 1981, #19), my first thoughts were to make a simple maze game. The problem, though, was that all I had done was replace the paper with my television screen and the pencil with my joystick; the boredom remained. That is why I chose to use my personal computer to its fullest, having it perform functions impractical with paper and pencil. This three-dimensional maze game is the result.




*Preparing to start a one-level maze in "Mastermaze."*

### One Level At A Time

First, let me explain how to use the program. Since it is impractical and nearly impossible to display an entire three-dimensional maze at one time, the program displays only the level that the player is on, which is really of no consequence to the user, but makes life a lot easier for the programmer. What we are doing is analogous to a book: instead of showing the entire book in one screen, we are displaying only one page at a time – the page that is being read.

After you have typed in the entire program, the first thing you must do is SAVE a copy to tape or disk. This program plays around with the display list, so typos could cause problems and possibly crash your computer.

Once a copy has been SAVEd, type RUN and you will be prompted with the question "# OF LEVELS?". What the computer really wants to know is how deep you would like your maze to be. In other words, the computer wants you to tell it one more than the minimum number of down "tunnels" the user must pass through before he reaches the end. In terms of our book analogy, the computer is asking for the number of pages in the book.

For a first-time user, I suggest three or four levels at most. The minimum number of levels is one (which is just a standard maze), and the maximum number is 32. The maximum number of levels on any machine with less than 48K is approximately eight less than the total number of kilobytes of memory you have. For a 48K machine, the BASIC cartridge disables the top 8K, and the program uses the bottom 8K, making the maximum number of levels equal to 32.

Once you have entered your desired number of levels, the program will ask "INVISIBLE (1) OR VISIBLE (2)?". All you are doing here is entering the number to be POKEd into CHACT (location 755, hex 2F3), which tells the OS what to do with bit seven of screen output characters. POKEing a one into CHACT causes bit seven to be ignored on all screen output, and all inverse video characters appear only as blank spaces. CHACT usually contains a two, so entering two will not change screen output.

If you try invisibility, beware. Although the screen appears to be blank, the walls to the maze are still there. The one in CHACT does not change bit seven of screen characters – it just changes bit seven's function in the display handler.

Now that the program has the necessary data, the computer begins to build the maze to your specifications. Before work actually begins, the screen informs you of the work to be done. After this short delay, the screen is turned off and the

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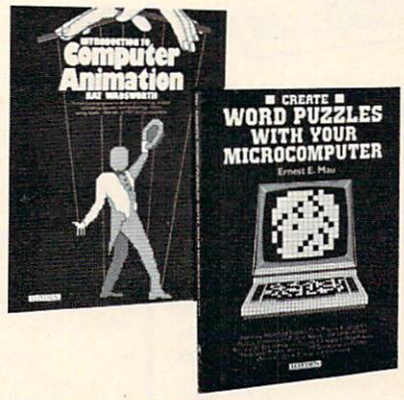


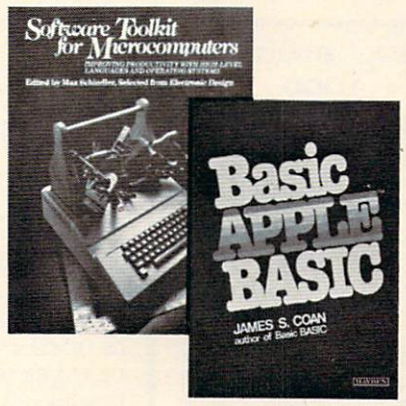


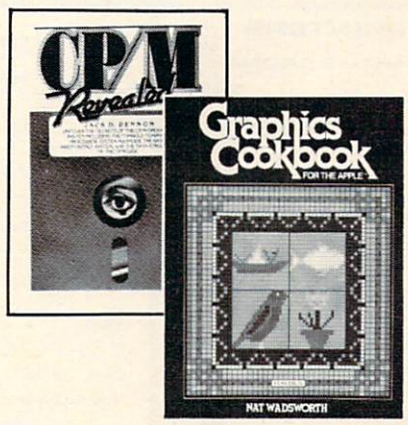


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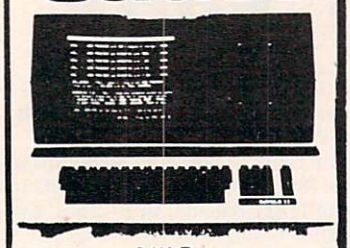

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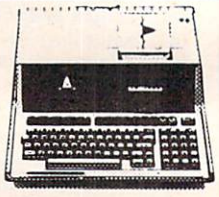

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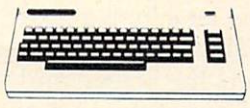

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maze is constructed. The actual time needed to construct the mazes varies greatly; a one-level maze takes approximately 30 seconds, while a 32-level maze will take approximately 16 minutes to build. For a rough estimate of the time you have for a coffee break, divide the number of levels entered by two. The result is the approximate time needed by the computer, in minutes.

Once the computer has completed construction of the maze, the screen is turned back on, and you are asked to PRESS START TO BEGIN. Watch the word START closely. See how it is flashing on and off? This effect is produced by toggling CHACT in rapid succession (alternately POKEing in one and two). You are asked to press START when you are ready because the program times you, and it would not be fair to start timing from the moment the maze was completed.

Therefore, when you are ready to begin, you press START, which tells the program that you are poised with joystick in hand; the top level is displayed and timing begins. You will see an "S" in the upper left corner of the screen, with the ball character (control-T) underneath. *You* are the ball character.

## Threading The Tunnels

Just move the joystick in the direction you want to go. "Sure," you say, "but where *do* I want to go?" Simple enough. If you chose a one-level maze (chicken!), you will see an "F" at the lower right corner of the maze. That's where you want to go. If you were gutsy, however, and chose any number of levels greater than one, you will see five graphics "+" characters at random points throughout the top level. These symbols represent tunnels, through which you must pass to reach the finish (which is always in the lower right of the bottom level of the maze). As you might have guessed, you always start at the upper left of the top level.

To pass through a tunnel, simply move onto the "+" symbol and press the "fire" button. Viola! The new level is displayed instantly. Have you gone up or down? Well, if you were on the top level, the only place you could go is down. If you are in the middle of a maze of four or more levels, then I have absolutely no idea which direction you'll go; you may pass through the same level three or four times before you realize that you've gone nowhere.

In mazes of ten or more levels, be prepared to see the same level a few times before you make any progress. No matter how many levels you chose, however, the goal is still the same. You must try to go down to unexplored levels; if you end up on a level you have been on already, you have looped, and you must figure out whether you've gone up or down.

In any case, find the "F" on the lowest level, go to the space directly above it, and move down. If you do not push the joystick down, the timer will continue, and your record time will be lost. When the timer has stopped, you will hear five beeps.

If you do not hear the five beeps, you have not stopped the timer or the sound is gone on your machine. Either way, just remember to go down when you reach the finish – as you get better and better, times will get tougher and tougher to beat, and each second will become important.

That's all there is to it. After the five beeps have informed you that the timer has stopped, the screen will become visible (no change for visible mazers), and the time used to complete the maze will be displayed in hours:minutes:seconds format. The program will loop until you press the START button again, which will cause the program to re-RUN.

## Possible Dead Ends

There are a few caveats, however. First, if you are attempting an invisible maze, some joystick directions may not work. There is nothing wrong with the program; if you cannot move in a certain direction, you have hit a wall (I told you they were still there!). Second, don't even try to do deep invisible mazes without the consent of your psychologist. Third, each tunnel can be used only once, so make your moves wisely.

Last, and most important, don't *ever* remove lines 14 and 15. This program, as mentioned earlier, will cause the computer to do some strange things if you hit the BREAK key. Lines 14 and 15 turn off the BREAK key; the only way to get out of the program is to hit the SYSTEM RESET button.

## The Program

Now let's look at how the program accomplishes what it does. Line 8 is self-explanatory. Line 10 resets the screen and sets the variable TOP to the address of the LSB of the screen memory address. By POKEing different numbers into TOP and TOP+1, we can display any area of memory. Line 12 stores the value of SAVMSC (locations 88 and 89, 58 and 59 hex) into RL and RH, respectively. This step is necessary to reset the destination of PRINT statements after these locations have been modified by the maze generator routine.

Lines 20 and 23 obtain the required data from the user and determine the value of BOT, the page number of the lowest memory address to be used. Line 25 makes sure that we haven't used up all available memory, and informs the user of any memory conflict. Line 27 lets the user know that the delay which will follow is intentional, not

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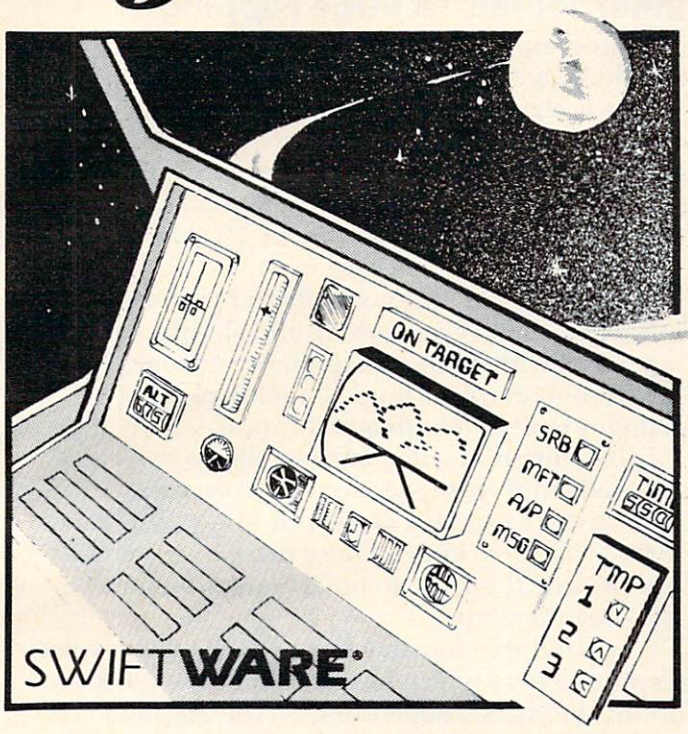


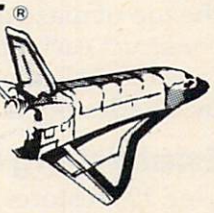

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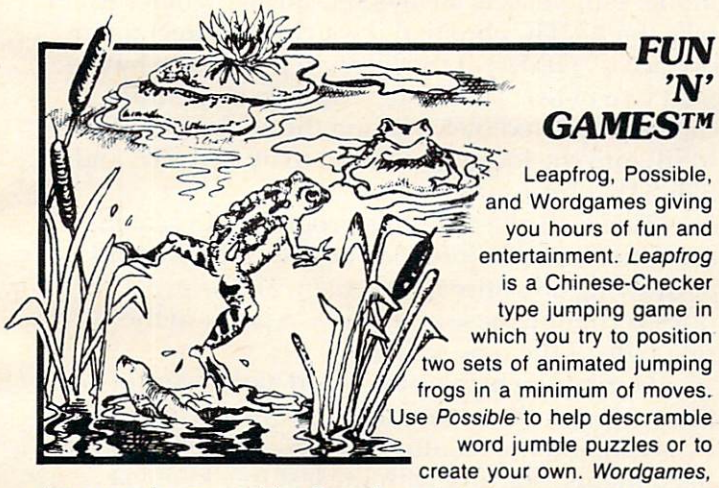

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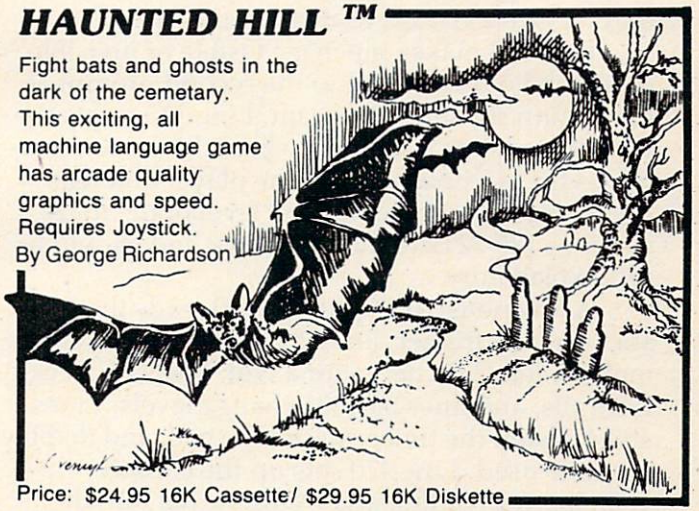

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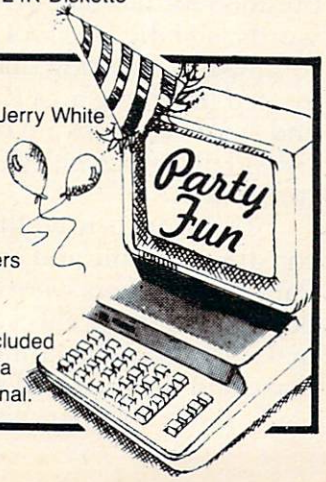


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something gone wrong with the program.

Line 28 turns off the screen and sets up the display for the start of the game. Line 29 employs a trick described by Bill Wilkinson in "Insight: Atari" (**COMPUTE!**, May 1982, #24), for clearing memory using the CLEAR key. Line 31 establishes the top of maze memory and sets up a loop to construct each of the MAXLEV levels of the maze. Lines 40-111 constitute the maze generator routine by Charles Bond.

## Establishing Start And Finish

Line 120 restores the PRINT statement destination to its original value by POKEing RL and RH back into SAVMSC. Line 130 establishes the "S" in the upper left and the "F" in the lower right of the maze. Line 135 checks to see if any tunnels have to be built; in other words, if the maze is only one level, jump over the tunnel building routine (lines 140-170).

The tail end of line 170 restores the screen and sets up the console switches for reading. Line 172 executes a GOSUB to the routine that randomly sets the color of the background at the beginning and also each time the user passes through a tunnel. Line 173 loops indefinitely until the user presses the START button. This line is the one that toggles CHACT, as described earlier.

Line 174 makes the maze visible or invisible, based on your response to the second prompt at the beginning of the program. Line 175 resets the three-byte timer RTCLOK to zero. Line 180 determines the start position for the player and tells the display list where the first level of the maze is. Lines 185-321 are the main loop and should be self-explanatory.

A few notes, though: line 190 reads the joystick and the trigger, lines 200-230 perform routine motion, line 235 checks for a win, line 240 checks for walls, and lines 300-321 change levels. Lines 400-415 stop the timer, sound the bell, and display the time used. Line 420 sets up the console switches for reading and POKEs a 124 into the attract mode flag ATRACT (location 77, hex 4D). The 124 in ATRACT gives the user approximately 16 seconds before the screen goes into attract mode.

Line 430 loops until the START button is pressed. Line 450 is the string A$ (we can't PRINT it because we've changed the screen memory locations). Don't forget to put the exclamation point towards the end of the line; doing that fools BASIC into reading trailing blanks to fill up A$. Finally, line 500 reads a random number from the random number generator RANDOM (location 53770, D20A hex), masks out the four low-order bits, and uses it to set the background color. If you're interested in the technical aspects of the game, read on. If not, RUN the program and have some fun.

## Inner Secrets Of Page Flipping

The programming tool behind the entire program is called page flipping. What this technique involves is changing the address that the ANTIC chip reads to determine the start of screen memory. This address is always in the display list, which is pointed to by SDLSTL and SDLSTH (locations 560 and 561, hex 230 and 231) in standard LSB, MSB order.

In the display list you will find all sorts of numbers; all have a meaning and should not be tampered with by the inexperienced programmer. In different graphics modes, the display list changes both in length and location.

In general, the display list follows two rules. First, all graphics modes accessible through BASIC have display lists that start with 112, 112, 112 in three successive bytes. These three bytes tell the ANTIC that there are to be 24 blank lines on the television screen.

Second, the fourth location of the display list contains a byte which has its sixth bit set. The rest of the byte varies depending on the graphics mode, but bit six is always set. Bit six, when set, tells the ANTIC chip that it is to begin direct memory access (DMA) at the location pointed to by the next two bytes. Therefore, any area in memory can be displayed by POKEing the address (LSB, MSB) into the location pointed to by SDLSTL and SDLSTH plus four.

This is the basis of this program. All screens are constructed before play begins, and, instead of drawing an entire new screen, all the program does is change these addresses to point to the first byte of the new screen.

During the blank-out period at the start of the program, the entire maze is constructed, layer by layer, and the resulting mazes are stored in 1K decrements, starting with the last free kilobyte memory block before the display list. The maze generator routine does not even need to be modified for this purpose; all that was done was to change the PRINT destination pointer SAVMSC (location 88, hex 58, mentioned earlier). In other words, all I did was fool the maze generator routine into thinking that screen memory was located in middle area RAM (instead of the top), and since 960 bytes are needed for the standard GRAPHICS 0 screen, 1K blocks were very convenient.

The tunnels used this information both at construction time and at level-changing time. Random numbers were all that was necessary to build the tunnels; checks were required only to make sure that the tunnels would be within the maze and that they did not cut through maze walls. Since no other checks are made, it is possible

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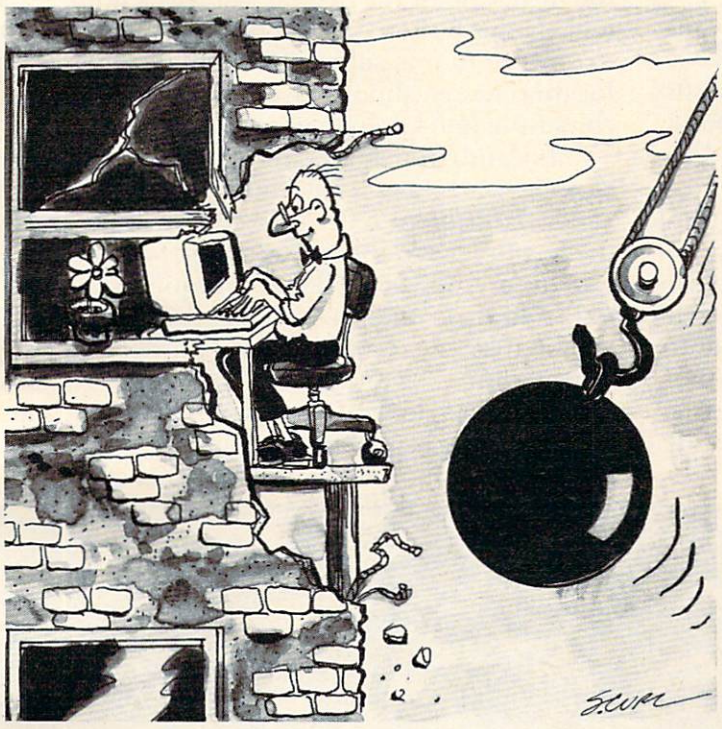

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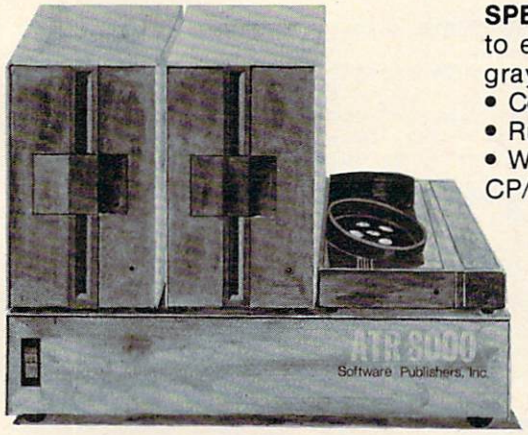


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to have many tunnels packed closely together.

The simple method of checking upward and downward movement causes tunnels to be disabled as they are used. When the player changes levels, a control-T character is left where the graphics plus symbol was previously. As a result, the checks for the graphics plus symbols will always fail on an already-used tunnel. This feature, added only to make the mazes more challenging, can easily be altered by changing the GOTO 185 in line 250 to GOTO 190.

This simple change makes the program think that you have just moved across or down (i.e., you have not changed levels). Therefore, the program replaces the previous space with the variable T, which contains the screen memory value of the space you were on before. When you move, the control-T is moved in the proper direction, and T is POKEd into the space you just moved from. It is confusing, but it works, and it works fast.

## Tunnel Checking

The tunnels, when used, merely change the value of the sixth byte of the display list. Since 1K memory blocks are used, it is not necessary to change the fifth, LSB of the display list DMA address; it will always be zero. Either the sixth byte is added to four, or four is subtracted from it. The reason for this change should be evident – four pages constitute one kilobyte of memory.

Locating the mazes in this fashion greatly simplifies all checks. Instead of going through a series of different LSB, MSB checks to determine the location (two-dimensionally) of a space on two different levels, all that is required is a PEEK to the address plus 1024 (1K) and the address minus 1024. Again, this is how tunnel checking is done in lines 305 and 310.

Last, let's look at the timer. From the time the computer is powered up until the time it is powered down, the OS, as part of its stage one

# Mazemaking For VIC, 64, PET/CBM, And Other Microsoft BASIC Computers

In the December 1981 **COMPUTE!**, we published one of the most useful (and deceptively short) subroutines for game-lovers of all ages. "Mastermaze" for the Atari is based upon Charles Bond's original idea that a random maze of any size could be created quickly right on the screen.

For those who might have missed this excellent subroutine, the basis for all kinds of games, the version in Program 1 below can be used by any computer with Microsoft BASIC where you can POKE to the screen memory. As listed, it will work on Commodore VIC, 64, and PET/CBM's. You need to know the number of columns on your screen and the memory address of the start of the screen RAM memory (the listing contains this information for Commodore computers).

This maze generator can get you started toward programming a variety of entertaining and challenging games. It always results in a maze with only one significant pathway to the solution and it will always fill the screen with pathways.

The short additional routine (Program 2) creates a semi-intelligent "mouse" that runs through the maze, attempting to solve it as best it can. Add it to the maze generator and, when the maze is drawn, hit any key. See if you can tell what rules the mouse uses to find the solution to the maze.

If you come up with an interesting game based on this generator, send it in to **COMPUTE!** and if we think others will enjoy it, we'll print it.

## Program 1.

```
100 DIMA(3): REM SET UP DIRECTION TABLE
110 A(0)=2:A(1)=-80:A(2)=-2:A(3)=80:REM VALUES
     FOR 40 COLUMN SCREEN
111 REM FOR 80-COLUMN SCREEN CHANGE: A(1)=-160
    : A(3)=160
112 REM FOR THE VIC 22 COLUMN SCREEN CHANGE: A
    (1)=-44: A(3)=44
120 WL=160:HL=32:SC=32768:A=SC+81: REM CHARACT
    ER, SCREEN, & START
121 REM FOR UNEXPANDED VIC USE SC=7680:A=SC+45

130 PRINT"{CLEAR}": REM CLEAR SCREEN AND GENER
    ATE MAZE BACKGROUND FIELD
140 FORI=1TO23
150 PRINT"{REV}
              ":REM 22,40, OR 80 SPACES
151 REM PRINT THE CORRECT AMOUNT OF RVS SPACES
     TO MAKE A SCREEN LINE WHITE.
160 NEXT I
200 REM GENERATE MAZE
210 POKEA,4
220 J=INT(RND(1)*4):X=J
230 B=A+A(J): IF PEEK(B)=WL THEN POKE B,J:POKE
    A+A(J)/2,HL:A=B:GOTO220
240 J=(J+1)*-(J<3):IFJ<>XTHEN230
250 J=PEEK(A):POKEA,HL:IFJ<4THENA=A-A(J):GOTO2
    20
300 REM MAZE IS DONE.  WAIT FOR A KEY TO BE PR
    ESSED.
310 GETC$:IFC$=""THEN310
```

## Program 2.

```
1000 REM MAZE MOUSE
1010 POKEA,81:J=2
1020 B=A+A(J)/2:IFPEEK(B)=HLTHENPOKEB,81:POKEA,
    HL:A=B:J=(J+2)+4*(J>1)
1030 J=(J-1)-4*(J=0):GOTO1020
```

VBLANK (vertical blank) routine, increments the three-byte jiffy counter RTCLOK. RTCLOK is located in three consecutive bytes starting at address 18 decimal, 12 hex.

Unlike most of the system numbers, this clock is stored in MSB first, LSB last order. Since vertical blanks occur once every sixtieth of a second, this timer counts "jiffies" (sixtieths of a second). When the game start is pressed, zeros are POKEd into the clock addresses (line 175). As soon as the player has completed the maze, the locations are read and stored in the variable ET (for elapsed time). Simple mathematical manipulations derive the hours, minutes, and seconds and store them in the variables EH, EM, and ES, respectively.

That's all there is to it. Since we know that we started at zero, no other manipulations are needed. (Incidentally, it is possible to stop the clock, but doing so requires a shutdown of the entire system VBLANK routine, which can have disastrous effects on your computer.)

And there's the entire program. If you have any questions or if you would like me to make a cassette copy of the program, send a cassette, a self-addressed, stamped mailer, and $3 to:

*Ken Szajda*
*59 West Lakeshore Drive*
*Rockaway, NJ 07866*

```
8 DIM A(3),A$(37):SW=0
10 GRAPHICS 0:TOP=PEEK(560)+256*PEEK(
   561)+4
12 RL=PEEK(88):RH=PEEK(89)
14 O=PEEK(16)-128:IF O<0 THEN O=O+128
15 POKE 16,O:POKE 53774,O
20 ? :? "# OF LEVELS";:INPUT MAXLEV:M
   AXLEV=MAXLEV-1:? "INVISIBLE (1) OR
    VISIBLE (2)";:IF MAXLEV<O THEN MA
   XLEV=O
23 BOT=INT(TOP/256)-MAXLEV*4-4:INPUT
   INV
25 IF BOT*256<PEEK(144)+256*PEEK(145)
    THEN ? "***INSUFFICIENT MEMORY***
   ":GOTO 20
27 ? "{CLEAR}":POKE 755,1:POSITION 4,
   10:? "CONSTRUCTING MAZE...PLEASE W
   AIT":FOR DEL=O TO 1000:NEXT DEL:PO
   KE 755,2
28 POKE 559,O:? "{CLEAR}":POSITION 10
   ,11:? "PRESS START TO BEGIN"
29 TM=PEEK(106):POKE 106,TM-6:POKE 88
   ,O:POKE 89,BOT:? "{CLEAR}":POKE 10
   6,TM
30 R1=BOT+MAXLEV*4:FOR X=BOT TO R1 ST
   EP 4:POKE 77,O:POKE 88,O:POKE 89,X
40 REM MAZE GENERATOR ROUTINE BY C. B
   OND
50 A(O)=2:A(1)=-80:A(2)=-2:A(3)=80:B=
   O
60 SC=PEEK(88)+256*PEEK(89):A=SC+43
65 POSITION 2,O:POKE 752,1:FOR I=1 TO
    23:? "{37 SPACES}":NEXT I
70 POKE A,5
80 J=INT(RND(O)*4):X1=J
90 B=A+A(J):IF PEEK(B)=128 THEN POKE
   B,J+1:POKE A+A(J)/2,O:A=B:GOTO 80
100 J=(J+1)*(J<3):IF J<>X1 THEN 90
110 J=PEEK(A):POKE A,O:IF J<5 THEN A=
   A-A(J-1):GOTO 80
111 IF J=128 THEN STOP
120 NEXT X:POKE 88,RL:POKE 89,RH
130 POKE BOT*256+917,38:POKE R1*256+3
   ,51
135 IF MAXLEV=O THEN POKE 559,34:POKE
    53279,8:GOTO 172
140 FOR X=BOT TO R1-4 STEP 4:FOR Y=1
   TO 5
150 J=INT(RND(O)*876)+43
151 W=J-(INT(J/40)*40):IF W<3 OR W=39
    THEN 150
155 IF PEEK(X*256+J)=O AND PEEK(X*256
   +1024+J)=O THEN POKE X*256+J,83:P
   OKE X*256+1024+J,83:GOTO 170
160 GOTO 150
170 NEXT Y:NEXT X:POKE 559,34:POKE 53
   279,8
172 GOSUB 500
173 IF PEEK(53279)<>6 THEN POKE 755,-
   PEEK(755)+3:GOTO 173
174 POKE 755,INV
175 POKE 18,O:POKE 19,O:POKE 20,O
180 ST=R1*256+43:WIN=BOT*256+960:POKE
    TOP,O:POKE TOP+1,R1
185 S=PEEK(ST):T=ST:POKE ST,84
190 Q=STICK(O):R=STRIG(O):IF R=O AND
   S=83 THEN 300
200 IF Q=7 THEN ST=ST+1
210 IF Q=11 THEN ST=ST-1
220 IF Q=14 THEN ST=ST-40
230 IF Q=13 THEN ST=ST+40
235 IF PEEK(ST)=38 THEN 400
240 IF PEEK(ST)=128 OR PEEK(ST)=51 TH
   EN ST=T
250 IF ST<>T THEN SW=O:POKE T,S:POKE
   77,O:GOTO 185
251 GOTO 190
300 IF SW=1 THEN 190
305 IF PEEK(ST+1024)=83 THEN R1=R1+4:
   ST=ST+1024:GOTO 320
310 IF PEEK(ST-1024)=83 THEN R1=R1-4:
   ST=ST-1024
320 IF R1<BOT OR R1>MAXLEV*4+BOT THEN
    330
321 POKE TOP+1,R1:SW=1:GOSUB 500:GOTO
    185
400 ET=PEEK(18)*65536+PEEK(19)*256+PE
   EK(20):EH=INT(ET/216000):EM=INT((
   ET-EH*216000)/3600)
401 FOR X=1 TO 5:FOR Y=15 TO O STEP -
   O.2:SOUND O,9,10,Y:NEXT Y:NEXT X:
   POKE 755,2
402 ES=INT((ET-EH*216000-EM*3600)/60)
403 ? "{CLEAR}":? :? "445 DATA ELAPSE
   D TIME: ";EH;":";EM;":";ES;"
   {19 SPACES}:"
404 ? "CONT":POSITION O,O:POKE 842,13
   :STOP
405 POKE 842,12
406 POSITION 2,15:RESTORE:FOR Y=O TO 1
410 READ A$:FOR X=BOT*256+Y*40 TO BOT
   *256+Y*40+LEN(A$)-1:POKE X+2,ASC(
   A$(X-BOT*256+1-Y*40,X-BOT*256+1-Y
   *40))-32
415 NEXT X:NEXT Y
420 POKE 53279,8
430 IF PEEK(53279)<>6 THEN 430
440 RUN
450 DATA PRESS START FOR ANOTHER MAZE
   {10 SPACES}"
500 AA=PEEK(53770):AB=AA-(INT(AA/16)*
   16):SETCOLOR 2,AB,4:POKE 712,PEEK
   (710):RETURN
```

# Making Change

Myron Miller

*"Making Change" is an educational program to teach children the concept of using quarters, dimes, nickels, and pennies to make a given amount of change. The program uses 3K RAM memory and will work on the TRS-80 Color Computer, PET/CBM, Apple, Atari, and VIC computers.*

This program first asks for the user's name and then presents the first problem. There are two types of problems which are alternately displayed. All odd-numbered problems begin like this:

```
1 JOHN GIVE ME 68 CENTS.
HOW MANY QUARTERS?
```

One is the problem number, John is the user's name, and 68 is a random integer between and including 1 and 100.

The player must enter how many quarters there would be in the requested amount. The program will then ask for dimes, nickels, and pennies in the same manner. For each type of coin the user must enter the number of coins and press RETURN. If a certain coin is not needed, the user should enter 0 and press RETURN. The total value of the user's answer should equal the requested amount (for 68 cents: 2 quarters, 1 dime, 1 nickel, and 3 pennies would be entered).

Even-numbered problems look like this:

```
2 JOHN I HAVE:
  3 QUARTERS,
  1 DIMES,
  0 NICKELS, AND
  4 PENNIES.
HOW MUCH CHANGE DO I HAVE?
```

The even problems present the opposite case. The user must add up the change and enter the total amount. Again, RETURN must be pressed after the entry. The total amount will always be in the range of 1 to 100 cents since both types of problems use the same program line to generate a random integer.

For both types of problems, the program checks the user's answer. If the answer is correct, the program will so indicate and will go on to the scoring routine. If the answer is wrong, the program will print out X CENTS SHORT JOHN, or X CENTS TOO MUCH JOHN. The youngster should be encouraged to use this information to correct the answer, for the problem will repeat up to three additional times. If the answer is still wrong, the program will display the correct answer and will move on to scoring.

## Reward Or Penalty

The program keeps track of two independent scores: conventional and reward. The conventional score is similar to a test score used in schools. It records how many problems were done, how many were correct, how many were wrong, and gives a percentage of correct answers. The conventional score is applied only to the first presentation of the problem; that is, repeat problems are not counted in the conventional score.

The reward score tries to motivate the user by paying one cent for every correct answer. To keep things fair, it charges one cent for every wrong answer. Thus the user earns money for right answers, but loses money for wrong answers. The reward score is applied to the repeat problems as well as to the first presentation. The reason for this is to encourage the user to take the repeat problems seriously. There can be a difference between the two scores because the conventional is applied only to the first attempt.

In the odd problems, the program will reject an answer given in all pennies (38 pennies for 38 cents) for any amount greater than four cents. It will also reject a fractional answer (3.8 dimes for 38 cents). In either case, the user is fined one cent for cheating. This should take care of any get-rich-quick schemes. The even problems will not accept a decimal answer (.38 for 38 cents). The concern here is to avoid round off errors in floating point numbers, not cheating. Thus the score is not affected.

## How To Encourage The Player

There are some changes and improvements that can be added. If your child is having a rough time with the program, I would recommend deleting line number 4100 from the program. This removes the "money lost" counter used by the reward score. The reward score can be brutal to a youngster having difficulty. Each problem has a potential earning of one cent, but a potential loss of four

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| * Different Shape Identification | ● | ● | ● | |
| Cave Game | ● | ● | ● | ● |
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| Number Recognition | ● | ● | ● | ● |
| Addition | | ● | ● | |
| Subtraction | | ● | ● | |
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| Sub.—Vertical/Horizontal | | ● | ● | |
| Advanced Addition/Subtraction | | ● | ● | ● |
| Ones and Tens | | | ● | ● |
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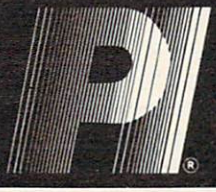

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cents. A child can lose a lot more money than he or she earns. We want to encourage the youngster, not chip away at self-esteem. Take out 4100 and the player can earn money, but not lose it (except for fines). Kids will learn far more if you let them win something.

If you enjoy programming graphics (I don't), you may want to liven up the program. Add graphics only for correct answers; don't make it interesting to get the problem wrong. For both odd and even problems, the program will go to line 3000 if the correct answer is given. Insert your graphics in lines 3001 to 3899; this space was left open for that purpose.

**Kids will learn far more if you let them win something.**

As the program uses no PEEKs, POKEs, or machine language, it is easy to modify. Original ROM PET machines need to have line number 540 changed to:

```
540 X%=100*RND(-TI)+1
```

No other changes should be necessary. On the VIC, some of the printed lines will exceed the screen's 22 columns. You will have to break up the longer lines into two shorter lines. Don't forget to leave room for the user's name in lines that include NA$.

One last item. When the computer says I OWE YOU 37 CENTS, it is speaking for the hardware owner, not the software author. In other words, the "I" ain't me; the "I" is you! Don't send me a bill stating that I owe your kid $87.52 for a job well done. Unleash this program on your kids at your wallet's peril!

## Program 1: Color Computer, Apple, Commodore Version

```
120 REM CHR$(147)= CLEAR SCREEN
140 REM CHR$(18)= REVERSE VIDEO ON
160 REM CHR$(146)= REVERSE VIDEO OF
    F
500 PRINT CHR$(147) "MAKING CHANGE"
    : PRINT: PRINT
520 INPUT "PLEASE ENTER YOUR NAME";
     NA$
540 X%=100*RND(-RND(0))+1
560 PC=PC+1: RC=0: PRINT CHR$(147)
580 IF INT(PC/2)=(PC/2) THEN 2000: ~
    REM PROBLEM TYPE SELECTION
1000 REM GIVE CHANGE PROBLEM ROUTINE

1020 PRINT PC " " NA$ " GIVE ME "X%"
     CENTS.": PRINT
1040 INPUT "HOW MANY QUARTERS"; Q: Q
    1=Q*25: PRINT
1060 INPUT "HOW MANY DIMES"; D: D1=D
    *10: PRINT
1080 INPUT "HOW MANY NICKELS"; N: N1
    =N*5: PRINT
1100 INPUT "HOW MANY PENNIES"; P: PR
    INT: PRINT
1120 Q%=Q: D%=D: N%=N: P%=P: TC=Q1+D
    1+N1+P
1140 IF Q%<>Q OR D%<>D OR N%<>N OR P
    %<>P THEN GOSUB 5000: GOTO
     1220
1160 IF P=X% AND X%>4 AND TC=X% THEN
     GOSUB 6000: GOTO 1220
1180 IF X%=TC THEN 3000
1200 GOSUB 4000
1220 IF RC>3 THEN 8000
1240 GOTO 1020: REM REPEAT PROBLEM
2000 REM COUNT CHANGE PROBLEM ROUTIN
    E
2020 PRINT PC " " NA$ ", I HAVE:"
2040 XX%=X%: QU%=XX%/25: XX%=XX%-QU%
    *25
2060 DI%=XX%/10: XX%=XX%-DI%*10: NI%
    =XX%/5: PE%=XX%-NI%*5
2080 PRINT: PRINT TAB(10) QU% "QUART
    ERS,"
2100 PRINT: PRINT TAB(10) DI% "DIMES
    ,"
2120 PRINT: PRINT TAB(10) NI% "NICKE
    LS, AND"
2140 PRINT: PRINT TAB(10) PE% "PENNI
    ES."
2160 IF RC>3 THEN RETURN: REM FOR CO
    IN PRINT OUT AT 8040
2180 PRINT: INPUT "HOW MUCH CHANGE D
    O I HAVE"; TC: PRINT: PRIN
    T
2200 IF INT(TC)<>TC THEN PRINT NA$ "
    , DON'T USE DECIMAL POINTS
    .": GOTO 2180
2220 IF X%=TC THEN 3000
2240 GOSUB 4000
2260 IF RC>3 THEN 8000
2280 GOTO 2020: REM REPEAT PROBLEM
3000 REM CORRECT ANSWER ROUTINE *** ~
    LINES 3001 TO 3899 FOR USE
    R GRAPHICS.
3900 PRINT CHR$(18) "CORRECT " NA$ "
    !!!!!" CHR$(146)
3920 PRINT: PRINT "YOU EARN 1 CENT!!
    !!"
3940 ME=ME+1: GOTO 7000
4000 REM WRONG ANSWER ROUTINE
4020 IF TC>X% THEN 4060
4040 PRINT X%-TC "CENTS SHORT " NA$ ~
    "!": GOTO 4080
```

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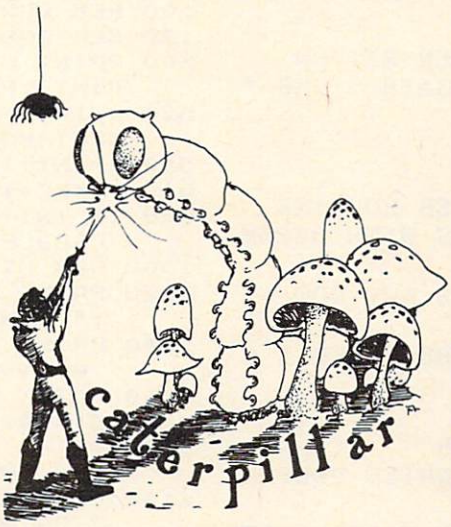


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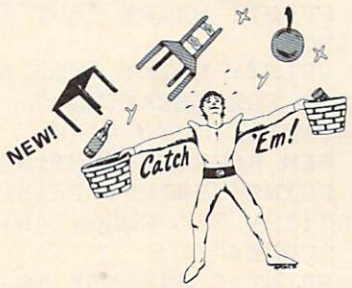


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```
4060 PRINT TC-X% "CENTS TOO MUCH " N
    A$ "!"
4080 PRINT: PRINT "YOU LOSE 1 CENT!"

4100 ML=ML+1
4120 RC=RC+1: IF RC>3 THEN RETURN
4140 PRINT: PRINT "TRY AGAIN " NA$ "
    .": PRINT: PRINT
4160 IF RC=1 THEN W=W+1
4180 RETURN
5000 REM FRACTIONAL ANSWER ROUTINE
5020 PRINT NA$ ", ANSWERS WITH DECIM
    AL"
5040 PRINT: PRINT "POINTS ARE NOT AL
    LOWED."
5060 PRINT: PRINT "YOU ARE FINED 1 C
    ENT."
5080 F=F+1: GOTO 4120
6000 REM ALL PENNY ANSWER
6020 PRINT NA$ "," P "PENNIES DOES E
    QUAL" X% "CENTS."
6040 PRINT: PRINT "BUT THAT IS CHEAT
    ING."
6060 PRINT: PRINT "YOU ARE FINED 1 C
    ENT FOR CHEATING."
6080 F=F+1: GOTO 4120
7000 REM SCORING ROUTINE
7020 PRINT: PRINT: PRINT "PRESS " CH
    R$(18) "S" CHR$(146) " FOR
     SCORE,";
7040 PRINT " ANY KEY TO CONTINUE."
7060 FOR X=1 TO 10: GET A$: NEXT X
7080 GET A$: IF A$="" THEN 7080
7100 IF A$<>"S" THEN 540
7120 PRINT CHR$(147) NA$ "'S SCORE!!
    "
7140 PRINT: PRINT "TOTAL PROBLEMS:" ~
    PC
7160 PRINT: PRINT "TOTAL CORRECT:" P
    C-W
7180 PRINT: PRINT "TOTAL WRONG:" W
7200 PRINT: PRINT "PERCENT CORRECT:"
     (PC-W)/PC*100 "%"
7220 PRINT: PRINT "MONEY EARNED:" ME
     "CENTS"
7240 PRINT: PRINT "MONEY LOST:" ML "
    CENTS"
7260 PRINT: PRINT "FINES:" F "CENTS"
    : PRINT
7280 PA=ME-ML-F
7300 IF PA<0 THEN PA=ABS(PA): PRINT ~
    "YOU OWE ME" PA "CENTS!": ~
    GOTO 7340
7320 PRINT "I OWE YOU" PA "CENTS!"
7340 GOTO 7000
8000 REM CORRECT ANSWER PRINT OUT
8020 PRINT: PRINT: PRINT NA$ ", THE ~
    CORRECT ANSWER IS:"
8040 GOSUB 2040: REM COIN PRINT OUT
8060 PRINT: PRINT " MAKES" X% "CENTS
    ."
8080 GOTO 7000
```

## Program 2: Atari Version

```
20 REM MAKING CHANGE  ATARI VERSION
30 DIM NA$(30)
100 REM SCREEN ASCII CODES
120 REM CHR$(125)= CLEAR SCREEN
500 PRINT CHR$(125);"MAKING CHANGE":P
    RINT :PRINT
520 PRINT "PLEASE ENTER YOUR NAME";:I
    NPUT NA$
540 X=INT(100*RND(-RND(0))+1)
560 PC=PC+1:RC=0:PRINT CHR$(125)
580 IF INT(PC/2)=(PC/2) THEN 2000:REM
     PROBLEM TYPE SELECTION
1000 REM GIVE CHANGE PROBLEM ROUTINE
1020 PRINT PC;") ";NA$;", GIVE ME ";X
    ;" CENTS.":PRINT
1040 PRINT "HOW MANY QUARTERS";:INPUT
     Q:Q1=Q*25:PRINT
1060 PRINT "HOW MANY DIMES";:INPUT D:
     D1=D*10:PRINT
1080 PRINT "HOW MANY NICKELS";:INPUT
     N:N1=N*5:PRINT
1100 PRINT "HOW MANY PENNIES";:INPUT
     P:PRINT :PRINT
1120 IF Q<>INT(Q) OR D<>INT(D) OR N<>
     INT(N) OR P<>INT(P) THEN GOSUB 5
     000:GOTO 1220
1140 Q=INT(Q):D=INT(D):N=INT(N):P=INT
     (P):TC=Q1+D1+N1+P
1160 IF P=X AND X>4 AND TC=X THEN GOS
     UB 6000:GOTO 1220
1180 IF X=TC THEN 3000
1200 GOSUB 4000
1220 IF RC>3 THEN 8000
1240 GOTO 1020:REM REPEAT PROBLEM
2000 REM COUNT CHANGE PROBLEM ROUTINE
2020 PRINT PC;") ";NA$;", I HAVE:"
2040 XX=X:QU=INT(XX/25):XX=XX-QU*25
2060 DI=INT(XX/10):XX=XX-DI*10:NI=INT
     (XX/5):PE=XX-NI*5
2080 PRINT :PRINT QU;" QUARTERS,"
2100 PRINT :PRINT DI;" DIMES,"
2120 PRINT :PRINT NI;" NICKELS, AND"
2140 PRINT :PRINT PE;" PENNIES."
2160 IF RC>3 THEN RETURN :REM FOR COI
     N PRINT OUT AT 8040
2180 PRINT :PRINT "HOW MUCH CHANGE DO
      I HAVE";:INPUT TC:PRINT :PRINT
2200 IF INT(TC)<>TC THEN PRINT NA$;",
      DON'T USE DECIMAL POINTS.":GOTO
      2180
2220 IF X=TC THEN 3000
2240 GOSUB 4000
2260 IF RC>3 THEN 8000
2280 GOTO 2020:REM REPEAT PROBLEM
3000 REM CORRECT ANSWER ROUTINE *** L
     INES 3001 TO 3899 FOR USER GRAPH
     ICS.
3900 PRINT "CORRECT ";NA$;"!!!!!"
3920 PRINT :PRINT "YOU EARN 1 CENT!!!
     !"
3940 ME=ME+1:GOTO 7000
4000 REM WRONG ANSWER ROUTINE
4020 IF TC>X THEN 4060
4040 PRINT X-TC;" CENTS SHORT ";NA$;"
     !":GOTO 4080
4060 PRINT TC-X;" CENTS TOO MUCH ";NA
     $;"!"
4080 PRINT :PRINT "YOU LOSE 1 CENT!"
4100 ML=ML+1
4120 RC=RC+1:IF RC>3 THEN RETURN
4140 PRINT :PRINT "TRY AGAIN ";NA$;".
```

```
    ":PRINT :PRINT
4160 IF RC=1 THEN W=W+1
4180 RETURN
5000 REM FRACTIONAL ANSWER ROUTINE
5020 PRINT NA$;", ANSWERS WITH DECIMA
     L"
5040 PRINT :PRINT "POINTS ARE NOT ALL
     OWED."
5060 PRINT :PRINT "YOU ARE FINED 1 CE
     NT."
5080 F=F+1:GOTO 4120
6000 REM ALL PENNY ANSWER
6020 PRINT NA$;",";P;"PENNIES DOES EQ
     UAL";X;"CENTS."
6040 PRINT :PRINT "BUT THAT IS CHEATI
     NG."
6060 PRINT :PRINT "YOU ARE FINED 1 CE
     NT FOR CHEATING."
6080 F=F+1:GOTO 4120
7000 REM SCORING ROUTINE
7020 PRINT :PRINT :PRINT "PRESS [3] FOR
      SCORE,"
7040 PRINT " ANY KEY TO CONTINUE."
7060 POKE 764,255
7080 K=PEEK(764):IF K=255 THEN 7080
7100 POKE 764,255:IF K<>62 THEN 540
7120 PRINT CHR$(125);NA$;"'S SCORE!!"
7140 PRINT :PRINT "TOTAL PROBLEMS:";P
     C
7160 PRINT :PRINT "TOTAL CORRECT:";PC
     -W
7180 PRINT :PRINT "TOTAL WRONG:";W
7200 PRINT :PRINT "PERCENT CORRECT:";
     INT((PC-W)/PC*100);"%"
7220 PRINT :PRINT "MONEY EARNED:";ME;
     " CENTS"
7240 PRINT :PRINT "MONEY LOST:";ML;"
     CENTS"
7260 PRINT :PRINT "FINES:";F;" CENTS"
     :PRINT
7280 PA=ME-ML-F
7300 IF PA<0 THEN PA=ABS(PA):PRINT "Y
     OU OWE ME ";PA;" CENTS!":GOTO 73
     40
7320 PRINT "I OWE YOU ";PA;" CENTS!"
7340 GOTO 7000
8000 REM CORRECT ANSWER PRINT OUT
8020 PRINT :PRINT NA$;", THE C
     ORRECT ANSWER IS:"
8040 GOSUB 2040:REM COIN PRINT OUT
8060 PRINT :PRINT " MAKES";X;"CENTS."
8080 GOTO 7000                    ©
```

# Learning With Computers

Glenn M. Kleiman

Each of the prior *Learning with Computers* columns focused on a single main topic. Word processing, graphics, Logo, PILOT, preschool computing, computer camps, introducing programming, computer literacy and other topics have been discussed in the past year. Meanwhile, software, books, comments from readers, and other pieces of information have been piling up on my desk, waiting to be fit into a column. For the next few months, I will work my way through this stack, and not focus on any particular topics.

## Information Directories

The stacks on my desk illustrate that products, information, resource centers, and uses of computers in education are increasing at an astounding rate. Fortunately, there are people who collect and organize this information for the convenience of the rest of us. You may find the following recently published directories useful:

*Instructor Magazine Computer Directory For Schools.* This directory contains four main categories of information: hardware, software, publications, and companies. Hardware is subdivided into computers, memory devices, monitors, printers, modems, networking devices, graphics devices, and other categories. Software is listed by area of use – language arts, mathematics, science, social studies, art, music, and so on.

Publications are divided into books, magazines, and other resources. For each of the nearly 2,000 products listed, there is a brief description, including, when relevant, equipment requirements, grade level, source, and price. There are also 400 companies listed. The aim of this directory is to be encyclopedic rather than selective, so no evaluative information is provided. This directory is available for $19.95 (plus $2 shipping) from Instructor Books, P.O. Box 6177, Duluth, MN 55806.

*Classroom Computer News Directory.* Part I of this directory lists and describes sources of information. It is divided into six sections. The first lists and briefly describes anthologies, bibliographies, indexes, on-line data bases, resource centers, and research and development projects. The second section covers software directories, sources of reviews, and clearing-houses. The remaining sections cover associations, periodicals, funding, and miscellaneous resources.

Part II is divided according to computer systems, with sections covering Apple, Atari, Commodore, Radio Shack, Sinclair, and Texas Instruments. Periodicals, software directories, and user groups are listed for each computer.

Part III covers local and regional resources, organized by state and province. User groups, projects, organizations, computer learning centers, and state or provincial personnel responsible for educational computing are listed.

Part IV lists colleges and universities offering courses on computers in education, and the types of courses offered. Part V is a calendar of national and regional conferences and workshops, and Part VI is a "yellow pages" of paid advertisements.

Overall, the directory contains a great deal of well organized information which can help you find answers to all sorts of questions. It is available for $14.95 from *Classroom Computer News*, 341 Mt. Auburn Street, Watertown, MA 02172.

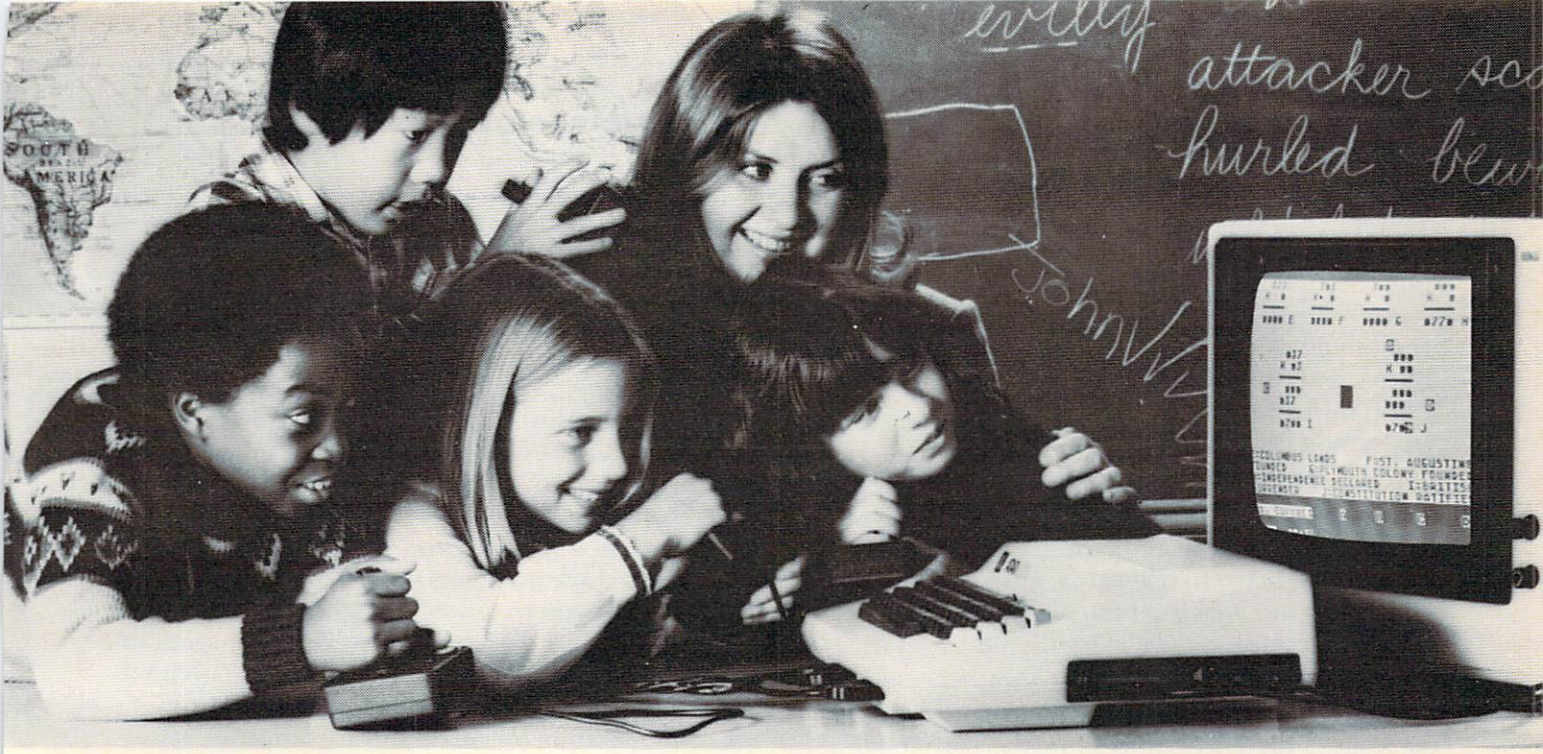
*Microcomputer Directory: Applications In Educational Settings.* This directory lists projects using microcomputers for instructional and administrative purposes at over 1,000 sites in the United States. It includes elementary and secondary schools, computer camps, museums, prisons, alternative learning sites, and colleges and universities. Each listing includes a brief description of the project and the name and address of a person to contact for more information. It is available for $15 (plus $1 postage) from Gutman Library, Harvard University Graduate School of Education, Appian Way, Cambridge, MA 02138.

## On Software Reviewing

During the past year, I have discussed many software packages. As some readers have noted, my overall evaluations have generally been very positive. There is a simple reason for this. I try to bring useful, innovative, well-designed software to your attention, and I do not take the time or space to mention software I find lacking or uninteresting. That is, I filter poor software rather than criticize it. Of course, this doesn't mean that I have found any perfect programs, but there certainly are some very good ones available now.

## More Programs For Preschoolers

In last May's column, I discussed some principles



# UNIQUE MULTI-USER SOFTWARE BRINGS NEW EXCITEMENT TO GROUP LEARNING.

The results are always the same. Put a computer in a classroom and children are drawn to it like steel to a magnet. And even though only one child actually uses the computer, the others coach or offer encouragement. Involving as this activity may be, it fails to take advantage of one of the best known principles of learning. But more about this later.

**A simple idea.**

When two educational researchers, Dr. Matilda Butler and Dr. William Paisley, studied the interaction of children around microcomputers they had an interesting, yet simple, idea. Instead of one user and several observers, why not give every child the opportunity to learn simultaneously. This idea sparked an entire line of unique educational software and gave birth to a new company, Edupro.

**Learning through cooperation and competition.**

Each one of Edupro's Microgroup™ computer programs presents your students with a different learning environment. It may be a visit with storybook friends. A trip through American history. Or an exploration of the world around us.

In any case, the principles are the same. Mathematical, language arts, social studies, and science problems are presented as contests, races, and puzzles. Using joysticks or paddles up to eight children work together, either competitively or cooperatively. They race against time, each other, or both.

**Forgotten principle.**

Now about that principle of learning other educational software ignores.

For years, studies have shown that children learn more efficiently in groups. Group learning motivates slower learners to persevere. It promotes divergent thinking. And it teaches the importance of working together for a common goal.

Ordinary educational software can't provide this stimulation. But with Edupro software children can experience the challenge and excitement of group learning on a daily basis.

**Designed for the simplest computers.**

Even with all the advances in computer science and micro-electronics, multi-user software typically requires a sophisticated, expensive computer. At a cost beyond the reach of most school districts. So the following paragraphs may contain the best news of all.

These unique programs run on Atari 400 or Atari 800 personal computers. They're available on floppy disk or cassette, and use the minimum amount of computer memory (16K bytes). So even the simplest Atari computer can teach eight students simultaneously.

And the learning doesn't have to stop in your classroom.

These Atari units are also one of the most popular home computers, so Edupro programs can involve the entire family in the group learning process. Not only can parents work with their children, brothers and sisters can share learning with each other. A feat that's hard to duplicate inside a classroom.

**Your own hands-on experience.**

If you were at this fall's Computer-Using Educators Conference you may have had a demonstration of our programs. Hundreds of educators did. Many of them said that this was an effective way to judge the potential of these programs. But you can have a better opportunity.

We've prepared a sampler kit of the conferences' most popular four user programs. It includes selections from six different programs spanning ages five to adult (all our programs are age graded). We'll be happy to send it to you so you can introduce these programs to your own students. The kit comes with complete instructions and our catalog listing over


50 additional programs. Plus we'll include a coupon good for a 10% discount on your first order.

We know of no other software that can turn a microcomputer into a tool for sharing the excitement of group learning.

Fill out the order form below and see the results in your own classroom.

I want to share the excitement of group learning with my students. Please send me the number of sampler kits I've indicated below. I understand that each kit includes a disk or cassette (my choice) of selected Edupro programs, instructions, catalog, and 10% discount coupon for my next order.

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of designing software for young children and described seven educational programs suitable for preschoolers. Since then, I have received several new excellent programs for young children.

**Facemaker** combines a creative tool with a memory game. The child begins by creating a face. The program presents sets of mouths, noses, ears, eyes, and hair. The child selects the specific parts, and the computer automatically combines them into a face. *Facemaker* will be reviewed in an upcoming issue.

**My First Alphabet**, by Fernando Herrara, is designed to help children learn to recognize letters and numbers, associate words with each letter, count, and learn to use the computer keyboard. This program was the first-place winner of an Atari competition, and is marketed by Atari.

For each letter of the alphabet, the program contains a screen display with a picture, a large version of the letter, and four words that begin with it. For example, for the letter A, first an airplane and a large A are drawn on the screen. Then large letters show the sentence "A IS FOR AIRPLANE," and the words ARROW, ARM and ANT appear. Each number also has its own display. For example, for the number five, nine clowns are drawn on the screen, then smiling faces are added to five of them and frowning faces are added to the other four.

After an initial display of the letters, accompanied by the alphabet song, the program provides several ways of using the screen displays. You can have the computer automatically show the displays for randomly selected letters and numbers, or you can specify which displays are to be shown. You can have the displays run continuously, or have the program wait for the child to type the matching letter or number for each screen display. When the child types a correct key, music plays and the screen colors change.

The pictures are excellent and realistic, so children can easily recognize each item portrayed. The program holds children's attention, and they enjoy seeing the pictures, recognizing the letters, and finding the right keys to press.

*My First Alphabet* is designed for a child to use with an adult present to exchange questions and answers, prompt the child, read the words, and so on. This is important since the program itself requires very little activity on the child's part. It takes quite awhile to draw each screen display and, once the display is completed, the most the child is to do is to press the corresponding key. Without someone to question, prompt and guide them, children using this program spend most of their time watching, and very little time doing anything.

## Children's Television Workshop Software

Children's Television Workshop (CTW), producers of *Sesame Street*, *The Electric Company* and *3-2-1 Contact*, has developed four disks of play-and-learn programs for Apple II computers. Each disk contains four programs, many of which are variations of classic games and puzzles, such as *Hangman*, *Anagrams*, and *Tower of Hanoi*. Less expensive computer versions of these games and puzzles are available elsewhere, such as from user groups or from program listings in books and magazines.

However, the CTW versions are especially well-designed, easy to use, and contain fine graphics. There are disks for children four to seven years old, seven to ten years old, nine to thirteen years old, and a disk containing programs suitable for a wide range of ages. Each disk comes with a book containing instructions for the programs and suggestions for related non-computer activities and games.

**Ernie's Quiz** is the disk for the youngest children. One program on it, called "Guess Who," uses colorful, low-resolution pictures of Sesame Street Muppets, such as Bert, Ernie, Big Bird, and the Cookie Monster. The computer begins by displaying a few blocks of color and then it gradually fills in more and more of the picture. The child tries to figure out, as quickly as possible, which Sesame Street character is being portrayed.

A "Face-It" program lets children create faces on the screen. It is similar in concept to the *Facemaker* program described above, but Face-It has larger, more colorful faces, lets the child add more features (such as eyeglasses, mustaches, beards), and lets the child control colors. The game paddles are used to select features and colors. (Face-It does not contain the animation and memory game options found in *Facemaker*.)

There are two more programs on the disk. "Jelly Beans" is a simple counting game. The "Ernie's Quiz" program provides hints about a Muppet, and the child is to choose which Muppet is being described.

**Mix and Match** is the disk for all ages. One program on this disk lets children create pictures by combining the heads, bodies, and feet of different Muppets. For example, the child can create Muppet with Bert's head, Big Bird's body, and Oscar the Grouch's feet. The computer will show the picture and tell the children that this creature is called "Berber the Grouch."

The disk also contains an excellent version of *Animal*, a classic computer game in which the player thinks of an animal and the computer tries to figure out which animal it is by asking questions such as "Does it live on land?" and "Does it fly?" If the computer cannot guess the animal, it asks

the player questions. In this way, the computer adds information to its knowledge base so it improves how well it plays the game.

There are two other programs. "Layer Cake" is a version of the *Tower of Hanoi* puzzle. It is easy to use and takes good advantage of the Apple's graphics capabilities. "Raise the Flags" is a non-violent variation of *Hangman*. The disk also contains a word editor which lets you enter your own words for the Raise the Flags program.

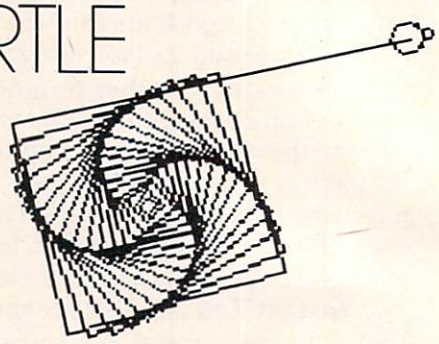
**Instant Zoo** is a disk for children ages seven to ten. Its four games are: Instant Zoo, a picture recognition game similar to Guess Who, but with animals instead of Muppets; Star Watch, which measures how long the child takes to press a key after a shooting star appears on the screen; Quick Match, in which two words are shown and the child presses one key if they match and another if they do not match; and Scramble, an anagram game in which the child races the computer to unscramble words. There is also a word editor for creating your own word lists for Quick Match and Scramble.

**Spotlight** is a disk for children ages nine to thirteen. It has two programs in which the child turns mirrors to direct lights to targets. The third program, called "Hot Stuff," is a game of logic in which the player tries to guess the computer's secret three-digit number. After each guess, the computer tells how many of the three digits are in the right place, and how many appear in the secret number, but not in the same place as guessed. Sounds simple, but complex logic is needed to figure out the secret number with as few guesses as possible.

The CTW disks are marketed by Apple and are available from Apple dealers. Each disk costs $50. The Mix and Match disk programs are in Applesoft. The programs on the other disks are in Integer BASIC, so they require either an Apple computer with Integer BASIC, or one with 64K (in which case Integer BASIC will automatically load into the extra memory when the disk is booted). Some of the programs also require game paddles.

The CTW programs, *Facemaker*, *My First Alphabet*, and those I reviewed in last May's column provide an excellent and varied set of software for introducing young children to computers. ©

# FRIENDS OF THE TURTLE



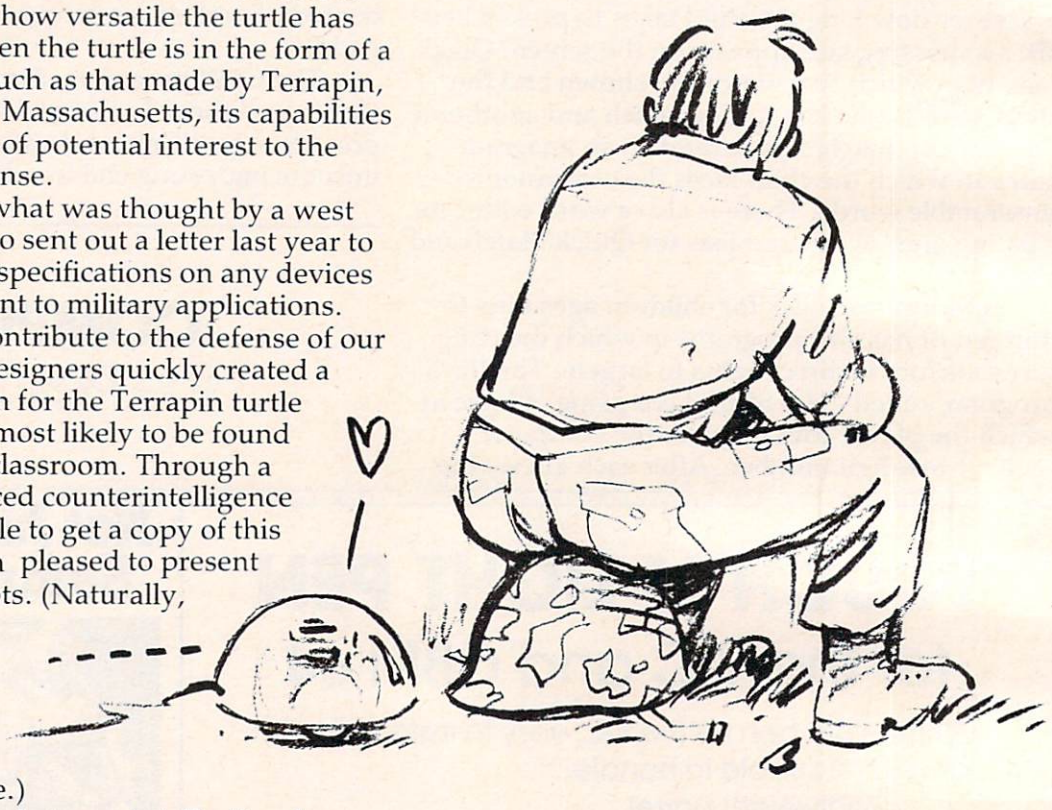
David D. Thornburg, Associate Editor

## The Department Of Turtle Defense

Those of us who limit our use of turtle graphics to the aesthetic pleasures of art or to its use in education have no idea how versatile the turtle has become. In fact, when the turtle is in the form of a mechanical robot, such as that made by Terrapin, Inc., in Cambridge, Massachusetts, its capabilities are so great as to be of potential interest to the Department of Defense.

At least this is what was thought by a west coast think-tank who sent out a letter last year to Terrapin asking for specifications on any devices that might be relevant to military applications.

Ever eager to contribute to the defense of our country, Terrapin designers quickly created a military specification for the Terrapin turtle – a $600 peripheral most likely to be found in a primary grade classroom. Through a network of well placed counterintelligence operatives, I was able to get a copy of this specification and am pleased to present the following excerpts. (Naturally, I have made sure that I haven't included any information that would compromise our nation's defense.)



From a functional viewpoint, Turtles show great promise as all-terrain vehicles for pushing heavy payloads to their destination. Under the heading of survivability, we find that:

> *The turtle enjoys a low observability, due to a minimal radar cross section and an almost non-existent infrared signature. In addition, its ground-hugging characteristics maximize terrain masking, resulting in lower target acquisition by most classes of SSM and ASM threats. ... The Turtle can make a 180-degree turn in less space than any military vehicle currently in use by US forces, ground, air, or sea. With minor modifications, a Turtle could be constructed that could double its cruising speed for a terminal "dash" capability that would greatly enhance survivability in the endgame.*
>
> *... Even if a suitable counter were found to all these properties of the Turtle, it is doubtful that an enemy could afford to deploy counter-weapons in sufficient number to nullify the possibility of defense saturation in the event of an all-out Turtle attack.*

On the topic of range ...

> *The Mark I, Mod 0 Turtle has an effective range of some 3 to 4 meters, depending on its winding count. Range is most severely limited by the Turtle's cable, but this limitation is trivial by comparison to the inherent advantages of wire-guidance. ... Furthermore, our research department is currently engaged in the testing of a 100 mile cable for the Turtle. ... While this does result in a shorter tooth-to-tail ratio, we feel it could significantly enhance the battlefield capabilities of the Turtle installations.*

On the topic of guidance ...

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*trolled, military data processing technicians can write arbitrarily baroque programs that will cause it to do pretty much unpredictable things. Even if an enemy had access to the programs that guided the Turtle Task Team™, it is quite likely that they would find them impossible to understand, especially if they were written in ADA. In addition, with judicious use of the Turtle's touch sensors, one could, theoretically, program a large group of Turtles to simulate Brownian motion. The enemy would hardly attempt to predict the paths of some 10,000 Turtles bumping into each other more or less randomly on their way to performing their mission. Furthermore, we believe that the spectacle would have a demoralizing effect on enemy ground troops.*

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Instead of Basic training, the turtles will, no doubt, have to go through Logo training with procedures such as:

```
TO HUP :NUM1 :NUM2 :NUM3
REPEAT 4 [FD 10 WAIT 20]
HUP 2 3 4
END
```

Hats off to the Terrapin Patriots! May this be an ever safer world for turtles. ©

# Recreational Computing Back Issues

*Recreational Computing* was the first and only personal computing magazine when it started in 1972 (it was called the *PCC Newspaper* back then). Bob Albrecht, David Thornburg, Isaac Asimov, Don Inman, Ramon Zamora, Robert Jastrow, Mac Oglesby, Adam Osborne – the list of authors reads like a Who's Who of microcomputing. These and many other authors contributed some of the finest articles about computers and now-classic games to the pages of *Recreational Computing*.

Last fall, *Recreational Computing* was merged into **COMPUTE!** and we are now offering available back issues. Whatever your interest, you'll find something here – from Spanish BASIC to Computers in Sports Medicine, from Future Fantasy Games to Robot Pets.

**September 1974** A Practical, Low-cost Home/School Microprocessor System, The Computer Illiteracy Problem, Eight "Games In BASIC

**March 1975** Build Your Own BASIC, The Computer In Art, Biorhythms

**March/April 1976** A TTY Game, Games With The Pocket Calculator, Dodgem, Square, Tiny BASIC To Go

**July 1976** BASIC Music, Tiny Trek For Altair, 16 Bit Computer Kit, Musical Numbers Guessing Game, Programmer's Toolbox

**September/October 1976** Computer Games In The Classroom, Planets Game, Dungeons And Dragons, Hats Game, Pythagoras And Rational Music

**November/December 1976** Story, Snake, Packl, Frogs Games, Make Believe Computers, The First West Coast Computer Faire, Subroutines, The First Computer

**January/February 1977** Robot Pets, Computers And Space, Tiny Languages, Teaching Using Conversational Programming, High School Computers, Reverse, Tiny PILOT, Mastermind

**March/April 1977** Z-80 PILOT, 6502 Assembly Programming, Tiny BASIC For Beginners, Math Drills & Games, Community Information Systems, Mine, Sales Simulation, Native American Board Games

**July/August 1977** Do-it-yourself CAI, Pet Robots: New Capabilities, PILOT, CAI In BASIC, Programming The HP-25, Capture, Inverse Reverse, 8080 Matrix Subroutines, Women And Computers

**September/October 1977** The $595 PET, More Tiny Languages, Computer Networks, The Bead Game, Biofeedback And Microcomputers Part 1, Home Energy Management, Sandpile Game, A BASIC PILOT

**January/February 1978** Pascal Vs. BASIC, COMAL: Structured BASIC, Video Disks: Magic Lamps for Educators?, A Computer Revolution?, Pounce, The Mechanics of Robots, TRS-80: A Status Report

**March/April 1978** Epic Computer Games, Micros for the Handicapped, Buckets Game, Prayer Wheel Program, Computer Contagion, Measuring Time, Frog Race, The IBM 370 Model 69

**July/August 1978** Computer Whiz Kids, Public Access To Computers, Man-made Minds, Post-human Intelligence, A Modern-day Medicine Show, Live Wire Design, ASCII Graphix, Baseball, Concentration, Gambler's Paradox

**September/October 1978** Kingdom Game, Computers and Museums, Sorcerer of Exidy, Snooping With Your PET, APL, Decimals in Tiny BASIC, Apple Math, TRS-80 Level II: A Grown-up Field Evaluation

**November/December 1978** APL Games, The Return of the Dragons, Animated Games for TRS-80, Runequest, All In The Mind, The L-5 Society, Phantnum, Some Guidelines for Microcomputer Chess, Dataman

**January/February 1979** A Jules Verne Fantasy, Artificial Intelligence, The Apple Corps is With Us, TRS-80 Personal Software, Vending Machine Gets "Brain," Apple II I/O, The Memory Game, REINO: Spanish Kingdom

**March/April 1979** Calculator Comics, "Lord of the Rings," Chess Reconsidered, Database, Beastiary, Color Your Own Graphics, Universe, Easy POKEing with Applesoft BASIC, Air Raid, TRS-80 3-D Plots, Slot, Apple Rose

**May/June 1979** PILOT for Apple II, The Game of Life, Gold Handicapping, Hunt, BASIC vs. Pascal, Inspector Clew-so, Flash for SOL, Faster Jumble, Concept Sans Computer, A Beginner's Guide To FRP

**July/August 1979** Summer Fun, Fooling Around With Your PET, Cryptarithms, Baseball, Newett Awl's Goat, Zork: A Computerized Fantasy Simulation Game, What Light on Yonder Panel Flashes, The Dedicated Word Processor, The FORTE Music Programming Language

**September/October 1979** TRS-80: Outside Connection, The Architecture of Multi-Player Games, The Sounds of Texas Instruments, Dynamic Color Graphics on the New Atari, An Apple PILOT, Gandalf, Spanish BASIC, Designing Animal Games, APL Mastermind

**November/December 1979** SHOGI: Games For You To Program, Atari Sounds, Texas Instrument Graphics and Animation, Interrupt, Match Me, Calendar, Making Music on the PET, Tower of Hanoi, Bingo, Animal Games

**January/February 1980** Computing and Holistic Health, TI Graphics and Animation Part 2, Games To Program, New Directions in Numerical Computing, An Extended BASIC "IF" Facility, Beating Computer Anxiety, Capture for PET, 8080 Tic Tac Toe, Chainwalk, Programming Problems

**March/April 1980** Special Games Issue: Recreation Apple II Hi-res Graphics, Delicious Functions, Galaxy II, Fairy Chess, Raging Robots, Program Instruction Builder, Data Retrieval: An Introduction

**May/June 1980** Introduction to Computer Music, CBBS Phone Numbers, 6502 Machine Language, The Electric Phone Book, Number Translation, Sea Search, Apple Animation, Twister Move Generator, DOZO, Shell Game, Home Video Displays, A Proposed Graphics Language

**July/August 1980** Fantasy Games Issue: Write Your Own Computer Fantasy Simulation, Wizard's Castle, On Future Fantasy Games, Wonderful World of Eamon, In Defense of Hackers, Touch Panels and Interactive Graphics

**September/October 1980** Probability Trees: Big Business on the Micro, The Best of People's Computer Company, Computer Analysis of Athletics, Word Search, Computers in Sports Medicine, Wired, Revolution in Typography?, Textrapolation

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**January/February 1981** The Education Revolution: Computer Games in the Classroom, An Art-producing Turtle, Computer Literacy Resources, Musical Compositions Using Computers, Microcomputers in China, Twenty Questions, The Pirate's Life for Me, Computers and the Volcanic Fallout

**March/April 1981** Space Exploration: Frontiers for You and Your Micro, Voyage To Antares, A Spaceship Simulator, The Computer as Chess Ally, Star Trek – A Dialogue Approach, Mark of Breeding (fiction), The Fifteen Puzzle

**May/June 1981** Using Computers at Sesame Place, Atari PILOT and Turtle Graphics, Computer Anatomy for Beginners, The Impact of Micros, Nevada-style 8-spot Keno, Sketch Pad, Sum of the Digits, TRS-80 Property Management Program, The Pocket Corner

**July/August 1981** Which Computer Should You Buy?, Commodore's New Rainbow Machine, The Wired Nation: Do We Want It?, Computers at the Junior Museum, 3-D Tic Tac Toe for PET, Number Crossword for all Computers

**September/October 1981** 43 Ways To Make Money With Your Micro, How To Start A Software Exchange, Who Are Computer Criminals?, Micros Behind Bars, Number Systems, Computer Knock-knock Jokes in BASIC and LISP, For Photographers Only, Fibonacci Nim, Roman Numeral Conversum Programum

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# THE WORLD INSIDE THE COMPUTER

# A Computer Language For Kids

Fred D'Ignazio, Associate Editor

In this column we have explored ways to make computers more accessible to kids. In the August to December columns, for example, we developed a computer "friend" for kids.

When the friend program is run, the friend's face appears on the TV screen. At first, the friend is asleep. "Ding! Dong!" goes a bell. The friend wakes up and winks. "I'm Ged," he announces. "Who's out there?"

The child answers by typing in her name. The friend greets the child and asks if she'd like to play a game. If she would, the friend gives her a menu of the games in its repertoire.

If the child is using a disk-based system, the friend starts the game automatically. If the child is using a cassette-based system, the friend helps the child load the game program from tape.

After the game, the friend comes back on the TV screen. "I hope you had fun," it says. It offers to play a new game with the child.

## The Friendly Operating System

The friend is like a simple operating system. It is the interface, the middleman, between your child and the computer. It is a first attempt at making computers warmer, more human and personable.

In coming months, we'll be gradually expanding the friend's capabilities. Next month, for example, I will write about a way for the friend to learn more about the child. In a preliminary program the friend and the child will be "introduced." The child will give the friend personal information: name, age, the color of hair and eyes, address, phone number, likes and dislikes.

The friend will ask what kind of friend the child would like. The child will get a chance to mold the friend – to select the friend's name, shape, history, likes, and dislikes. If the child wishes, the friend can remain a computer. Or else the friend can become something completely imaginary and make-believe.

In fact, the child will be able to use the "Introduction" program to create several friends. The friends will have different characteristics and names.

If the child wishes, she can introduce the friends to each other.

## Friendly Programming

The computer friends should liven up your child's computing. But they won't help with *programming*.

No matter how many games a friend has up its "sleeve," the child is never actually programming the computer. He or she is interacting with the friend and its programs. But not programming. Instead, in a way, the friend is programming the child.

This is one of the major drawbacks of the computer friends. They don't encourage children to write programs on their own. At least half of the value of the computer is unleashed when you program it yourself. Without that opportunity, your child is missing out on a lot.

Right now the friend is a friendly operating system. What we need is a friend that can also act as a *friendly computer language*. Then the friend can encourage the child to create, save, and run programs.

## Beyond Logo

"Wait a second!" you say. "What about BASIC, PILOT, and Logo? These languages are easy to learn. They are friendly. They are perfect for kids."

---

*Fred D'Ignazio is a computer enthusiast and author of several books on computers for young people. He is presently working on two major projects: he is writing a series of books on how to create graphics-and-sound adventure games. He is also working on a computer mystery-and-adventure series for young people.*

*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!**.

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the SOFTWARE connection

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My answer to that is: Do you have kids of your own? Do you teach kids? Have you ever tried to teach little kids how to use BASIC? Or PILOT? Or Logo?

I have two kids. My daughter Catie is almost seven. She's a first grader. My son Eric is three and a half. Eric spends his mornings at "Miss Eleven's Castle" (Evelyn's Day Care).

Both kids are whizzes at using the family computers. They have their own disks and tapes. They can turn the computers on and off, boot up disks, run programs, and key in the letters, numbers, and words the programs request. Both kids know all the special-function keys on the computer keyboard.

But try getting them to program? Forget it.

I can understand Eric's reluctance to program. After all, the kid doesn't even know how to read or write. If he gets 6's and 9's mixed up, and M's and W's, how can I expect him to master FOR/NEXT loops, string variables, subroutines, and arrays?

But Catie is a different matter. She reads Nancy Drew mysteries and "Choose Your Own Adventure" books. She is good at arithmetic, and she loves logic games, puzzles, and mazes. But she has no interest in programming.

Maybe it's just getting over the first hurdle. Unfortunately, Catie and I have been stuck on that hurdle for over two years.

The first hurdle is the first line of code in a program.

That first line is invariably a FOR/NEXT loop. The FOR/NEXT loop might do different things. It might print the message "CATIE LOVES MOWIE" a thousand times, all over the TV screen. (Mowie is Catie's kitty.) It might make the sound of a police siren or a dropping bomb, or the noise of water, or of crashing dishes. Or it might draw a drunken fly wandering across the screen.

What is Catie's reaction to all this? It's not positive, I'll tell you that.

Even if I get the fly to change into 16 different colors, Catie couldn't care less. After the first line of code, her reaction is sudden and dramatic. She gets hungry. Or she has to go to the bathroom. Or she has a headache. Or her spine dissolves and I get to watch her slide out of her seat and collapse into a puddle on the floor.

Or else she begins giggling and acts silly. She begins typing on the computer with her nose. Or her tongue.

This is an embarrassing situation.

On all sides we hear about friendly computers, computer literacy for kids, teaching kids to speak "computer" along with English. And here I am, a computer expert, a writer, an advocate for teaching computing to kids. So what do I do? I try to drag my kids into the computer age.

But they don't want to go.

## Computer Literacy For Whom?

It's not so much that my kids resist me actively. It's just that they don't see the point. They have too much itching powder in their pants to make them sit still long enough to program.

At least using the languages available now.

But what if we created programming languages that incorporated the same ingredients as the best software designed for children? What are these ingredients? Quick response, for one. Other ingredients include: action, sound effects, pictures, colors. Quick mastery, a sense of power and control. Progress. Encouragement. Humor. These are qualities found in all good software for kids. But these qualities are not evident in programming languages. Even in PILOT. Even in Logo.

## What Do You Think?

I hope I have lit some fires. Or started some fights.

What do you think? What kind of experiences have you had with your younger kids? Have they been similar to my experiences, or different?

Over the next few months as I continue to develop the computer friend and to write about other subjects, I plan to design and develop some prototype programming languages for little kids. The languages will be written in BASIC (or PILOT or Logo). They will be simple and experimental, something you can type into your computer and try yourself.

Also, the languages should contain the same qualities that make good programs so popular with kids. Maybe the programming will be in terms of colors, or sounds. Maybe in terms of shapes.

However it's done, the kids should be able to create programs themselves. They should be able to save, retrieve, and run those programs. The programs should not be trivial. They should do something. (Of course, they are doing *some*thing if they are teaching a child how to program.)

Most of all, the programming language should be fun for the kids to use. It should teach the kids that programming isn't something ugly that you have to do to get something nice. It's fun in itself. It's a way to express yourself, like coloring or playing music, or dancing.

The language shouldn't deter kids. It should encourage them to sit down and write a whole program. Even a short program.

Please write to me and tell me what you think. Send your letters to:

*Fred D'Ignazio*
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# The Joy Of Joysticks

## Atari/Commodore Game Controller Roundup

Tom R. Halfhill, Features Editor
Charles Brannon, Editorial Assistant

*These joysticks and joystick substitutes will work with the Atari 400/800/1200XL computers, Commodore 64, VIC-20, and P Series computers, the Commodore Max Machine, the Atari VCS and 5200 video game machines, and the Sears Video Arcade. Some of the products, with proper adapters, also work with Apple, TRS-80, or Texas Instruments computers, and the Colecovision game machine.*

Maybe you're playing a *Pac-Man*-type game....

Fleeing desperately from a relentless ghost, you make a break for the last energy pellet that will allow you to turn the tables on your pursuer. You try to round a corner in the maze, but suddenly find yourself slapping up against a wall. Why can't you turn? Blast that sticky joystick anyway! You've had it.

Or maybe you're playing a *Missile Command*-type game....

MIRVs and ICBMs are raining down and that infernal smart bomb is making straight for your last city. Quickly positioning the crosshair with the joystick, you take aim and fire your last ABM...and miss. If only you had a trackball like the one you're accustomed to in the arcades!

Or maybe you're playing an *Asteroids*-type game....

Hopelessly surrounded by an oncoming hailstorm of space debris, you yank back on the joystick to flip your spaceship into hyperspace, and find yourself dizzily spinning instead. Oh, for a hyperspace button like the one in the arcades!

### The Joy Of Joysticks

Don't give up the spaceship – there is relief. A growing national obsession with home computer/video games has spawned an expanding market in custom game controllers. Only a year ago there were few alternatives to the common Atari-type joysticks supplied by the various manufacturers which use the Atari joystick standard. Now there are more than a dozen to choose from. The controllers covered in this overview were gathered after visiting computer stores, scanning magazine advertisements, and scouting new products at trade shows. While there are sure to be even more by the time this article appears, we tried not to leave any of the existing products out.

At first, it might seem that all joysticks must be more or less alike. Can there really be that much difference? After all, what is there to a joystick?

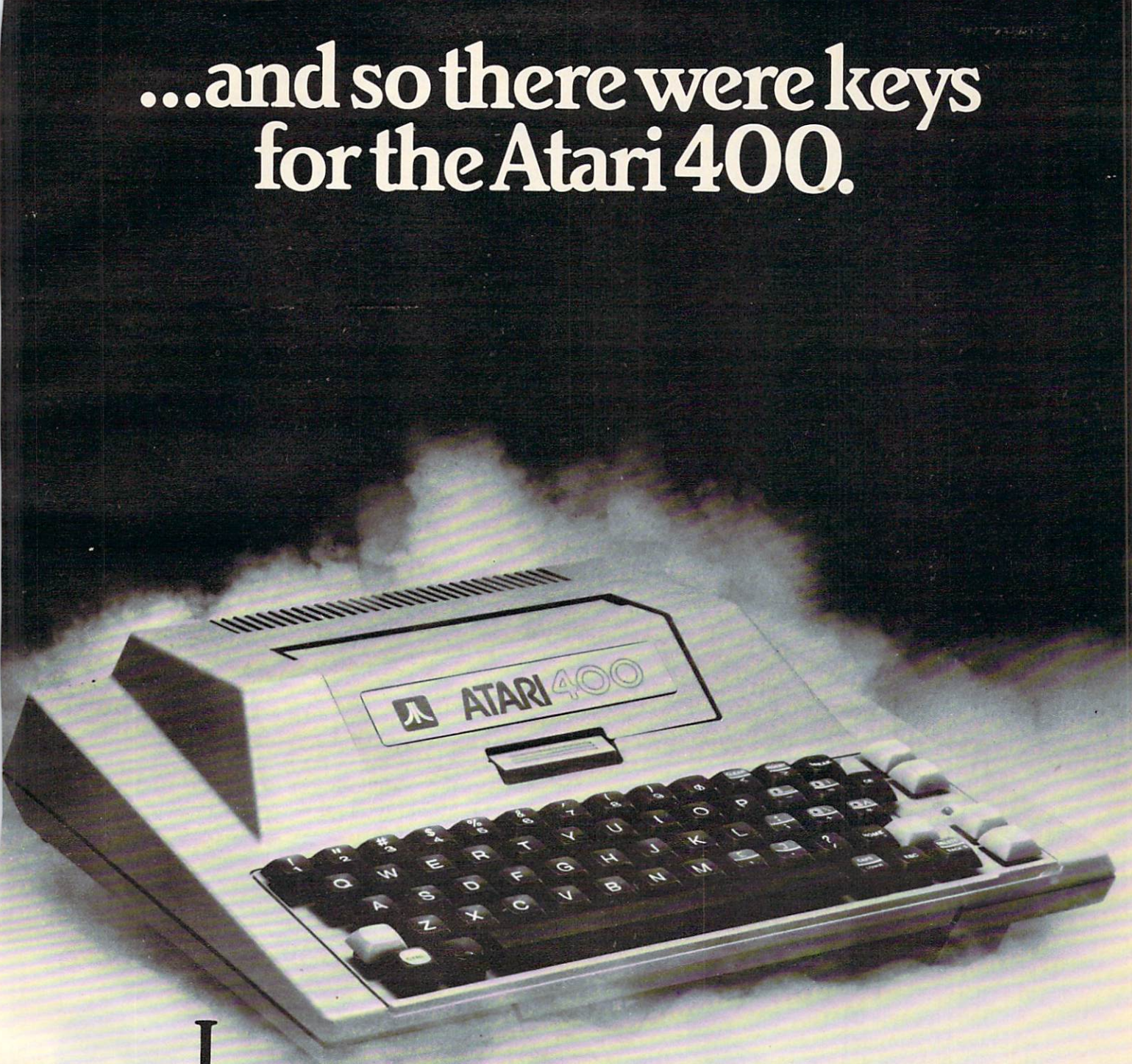
Externally, as the photos show, there is a wide range of configurations for joysticks (the name *joystick*, incidentally, originates from an early aviators' term for an airplane's control stick). Some joysticks are made to be hand-held and manipulated with a finger or two. Others are designed to rest on a tabletop and to be controlled with one hand. Some have hand-sized grips instead of short sticks. Some mount the fire button on the base, others on the stick, and still others have both.

Internally, there can be even greater differences. Some are constructed largely of plastic, others of metal. The construction largely accounts for a joystick's "feel." Since feel is a highly subjective reaction, we will avoid value judgments as much as possible. There is no substitute for trying a joystick yourself.

Some controllers, of course, are not joysticks at all. The push-button boxes are intended largely for *Asteroids*-type games, duplicating the arcade controls. Trackballs are at their best in games requiring rapid 360-degree movement, such as *Missile Command* and *Centipedes*.

And finally, a word about the standard Atari joystick. It's received some bad press, not all of it deserved. It's accused of being too fragile, unre-

# ...and so there were keys for the Atari 400.




In the beginning there was the membrane keyboard.

So it was to be done that Inhome Software would create a full-stroke keyboard for the Atari 400 Home Computer and it would be called the B Key 400, and would sell for $119.95 U.S. funds.

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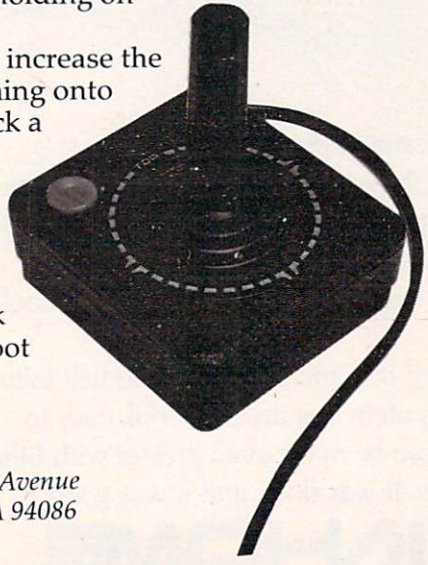
sponsive, and even ugly. The joysticks do wear out after months of heavy use, but this isn't all the joystick's fault. First, in our experience, many "broken" joysticks are really the victims of faulty cords. The cords are subjected to a lot of twisting and pulling, and the thin wires tend to fray and snap. A dead joystick can often be revived by replacing the cord. Keep this in mind when admiring a custom joystick's hefty construction: the standard cord is probably its weakest link.

**It might seem that all joysticks must be more or less alike. Can there really be that much difference?**

Second, when an Atari joystick's joint or switches do break, it is often the fault of excessive flexing. Contrary to some beliefs, the Atari joystick *is* pretty responsive. Only a slight deflection is required to activate its switches. But its inherent stiffness, and the lack of any *tactile feedback* – that is, a positive click or snap when a switch makes contact – encourages people to wrench it harder than they have to. Games with slow joystick response, especially those written in BASIC, aggravate this problem.

## Atari Joystick

Since the Atari joystick is the standard against which the others are most often compared, we'll start by pointing out that it's a two-handed instrument. Note that some joysticks permit one-handed operation, freeing the other hand for the keyboard (or for holding on to a chair).



Some people increase the leverage by jamming onto the end of the stick a PVC plastic "T" connector (available at hardware stores) or even a wine bottle cap. The Atari joystick includes a four-foot cord.

*Atari Joystick*
*Atari, Inc.*
*1196 Borregas Avenue*
*Sunnyvale, CA 94086*
*$9.95 Each*

## Slik Stik

The Slik Stik is one of two joysticks by Suncom. Both resemble the Atari joystick, but incorporate some important differences. The Slik Stik's stick is only about half the height of the Atari's, but is topped by a jawbreaker-sized red ball for easy handling. And while the Slik Stik doesn't flex any more than the Atari stick, the action is more positive and you can feel a slight detent, or click. The fire button is very small but responsive.

The Slik Stik has a long six-foot cord reinforced at both ends with tough plastic collars where the cord joins the joystick base and plug. Suncom markets the Slik Stik as a direct replacement for the Atari joystick, and it is the only controller we reviewed which costs the same as the Atari product.


*Slik Stik*
*Suncom, Inc.*
*270 Holbrook Drive*
*Wheeling, IL 60090*
*$9.95*

## Starfighter

Suncom's Starfighter, advertised as "The Ultimate Joystick," is very similar to the company's Slik Stik. However, Suncom claims it is more ruggedly constructed than their less expensive product, and it is guaranteed for two years instead of 90 days.


Where the Slik Stik has a ball-tipped controller, the Starfighter has a smooth plastic cylinder with a rounded top. It is taller than the Slik Stik, but still shorter than the Atari stick. The action is more positive, and the contacts in all eight positions can be distinctly felt. What's more, there are definite "stops" to the stick's movements, so it can't be damaged by over-twisting as the Atari joystick can. The Starfighter has the same convenient six-foot cord and reinforced connections as the Slik Stik.

*Starfighter*
*Suncom, Inc.*
*$16.95*

## Baylis Big Stick

The Baylis Big Stick is the largest controller we tested. Actually, its name is something of a mis-

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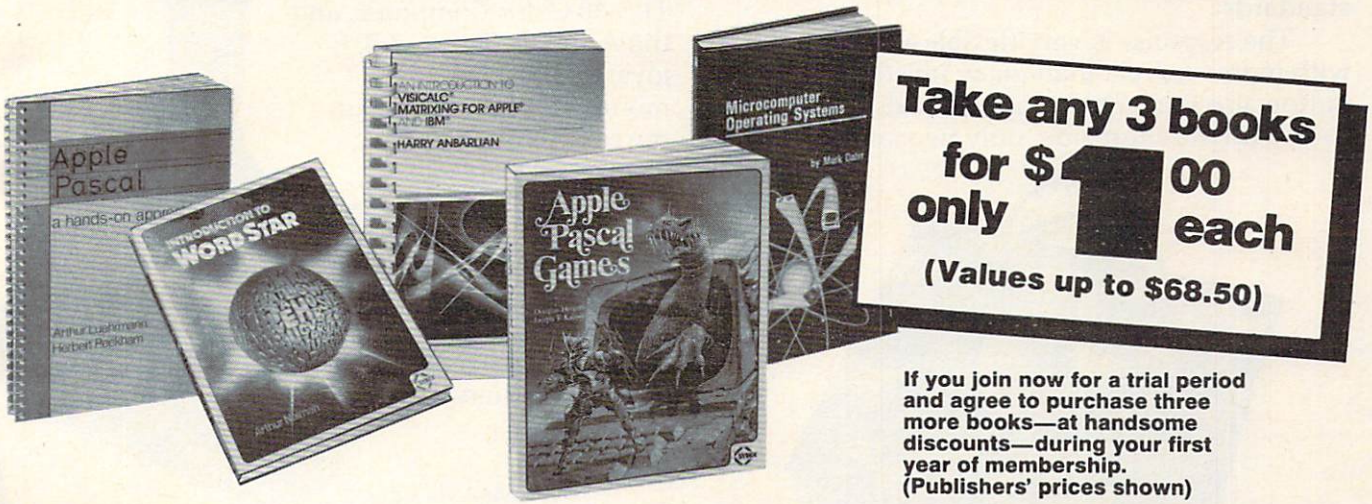


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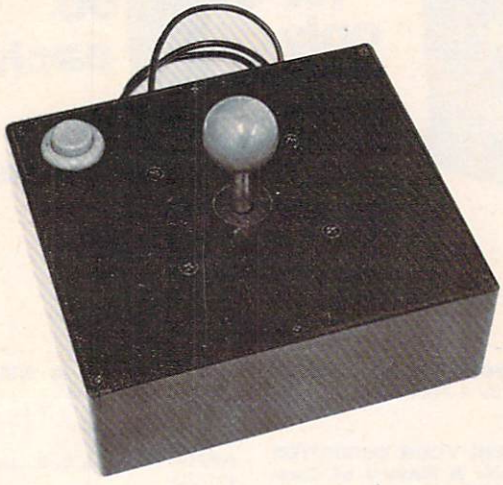
nomer; the stick itself is only two and a half inches high, including the large red ball on the tip. It is the base that is big – nearly eight inches square. Obviously, the Baylis is designed to be rested on a tabletop or lap and operated with one hand.

The base is heavy enough to permit this kind of operation, although it does tend to rock around a bit during heavy action. However, there seems to be plenty of empty room inside the base to add weights, if you want to customize it. The stick itself is a rigid steel shaft built to tough arcade standards.

The response is very flexible and positive, with more "travel" than many joysticks. The fire button also is a large, arcade-style device. The cord is on the short side, only two and a half feet



long, but since this oversized controller is not meant to be hand-held, this probably will not be a handicap.

The first Baylis Big Stick we sampled did not function in five of the eight directions. The internal switches were working perfectly, so the problem was traced to the cord. This is a perfect example of how even the most solidly constructed joystick can be paralyzed by the weakest link of any controller – its cord.

*Baylis Big Stick*
*Released By:*
*Torrey Engberg Smith Co.*
*P.O. Box 1075*
*Glendale, CA 91209*
*$59.95*

## WICO Command Control

WICO's Command Control joystick is ruggedly built to arcade standards, with a steel shaft inside the plastic stick and metal parts at critical joints. This construction is not surprising, since WICO happens to be a major supplier of controllers for commercial arcade machines.

The Command Control joystick has a long "baseball-bat" handle, long enough to wrap your whole hand around. The action is smooth and flexible, with almost as much travel as the Big Stick. There is a small fire button on the tip of the stick and a larger one in the usual position on the base. A slide switch on the base selects between the two. The cord is five and a half feet long, strengthened with a plastic collar at the base end only.

WICO's product line includes two other joysticks, a trackball, extension cords, and adapters for Texas Instruments computers, the Radio Shack TRS-80 Color Computer, and the Apple II. The Red Ball joystick has a large ball mounted on the stick with the same base as the Command Control joystick, and the Command Control Deluxe features a batlike handle on a much larger base. All models are built to the same standards.

*WICO Command Control*
*WICO-Consumer Division*
*6400 W. Gross Point Road*
*Niles, IL 60648*
*Command Control $29.95*
*Red Ball $34.95*
*Command Control Deluxe $39.95*

## Pointmaster

The Pointmaster is from Discwasher, a company whose best-known product is a popular cleaning system for phonograph records. The Pointmaster consists of a long plastic handle with a molded grip, attached with a ball joint to a plastic base. Since this unit is too light to use as a one-handed model, check to see if it is comfortable to use as a hand-held model, given its large size.


The stick is flexible enough, but there are no obvious contact points or "stops," so players should be careful not fo force the handle too far in the heat of video combat. Due to the stick's leverage and flexibility, precise positioning is sometimes difficult. The contoured fire button,

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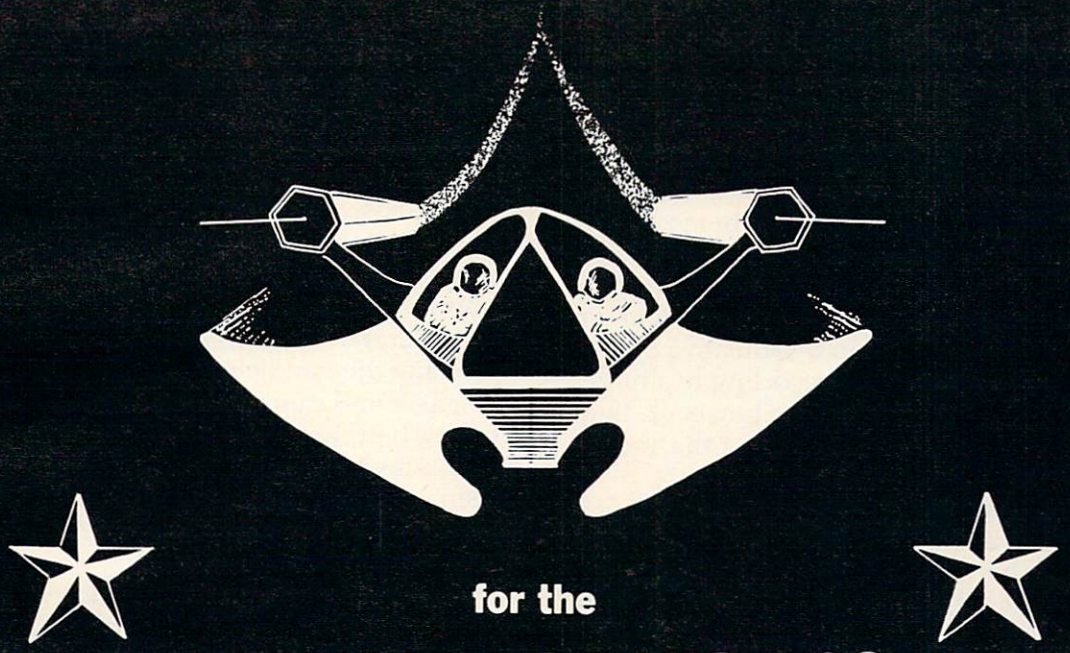

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mounted on the tip of the handle, has almost no travel. When first toying with the Pointmaster, without plugging it in, we feared the button would have a "dead" feel. But actually, it turned out to be very sensitive and fast.

The cord is five feet long, reinforced with a collar at the base end only.

*Pointmaster*
*Discwasher, Inc.*
*1407 N. Providence Road*
*Columbia, MO 65201*
*$16.95*

## Quick Shot

Spectravision's Quick Shot joystick has one unique feature that interested us immediately – the four rubber pads that are standard on other joysticks can be removed and replaced with four suction cups. This allows Spectravision to make the joystick small and light enough to be hand-held, yet still capable of being anchored firmly to a tabletop for one-handed use without resorting to a huge base or extra weights. We found, however, that the tabletop must be very smooth for the suction cups to stick, even if they are moistened.

Plastic construction dominates in the Quick Shot. The stick is a large, molded pistol grip that fits an adult's hand better than most of the other joysticks we tested. The action is flexible, with definite stops, although the contact points are hard to feel. There are two fire buttons, one on the stick and another on the base, and both are always "live," so you can switch back and forth in mid-action. The buttons also have a detent, or "click," at the bottom of their travel.

The Quick Shot includes a four-foot cord strengthened at the base end only.

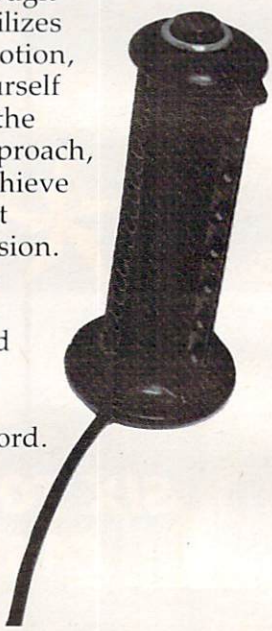
*Quick Shot*
*Spectravision*
*39 W. 37th Street*
*New York, NY 10018*
*$14.88*

## Le Stick

Le Stick is the most unusual joystick we tested. Datasoft claimed in early magazine ads that Le Stick was adapted from Air Force designs for advanced controllers. Le Stick consists only of a joystick – no base. Constructed of a pliant, rubber-like plastic, the handle incorporates four mercury switches which are activated by tilting. That is, tilting the handle forward causes the screen object to move up, tilting it backward moves the object down, and so forth.

This ingenious approach seems to have several advantages: without a mechanical connection to a base, flexibility is unlimited; there is no ball joint to wear out; true one-handed operation is possible, since the fire button is tip-mounted; and the joystick is very light.

However, since the joystick has no "self-centering" or definite "up" position relative to an attached base, it can be difficult to maneuver for those accustomed to conventional joysticks. For example, our untrained hands found it difficult to tilt horizontally without mixing in some vertical motion, and vice versa. Although squeezing the handle immobilizes the sensor and cancels any motion, it can be hard to re-orient yourself without taking your eyes off the screen. As with any novel approach, practice will be required to achieve mastery – we suggest you test Le Stick before making a decision. Our last suggestion – beware the "grip of death" when, in panic, your hand clinches and immobilizes the joystick ... a calming challenge.



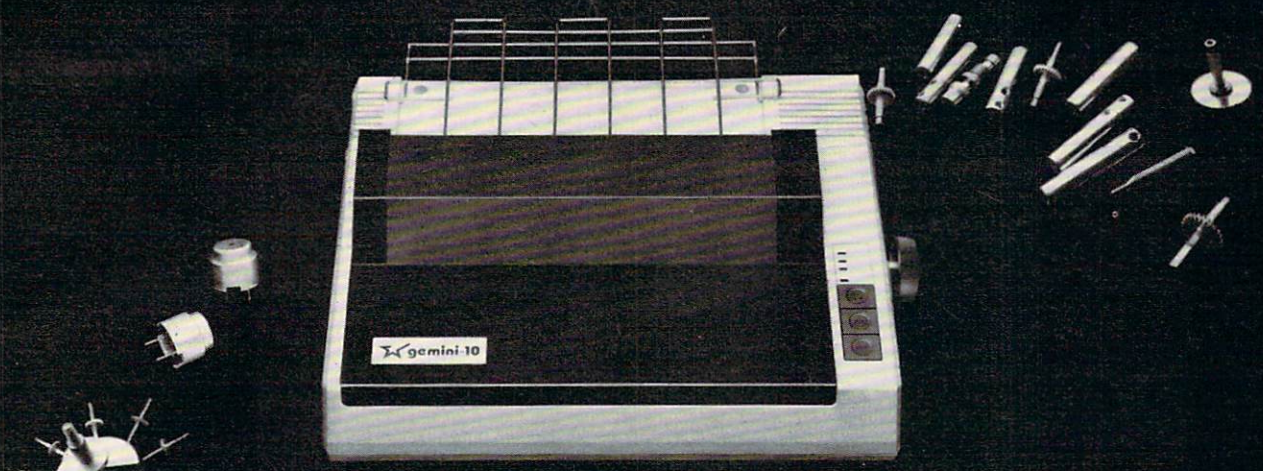
Le Stick has a four-foot cord.

*Le Stick*
*Datasoft, Inc.*
*19519 Business Center Drive*
*Northridge, CA 91324*
*$39.95*

## Starplex Video Game Controller

Unlike the joysticks reviewed, the Starplex Controller and the KY Enterprises box covered below are not really general-purpose devices suitable for all types of computer games. Instead, the Controller is intended largely for one game – *Asteroids*. The button layout is designed to simulate the controls on the commercial arcade version. Thus, we find buttons labeled "Left," "Right," "Up," "Down" (Hyperspace), and "Fire." These correspond to the rotational, rocket, and panic buttons on the arcade machine.

The Starplex Controller fulfills its task very well. Anyone accustomed to playing *Asteroids* in the arcades will feel much more at home with these large, sensitive buttons than with a joystick. One interesting feature is the "Astroblast." Selecting this option with a slide switch allows automatic repeat when the fire button is held down. In other

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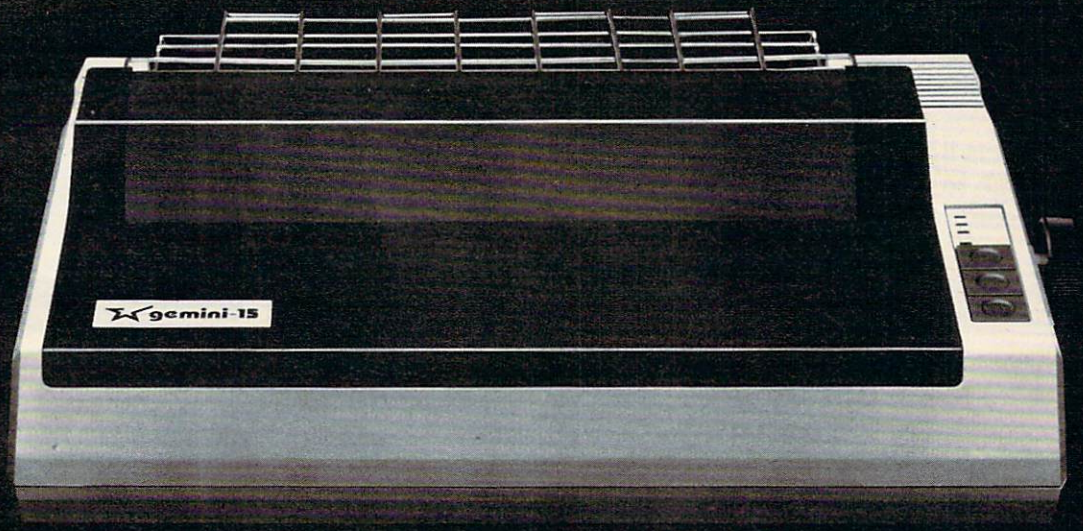


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words, now you can machine-gun the nasty asteroids. This feature requires an AA battery to be installed inside the controller.

The Starplex also works well with *Space Invaders* and other games requiring simple up-down or left-right movement. For games that demand complex 360-degree movement, stick with a joystick. Obviously, you'll have to decide if you can use this type of controller often enough to justify its cost.

The Starplex is light enough to rest on a lap, and stable enough to hold still on a tabletop. It has a four-foot cord reinforced at the base end only.

*Starplex Video Game Controller*
*Starplex Electronics, Inc.*
*E23301*
*Liberty Lake, WA 99019*
*$29.95*

## Fingertip Controller

This controller is very well constructed, with a heavy metal box and five large, springy, arcade-style buttons. The buttons are unlabeled, but the white ones correspond to up, down, left, and right, while the red one is the fire button.

Although you can achieve diagonal movement by simultaneously pressing both a vertical and horizontal button, the Fingertip Controller seems most suited to games with simple up-down or left-right movement, such as *Space Invaders*. Like the Starplex Controller, it also works well for *Asteroids*, but with a quirk – it's left-handed. That is, your right hand controls the rotational movement while your left hand hits the fire button, just the opposite of the arcades.

As per the instructions, it's easy to adjust the sensitivity of the buttons by opening the box and bending the spring switches. The Fingertip Controller has a five and a half-foot cord.

*Fingertip Controller*
*KY Enterprises*
*3039 East Second Street*
*Long Beach, CA 90803*
*$26.95*

## Command Control Trackball

True arcade fans have been hungering for one of these for a couple of years now. Commercial arcade games which use trackballs – such as *Missile Command* and *Centipedes* – work okay when translated to joysticks in home versions, but the "feel" just isn't there. And since the avid arcade fan strives to re-create the arcade experience as closely as possible, joysticks sometimes just don't quite measure up.


Since WICO supplies trackballs for commercial arcade machines, you would expect the company's home version to be similarly well-constructed – and you won't be disappointed. The heavy billiard-style ball rotates quite smoothly and "coasts" with a good spin. This is due to high-quality steel shafts with ball bearings (see the accompanying sidebar and inside photo describing how the trackball works). Even the five-foot cord is extra heavy-duty. The trackball's inherent weight and rubber footpads keep it from sliding around on a tabletop, and the fire button is the same as those found on WICO's joysticks.

As an example of what a trackball can do in a game demanding fast 360-degree movement, one of our testers tried it out on Atari's *Missile Command*. His former high score was 39,000. With the trackball, after a few warm-up games, he scored 66,000.

*Command Control Trackball*
*WICO*
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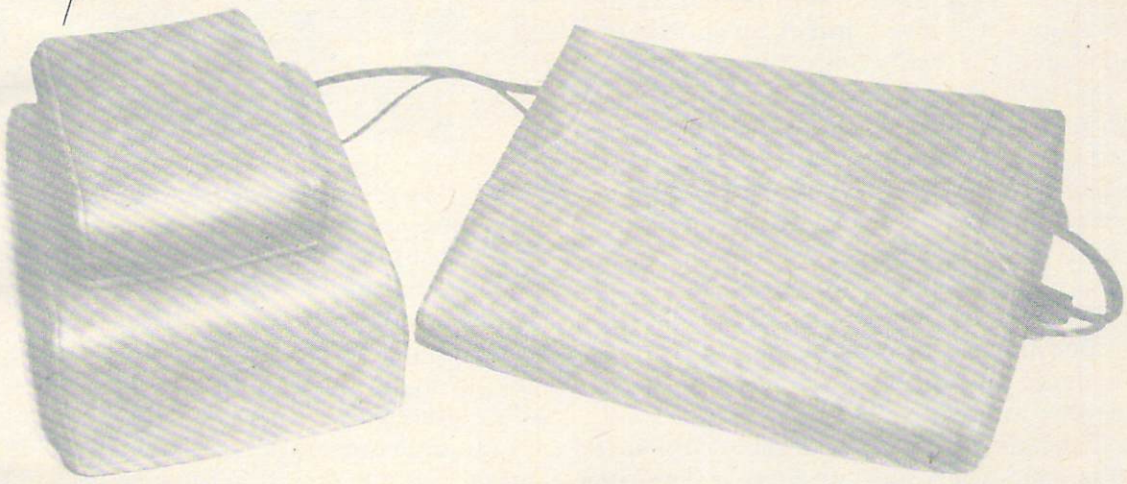



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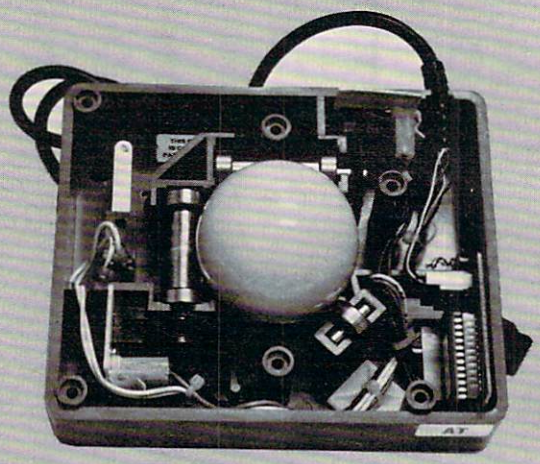
# WICO Trackball:
## The Inside Story

Ottis Cowper, Technical Editor



Most joysticks operate by opening or closing switches as the handle is moved. In the standard Atari configuration, four switches provide a four-bit binary number for control of motion in eight distinct directions.

Exceptions to this rule are joysticks such as those used with the TRS-80 Color Computer which use a pair of potentiometers (variable resistors) to provide varying voltages which must be converted by the computer to meaningful binary values. Such joysticks are essentially two-dimensional game paddles. The WICO trackball uses an altogether different technique. Let's take a look inside this rather unconventional game controller to see how it works.

The ball, which is remarkably similar to a billiards cue ball, rests on three rollers with ball bearings for smooth motion. The two larger rollers, one placed vertically and one horizontally, both have a shaft with a slotted disk on one end. These disks pass through the gap in an electronic device known as a *photon-coupled interruptor* and herein lies the key to the trackball's operation. A photo interruptor consists of a light-emitting diode (LED) and a phototransistor separated by a gap. As long as the gap is not obstructed, light from the LED strikes the phototransistor and turns it on. If the light is blocked, the transistor turns off.

As the slotted disk rotates, an alternating series of solid sections and holes passes through the gap, causing the transistor to toggle on and off as light from the LED is alternately blocked and allowed to pass. (The photo interruptors make it possible to determine in which direction the disk is rotating.) Since the transistor can be thought of as an electronic switch, this has the same effect as pushing the joystick handle in one direction, except that the input is much faster and smoother.

For games which require rapid motion all over the screen, the trackball is a major improvement, although the standard joystick is probably more suitable for applications which require precise positioning.

### TG Trackball

This trackball should be on the market by the time you're reading this issue. The unit we tested was a prototype that we obtained at the COMDEX trade show in Las Vegas. TG Products also is introducing an Atari plug-compatible joystick, but we were unable to obtain one of these for testing.


The TG Trackball works much like the WICO Trackball, using LEDs and phototransistors to detect the ball's spin. The plastic ball glides less smoothly than the WICO's, however, and has much less tendency to coast. Approximately one third of our testers preferred this "feel" for fine positioning, so this is purely a personal matter that should be tested by the purchaser. Inside, the TG Trackball supports the "billiard ball" on plastic shafts without ball bearings. It might be a good idea to lubricate these shafts to reduce excessive wear if this hasn't been done in production models.

The trackball's extra-heavy cord is just short of five feet and is reinforced at both ends.

*TG Trackball*
*TG Products*
*1104 Summit Avenue*
*Suite 110*
*Plano, TX 75074*
*$64.95*

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# PROGRAMMING THE TI

C. Regena

# Write Your Own Games

*Some tips on getting the most out of your TI when writing games.*

You have probably discovered that one of the fun things to do with your TI-99/4A is to play games. In fact, many people who wanted one of the popular game machines have discovered that for about the same amount of money they could have a *computer* and still be able to play games. Many of the games written for the TI-99/4A are arcade quality – that is, they have good graphics and fast action.

The programs on the command modules can be programmed in UCSD Pascal, TMS9900 Assembly, and Graphics Programming Language (GPL). These languages take maximum advantage of the color, graphics, sound, and speech capabilities of the computer. GPL is an excellent language for drawing graphics and allows the speed of an assembly language.

To program your own games with fast, smoothly-moving objects, you will want to use TI Extended BASIC. It allows you to use up to 28 "sprites." You may define the shapes of the sprites and designate a certain magnification. You may also specify the sprites' speed. The row velocity and the column velocity may vary from -127 to +127, and by specifying numbers for both velocities you will get a diagonal movement. Sprites "wrap" at the edges of the screen, so you don't need to worry about "crashing" your program on edge conditions. With *one* CALL SPRITE statement you can define the sprite number, shape, color, position, and speed.

TI Console BASIC (the BASIC built in with no accessories or peripherals) is a language powerful enough that you can design a variety of fun games with it. If you have moving objects, however, they have to move a square at a time and thus will have jerky movement. Depending on the number of objects, BASIC games tend to be slow; however, I have seen several fast action games that really require nimble fingers.

Whether you are writing a game in TI BASIC or in TI Extended BASIC, I can offer a few programming tips. Keep in mind that the best way to learn is to actually start programming – and playing.

## Randomness

Probably a central tool in computer games is the machine's ability to choose things randomly. Most computers have the command RND, but each computer has a slightly different syntax (way of writing the command). On the TI-99/4A, RND represents a random number between zero and one. Turn on your computer, press any key to begin, and press 1 for TI BASIC. Now type in PRINT RND and press ENTER. The computer will print a decimal fraction (to ten places). Usually in game situations you won't want a fraction, so multiply that fraction by a number. For example, multiply RND by 10 like this: PRINT 10*RND or PRINT RND*10. Now you will get ten times that decimal fraction.

You probably want just the whole number part of that mixed decimal number. Use the INTeger function to get the whole number. PRINT INT(10*RND). If you keep trying this command, you will get numbers from zero to nine. Remember, INT truncates the decimal portion; it does not round the number. Suppose you really wanted random numbers from one through ten. The command would be: PRINT INT(10*RND)+1 or PRINT INT(10*RND+1).

One more step. Assume you want a number N to be a random number between 10 and 20, inclusive. 20 - 10 = 10. There are 10 numbers plus 1 ("inclusive"). The command could be N = INT(11*RND)+10. The portion INT(11*RND) will give you numbers from 0 to 10; then you add 10 to get numbers from 10 to 20.

Now try this short program:

```
100 FOR I=1 TO 10
110 PRINT INT(10*RND)+1
120 NEXT I
```

RUN the program. RUN it again. And again. The program is printing ten random numbers from 1 to 10. However, you'll notice that each time you run it, you get the same numbers in the same order. You need to add the line: 105 RANDOMIZE.

The RANDOMIZE command mixes up the numbers so that each time the program is run you will get different numbers – and that's what you want in a game. The *User's Reference Guide* indicates that the RANDOMIZE statement only needs to be somewhere in the program to generate different

numbers; however, I have found that one RANDOMIZE statement at the beginning of a program does not always work. It is better to use the RANDOMIZE statement just before you use the statement containing RND. Note: If you are debugging a program, you may want to leave RANDOMIZE out so you'll know exactly what numbers your program is choosing. Debug your program, then add the statement and test it.

## Moving Objects

In general, the fewer moving objects you have in your game, the faster the action can be, and the logic will be a lot less complex. Also, each moving object should be specified by only one character number so you don't have to use up valuable time by building an object out of several characters. To move an object in TI BASIC you need to erase the object in the first position (replace it with a space) and draw it again in the second position – each move takes two statements.

## Player Input

There are two main ways the computer can understand what you want: by your using the joysticks or pressing keys on the keyboard. Your game may be designated for joysticks only, keyboard only, or both. Because of the logic involved, a game using both methods of input will be slightly slower in response; and depending on the branching sequence, one of the methods will be slower than the other.

Joysticks may be easier to use to learn a game, especially if the player is used to a video game using joysticks. My own children, and many other players I know, prefer using the keyboard for *TI Invaders* and *Munchman* because the joystick response is considerably slower than the keyboard response.

The keyboard action is easy to learn because there are standard arrow keys for all games designed for the TI-99/4A. Programmers writing games for other computers often choose their own favorite keys to use, and the directions are different for each game. On the TI-99/4A, the arrow keys are E (up), X (down), S (left), and D (right), with the shooting key either the ENTER key or the period key. If there are two players, the standard arrow keys on the right half of the keyboard are I, J, K, and M. The TI-99/4 owners have a slight advantage here – there is an overlay available for the old keyboard that shows the arrow keys, and it is easier to use the old keyboard for two-player games.

The TI joysticks (wired remote controllers) come with a little instruction book with some sample programs. The main command is CALL JOYST(K,X,Y), which returns an X and Y value for the position of the joystick, where X and Y may be 4, -4, or 0.

To detect keys pressed on the keyboard, use the CALL KEY command. This command is like the GET command in other BASIC languages. The form is CALL KEY(0,KEY,STATUS) where 0 means to scan the whole keyboard. STATUS is a variable name (it could be ST or S, or whatever you wish) which will return whether a key has been pressed or not. KEY is a variable name (again, use whatever you wish) that will return the ASCII code of the key pressed, such as 13 for the ENTER key, 65 for the letter A, 69 for the letter E, etc.

By using IF statements, you can check which key was pressed and branch accordingly. You can also GOTO the CALL KEY statement for other keys to make the computer act as if it is ignoring all responses except the keys allowed. Here is a sample using arrow keys:

```
100 CALL KEY(0,K,S)
110 IF K=69  THEN 1000      (up arrow)
120 IF K=68  THEN 2000      (right arrow)
130 IF K=88  THEN 3000      (down arrow)
140 IF K=183 THEN 4000      (left arrow)
        ELSE 100            (any other key will be ignored)
```

Remember, there are several ways to program the same procedure; this is just one way. You may prefer to use "not equal" signs or a split keyboard and an ON GOTO statement.

A split keyboard approach scans half the keyboard using CALL KEY(1,K1,S1) or CALL KEY(2,K2,S2). The key codes returned for up, right, down, and left are 5, 3, 0, and 2. A sample program using the split keyboard is:

```
100 CALL KEY(1,K,S)
110 IF (K<0)+(K>5)THEN 100
120 ON K+1 GOTO 3000,100,4000,2000,100,1000
```

Line 110 makes sure the K value is in the right range; the key value must be from 0 to 5. All other keys are ignored. Line 120 branches according to which key was pressed. The keys corresponding to 1 and 4 were not acceptable, so they return to the CALL KEY statement. If you want to try out either of these programs, add the following lines, then RUN and try pressing various keys.

```
1000 PRINT "UP"
1010 GOTO 100
2000 PRINT "RIGHT"
2010 GOTO 100
3000 PRINT "DOWN"
3010 GOTO 100
4000 PRINT "LEFT"
4010 GOTO 100
```

There is a slight problem in testing for zero on the TI-99/4A console. Use logic such as IF K+1<>1 rather than IF K<>0. Also, some of the split keyboard codes are different for the TI-99/4A than for the TI-99/4. It is better not to use the comma, period, semicolon, slash, space bar, ENTER, SHIFT, B, and G so that programs may be used on either console. ©

# Five VIC Games From Nufekop

David Malmberg

This latest batch of Nufekop games once again proves the company is worthy of its name. The word *Nufekop*, according to the firm's early ads, has a Druid origin, and means putting an extraordinarily large amount into a small pocket or enclosure, possibly through the use of magic. This is an apt name for a software company that can pack so much fun, excitement, fantastic sound, and colorful graphics into its programs and get them to fit into the VIC-20's relatively small memory.

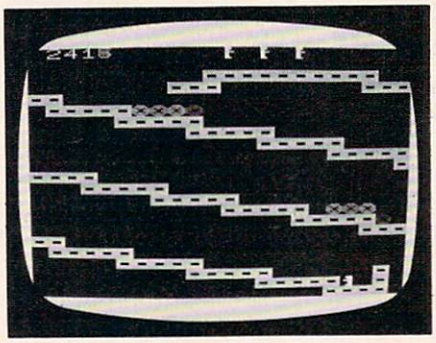
Before describing the individual games, let me explain the evaluation criteria. I believe the most important attribute of a great game is its "lasting power." It should be just as much fun to play the game the hundredth time as the first or second time. You shouldn't become bored or jaded. Ideally, the game should have multiple levels of difficulty. The game shouldn't be too easy for the expert or too hard for a beginning player. A great game will make you want to play it again and again – or as they say in the coin-operated video game trade, a great game is one which will keep you "pumping in the quarters."

In evaluating these games, I made use of a panel of expert consultants – the neighborhood children from 8 to 14 years old. Each was asked to comment on the things he or she liked and disliked and to rate each game on a scale from zero to ten. A zero rating means it is a waste of time to play the game even *once*. A ten means it's as good as the best full-fledged arcade games, for example, *Centipede* or *Pac-Man*. The comments and ratings that follow reflect the consensus of these experts, as well as my own opinions.

## Krazy Kong

The object in this game is to rescue the maidens from the evil Kong's clutches while he tries to stop you by hurling barrels down at you. There are various configurations of steps to climb. You may use either the keyboard or a joystick to climb the steps and jump over the barrels. As you save each maiden, you are presented with a new set of steps – each harder than the last. The game ends when you are killed by a falling barrel, run out of energy, or have rescued all three maidens.

*Krazy Kong* is well done. It has great graphics, sound effects, and music. The action is very fast. There are four levels of play that govern the number of barrels and the length of your jumps. The highest level is tough enough to challenge even the most seasoned gamester.

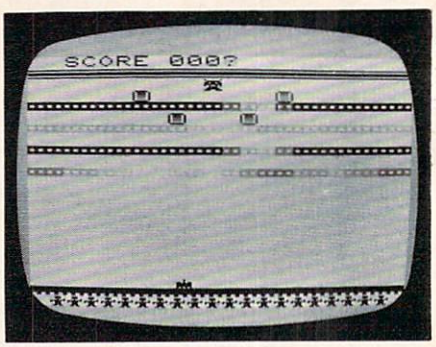



*Barrels tumble down the stairways as the little man begins his ascent to rescue the maiden in* Krazy Kong .

However, my experts were a bit disappointed that *Krazy Kong* didn't have a little more variety in the paths up to the maidens and in the obstacles to dodge. Challenging though it was, they quickly became bored with climbing steps and jumping barrels. *Krazy Kong* doesn't have the lasting power of a really great game, so the consensus rating was seven out of a possible ten. *Krazy Kong* works in a standard 5K VIC and is priced at $12.95.

## Anti-Matter Splatter

This game is difficult to describe. Anti-matter "bombs" are falling to earth. You control a splatter-matter cannon using either the keyboard or the joystick. You try




*Deadly anti-matter bombs drop from the sky toward your people in* Anti-Matter Splatter.

to shoot the bombs with your cannon before they hit the people at the bottom of the screen and make them disappear. (What else would you expect an anti-matter bomb to do to a person?) As the game progresses, the action gets increasingly frantic

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Or call in order to (212) 741-1770

with more bombs and greater speed.

You lose the game whenever a bomb hits your cannon or whenever all of the people have been reduced to anti-matter. You score points by shooting down the bombs, but the high score is not saved. No one who tried this game was ever able to "win," so it is not clear how (or if) it is possible.

*Anti-Matter Splatter* is written entirely in machine language so the speed is incredibly fast. The graphics and sound are outstanding. This game has good lasting power; the kids played it again and again.

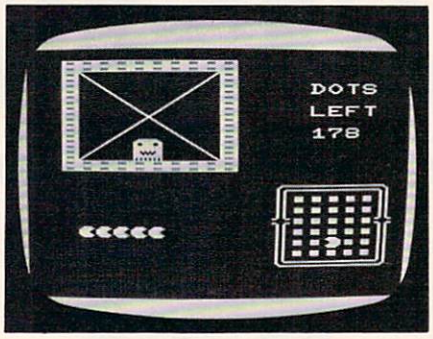
However, the game could have been improved. You get only one cannon, so the game is often over before it has barely begun. The high score should be displayed, so players would have something to try to beat. A variable level of difficulty would be a nice improvement. This could be done by varying either the speed and/or the number of cannons.

*Anti-Matter Splatter* was rated an eight out of ten. The program works in a standard 5K VIC and retails for $24.95.

## 3-D Man

*3-D Man* is a very clever idea for a game – you move through a maze that is displayed in three dimensions. Long corridors with occasional passageways on the sides are displayed in perspective. The object of the game is for your 3-D Man to eat all of the dots, before he is eaten by one of the four ghosts that randomly roam the maze. During the game, the screen shows what your 3-D Man sees ahead of him. At the same time, a small radar screen shows the overall maze and your 3-D Man's location and direction within it. The score corresponds to the number of dots gobbled. You get five 3-D Men before the game is over.

The graphics of *3-D Man* are extremely fast and superbly




*In* 3-D Man, *players must eat dots in a three-dimensional maze (upper left) while watching out for pursuers on the bird's-eye view map (lower right).*

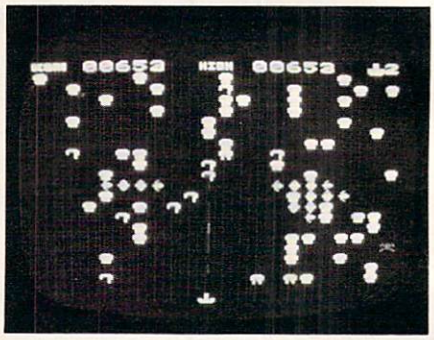
done. Sound is very effectively used, with different noises for such events as eating a dot, being eaten by a ghost, or trying to make an illegal movement (i.e., bumping into the maze wall).

*3-D Man*, however, is an example of a game that lacks lasting power. Everyone loved it the first couple of times. As they continued to play, they discovered its major flaw – that the ghosts' positions are truly random; they do not move from one location to a contiguous one. As an example, it is quite common to encounter a certain ghost (e.g., the red one), then turn around and attempt to flee in the opposite direction, only to find the same ghost there, too. Because of the random nature of the ghosts, *3-D Man* is not really a game of skill. With success so dependent on luck, all of my experts soon lost their enthusiasm. The consensus rating was a five.

*3-D Man* requires a 3K memory expander and a joystick. It is priced at $19.95.

## Exterminator

This is one of the best games I've ever seen for the VIC or any other computer. The object is to shoot everything that moves and everything that doesn't. You normally have three shooters, but you can get a free one at 5000 points. Spiders speed up when you get to 20,000 points. The screen changes color combinations whenever you annihilate all of the pieces of the current centipede.



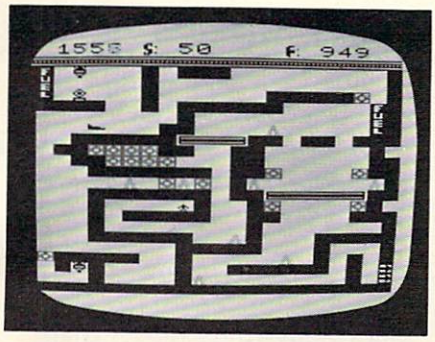
*Blasting away at centipede sections, spiders, mushrooms, and other obstacles in* Exterminator.

*Exterminator* is an absolute marvel! Written entirely in machine language, it is unbelievably fast. The graphics, sound, and music are all fantastic. This game is clearly the most popular in my library. The fact that Nufekop was able to fit all of this action and fun into a standard 5K VIC without any additional memory is a tremendous accomplishment. The rating was unanimous among my panel of experts – ten out of ten. *Exterminator* is a great buy at $24.95.

## Defender On Tri

The object of this game is to save a group of scientists who have become trapped while exploring an abandoned space station (with the code name "Tri") before the station crashes into the sun. Using the joystick, you control a small rescue vessel. Unfortunately, your ship has room for only one passenger – so you must find the scientists and bring them safely through the maze of machinery in the space station one at a time. This is a very hazardous journey, since the machinery is moving very fast and will destroy your ship unless your defense shields are activated.

However, you cannot have your shields energized too often because they drain so much of




*In* Defender On Tri, *players must maneuver a tiny ship (upper left) through a maze of machinery in a huge space station to rescue scientists.*

your ship's fuel that you would be unable to complete your mission. You are in a dangerous race against the clock. Time is running out. As Tri moves closer and closer to a collision with the sun, the machinery begins to speed up. You have precious little fuel left and have to make every drop count as you thread your way through a maze where one false move means sudden death.

This game, too, is exceptionally well done. The graphics are great. The action is fast. The sound effects are good. The game is quite exciting, although it is very difficult. The only complaint anyone had was that the game was probably too difficult. None of the neighborhood kids was ever able to rescue all of the scientists. Several kids got frustrated and gave up on the game. Still, the consensus rating was a high nine out of ten.

*Defender On Tri* requires a 3K memory expander and a joystick. It retails for $19.95.

Nufekop games are widely distributed. The games may also be purchased directly from the company.

Krazy Kong
Anti-Matter Splatter
3-D Man
Exterminator
Defender On Tri
*Nufekop Software*
*P.O. Box 158*
*Shady Cove, OR 97539*
*5K to 8K RAM*
*$12.95 to $24.95*

# Apple Game Animation Package

Michael P. Antonovich

The *Game Animation Package* is marketed by Synergistic Software as a two-part program package: *Fast Draw* and *Micro Sketcher*. *Micro Sketcher* is for creating high-resolution color pictures which can be used as backgrounds in games or other programs. *Fast Draw* is an excellent graphics utility for creating bit-mapped shape tables which can be accessed from BASIC programs to achieve fast, smooth, flicker-free action.

## Fast Draw

First, let's look at *Fast Draw*. Have you ever wanted to be able to create shape tables in color? Or to move shapes around the screen at lightning speed without screen flickering as you draw and erase the shapes? I, for one, was glad to see this package. I found *Fast Draw* a very easy way to create and manipulate shapes.

*Fast Draw* consists of four major program segments which allow the user to create and manipulate bit-mapped shape tables. The four segments are:

**Delimit** – This program is a shape table editor which allows you to create shapes using any combination of the eight standard high-resolution colors.

**Examine** – This program provides a very simple way of viewing each shape in the shape table as it moves across the screen at various speeds.

**Placement** – This allows the shapes from a table to be placed on the screen under paddle control. This option is the only way to segment a previously created shape table and to re-create it in a different form or with a different set of shapes.

**Shift** – This utility performs color shifts on the shapes on the screen. Shapes can also be inverted.

The Delimit program allows you to create a shape dot-by-dot in a manner somewhat similar to that used in the character generator section of the *DOS Tool Kit*. One major advantage over the *Tool Kit* is the ability to define the size of the shape in terms of the number of horizontal and vertical dots. Thus one shape is not limited to the size of a single letter. Of course, another major advantage is the ability to create colored shapes. Delimit is easy to use, and a menu is provided at the bottom of the screen in case you forget the commands or you don't read manuals. Shapes are added to the shape table one at a time.

Once a shape has been added to a table, it is relatively easy to remove that shape by using Delimit in combination with the Placement utility. Have you ever tried to combine or eliminate shapes from a regular Apple shape table by hand? With these two utilities, it is easy. Delimit also provides two modes to store shapes. There is the normal shape-saving mode for objects which require smooth movement, and a space-saving mode for objects which require smooth movement, and a space-saving mode for shapes that can move using larger jumps. In general, I found it quite easy to create fairly complicated shape tables using Delimit.

## Viewing, Positioning, And Controlling Color

Examine is a simple utility for viewing the shapes in the shape table. Each shape is shown, one at a time, moving across the screen with nine different combinations of "speed" and "delay." The major problem with this utility is that if you want to see the fifth shape in the table, you must first watch the first four shapes dance across the screen nine times each. If you just want to view a shape table, it is quicker to use the Placement utility rather than Examine.

Placement allows each shape to be placed onto the screen as many times and in as many places as desired. This utility has two major uses. The first is when a background picture is needed in which a single shape is to be displayed several times in different places on the screen. Placement can place any shape anywhere on the screen as many times as necessary, after which the screen can be saved. The second major use of Placement is to edit shape tables. While a shape cannot be removed from a shape table by simply deleting the shape, the shapes you want to keep can be placed on the screen using Placement, and then reassembled into a new shape table using Delimit.

The Shift utility allows a shape's color to be shifted. Shapes can also be inverted.

*Fast Draw* routines are easy to access from BASIC programs. I found the instructions very clear on the methods available to access *Fast Draw* shape tables from BASIC. The only problem with the documentation is that the three demo programs listed in the manual will not work as is. However, with careful reading of the *Fast Draw* instructions, I was able to correct the demo programs. The only feature that I felt was missing from *Fast Draw* was a way to edit existing shapes. Once a shape was made, it could not be changed or used as the basis of the next shape. Therefore, if you needed a series of similar shapes, you would have to start each one from scratch.

*Fast Draw* (written by Glen Bredon) is an excellent graphics utility: well-written, easy to use, and well-documented. These procedures are so good that you might want to use them in your own programs. Fortunately, Synergistic Software decided not to copy-protect the diskette, so these routines can be used on any other diskette. However, Synergistic Software requests that you sign a license agreement first. There is no fee for the license agreement. That's fair enough, isn't it?

## Micro-Sketcher

*Micro-Sketcher* is a menu-driven graphics utility for creating high-res color pictures, allowing you to create, display, edit, save, fill, and load tables to create full screens. One thing that makes *Micro-Sketcher* unique is that it allows you to create and save segments of a picture rather than having to work with the entire screen. These picture segments then can be displayed individually or in combination to create the final screen image.

I did find some problems with this package. First of all, full screen means only 256 positions horizontally, while, as we all know, the Apple screen is 280 positions in the high-resolution mode. This means there is a wide black border on the right side of the screen. This creates a problem with the fill routines, which fill out to all 280 positions. If a border is not placed around the screen, the color fill routine can cause some rather undesirable effects. In addition, once a color has been selected and an area filled, that area cannot be redefined with a new color. If a new color is desired, that sketch in the shape table will have to be redone. If you are working with the entire screen and choose the wrong color, you will have to start over or live with the color selected.

There is also no continuous draw capability. All lines are drawn as line segments by defining both end points of the line. This method is known as "rubber banding" in some packages because a flashing line is shown on the screen from the first end point to the current position. When the second end point is chosen, the line becomes solid. This is great for drawing tables, rooms, and buildings, but it is very difficult to draw curved shapes such as circles, letters, trees, etc. There are no circle utilities to create circles, or character utilities to add letters or text to your picture, either.

There is also no "paintbrush mode" such as is found in many packages which would allow you to create interesting effects such as shading, trees, bushes, and so on by using different "paint brushes."

A minor problem is that it is too easy to erase the entire screen with the "X-clear" command. After you've worked hard over a picture, a simple slip of the left hand onto the X key can make you want to bang your head against the wall. A two-key command such as CTRL-X would be far better and safer.

The edit mode of *Micro-Sketcher* is unusual. To edit a shape, the program removes one line at a time from the end of the shape. Therefore, if an error was made at the beginning of the shape, all of the lines must be removed until you get back to the line in error, and then the lines must be redrawn. Also, the edit mode may not remove all of the dots from the screen as it removes the lines. These remaining dots cannot be edited out of the picture with this package. You cannot simply draw over these dots with a black pen, because you can only draw white lines on a black background. Start over with a clean screen.

On the positive side, *Micro-Sketcher* has a fast and very efficient fill routine (written by John Conley) which is capable of handling fairly complex shapes. In fact, the fill routine is much better than those in many other graphics packages.

Except for the X key, the program has good protection against faulty input. The documentation is good, but not as clear as the *Fast Draw* documentation. Up to 32 colors are available for the fill routines, and the author has split these colors into compatible groups to eliminate the problem of color smearing when two colors are placed next to each other.

Another nice feature is the use of game paddles or a joystick to roughly position a point, and the use of the I, J, K, or M keys to disable the paddles or joystick and make fine adjustments.

In general, the *Game Animation Package* is well worth the price for people who would like to write animated games, but who do not know 6502 machine language. The *Fast Draw* routines are worth the price of the package themselves for that purpose. While the documentation is fairly good, it does help to first have an understanding of the way the Apple uses graphics and the graphics screens. However, the shape tables created by these two packages are not the same type of shape tables described in the *Apple Reference Manual* or in some other Apple books.

You must use the routines provided on the *G.A.P.* diskette to be able to draw these shapes. In fact, the shape tables created by the two different methods are not really compatible with each other (or at least I was not able to use them interchangeably). However, since the manual explains how to access these shape tables from BASIC, and since the routines are on the diskette, let's go out and add some animation to our games.

Game Animation Package
*Synergistic Software*
*5221 120th Avenue SE*
*Bellevue, WA 98006*
*$49.95*

# *Mazogs* For Sinclair/ Timex

Arthur B. Hunkins

*Mazogs* is an excellent, single-player, treasure/ maze game for Sinclair/Timex computers with the 16K memory expander. Its full screen graphics make excellent use of the Sinclair/ Timex capability. *Mazogs* is written largely in machine language and runs immediately upon loading. A review copy loaded reliably on my Timex TS-1000. (The program also runs on 16K Sinclair ZX-81 and ZX-80 with 8K ROM.) It is recorded on both sides of the cassette, and comes with a four-page explanatory brochure. (You'd better read it carefully – this game can get complicated!)

*Mazogs* has three particularly strong points I'd like to mention: 1) there are three levels of play, from neophyte to highly skilled and self-competitive; 2) there are sufficient options so that various strategies may be tried out and implemented; 3) high score is kept (no maximum "high score" limit exists) so that there is always an incentive to do better.

Mazogs are ugly, threatening little creatures who inhabit the treasure maze and love to devour treasure-seekers. They frequently block the way; if you engage them in battle without a sword (swords are scattered throughout the maze), you have only a 50-50 chance of surviving. Your job is to find the treasure and get back out without being devoured. The maze is huge, and the number of moves to the treasure is anywhere from 120 to over 400.

## Prisoners With Blinking Eyes

Most of the play takes place on a local scale (full screen), where you can see only several moves in advance. However, a "view" is always available, which gives a larger perspective in your immediate area. Also accessible is a "situation report" which informs you, among other things, how far you are from your goal (treasure or exit).

Your main allies are the "prisoners," with blinking eyes, locked in the walls of the maze by the ruthless Mazogs. Positioned randomly throughout the maze, they know both the way to the treasure and the way out. When you stop to ask advice, they show you the way (marking the path "THIS WAY"). The only problem is that their memories (or yours?) last only about ten seconds. After that, you are on your own again.

In the two advanced levels of play there are four intriguing features: 1) you get only a specified number of moves, depending on total distance – if you exceed this number, you "die" in the maze; 2) you get points (more moves) for killing Mazogs, etc., and lose points for such things as asking for "views," "situation reports" (even "buying a sword" when in the direst of straits); 3) prisoners die once they help you, and swords can be used only once before disappearing; 4) Mazogs themselves become aggressive and mobile – they jump around and attack, sometimes even in twos and threes. Of course, there are various defenses, described nicely in the instructional brochure. The point is that strategy takes a while to develop; so the game takes skill, invites involvement, and has "staying power." In short, *Mazogs* has the ability to become at least moderately addictive.

## Something For Everyone

One of the best features is the graphics display. There is a fair amount of animation (Mazogs, treasure-seeker movement, prisoners' eyes blinking, as well as treasure glittering). Much of this is seen in the opening display, which, with its simultaneous animation, is quite impressive.

At game's end, you have the option of playing another game (any skill level), or of seeing (and exploring) the entire maze, including viewing its solution. A bird's-eye view of the maze takes four full screens, and you can see different parts of it by pressing the directional keys. (The same four keys are used to maneuver your treasure-seeker during the game.) Another option is offered at the beginning: a choice of two ways to enter the maze – from the left or right. An initial "view" displays the options as you prepare to start your journey.

There are numerous details, all nicely done, that add to the pleasure and challenge of the game. For example, there are two alternate keypad directional schemes – one is conceptually clearer, the other is faster. Take your choice; there is something for everyone! As a matter of fact there is only one thing I can think of to criticize about *Mazogs* – and I doubt whether the authors could have done anything about it. The program is a bit slow responding to key-presses (they do automatically repeat if you hold them down).

At $14.95, *Mazogs* is a good value and should furnish many hours of creative entertainment. It's one of the better 16K Sinclair/ Timex games out there. I recommend it.

Mazogs
*Bug-Byte Software (England)*
*Distributed by Softsync, Inc.*
*P.O. Box 480, Murray Hill Station*
*New York, NY 10156*
*$14.95*

# *Andromeda* For Atari

Larry Isaacs

*Andromeda* is a game distributed by Gebelli Software Inc. It is written in machine language and requires an Atari 400 or 800 with at least 24K, a disk drive, and a joystick. It is a re-release of an earlier version, and current owners can get the new game by returning their old copy to Gebelli Software.

In *Andromeda* you are in control of the "Andromeda" cell, which has invaded the body of a multi-cellular organism. The object of the game is to keep Andromeda alive as long as possible, scoring as many points as you can.

The field of play is the multicellular organism, which is approximately 18 times larger than the display screen. You direct Andromeda about the screen using the joystick. When Andromeda reaches the edge of the screen, the field scrolls underneath Andromeda to display other parts of the organism. Inside the organism, you will see fat cells, which appear as smiling green faces, and blood vessel cells, which are red four-pointed stars. You can even see moving blood cells within the blood vessels, though they do not figure in the game.

One of the requirements for keeping Andromeda alive is to destroy cells inside the organism. If you fail to destroy cells, Andromeda will become weaker, and could get too weak to move. You destroy a cell by positioning Andromeda just below the cell you wish to destroy and pressing the fire button on the joystick. You may also simply hold the fire button down while you position Andromeda underneath the cells you want to destroy. Destroying cells also scores points. You get 100 points for fat cells, 200 points for a blood vessel cell, and 500 points for one of the few mutant cells in the organism. When a cell is destroyed it will disappear. However, after a certain number of that type have been destroyed, the destroyed cells will begin to reappear in a different color. The new color indicates that this regenerated cell is immune to Andromeda. When most of the cells on the screen are regenerated cells, you will have to move to another part of the organism to seek fresh cells.

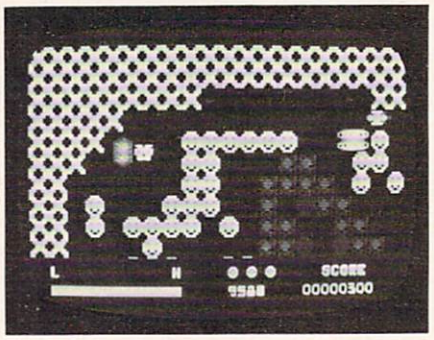
## The Dread Antibodies

The foes you must face in this game are, naturally enough, antibodies. If an antibody comes in contact with Andromeda, one of Andromeda's three lives is lost. There are four types of antibodies, each with its own pattern of movement. Fortunately, Andromeda is not always at their mercy. Each time you add 5000 points to your score, Andromeda assumes an enlarged state.

If Andromeda comes in contact with an antibody while in the enlarged state, the antibody is destroyed. Naturally, destroying an antibody is worth more points than destroying the regular cells. The points range from 300 to 1000, depending on the type of antibody. Andromeda's enlarged state is only temporary. Fortunately, you are given an audible warning a couple of seconds before Andromeda reverts to its normal size and vulnerability.

At the bottom of the display are several status indicators to assist you during the game. On the left side is an indicator that shows the organism's level of resistance to Andromeda. This level is lowered by destroying cells, and once the level reaches zero, the organism itself is destroyed. On the right side, your score is shown. In the middle is

a timer which starts at 9999 and counts down. When you destroy the organism, you get a bonus of the current count times 100 points. Above the timer are indicators, up to three, which show the number of lives Andromeda has left. When Andromeda destroys an organism, Andromeda receives a bonus life and gets to invade another organism.




*Dodging antibodies and destroying enemy cells in* Andromeda.

Implementation of the game has been carried out fairly well. The use of graphics is simple but good, and player movement is very smooth. The game supports seven levels of play, with the speed of movement and rate of appearance of the antibodies increasing with each level. Andromeda's rate of movement is slower while moving through blood vessel cells. This contributes to the realism within the game.

My major criticism of this product concerns the instruction sheet. The instructions are very sketchy, and in some cases, incorrect. For example, the instructions state that the indicator at the lower left corner shows the level of antibodies. I was unable to see any correlation of this indicator number to the number of antibodies that have been destroyed, or the number present on the screen. Also, illustrations of the different cells in the instructions don't match with what appears on the screen.

Nor do the instructions give any hints on strategy. For example, it isn't very difficult to destroy the organism before the timer count goes below 8000. This means that your bonus score will typically be over 800,000 points. While destroying the organism, you might accumulate about 30,000 points for destroying individual cells and antibodies. As a result, points from destroying individual cells and antibodies become somewhat negligible compared to bonus points. This would seem to imply that destroying the organism as fast as possible is the primary goal. However, the instructions don't even mention that the organism is capable of being destroyed. Fortunately it isn't hard to pick up most of what the game is about just by playing it a few times. However, you could miss out on some subtleties of the game which need a hint or brief description.

One other slight annoyance is that you can't restart the game without reloading it from disk. Since it comes on a copy-protected disk, it would have been nice to eliminate any unnecessary disk wear.

Overall, it is a fairly good game, though not on the level of a *Star Raiders*. If you like the *Pac-Man* style game, you will probably like *Andromeda*. It has a different flavor than *Pac-Man* – you don't have as much control over entering the state when you can eat your opponents, but you also don't have a rigid maze to contend with.

Andromeda
*Gebelli Software Inc.*
*1787 Tribute Road, Suite G*
*Sacramento, CA 95815*
*$29.95*

# *Shamus* For Atari

Tom R. Halfhill, Features Editor

You're prowling along the corridors of yet another unexplored room, searching for the key to the Shadow's lair...

Suddenly you are attacked by a hunting pack of Whirling Drones, Robo-Droids, and the especially deadly Snap-Jumpers. Frantically dodging their molecular disruptors, you hurl several of your contraband Ion-Shivs, blasting them to fragments. Now you're free to pick up the key they were guarding, and you hope that it fits the lock you encountered in that other room far behind you.

But you've dallied too long in this chamber. From out of nowhere descends the Shadow himself, protected by Tri-Gamma body armor impervious to your Ion-Shivs, and he's bent on revenge for the destruction of his henchmen. You break for the exit, but stumble into a wall instead...and instantly disintegrate.

## A Blend Of Arcade And Adventure

That's a typical example of how Synapse Software's game *Shamus* is played – and a typical example of how it usually ends as well, since this game is extremely hard to beat. In fact, my guess is that it would take months of frequent play before any mere human could succeed in locating the Shadow's lair and destroying the elusive arch-enemy. This is a game for true addicts.

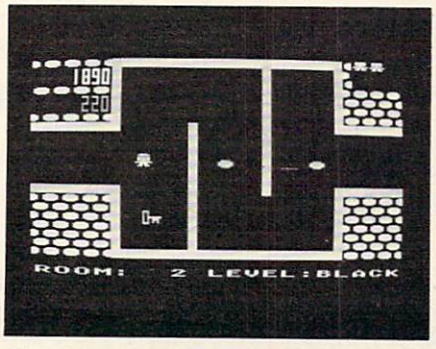
*Shamus* (pronounced "SHAW-muss" or "SHAY-muss," slang for *detective*) is a one-player game available on disk or cassette which requires at least 16K RAM and a joystick. Programmed by William Mataga, *Shamus* combines the puzzle-solving and exploration features of a graphics adventure game with the fast action of an arcade-style shoot-'em-up.

The object of the game is to locate the hidden lair of a creature known as the Shadow, and then to destroy him in a final struggle. Locating this lair is not easy. There are four levels of rooms to explore, and the only way to advance to the next level is to find the proper key for the proper lock. The locks and keys are color-coded and scattered throughout the rooms, forcing you to wander around, picking up keys and trying them on the various locks.

To give you some idea of the complexity of this task, each level contains no less than 32 rooms – according to the manual. Actually, in my aimless wanderings, I encountered rooms numbered as high as 37 on one level. This means there could be nearly 150 rooms!

The graphics and sound effects in *Shamus* are beautifully done. The game boots up from the disk or cassette with a very good rendition of the theme tune from the old *Alfred Hitchcock Presents* TV show. You then choose from four degrees of difficulty ranging from "novice" to "expert." The manual is absolutely correct when it states that each degree is significantly harder than the last. After briefly sampling the higher degrees, I stuck with "novice" and still found myself outmatched.

You start off in Room 0 on the first level. Your joystick controls a little man in a fedora (after all, what kind of detective would you be without a brimmed hat to pull down over your eyes?). Each of the 32 (or 37, or whatever) rooms on each level occupies a full TV screen. To move to another room, you simply head for a door and walk (or run, as is frequently the case) off the screen. Instantly, the next room appears.




*Going for the key to the next level while dodging Whirling Drones in* Shamus.

*Shamus* uses several redefined character sets, and the graphics are among the best I've seen on the Atari. Joystick response is instantaneous, and very often a half-dozen or more multicolored objects will be moving around at once.

These objects, by the way, are the Shadow's henchmen. Searching for keys and locks in scores of rooms spread over four levels would be hard enough, but these creatures are always there to make your life even more difficult. The easiest to dispose of are the Whirling Drones, little pinwheel-shaped machines that home in on your presence. The Robo-Droids aren't too bad either, although they're a headache when attacking in droves with the Whirling Drones. Far more dangerous are the Snap-Jumpers, shifty little critters who move in short leaps in the blink of an eye.

If any of these henchmen shoot you with their molecular disruptors, or even touch you, it's goodby. Your main defense is your inexhaustible supply of Ion-Shivs (Ionic-Short High Intensity Vaporizers). You can throw these in any direction by pressing the fire button while aiming the joystick, and they'll disintegrate anything. Another defense is dodging or even fleeing, but watch out – if you brush against a wall, you'll be instantly zapped to atoms.

By far the most dangerous obstacle, though, is the Shadow himself. If you stay in one room too long – say, half a minute or so – he appears out of nowhere and tries to destroy you with his deadly touch. Since the Shadow wears Tri-Gamma body armor,

your Ion-shivs will not kill him. However, they will stun him for a second or two, making escape at least possible.

## No Rest For The Weary

Running randomly from room to room spreading wanton destruction doesn't do much good either, since the rooms are repopulated with henchmen as soon as you leave. And they're always positioned between you and the next doorway, or else guarding a lock or key if one is present. This makes your mission a never-ending battle against relentless enemies.

As you advance from level to level (assuming you *do* advance), everything speeds up. The manual describes the final level as "insanely fast." I never made it that far, but I'm not skeptical.

There are a few factors in your favor. You start off with several "lives," and your little man is replaced at the spot where he's zapped – you don't have to restart at Room 0 on the first level. You can also accumulate bonus lives by retrieving bubbling flasks found in some rooms, or occasionally by checking out the question marks left as clues in some rooms. A scoreboard awards points for destroying henchmen and clearing out rooms, but apparently the points are for measuring your progress against other games; they don't seem to win you extra lives or otherwise affect the current game. Although *Shamus* is a one-player contest pitting you against the computer, the manual recommends that two people participate – one to work the joystick and fight the henchmen, and another to keep track of the room layout and locations of locks and keys.

As a final twist, the manual mentions "pod rooms" which exist in another dimension, accessible only through a small "time window." On several occasions I encountered one of these portals, but was never able to pass through.

Overall, I found *Shamus* an exceptionally high quality game, very addicting, and more difficult than most. The programming is top-notch. The only feature I missed was some sort of "pause" option in case the phone rings or the neighbor's house starts burning down. But since the challenge of *Shamus* depends on not giving you time to puzzle out the arrangemment of the rooms, a pause key would make it too easy to cheat. Since there is also no way to save games in progress until later, *Shamus* becomes a test of endurance as well as of memory, cleverness, and reflexes. It succeeds in combining some of the best qualities of arcade and adventure games.

Shamus
*Synapse Software*
*5327 Jacuzzi St. Suite 1*
*Richmond, CA 94804*
*$34.95*

# *Moptown* — Educational Games For Apple

Sheila Cory

Colorful blocks of varying sizes and shapes that are found in many elementary school classes are called Attribute Blocks. They are used to stimulate rational thinking by giving children experience in distinguishing attributes and carrying out logical operations.

The "Moppets" who live in *Moptown* are computerized Attribute Blocks, with each of the inhabitants identifiable by their peculiar combination of traits.

The traits used to identify the 16 Moppets who populate *Moptown* are: (1) tall or short, (2) fat or thin, (3) red or blue, and (4) Bibbit or Gribbit. All Bibbits have big noses and big feet, and all Gribbits have tails. Like work with Attribute blocks, games in *Moptown* involve logical thinking. Working with attributes on the computer allows, among other things, the random assignment of the attributes, feedback as to the correctness of response, and immediate reinforcement.

## Moptown

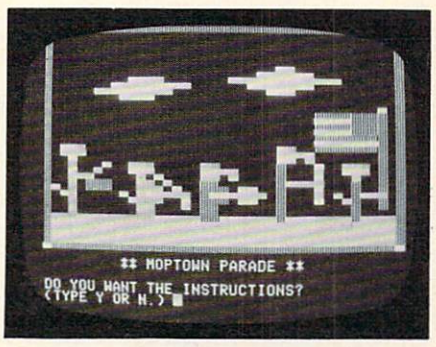
*Moptown* is a program designed for elementary school-aged youngsters. Programmed by Leslie Grimm (whose excellent programs – *Bumble Plot*, *Bumble Games*, and *Juggles' Rainbow* – were reviewed in **COMPUTE!** recently), this set of programs consists of 11 different games that develop the ability to identify and isolate attributes. The games are carefully sequenced from easy to hard, providing an ideal structure for understanding and learning. The programs would be appropriate for use in kindergarten through grade six, with the most difficult even providing challenging fun and learning for children in junior high school.

## Recognition Games: Easy To Difficult

In Make My Twin, the simplest of the games, the user looks at a *Moptown* villager (or Moppet, as they're called), and then describes its four attributes in order to make its twin. To do this, the child needs to be able to separate each of the attributes from the whole – an excellent activity for the development of analytical thinking. To save typing, the program allows the child to use a one-letter input to describe the attribute. With young children, this can be a very important feature in a program, yet one that some programmers forget to consider.

Who's Different? lines four Moppets up assembly-line style and asks the user to find the one that is different. After identifying the different Moppet, the user then must identify which of the four attributes makes it different. Another possibility in this game is to have four different Moppets drawn, and have the user choose which one is *most* different. This variation is considerably more difficult than the previous one.

What's the Same? is similar to the previous game, except the object is to find the one attribute the Moppets have in common. As in the other games, no help is given if the user continually selects the wrong answer. This could be a problem for a child who chooses to play a game that is beyond his or her level of skill.




*"Moppets" line up for review in the Moptown Parade game.*

Who Comes Next? is a pattern recognition game. There are three possible patterns: ABABAB, ABBABB, or AABAAB. Four Moppets are lined up; the user determines the pattern and then describes what the fifth Moppet should look like. The task involves not only identifying the pattern, but also dissecting the appropriate Moppet into its four attributes in order to describe them. If the Moppet is described incorrectly, it is drawn the way it was described and the user again has an opportunity to describe the Moppet correctly.

## User-Determined Patterns

The next game is Moptown Parade. Like all of these games, it is introduced with an appropriate picture and song – in this case, "She's a Grand Old Flag!" The object of this game is to create the participants in a parade according to a rule determined by the user.

The rule establishes how many traits each successive Moppet in the parade should have that are different from those of the previous Moppet. For example, if the rule is "1", then the next Moppet in the parade will differ from the Moppet in front of him by just one trait. If Moppet 1 is tall, blue, fat, and a Gribbit, then Moppet 2 could be tall, red, fat, and a Gribbit. If a mistake is made, the incorrect Moppet is drawn and then erased so the user can try again.

Who's Next Door? makes trait analysis of two Moppets an essential step for determining the second Moppet of another set. The first pair of Moppets are compared to see which single trait is different. A third Moppet is shown, and its pair must be described so that the two differ in the same attribute as the first pair.

In My Secret Pal, the user selects four traits to describe a

Moppet. The program responds by drawing the Moppet described, and then telling how many of those traits are correct to describe the secret pal. This game is quite a challenge, as the program does not tell you *which* traits are correct, only *how many* are correct. It is up to the user to develop good guessing strategies!

Careful trait analysis is necessary to be successful in the next game, Change Me!. In this game, four boxes are drawn on the screen. A Moppet is drawn in box one and box four. Again, as in Moptown Parade, a rule of "1" or "2" determines how many trait differences there should be in each successive Moppet. The problem is to determine what the second and third Moppet should look like in order for the fourth Moppet to have just the specified number of different attributes.

Clubhouse is more difficult still, requiring logical deductions to decide which Moppet can join the Moppets Club. Each time a Moppet is described, the program responds by telling whether or not he can join the club. The object of the game is to figure out what rule or rules are being applied to each Moppet to either accept him into or reject him from the club.

The last two programs, Moptown Map and Moptown Hotel, carry the skills developed in the previous games a step further. In both of these games, the user has to be concerned with attributes shared by Moppets in the same row *and* the same column. Thinking of relationships in two dimensions makes these two games substantially more difficult than the previous ones; but with mastery of the earlier games, these should be challenging enough to be interesting, yet easy enough to be fun.

## Color Monitor Crucial

The documentation for *Moptown* is clear and concise. I disagree with the claim that these programs are suitable for use with a black and white monitor, however. Color is crucial to these programs, as it is one of the four attributes by which the Moppets are distinguished from each other. As the manual states, it *is* possible to discern the differences on a black and white monitor, but I feel it makes the games too difficult. One outstanding feature of the manual is the inclusion of suggestions on how to use these programs when there is just one computer for a whole class.

Sound adds a lot to this program. However, sound can be a distraction in some classroom situations. The program does not have a "sound/no sound" option, which might make it inappropriate for some classes. The program also makes different sounds when a child gets an answer correct than when he or she gets an answer wrong. Some children could be very upset about having others know how they're doing when they're working so hard to master a difficult concept.

## How Children Rate *Moptown*

Because it is difficult for me to assess how kids would respond to a program, I gathered a group of "kid consultants" to test out these programs. Bret, 11 years old, spent about two hours on *Moptown*. He said he enjoyed all the games, but felt his friends would most enjoy Moptown Hotel, which is the most difficult. He said he would like to borrow the programs from me in order to have more time with them.

Cara, ten years old, enjoyed all of the programs *except* Moptown Map and Moptown Hotel, which she felt were too difficult. She had only a little more than an hour to spend on the programs, so she would possibly enjoy those difficult ones more if she could work with the games a bit longer. Cara felt her friends would enjoy Clubhouse the most. Like Bret, she asked if she could borrow the diskette for more work with these programs.

Chrissa, eight years old, loved the games. She thought Make My Twin was a little boring because it was too easy, but enthusiastically endorsed Clubhouse. The Kids all tended to ask adults how to play the games rather than read the instructions. In a classroom situation, it would be a good idea for the teacher to introduce each of the games to the whole class before having the children play individually.

*Moptown* runs on an Apple II Plus with 48K. It comes on diskette, with back-up diskette and manual included in a handy package.

Moptown
*Apple Computer, Inc.*
*20525 Mariani Avenue*
*Cupertino, CA 95014*
*$50*

# VIC Searcher

Heinz Wrosch

*There are times when you just can't find something in a large program. Instead of reading every line and wasting your time, why not join the growing number of people who say: "Let the computer do it. It does it better."*

This short program is a "BASIC loader" which means that it's written in and can be used in BASIC, but is actually a machine language program. Those DATA statements represent the various instructions (coded as numbers) that the computer can read even more easily and faster than it can follow BASIC instructions. Machine language is, after all, the computer's native tongue.

## So Much Faster

You don't have to know machine language to use this handy tool. Tools like "Searcher" are often called *utilities* which means "programs that help you program." For Searcher, all you need to do is to type in the mysterious program (SAVE it for future use) and then any time it's RUN it will figure out where your VIC's highest free memory area is, put itself up there, and build a wall around itself by telling the VIC a white lie: that there is a tad less memory available than there really is.

Finally, it self-destructs using NEW in line 60. *It* does all this, *you* just type LOAD and RUN. That's one good reason why computers should, quite often, do things for you. So much faster.

Now for the fun part. LOAD and RUN your Searcher. It will print a number on the screen which is the address you are going to send the computer to. On many VIC's this will be 7547, but it depends on how much memory your VIC has. Whatever the number is, make a note of it. Now LOAD in some long program. Imagine that you want to remove all the REM statements to save memory. To search them out, type a new BASIC line number into the program at line zero:

**0:REM (hit RETURN)**

following the zero with a colon and then the thing you want to search for (in this case "REM"). Then directly on the screen (not in a BASIC program) type: SYS 7547 (or whatever number the program told you to use). Instantly you'll have a list of all the places where your REM's appear in the program.

Searching is often useful in *debugging* programs (getting them to work right). You might need to know where all the examples of A$ are in a program, or where all the FOR/NEXT loops are, or something else. You can make adjustments more easily to the entire program if you know where and how often things are used. Or you might decide to change all the occurrences of the name "Tom" to "Sam" or something in a long series of DATA statements.

There are many ways to benefit from Searcher. Add it to your toolbox of VIC utilities and then the next time you need to analyze or modify a long program, to save memory space, or to remove or change a name in your address book program – let the computer do it.

```
10 T=PEEK(55)+256*PEEK(56):CS=0
20 T=T-133:TL=(T/256-INT(T/256))*256:TH=INT(T
   /256)
30 POKE55,TL:POKE56,TH
40 FORI=TTOT+132:READA:POKEI,A:CS=CS+A:NEXTI
50 IF CS<>14881 THEN PRINT"ERROR IN DATA STAT
   EMENTS":STOP
60 PRINT"{CLEAR}SYS";T;"TO START":NEW
100 DATA 160, 0, 177, 43, 133, 1, 200, 177, 43
    , 133, 2
110 DATA 160, 0, 177, 1, 208, 1, 200, 177, 1, ~
    208, 1
120 DATA 96, 160, 0, 177, 1, 141, 52, 3, 200, ~
    177, 1
130 DATA 141, 53, 3, 200, 177, 1, 133, 99, 200
    , 177, 1
140 DATA 133, 98, 200, 24, 165, 43, 105, 5, 13
    3, 67, 166
150 DATA 44, 144, 1, 232, 134, 68, 177, 1, 240
    , 55, 162
160 DATA 0, 193, 67, 240, 4, 200, 24, 144, 242
    , 192, 0
170 DATA 240, 10, 136, 230, 1, 208, 2, 230, 2,
     24, 144
180 DATA 242, 160, 0, 177, 67, 240, 8, 209, 1,
     208, 218
190 DATA 200, 24, 144, 244, 169, 35, 32, 210, ~
    255, 166, 99
200 DATA 165, 98, 32, 205, 221, 169, 32, 32, 2
    10, 255, 173
210 DATA 52, 3, 133, 1, 173, 53, 3, 133, 2,  2
    4, 144, 134
```

# SuperFont Plus

John Slaby

*You can generate excellent Atari game graphics by using ANTIC modes 4 and 5. This program provides an ANTIC version of SuperFont. Requires 16K RAM.*

After typing in "SuperFont" (**COMPUTE!**, January 1982), I was very pleased. I couldn't imagine needing any additional functions or purchasing any font that could possibly improve upon it. Then I bought *De Re Atari*, and everything I had read previously in the *Hardware Manual* on ANTIC modes 4 and 5 fell into place. At the same time I realized that it was ANTIC mode 4 that allowed the great graphics in *Caverns Of Mars*. I realized I *could* make some useful additions to the original program. Therefore, I offer SuperFont Plus.

Mr. Brannon stated in his article that it would be easy to expand the program, so I did. The additional commands are the ANTIC, PRINT, and Color Change modes. Of these, only the PRINT mode can be used along with the original version of graphics modes 0, 1, and 2. This expanded version is about 40% longer and, if you only have 16K RAM memory, some manipulation will be required; but you can have an ANTIC version of SuperFont. For those of you that already have SuperFont, just add lines 10, 20, 1601 through 1606 and all lines after and including 2000. Also note the changes in lines 100 through 120, 270, 320, 340, 390 through 400, 650, 1300, 1360, 1370, and 1400 through 1410. Once you do this, you will have the capabilities of designing your own ANTIC 4/5 character set.

For those of you with only 16K, there is a way out. You will have to end up with two fonts: one font, the original, for the Basic-supported graphics modes, and one for the ANTIC 4/5 graphics modes. If you delete the following commands and change lines 250 and 300 to say RAM-4 instead of RAM-8, you will have a functional font. The deleted commands which have limited use for ANTIC 4/5 are: RESTORE (920-930), OVERLAY (870-910), GRAPHICS (1370-1390), WRITE DATA (1290-1360), and QUIT (1130-1140).

## Original SuperFont

Here's a quick review of the original SuperFont commands:

**EDIT:** The character you select via the joystick and pressing of the trigger is copied to the grid in the upper section of the screen. The cursor is relocated to this grid, and you can instantly modify the character by moving the joystick and pressing the trigger to either set or remove a point, as desired.

**RESTORE:** This will copy the pattern from the first character set to the second, located in the lower half of the screen.

**COPY FROM:** Select a character which will be copied to the current one you are working on.

**COPY TO:** The current character will be copied to the selected place.

**SWITCH:** Exchanges the current character for the one selected.

**OVERLAY:** Adds the selected character's pattern to the current one.

**CLEAR:** Clears the pattern of the current character. A must for ANTIC 4/5.

**INVERT:** Turns current character upside down.

**SAVE FONT:** Saves character set to disk or tape. Answer "Filename" with either C: or D:filespec. If you see an error message, press any key to return to the menu.

**LOAD FONT:** Retrieves a character set that you saved. Answer "Filename" like SAVE FONT.

**CURSOR-UP or SHIFT DELETE:** The line of points the cursor is on is deleted, and the following lines are pulled up to fill the gap.

**CURSOR-DOWN or SHIFT INSERT:** A blank line is inserted on the line the cursor is in, and all lines below it move down one. The bottom line is lost.

**SCROLL LEFT:** The bit pattern of the character is shifted left.

**SCROLL RIGHT:** The bit pattern of the character is shifted right.

**WRITE DATA:** The internal code (0-127) of the character and the eight bytes that make it up are displayed in the menu area. Press any key to return to menu.

**GRAPHICS:** This toggles the TEXT/GRAPHICS option of graphics modes 1 and 2 to let you see each half of the character set.

**REVERSE:** All blanks become points, and vice

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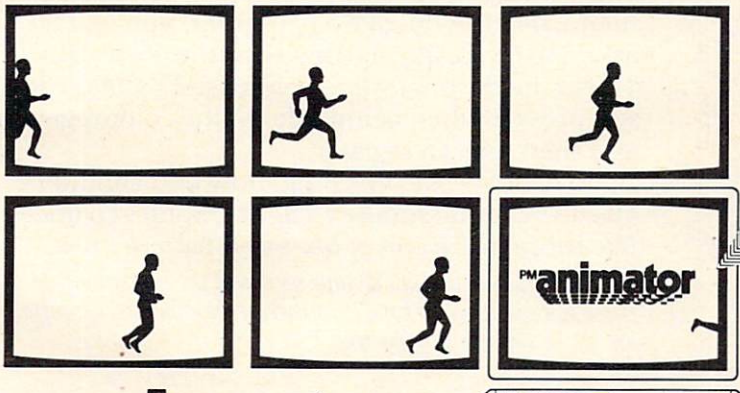


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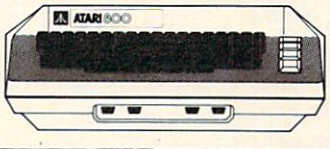


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versa. Works the same as pressing the Atari logo key and then typing.

**QUIT:** Exit program.

## SuperFont Plus: Three New Commands

The ANTIC(A) command mode modifies the display list so that the lower section of the screen now becomes ANTIC mode 4 except for the last line, which is ANTIC 5. Press A again to return to the original graphics 0, 1, and 2. Once you activate this command, the character set will become mostly unrecognizable. This is because the characters are now four pixels wide instead of eight, but the overall displayed width remains the same. This loss of resolution is the price you have to pay for the multicolor ability of these ANTIC modes.

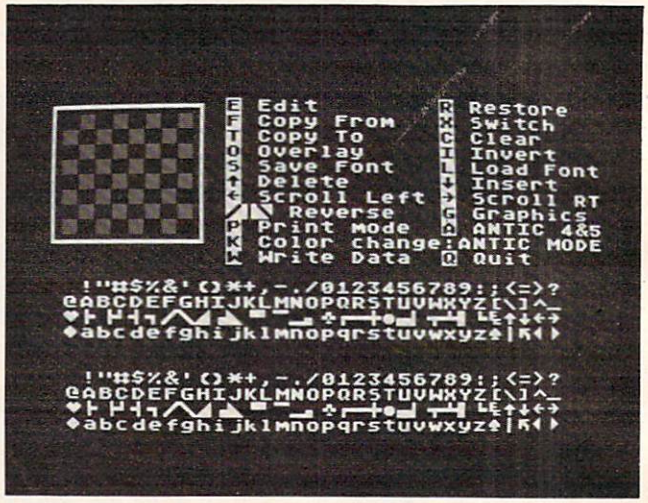
Use all other commands as before; they will work. Please note that the grid now has double-wide pixels when compared to the first display. This is because that binary number you place in each pixel determines the color that will be displayed and you need two bits per color. The binary number is related to the color registers as follows: 00 = Background; 01 = Playfield 0; 10 = Playfield 1; and 11 = Playfield 2. To use Playfield 3's color, you also use binary 11, but the internal code must be 128-255. This is accomplished by using reversed characters via the Atari logo key. There is no way to use this key in any of the original commands, so the PRINT command was created.

The PRINT mode (P) allows you to print any character in the bottom window next to another one just as in normal typing. This mode allows you to see that third playfield color via the logo key. You can type as long as you like, but if you exceed 38 characters, the first one will be lost and all the others will shift left. As noted before, this command can be used with the original graphics 1 and 2.

Since the keyboard is used for typing, the START and SELECT buttons will, respectively, return you to the menu and clear the typing area. When you return to the menu, the typing area isn't automatically cleared; this allows you to work on more than one character at a time, i.e., three characters together as a car, etc. This mode is also useful to get a full screen effect for one line of modified characters.

The final new command is the Color Change mode (K). When I started working with the first two new commands, it became obvious that the ability to change the color of the character I was working on would be very useful. Thus I expanded the Display List Interrupt to give me that ability and added a second interrupt for the background color change.

When you activate this command, you will be able to change only the colors for the ANTIC 4/5 character set. If you want to change the colors for the original graphics modes, modify lines 170 and 300 as desired. The menu area will be cleared, and you will be given the choice of the playfield or background color you want to change. If you change the background, it will affect only the typing window area. I did this to keep the clarity of the character set at its best, and you will probably want to see the change for only one or two characters at a time.




*The menu and character fonts ready for editing in "SuperFont+."*

After your register selection, you will be asked for the color and luminosity value (0-14) you want. To help you, a list of colors will be supplied in the menu area. If you give a bad input, you will be asked to try again, starting with the color value. To get the decimal value being used by that register, press R when being offered the color registers and then select a register.

That covers everything; now you should be able to generate some excellent graphics characters like those in *Caverns of Mars* and *Eastern Front*.

*The author will make tape copies of the program for those not wanting to type it in themselves. Send a cassette, an SASE mailer, and $3 to:*

*John Slaby*
*3328 Kaywood Drive*
*Easton, PA 18042*

```
10 GOTO 100
20 POKE 82,14:POSITION 14,0:FOR I=ST
   TO ED:? "{25 SPACES}":NEXT I:RETURN
100 REM *** SUPERFONT + ***
105 REM Character Set Editor
106 REM original
110 REM 11/10/81 Charles Brannon
115 REM ANTIC,COLOR, AND PRINT MODES
120 REM BY John Slaby 8/22/82
140 DIM I(7),FN$(14),N$(3)
150 IF PEEK(1536)=0 THEN GOSUB 1400
160 GRAPHICS 0:POKE 752,1
170 SETCOLOR 2,7,2:SETCOLOR 4,7,2
180 DL=PEEK(560)+256*PEEK(561)+4
```

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```
190 SD=PEEK(88)+256*PEEK(89)+12*40:AS
    D=SD+5*40
200 A1=1630:FUNC=1631:A2=1632:LOGIC=1
    628
210 RAM=PEEK(106)-8:PMBASE=RAM*256
220 CHRORG=57344
230 POKE 559,46:POKE 54279,RAM
240 POKE 53277,3:POKE 53256,3
250 CHSET=(RAM-8)*256
260 POKE DL+23,6:POKE DL+24,7
270 POKE DL+17,130:POKE DL+18,112
280 POKE 512,0:POKE 513,6
290 POKE 54286,192
300 POKE 1549,RAM-8:POKE 1672,RAM-8:P
    OKE 1538,0
310 A=USR(1555,CHSET)
320 P0=PMBASE+512+20:P1=PMBASE+640+20
    :P2=PMBASE+768+20:P=PMBASE+896+20
    :T=85:GOSUB 330:GOTO 350
330 FOR I=0 TO 7:FOR J=0 TO 3:T=255-T
    :POKE P0+I*4+J,0:POKE P1+I*4+J,T:
    T=255-T
340 POKE P2+I*4+J,T:NEXT J:T=255-T:NE
    XT I:RETURN
350 POKE 53248,64:POKE 53249,64:POKE
    53250,64
360 POKE 704,198:POKE 705,240:POKE 70
    6,68
370 POKE 53256,3:POKE 53257,3:POKE 53
    258,3:POKE 623,1
380 ? " {Q}{8 R}{E}":FOR I=1 TO 8:? "
     ¦{8 SPACES}¦":NEXT I:? " {Z}{8 R}
    {C}"
385 GOSUB 390:GOTO 490
390 POKE 82,14:POSITION 14,0
400 ? "E Edit{8 SPACES}R Restore"
410 ? "F Copy From{3 SPACES}X Switch"
420 ? "T Copy To{5 SPACES}C Clear"
430 ? "O Overlay{5 SPACES}I Invert"
440 ? "S Save Font{3 SPACES}L Load Fo
    nt"
450 ? "{ESC}{DEL LINE} Delete
    {6 SPACES}{ESC}{INS LINE} Insert"
460 ? "{ESC}{CLR TAB} Scroll Left
    {ESC}{SET TAB} Scroll RT"
470 ? "{P}{I}{V} Reverse{3 SPACES}G G
    raphics"
475 ? "P Print mode  A ANTIC 4&5"
477 ? "K Color change:ANTIC MODE"
480 ? "W Write Data  Q Quit":RETURN
490 FOR I=0 TO 3:FOR J=0 TO 31:POKE S
    D+J+I*40+4,I*32+J:POKE ASD+J+I*40
    +4,I*32+J:NEXT J:NEXT I:?
500 POKE 82,2:POSITION 0,0
510 OPEN #2,4,0,"K:"
520 P=PEEK(764):IF P=255 THEN 520
530 IF P=60 THEN 520
540 IF P=39 THEN POKE 764,168
550 GET #2,K
560 IF K<>ASC("E") THEN 790
570 GOSUB 1750
580 FOR I=0 TO 7:A=PEEK(CHSET+C*8+I):
    FOR J=0 TO 3:POKE P0+I*4+J,A:NEXT
     J:NEXT I
590 POKE ASD+169+(ANTIC*10),C:POKE AS
    D+190+(ANTIC*30),C
600 JX=0:JY=0
610 POSITION JX+4,JY+1
620 ? CHR$(32+128*FF);"{LEFT}";:FF=1-
    FF
630 IF STRIG(0)=0 THEN 750
640 IF PEEK(764)<255 THEN ? " ";:GOTO
     520
650 ST=STICK(0):IF ST=15 THEN 610
660 IF STRIG(0) THEN FOR I=0 TO 100 S
    TEP 20:SOUND 0,100-I,10,8:NEXT I
670 POSITION JX+4,JY+1:? " ";
680 JX=JX+(ST=7)-(ST=11)
690 JY=JY+(ST=13)-(ST=14)
700 IF JX<0 THEN JX=7
710 IF JX>7 THEN JX=0
720 IF JY<0 THEN JY=7
730 IF JY>7 THEN JY=0
740 GOTO 610
750 POKE A1,PEEK(CHSET+C*8+JY):POKE A
    2,2^(7-JX):POKE FUNC,73:A=USR(LOG
    IC)
760 POKE CHSET+C*8+JY,A:FOR J=0 TO 3:
    POKE P0+JY*4+J,A:NEXT J
770 FOR I=0 TO 10:SOUND 0,I*4,8,8:NEX
    T I:SOUND 0,0,0,0
780 GOTO 650
790 IF K<>ASC("F") THEN 830
800 S=C:GOSUB 1750
810 FOR I=0 TO 7:A=PEEK(CHSET+C*8+I):
    POKE CHSET+S*8+I,A:NEXT I
820 C=S:GOTO 580
830 IF K<>ASC("T") THEN 870
840 S=C:GOSUB 1750
850 FOR I=0 TO 7:A=PEEK(CHSET+S*8+I):
    POKE CHSET+C*8+I,A:NEXT I
860 C=S:GOTO 600
870 IF K<>ASC("O") THEN 920
880 S=C:GOSUB 1750
890 FOR I=0 TO 7:POKE A1,PEEK(CHSET+C
    *8+I):POKE A2,PEEK(CHSET+S*8+I):P
    OKE FUNC,9:A=USR(LOGIC)
900 POKE CHSET+S*8+I,A:NEXT I
910 C=S:GOTO 580
920 IF K<>ASC("R") THEN 940
930 FOR I=0 TO 7:POKE CHSET+C*8+I,PEE
    K(CHRORG+C*8+I):NEXT I:GOTO 580
940 IF K<>ASC("C") THEN 960
950 FOR I=0 TO 7:POKE CHSET+C*8+I,0:N
    EXT I:GOTO 580
960 IF K<>ASC("{R}") THEN 980
970 FOR I=0 TO 7:POKE CHSET+C*8+I,255
    -PEEK(CHSET+C*8+I):NEXT I:GOTO 58
    0
980 IF K<>ASC("X") THEN 1010
990 S=C:GOSUB 1750
1000 FOR I=0 TO 7:A=PEEK(CHSET+S*8+I)
     :POKE CHSET+S*8+I,PEEK(CHSET+C*8
     +I):POKE CHSET+C*8+I,A:NEXT I:GO
     TO 580
1010 IF K<>ASC("I") THEN 1030
1020 FOR I=0 TO 7:I(I)=PEEK(CHSET+C*8
     +I):NEXT I:FOR I=0 TO 7:POKE CHS
     ET+C*8+I,I(7-I):NEXT I:GOTO 580
1030 IF K<>ASC("{UP}") AND K<>ASC("
     {DEL LINE}") THEN 1050
1040 FOR I=JY TO 6:POKE CHSET+C*8+I,P
     EEK(CHSET+C*8+I+1):NEXT I:POKE C
     HSET+C*8+7,0:GOTO 580
1050 IF K<>ASC("{DOWN}") AND K<>ASC("
     {INS LINE}") THEN 1070
1060 FOR I=7 TO JY STEP -1:POKE CHSET
     +C*8+I,PEEK(CHSET+C*8+I-1):NEXT
     I:POKE CHSET+C*8+JY,0:GOTO 580
1070 IF K<>ASC("{LEFT}") THEN 1100
1080 FOR I=0 TO 7:A=PEEK(CHSET+C*8+I)
     *2:IF A>255 THEN A=A-256
1090 POKE CHSET+C*8+I,A:NEXT I:GOTO 5
     80
1100 IF K<>ASC("{RIGHT}") THEN 1130
1110 FOR I=0 TO 7:A=INT(PEEK(CHSET+C*
     8+I)/2)
```

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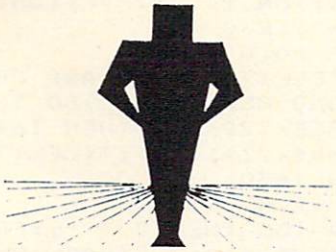

## BASIC COMMANDER

- **Single key entry file commands**
  - — ENTER "D:
  - — SAVE "D:
  - — LIST "D:
  - — RUN "D:
  - — LOAD "D:
- **Single Key DOS functions from BASIC**
  - — FORMAT a disk
  - — LOCK a file
  - — RENAME a file
  - — UNLOCK a file
  - — DELETE a file
  - — DISK DIRECTORY
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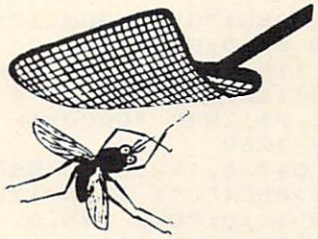
  - — automatically generates line numbers for you — speeds program entry 25-75%
- **BLOCK DELETE**
  - — deletes any range of lines instantaneously!
- **RENUMBER**
  - — renumbers lines and all references
  - — extensive error trapping
  - — 3 seconds to renumber 500 lines



## MMG BASIC DEBUGGER

- **TRACE through your Basic program**
  - — Single step
  - — TRACE while
  - — TRACE UNTIL
  - — change variables
  - — LIST line numbers executed
  - — examine variables' values
- **Full screen BASIC editing**
  - — scroll up or down by cursor
  - — edit your whole program easily
  - — no more LIST line number ranges
- **Split screen mode**
  - — view two parts of your BASIC program at once, and edit both!
  - — scroll each window independently
- **CROSS REFERENCE**
  - — provides a list of variables and the line numbers in which they are used in your program
- **SEARCH FOR PHRASE**
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---

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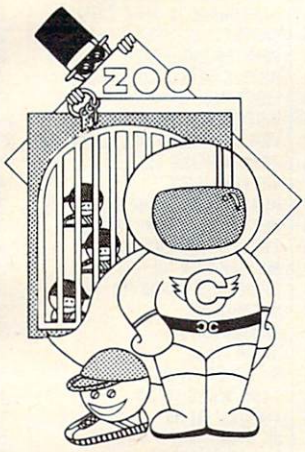
```
1120 POKE CHSET+C*8+I,A:NEXT I:GOTO 5
     80
1130 IF K<>ASC("Q") THEN 1150
1140 POKE 53248,0:POKE 53249,0:POKE 5
     3250,0:POKE 53277,0:GRAPHICS 0:E
     ND
1150 IF K<>ASC("S") THEN 1210
1160 GOSUB 1610:POKE 195,0
1170 TRAP 1190:OPEN #1,8,0,FN$
1180 A=USR(1589,CHSET)
1190 CLOSE #1:TRAP 40000:IF PEEK(195)
      THEN 1260
1200 POKE 54286,192:GOTO 580
1210 IF K<>ASC("L") THEN 1290
1220 GOSUB 1610:POKE 195,0
1230 TRAP 1250:OPEN #1,4,0,FN$
1240 A=USR(1619,CHSET)
1250 CLOSE #1:TRAP 40000:IF PEEK(195)
     =0 THEN 1200
1260 POSITION 14,0:? "{BELL}*ERROR -"
     ;PEEK(195);"*"
1270 IF PEEK(764)<255 THEN POSITION 1
     4,0:? "{19 SPACES}":GOTO 1200
1280 GOTO 1270
1290 IF K<>ASC("W") THEN 1370
1300 ST=0:ED=11:GOSUB 20:N$="
     {3 SPACES}":L=LEN(STR$(C)):N$(1,
     L)=STR$(C):L=LEN(N$):POSITION 14
     ,0
1310 FOR I=1 TO L:? CHR$(ASC(N$(I,I))
     +128);:NEXT I:? ">"
1320 Z=0:FOR I=0 TO 2:FOR J=0 TO 1+(I
     >0):A=PEEK(CHSET+C*8+Z):Z=Z+1
1330 SOUND 0,(I*3+J)*10+50,10,8
1340 ? A;",":NEXT J:? "{BACK S}":NEXT
      I:SOUND 0,0,0,0
1350 IF PEEK(764)=255 THEN 1350
1360 GOSUB 20:GOSUB 390:GOTO 520
1370 IF K<>ASC("G") THEN 2000
1380 CF=1-CF:POKE 1549,RAM-8+2*CF
1390 GOTO 520
1400 GRAPHICS 2+16:SETCOLOR 4,1,4:POS
     ITION 5,3:? #6;"SUPERFONT +"
1410 POSITION 5,5:? #6;"patience{3 N}
     ":POSITION 2,11:? #6;"john slaby
     ":POSITION 2,7:? #6;"ORIGINAL by
     "
1415 POSITION 2,8:? #6;"CHARLES BRANN
     ON":POSITION 2,10:? #6;"+  by"
1420 FOR I=1536 TO 1710:READ A:POKE I
     ,A:POKE 709,A:SOUND 0,A,10,4:NEX
     T I
1430 SOUND 0,0,0,0:RETURN
1440 DATA 72,169,100,141,10,210
1450 DATA 141,24,208,141,26,208
1460 DATA 169,6,141,9,212,104
1470 DATA 64,104,104,133,204,104
1480 DATA 133,203,169,0,133,205
1490 DATA 169,224,133,206,162,4
1500 DATA 160,0,177,205,145,203
1510 DATA 200,208,249,230,204,230
1520 DATA 206,202,208,240,96,104
1530 DATA 162,16,169,9,157,66
1540 DATA 3,104,157,69,3,104
1550 DATA 157,68,3,169,0,157
1560 DATA 72,3,169,4,157,73
1570 DATA 3,32,86,228,96,104
1580 DATA 162,16,169,5,76,58
1590 DATA 6,9,104,169,0,9,0,133
1600 DATA 212,169,0,133,213,96
1601 DATA 72,138,72,152,72,169,0,162,
     0,160,0
1602 DATA 141,10,212,141,26,208
1603 DATA 142,24,208,140,25,208
1604 DATA 169,0,141,22,208,141,10,210
     ,169,6,141,9,212,169,0,141,23,20
     8,169,156,141,0,2
1605 DATA 104,168,104,170,104,64,72,1
     69,0,141,10,212,141,26,208,169,1
     04,141,10,210,141,0,2,104,64
1610 POSITION 14,0:? "Filename?";
1620 FN$="":K=0
1630 POKE 20,0
1640 IF PEEK(764)<255 AND PEEK(764)<>
     39 AND PEEK(764)<>60 THEN 1670
1650 IF PEEK(20)<10 THEN 1640
1660 ? CHR$(21+11*K);"{LEFT}";:K=1-K:
     GOTO 1630
1670 GET #2,A
1680 IF A=155 THEN ? " ";:FOR I=1 TO
     LEN(FN$)+10:? "{BACK S}";:NEXT I
     :RETURN
1690 IF A=126 AND LEN(FN$)>1 THEN FN$
     =FN$(1,LEN(FN$)-1):? "{LEFT}";CH
     R$(A);:GOTO 1630
1695 IF A=126 AND LEN(FN$)=1 THEN ? C
     HR$(A);:GOTO 1620
1700 IF A=58 OR (A>48 AND A<57) OR (A
     >65 AND A<=90) OR A=46 THEN 1720
1710 GOTO 1630
1720 IF LEN(FN$)<14 THEN FN$(LEN(FN$)
     +1)=CHR$(A):? CHR$(A);
1730 GOTO 1630
1740 END
1750 REM GET CHOICE OF CHARACTER
1760 CY=INT(MRY/32):CX=MRY-32*CY
1770 C=CX+CY*32
1780 POKE SD+CX+CY*40+4,C+128
1790 POKE ASD+CX+CY*40+4,C+128
1800 IF STRIG(0)=0 OR PEEK(764)<255 T
     HEN MRY=C:GOTO 1900
1810 ST=STICK(0):IF ST=15 THEN 1880
1820 POKE 53279,0
1830 GOSUB 1900
1840 CX=CX-(ST=11)+(ST=7):CY=CY-(ST=1
     4)+(ST=13)
1850 IF CX<0 THEN CX=31:CY=CY-1
1860 IF CX>31 THEN CX=0:CY=CY+1
1870 IF CY<0 THEN CY=3
1880 IF CY>3 THEN CY=0
1890 GOTO 1770
1900 POKE SD+CX+CY*40+4,C
1910 POKE ASD+CX+CY*40+4,C
1920 RETURN
2000 IF K<>ASC("A") THEN 2200
2005 POKE 54286,0
2007 POKE ASD+169+(ANTIC*10),0:POKE A
     SD+190+(ANTIC*30),0
2010 IF ANTIC=1 THEN 2100
2020 POKE DL+24,5
2030 FOR I=19 TO 23:POKE DL+I,4:NEXT
     I:POKE DL+22,132
2040 POKE 512,104:ANTIC=1
2050 COLF0=2*16+6:COLF1=6*16+6
2060 COLF2=10*16+8:COLF3=15*16+8
2070 POKE 1664,COLF0:POKE 1648,COLF1
2080 POKE 1650,COLF2:POKE 1677,COLF3
2090 POKE 54286,192:T=51:GOTO 2127
2100 ANTIC=0:POKE DL+23,6:POKE DL+24,
     7
2110 POKE 512,0:FOR I=19 TO 22:POKE D
     L+I,2:NEXT I
2120 POKE 54286,192:T=85
2127 GOSUB 330:POKE ASD+169+(ANTIC*10
     ),C:POKE ASD+190+(ANTIC*30),C:GO
     TO 520
2200 IF K<>ASC("P") THEN 3000
2205 ST=0:ED=10:GOSUB 20
```

# NEXA presents



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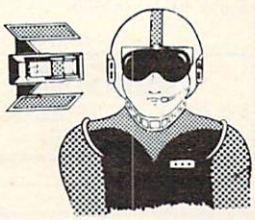

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```
2210 POSITION 14,0:LT=0
2220 ? "{5 SPACES}PRINT MODE"
2230 ? :? " Press START to return"
2240 ? "{5 SPACES}to menu"
2250 ? :? " Press SELECT to clear"
2260 ? "{3 SPACES}typing area"
2270 KK=PEEK(53279):IF KK=6 THEN GOSU
     B 390:GOTO 520
2280 IF KK=5 THEN 2600
2290 P=PEEK(764):IF P=255 THEN 2270
2300 GET #2,K
2302 IF K>=0 AND K<32 OR K>=128 AND K
     <160 THEN K=K+64:GOTO 2310
2304 IF K>=32 AND K<96 OR K>=160 AND
     K<224 THEN K=K-32
2306 IF CT>(ANTIC+1)*17 THEN 2320
2310 POKE ASD+161+CT,K:POKE ASD+181+(
     ANTIC*20)+CT,K:CT=CT+1:GOTO 2270
2320 FOR I=0 TO 17*(ANTIC+1):POKE ASD
     +161+I,PEEK(ASD+162+I):POKE ASD+
     181+(ANTIC*20)+I,PEEK(ASD+182+(A
     NTIC*20)+I)
2330 NEXT I:CT=17*(ANTIC+1):GOTO 2310
2600 FOR I=0 TO 19*(ANTIC+1):POKE ASD
     +161+I,0:POKE ASD+181+(ANTIC*20)
     +I,0:NEXT I:CT=0:GOTO 2270
3000 IF K<>ASC("K") THEN 520
3010 ST=0:ED=10:GOSUB 20:DIS=0
3020 POKE 82,14:POSITION 14,0:? "COLO
     R CHANGE MODE"
3030 ? " PRESS K TO RETURN"
3040 ? "{5 SPACES}TO MENU"
3050 ? " 0 PLAYFIELD 0"
3060 ? " 1 PLAYFIELD 1"
3070 ? " 2 PLAYFIELD 2"
3080 ? " 3 PLAYFIELD 3"
3090 ? " 4 BACKGROUND":? "R READ REGI
     STER"
3100 GET #2,K:DIS=0:IF K=ASC("0") THE
     N DIS=18
3105 IF K=ASC("R")THEN RDE=1:GOTO 3100
3110 IF K=ASC("1") THEN DIS=31
3120 IF K=ASC("2") THEN DIS=2
3130 IF K=ASC("3") THEN DIS=4
3140 IF K=ASC("B") THEN DIS=48
3150 IF K=ASC("K") THEN GOSUB 390:GOT
     O 520
3155 IF RDE=1 THEN 3410
3160 IF DIS=0 THEN 3100
3170 ST=2:ED=10:GOSUB 20
3180 POKE 82,14:POSITION 14,0
3190 ? "0 GREY  1 GOLD  2 ORANGE"
3200 ? "3 RED{3 SPACES}4 PINK  5 PURP
     LE"
3210 ? "6 BLUE  7 BLUE  8 LT.BLUE"
3220 ? "9 TURQUISE 10 GREENBLUE"
3230 ? "11 GREEN{5 SPACES}12 YELLOW/G
     R"
3240 ? "13 ORANGE/GR 14 LI.ORANGE"
3245 TRAP 3400
3250 INPUT COL:?"{3 SPACES}Luminosity"
3260 ? " input(0-14)";
3270 INPUT LUM
3280 CLCHG=COL*16+LUM
3290 POKE 1646+DIS,CLCHG
3300 GOTO 3010
3400 TRAP 40000:POSITION 14,6:? "TRY
     AGAIN":FOR I=1 TO 100:NEXT I:POS
     ITION 14,6:? "{9 SPACES}":POSITI
     ON 14,6:GOTO 3245
3410 RDE=0:DRE=PEEK(1646+DIS):POSITIO
     N 14,9:? "COLOR REGISTER ";CHR$(
     K);"=";;"{3 SPACES}";"{3 LEFT}";
     DRE:GOTO 3100
```

# Creating Graphics On The Expanded VIC

Ed Harris

*This short program will simplify creating new character sets and graphics on an expanded VIC.*

Do you have more than 8K of RAM in your VIC? Do you want to make your own character set? Any character sets in RAM must be in the VIC's *internal* memory. When you add the first 8K memory expander, screen memory changes to 4096, and BASIC starts at decimal 4608, leaving no room to put your character set.

This program raises the bottom of memory to 8192 ($2000) and copies the character sets from 32768 to 35839 down into RAM starting at 5120 and going to 8191. You can then create new character sets or game graphics for use on your expanded VIC.

The BASIC program puts the machine code at $3000 and will be erased when you load a program.

All commands still work properly, and you can change from standard to custom characters with "POKE 36869,PEEK(36869) AND 240 OR 13" and restore to normal by "POKE 36869,PEEK (36869)AND 240 OR 0".

```
5 REM **************
6 REM FOR VICS WITH
7 REM  MORE THAN 8K.
8 REM  **************
9 REM  MOVES BASIC TO
10 REM 8192
11 REM *************
12 REM AND COPIES
13 REM CHARACTER SET
14 REM TO 5120-8191
15 REM *************
16 FORT=12288 TO 12379: READ N:POKE T,N:NEXTT
17 PRINT"{CLEAR}SYS12288":FORT=631TO633:POKET
   ,145
18 NEXT T
19 POKE634,13:POKE635,131:POKE198,5:END
20 DATA56,32,156,255,200,24,32,156,255
21 DATA 174,44,0,232,142,44,0,142,46
22 DATA 0,173,46,0,201,32,208,230,169
23 DATA 0,141,0,32,141,1,32,141,2
24 DATA 32,169,205,141,5,144,162,0,142
25 DATA 123,48,174,123,48,189,0,128,157
26 DATA 0,20,224,255,240,7,232,142,123
27 DATA 48,76,47,48,172,55,48,192,31
28 DATA240,14,200,140,55,48,174,52,48
29 DATA 232,142,52,48,76,42,48,96,96,0,0
```

# Vehicle Cost Performance

Linton S. Chastain

*Use your Radio Shack Color Computer to analyze your car's performance. The program is written for systems with 32K, Extended BASIC, and disk capability, but the article notes the necessary changes for use with 16K systems or for non-Extended BASIC systems with cassette.*

Have you ever wondered how much your car was costing to operate or whether you were getting good fuel performance? If so, you may want to load the following program and run it.

The program – "Vehicle Cost and Performance" – was written on a 32K Color Computer with Extended BASIC and disk drive. It requires a minimum of 4.813K to load and 12.727K to run, as is. If you have a 16K machine with Extended BASIC and a disk drive, you will have to use "Pclear1" and adjust lines 40 and 50 in order to run the program. Line 40's clear x is 10 times "MR" for safety. I have two years of data and a minimum of two entries per month, and have not run out of storage in memory.

Those of you who have a cassette recorder and non-Extended BASIC will have to make the following changes:

```
130 PRINT"5-READ OLD MASTER FILE":PRINT"FROM C
    ASSETTE
150 PRINT"7-WRITE NEW MASTER FILE":PRINT"TO CA
    SSETTE
670 OPEN"I",#-1,T$:PRINT"READING FILE: ";T$:IN
    PUT#-1,N
680 IFN>MR THEN PRINT"*** TOO MANY FILES ON CA
    SSETTE***":END
700 FORJ=1 TO N:INPUT#-1,A(J),D$(J),O(J),G(J),
    NO$(J),C(J):PRINTJ:NEXTJ
720 CLOSE:GOSUB1440
770 OPEN"O",#-1,T$:WRITE#-1,N
790 FORJ=1 TO N:PRINT#-1,A(J),D$(J),O(J),G(J),
    NO$(J),C(J):PRINTJ:NEXTJ
800 CLOSE:GOSUB1440
```

**CHANGE LINE 540 "PRINT @ 192, "STRING$(31,"-")" TO PRINT @ 192, "------------------------------"**

**CHANGE LINE 1140 "PRINT @ 320, "STRING$(62,32)" TO PRINT @ 320, "{type 62 spaces}"**

**CHANGE LINE 1350 "PRINT @ 320, "STRING$(32,32)" TO PRINT @ 320, "{type 31 spaces}"**

**CHANGE LINE 1580 "PRINT #-2, "STRING$(48,32);" TO PRINT #-2, "{type 48 spaces}";**

Those who have Extended BASIC do not have to change anything in lines 540, 1140, 1350, or 1580.

## Record Keeping

The program keeps records on Maintenance (accnt #4), Gas (accnt #5), Operating Fees (accnt #6), and Other (accnt #7). It also has two flags that are keyed to Dates. They remind you at least one month in advance of the event's due date, so that you can organize your budget and have time to accomplish the task. These two flags are in record position (J), one and two. You can use these two records to alert you to dates for needed oil changes or to the due dates of your tag, license, inspection, and insurance.

One word of caution about record numbers, "J = 1 to N": if you change a record number less than "N", you must enter the last record that is in memory in order to establish the proper "N" again. If you do not enter the last "N", then "N" will become the changed record number.

A third flag, in record position (J) three, keeps track of your vehicle's best MPG performance as well as the date of entry in which it occurred. This flag will flash on your screen if your present entry is equal to one MPG lower than your best MPG (recorded in record three) when you are in the "DISPLAY MILEAGE" section of the program. If you wish to tighten or loosen this criterion, you can change line :1260 IF G(3)-Z = >1 to anything smaller or larger than one.

## Making Hard Copies

This program also permits you to make a hard copy of the information generated by the program and/or its data base. You can make a hard copy of "Display Cost," "Display Mileage," "Display Data," and "Display Cost/Mile" by pressing shift down arrow when "PRESS ENTER FOR RETURN" appears on the screen. This action activates line 1540, which in turn activates an eight-line subroutine. The subroutine is very handy if you want a hard copy of text generated by a program. It is incorporated in my "Energy Monitor" program (**COMPUTE!**, August 1982, #27).

The nice thing about this subroutine is that it not only prints out what is on the screen, but it also allows you to control how much paper you wish to waste by controlling "VIM". "VIM" is defined as the last video text memory location which you want outputted to a printer. The Color Computer video memory occupies decimal mem-

ory 1024 through 1535. Each of the 16 lines has 31 memory locations plus the first memory of that line. For example, line one contains decimal memory location 1024 through 1055, while line two contains decimal memory location 1056 through 1087, and so forth until line 16.

This subroutine probably can be used on other computers as long as you are aware that the video memory location may be different; the number of each line's memory location and the number of lines may also be different. Try to incorporate the subroutine into your programs. On at least two occasions, it has helped me avoid having to write two different programs, one for the screen and one for the printer.

The second hard copy is generated in the "Display Data" part of the program. By pressing the up arrow, you will dump all records to your printer in nice, neat columns on a 80-character/line printer. This may come in handy if you are selling your car and the buyer wants a fairly complete record of maintenance and cost. However, if you want one or more of the data records, you can selectively print out each one by using shift down arrow, instead of the up arrow, while in the "Display Data" mode.

I hope you will find this program as useful as I have in helping keep track of cost and maintenance problems. It may help you make a more objective decision when purchasing your next vehicle or determining whether keeping your current vehicle might not be more cost effective.

```
10 'VEHICLE COST AND PERFORMANCE
40 CLEAR2000
50 MR=200:N=0
60 DIMA(MR),D$(MR),O(MR),G(MR),NO$(MR),C(MR)
70 CLS:AA=0:AB=0:AC=0:AD=0
80 PRINT"VEHICLE COST AND PERFORMANCE":PRINT:
   PRINT"COMMAND LIST #1"
90 PRINT"1-DISPLAY COST"
100 PRINT"2-DISPLAY MILEAGE"
110 PRINT"3-DISPLAY DATA"
120 PRINT"4-DISPLAY COST/MILE"
130 PRINT"5-READ OLD MASTER FILE FROM DISK"
140 PRINT"6-INPUT NEW DATA"
150 PRINT"7-WRITE NEW MASTER FILE TO DISK"
160 PRINT:INPUT"ENTER COMMAND BY NUMBER";R:IFR
   <1 OR R>7 THEN70
170 ON R GOSUB 470,1160,580,1410,650,190,740
180 GOTO70
190 CLS:PRINT:PRINT"ENTER THE FOLLOWING AS REQ
   UESTED"
200 PRINT:INPUT"INPUT N";R:N=R:IFN<0 THEN 200
210 INPUT"ACCOUNT CODE";R:A(N)=R:IFR<0 THEN 21
   0
220 INPUT"DATE (E.G. 07/31/82)";R$:R=LEN(R$):I
   FR<8 OR R>8 THEN 220
230 D$(N)=R$
240 INPUT"ODOMETER M=MILES OR K=KILOMETERS";R$

250 IFLEFT$(R$,1)="M" THEN 260 ELSE 270
260 INPUT"ODOMETER IN MILES";R:O(N)=R:IFR<0 TH
   EN 260 ELSE 280
270 INPUT"ODOMETER IN KILOMETERS";R:O(N)=R*.62
   :IFR<0 THEN 270
280 INPUT"FUEL MEASUREMENT G=GAL AND L=LITER";
   R$
290 IFLEFT$(R$,1)="G" THEN 300 ELSE 310
300 INPUT"AMOUNT OF FUEL IN GAL.";R:G(N)=R:IFR
   <0 THEN 300 ELSE 320
310 INPUT"AMOUNT OF FUEL IN LITER";R:G(N)=R/3.
   785:IFR<0 THEN 310
320 INPUT"NOTE";R$:NO$(N)=R$:R=LEN(R$):IFR>10
   THEN 320
330 INPUT"COST";R:C(N)=R
340 CLS:PRINT:PRINTTAB(3);"CHECK    N:";N
350 PRINTTAB(3);"    ACC #:";A(N)
360 PRINTTAB(3);"    DATE:";D$(N)
370 PRINTTAB(3);"    ODOMETER:";O(N)
380 PRINTTAB(3);"    FUEL:";G(N)
390 PRINTTAB(3);"    NOTE:";NO$(N)
400 PRINTTAB(3);"    AMT:";C(N)
410 PRINT:PRINT"   -IS INPUT O.K.?-":PRINT
420 INPUT"(Y=YES,N=NO,F=YES AND FINISHED)";R$:
   R$=LEFT$(R$,1)
430 IFR$="N" THEN PRINT"REDO LAST DATA":GOTO20
   0
440 IFR$="F" THEN RETURN
450 IFR$<>"Y" THEN 420
460 GOTO200
470 VIM=1279:FORJ=4 TO N
480 IFA(J)=4 THENAA=AA+C(J)ELSE490
490 IFA(J)=5 THENAB=AB+C(J)ELSE500
500 IFA(J)=6 THENAC=AC+C(J)ELSE510
510 IFA(J)=7 THENAD=AD+C(J)
520 NEXTJ
530 AE=AA+AB+AC+AD
540 CLS:PRINT@0,"CATEGORY","COST":PRINT@64,"MA
   INTENANCE",AA:PRINT@96,"GAS",AB
545 PRINT@128,"OPER. FEES",AC:PRINT@160,"OTHER
   ",AD:PRINT@192,STRING$(31,"-")
549 PRINT@224,"TOTALS",AE
550 YR(3)=2:YR(4)=2:MO(3)=2:MO(4)=2:E=0:F=0:GO
   SUB820
560 GOSUB1440
570 RETURN
580 VIM=1247:K=0:L=0:CLS
590 K=K+1:L=L+1:IFL>N THEN L=N
600 FORJ=K TOL:PRINT"N",J:PRINT"ACCNT",A(J):PR
   INT"DATE",D$(J):PRINT"MILEAGE",O(J):P
   RINT"FUEL",G(J)
605 PRINT"NOTE",NO$(J):PRINT"AMOUNT",C(J):NEXT
   J:PRINT
610 PRINT@384,"PRESS ↑ TO PRINT TO PRINTER"
620 IFPEEK(341)=247 THEN 1480
630 IFL=N THEN GOSUB1440:RETURN
640 PRINT@416,"HIT ENTER TO CONTINUE":GOSUB144
   0:CLS:VIM=1279:GOTO590
650 R$="READING":PRINT
660 INPUT"NAME OF FILE";T$
670 OPEN"I",#1,T$:PRINT"READING FILE: ";T$:INP
   UT#1,N
680 IFN>MR THEN PRINT"*** TOO MANY FILES ON DI
   SK ***":END
690 PRINT"READING RECORDS # ";
700 FORJ=1 TO N:INPUT#1,A(J),D$(J),O(J),G(J),N
   O$(J),C(J):PRINTJ:NEXTJ
710 PRINTN;" DATA RECORDS READ"
720 CLOSE#1:GOSUB1440
730 RETURN
740 IFN<1 THEN PRINT"*** NO DATA TO WRITE ***"
   :GOSUB1440:RETURN
750 R$="WRITING":PRINT
760 INPUT"NAME OF FILE";T$
770 OPEN"O",#1,T$:WRITE#1,N
780 PRINT"WRITING FILE: ";T$:PRINT"     RECORD
   S # ";
790 FORJ=1 TO N:WRITE#1,A(J),D$(J),O(J),G(J),N
   O$(J),C(J):PRINTJ:NEXTJ
800 CLOSE#1:GOSUB1440
810 RETURN
820 YR$(0)=RIGHT$(D$(N),2):YR$(1)=RIGHT$(D$(1)
   ,2):YR$(2)=RIGHT$(D$(2),2)
```

```
830 YR(0)=VAL(YR$(0)):YR(1)=VAL(YR$(1)):YR(2)=
    VAL(YR$(2))
840 YR(3)=YR(1)-YR(0):YR(R)=YR(2)-YR(0)
850 IFYR(3)=0 OR YR(3)=1 THEN GOSUB970 ELSE 86
    0
860 IFYR(4)=0 OR YR(4)=1 THEN GOSUB880 ELSE RE
    TURN
870 RETURN
880 MO$(0)=LEFT$(D$(N),2):MO$(2)=LEFT$(D$(2),2
    )
890 MO(0)=VAL(MO$(0)):MO(2)=VAL(MO$(2))
900 MO(4)=MO(2)-MO(0)
910 IFYR(4)=0 THEN 920 ELSE 930
920 IFMO(4)=0 OR MO(4)=1 THEN MO(4)=0 ELSE MO(
    4)=1
930 IFYR(4)=1 THEN 940 ELSE 950
940 IFMO(4)=-10 OR MO(4)=-11 THEN MO(4)=0 ELSE
     MO(4)=1
950 IFMO(4)=0 THEN F=2 ELSE F=0
960 GOTO1070
970 MO$(0)=LEFT$(D$(N),2):MO$(1)=LEFT$(D$(1),2
    )
980 MO(0)=VAL(MO$(0)):MO(1)=VAL(MO$(1))
990 MO(3)=MO(1)-MO(0)
1000 IFYR(3)=0 THEN 1010 ELSE 1020
1010 IFMO(3)=0 OR MO(3)=1 THEN MO(3)=0 ELSE M
    O(3)=1
1020 IFYR(3)=1 THEN 1030 ELSE 1040
1030 IFMO(3)=-10 OR MO(3)=-11 THEN MO(3)=0 EL
     SEMO(3)=1
1040 IFMO(3)=0 THEN E=1 ELSE E=0
1050 IFMO(3)=0 THEN GOSUB1090 ELSE1070
1060 RETURN
1070 E=0:IFMO(4)=0 THEN GOSUB1090 ELSE RETURN
1080 GOTO560
1090 FORI=1 TO 10
1100 GOSUB1120
1110 NEXTI
1120 PRINT@320,D$(E),NO$(E),D$(F),NO$(F)
1130 FORH=1 TO 300:NEXTH
1140 PRINT@320,STRING$(62,32):FORH=1 TO 300:N
    EXTH
1150 RETURN
1160 VIM=1119:CLD:PRINT"OVERALL MILES PER GAL
    LON":PRINT:PRINT"COMMAND LIST # 2"
1170 PRINT:PRINT"1-DISPLAY MILES/GALLON"
1180 PRINT"2-RETURN TO COMMAND LIST #1"
1190 INPUT"ENTER COMMAND BY NUMBER";R:IFR<1
    OR ~R>2 THEN 1160
1200 ON R GOSUB 1210,1400:GOTO1160
1210 X=0:Y=0:Z=0:FORJ=4 TO N
1220 X=(O(N)-O(4)):Y=Y+G(J)
1230 NEXTJ
1240 Z=X/Y:Z=INT(Z*100):Z=Z/100
1250 CLS:PRINT"TOTAL MILEAGE",X:PRINT"TOTAL
    GALLONS";Y:PRINT"MILES/GALLON",Z
1260 IFG(3)-Z=>1 THEN GOSUB 1300
1270 IFZ>G(3) THEN D$(3)=D$(N) ELSE D$(3)=D$(3)

1280 IFZ>G(3) THEN G(3)=Z ELSE G(3)=G(3)
1290 GOTO1380
1300 FORI=1 TO 10
1310 GOSUB 1330
1320 NEXTI
1330 PRINT@320,D$(N),"POOR PERFORMANCE"
1340 FORH=1 TO 300:NEXTH
1350 PRINT@320,STRING$(31,32):FORH=1 TO 300:N
    EXTH
1360 RETURN
1370 RETURN
1380 GOSUB1440
1390 RETURN
1400 GOTO70
1410 VIM=1055:CLS:PRINT"COST/MILE =";"$";AE/X
1420 GOSUB1440
1430 RETURN
1440 PRINT@448,"PRESS ENTER TO RETURN"
1450 B$="":R$=INKEY$:IFR$=B$ THEN 1450
1460 IFPEEK(342)=247 THEN 1540 ELSE 1470
1470 RETURN
1480 POKE153,10:POKE154,66:POKE115,80
1485 PRINT#-2,"N","ACCNT","DATE","MIL.","FUEL",
    "NOTE","AMOUNT"
1490 PRINT#-2,CHR$(10)
1500 FORJ=1 TO N
1510 PRINT#-2,J,A(J),D$(J),O(J),G(J),NO$(J),C(J
    )
1520 NEXTJ
1530 RETURN
1540 ZW=0:FORZX=1024 TO VIM:ZW=ZW+1
1550 ZY=PEEK(ZX)
1560 IFZY=>96 AND ZY<128 THEN ZY=ZY-64 ELSE ZY=
    ZY
1570 PRINT#-2,CHR$(ZY);
1580 IFZW=32 THEN PRINT#-2,STRING$(48,32);
1590 IFZW=>32 THEN ZW=0
1600 NEXTZX:PRINT#-2,CHR$(32)
1610 RETURN
```

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Using *your* computer in an interesting application? Write it up for other **COMPUTE!** readers to use.

# Joysticks And Sprites On The Commodore 64

Sheldon Leemon

As the owner of an Atari 800 computer, I welcomed Commodore's announcement of the Model 64 computer, because it closely parallels the Atari in its consumer orientation. One example is the inclusion of two ports for Atari-type joystick controllers. These controllers provide a simple way for the user to interact with any type of program, including, of course, arcade games.

## A Fascinating Chip

When I bought the computer, however, I discovered, to my dismay, that the consumer-oriented design approach did not seem to carry through to the BASIC interpreter and *User's Guide*. Not only was there no BASIC command for reading the joystick controllers, but the BASIC manual also made no mention whatever of these ports! This meant that if I discovered how to use these sticks any time soon, I would have to play hardware detective.

Fortunately, the 64 is quite similar to the VIC-20 in a number of ways. Since the VIC reads the joystick through the VIA (Versatile Interface Adapter) chip, it stands to reason that the 64 would read its joystick through the analogous CIA (Complex Interface Adapter) chip. An early memory map from Commodore shows CIA #1 to be addressed at location DC00, or 56320 decimal. The CIA is a fascinating I/O chip, and could well serve as the basis for an article in itself, but here I'll focus attention on the registers that read the joysticks.

Like the VIC-20, the 64 uses Peripheral Data Registers A and B to read these sticks, and I/O (input/output) through these registers is controlled by Data Direction Registers A and B. These registers are addressed at the chip's first four locations, so that on the 64 Data Register A is addressed at 65320, Register B is addressed at 56321, and Data Direction Registers A and B are addressed at 56322 and 56323, respectively.

## Reading The Joysticks

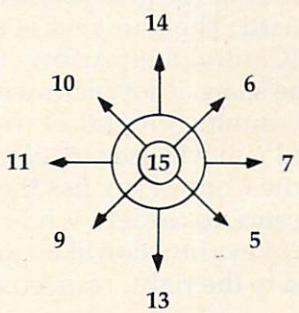
Knowing this, with a bit of trial and error I was able to figure out how to read the joysticks. A quick try seemed to indicate that it was not necessary to write to the Data Direction Registers before reading the sticks, as must be done on the VIC-20. Checking the values of Registers A and B while moving joysticks connected to Control Ports 1 and 2 revealed that the data from the stick connected to Control Port 1 appeared in Register B, and that the data from the stick in Port 2 showed up in Register A. This observation conflicts slightly with the memory map which Jim Butterfield published in the October issue of **COMPUTE!**. That map shows that Register A controls Joystick 0, and Register B controls Joystick 1.

The relationship of the data returned in the register to the direction of stick movement is exactly the same as on the Atari. Each of the low bits (0-3) corresponds to one of the switches that is closed by moving the stick in one of the four primary directions. These bits are normally set to 1, but are reset to 0 when the corresponding switch is closed. Bit 0 corresponds to the up switch, bit 1 corresponds to the down switch, bit 2 is left, and bit 3 right. Bit 4 is used to read the joystick trigger button. It is set to 1 normally, and reset to 0 if the button is pushed.

What this means to the hardware-weary reader who has borne with me thus far, patiently waiting for an explanation in plain English of how to use the Commodore 64 joysticks, is that it takes only a couple of BASIC statements to do the job. Those familiar with the Atari system of numbering the joystick positions (as I am) may want to use the following statements:

```
S1=PEEK(56321) AND 15: REM Reads Stick 1
S2=PEEK(56320) AND 15: REM Reads Stick 2
```

Because these registers can contain irrelevant information in bits 4-7, the logical AND is used to mask (block out) those bits. The figure below shows the way in which the number returned in variable S1 or S2 corresponds to the direction in which the stick is pushed.



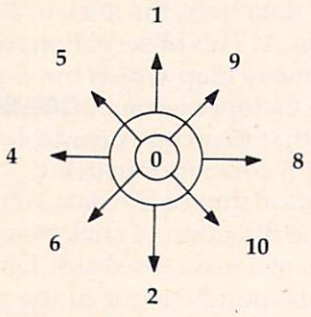

To read the trigger buttons, the following statements will return a 1 if a button is pressed, and a 0 if it is not:

```
T1=-((PEEK(56321) AND 16)=0)
T2=-((PEEK(56320) AND 16)=0)
```

Of course, if you prefer a system where the variable will be 0 when the stick is not pressed, you can use the logical operator NOT to adjust the values accordingly.

```
S1=NOT PEEK(56321) AND 15
S2=NOT PEEK(56320) AND 15
```

This will produce the following pattern:




## A Keyboard Bonus

The variations on these basic schemes are limited only by your applications. If you are using the joystick for an action game, for example, you may want to read the change in horizontal position and vertical position separately. You can do this with the following formulas:

```
H1=((PEEK(56321) AND 15)=4) - ((PEEK(56321)
  AND 15)=8)
H2=((PEEK(56320) AND 15)=4)-((PEEK(56320 AND
  15)=8)
V1=((PEEK(56321) AND 15)=1) - ((PEEK(56321) AND
  15)=2)
V2=((PEEK(56320) AND 15)=1)-((PEEK(56320) AND
  15)=2)
```

The value of H1 will be 1 if the stick is pressed to the right, -1 if the stick is pressed to the left, and 0 if centered. Likewise, the value of V1 will be -1 for an upward press, 1 for a downward press, and 0 if the stick is centered. If you wish, you can even read each switch separately. Program 1, short and not exciting, demonstrates the technique.

One interesting sidelight demonstrated with this program is the fact that some CIA registers that are used to read the joysticks are used also to read the keyboard. The four keys at the top left of the keyboard (Control, Left Arrow, 1, and 2) are read exactly the same as joystick switches 0-3. While you are running Program 1, try pressing these keys, and you will see what I mean.

Pressing the Control key has the same effect as moving the stick to the left, while the Left Arrow, 1, and 2 keys function like a joystick moved down, up, and to the right, respectively.

## Graphics Movement

The initialization routine, which I have put out of the way at the back of the program, starting with line 1000, sets up a flying saucer in double width, and then returns to the movement loop at line 2. The ON-GOSUB routes the program to the proper line number without having to test each stick position, which would slow down the loop.

There are a couple of points to note. First, the registers that designate sprite horizontal and vertical positions are not write-only registers, as are the Atari horizontal position registers. This means that you can find out the current position of the sprite just by reading those registers, without having to set up separate RAM variables to keep track of them as must be done on the Atari. I set up variables %X and %Y in Program 2 only for purposes of readability.

To move a sprite one position to the right, we need only read the current horizontal position, add 1, and POKE that number back into the horizontal position register. Of course, you must keep in mind that you can't POKE in a value less than 0 or greater than 255. If you examine the move-down and move-up subroutines at lines 80 and 90, you will see that I have incorporated logical statements to move the sprite to the bottom of the screen if it hits the upper limit, and which will move it to the top if the value tries to get below 0. This wraparound feature guarantees that no errors will result from trying to POKE in an illegal quantity.

## The Horizontal "Seam"

A more complicated situation arises when we deal with horizontal movement. Because there are 320 horizontal positions available, but only 256 combinations which can be accessed from the horizontal position register, we need to set the Most Significant Bit in the register located at 53264 whenever we wish to use a horizontal position between 256 and 320. Any time the sprite moves into or out of this zone, therefore, special handling of this bit will be required.

Accordingly, the horizontal movement routines (lines 40-45 and 70-75) have to test to see if this "seam" is encountered before moving the sprite. If the horizontal position register reads 0, for example, we don't know whether the sprite is located at the left edge of the screen or at the "seam" (i.e., location 256) until we check the MSB register. This extra checking is time consuming, and as a result the saucer moves noticeably faster up and down than it does right and left.

Because of the slowness of the motion in BASIC, I have multiplied all motion by the factor WUN, which is defined in line 1005, and which can be set from 1 to 3. When its value is 1, the motion is very smooth, but extremely slow. When it is 3, each push of the stick changes the position of the sprite by three places, speeding up the motion, but making it somewhat jerky.

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## Machine Language Motion

The best solution to the problem of achieving quick, smooth motion is the use of a machine language subroutine which will read a joystick, and move the sprite accordingly. Program 3 uses just such a subroutine. Though I POKE it into memory starting at C000 (49152 decimal), it is completely relocatable.

If it later proves that this large block of free RAM can be better used otherwise, you will be able to move the routine with no rewriting. You should be aware, however, that, as written, the routine checks only the joystick in Port 1, and moves only Sprite 0 in response to movement of that stick. Since some lines of Program 3 duplicate those of Program 2, you may want to edit the latter program rather than typing in Program 3 from scratch.

One difference that you will notice immediately is that this program asks you to select a speed (you should respond with a value from 1-5). The reason for this is that I wanted to demonstrate the degree to which even a machine-language subroutine is slowed down by BASIC. At Speed 1, each time through the loop the program calls the subroutine once and returns to BASIC. Though this produces smooth motion, it is still somewhat slow. At Speed 2, the program calls the subroutine twice in a row before returning, and so on up to Speed 4, which produces rather quick motion. At Speed 5, the machine language subroutine goes into a continuous loop, without ever returning to BASIC. At this speed, if you push on the stick diagonally, it will appear as if there are dozens of saucers on the screen at once!

Though my examples may seem most applicable to game programs, do not overlook the joysticks as input devices for more "mundane" tasks. Because each stick has only four switches, it limits the number of choices available to the user. It therefore reduces the number of mistakes that can be made, as compared with a keyboard, which has over 60 keys, each key having both a shifted and non-shifted value.

## Program 1.

```
10 FOR I=1 TO 25:DOWN$=DOWN$+CHR$(17):NEXT:HO
   ME$=CHR$(19):PRINTCHR$(147);CHR$(5)
15 PRINT" THIS PROGRAM READS STICK #1":PRINT"
    INSERT JOYSTICK, AND MOVE IT AROUND!
   "
20 S=NOT PEEK(56321) AND 15
30 UP=S AND 1:IF UP THEN PRINT HOME$;LEFT$(DO
   WN$,10);TAB(15);"UP   ";:GOTO 50
40 DOWN=S AND 2:IF DOWN THEN PRINT HOME$;LEFT
   $(DOWN$,10);TAB(15);"DOWN ";
50 LEFT=S AND 4:IF LEFT THEN PRINT HOME$;LEFT
   $(DOWN$,10);TAB(25);"LEFT ";:GOTO70
60 RIGHT=S AND 8:IF RIGHT THEN PRINT HOME$;LE
   FT$(DOWN$,10);TAB(25);"RIGHT";
70 IF S=0 THEN PRINT HOME$;LEFT$(DOWN$,10);TA
   B(15);"                "
80 GOTO 20
```

## Program 2.

```
1 GOTO 1000
2 S=PEEK(S0)AND15:ONSGOSUB3,3,3,3,20,30,40,3
   ,50,60,70,2,80,90,3:GOTO2
3 RETURN
20 GOSUB 40:GOSUB 80:RETURN
30 GOSUB 40:GOSUB 90:RETURN
40 X%=X%+WUN :IF X%>255 THEN X%=0:POKE SP+16,
   1
43 IF X%>65 AND PEEK(SP+16)=1 THEN POKE SP+16
   ,0:X%=0
45 POKEHP,X%:RETURN
50 GOSUB 80:GOSUB 70:RETURN
60 GOSUB 90:GOSUB 70:RETURN
70 X%=X%-WUN:IF X%<1 AND PEEK(SP+16)=1 THEN X
   %=255:POKE SP+16,0
73 IF X%< 1 AND PEEK(SP+16)=0 THEN X%=65:POKE
    SP+16,1
75 POKEHP,X%:RETURN
80 Y%=Y%+WUN+HI * (Y%>HI):POKEVP,Y%:RETURN
90 Y%=Y%-WUN-HI * (Y%<WUN):POKEVP,Y%:RETURN
1000 FORI=871TO895:POKEI,0:NEXT:FOR I=832TO870:
   READA:POKEI,A:NEXT:SP=53248
1005 HP=SP:VP=SP+1:X%=160:Y%=100:WUN=3:HI=252:S
   0=56321
1010 POKESP+21,1:POKE2040,13:POKESP+39,6:POKESP
   +29,1:POKEHP,X%:POKEVP,Y%
1020 POKESP+32,0:POKESP+33,0:PRINTCHR$(147)
1030 FORI=1 TO 50:POKE 1024+INT(RND(0)*1000),46
   :NEXT
1040 DATA 0,56,0,0,124,0,0,254,0,0,170,0,1,171,
   0,15,255,224,15,255,224,13,85,96
1050 DATA 13,85,96,15,255,224,15,255,224,0,254,
   0,0,124,0
1060 GOTO 2
```

## Program 3.

```
10 PRINTCHR$(147);CHR$(5): INPUT"SPEED ";S:GO
   TO 1000
20 ON S GOTO 30,40,50,60,70
30 SYS(49409):GOTO 30
40 SYS(49406):GOTO 40
50 SYS(49403):GOTO 50
60 SYS(49400):GOTO 60
70 SYS(49413):GOTO 70
1000 FORI=871TO895:POKEI,0:NEXT:FOR I=832TO870:
   READA:POKEI,A:NEXT:SP=53248
1010 POKESP+21,1:POKE2040,13:POKESP+39,6:POKESP
   +29,1:POKESP,160:POKESP+1,100
1020 POKESP+32,0:POKESP+33,0:PRINT CHR$(147)
1030 FORI=1 TO 50: POKE 1024+INT(RND(0)*1000),4
   6:NEXT
1040 DATA 0,56,0,0,124,0,0,254,0,0,170,0,1,171,
   0,15,255,224,15,255,224,13,85,96
1045 DATA 13,85,96,15,255,224,15,255,224,0,254,
   0,0,124,0
1050 FOR I=1 TO 101:READ A:POKE 49151+I,A:NEXT
1055 FOR I=1 TO 19:READ A:POKE 49399+I,A:NEXT:G
   OTO 20
1060 DATA 173,1,220,74,176,3,206,1,208,74,176,3
   ,238,1,208,74,176,38,173
1070 DATA 0,208,208,15,173,16,208,41,1,240,12,1
   73,16,208,41,254,141,16
1080 DATA 208,206,0,208,96,173,16,208,9,1,162,6
   3,141,16,208,142,0,208,96
1090 DATA 74,176,32,238,0,208,240,28,173,16,208
   ,41,1,240,20,169,64,205
1100 DATA 0,208,208,13,173,16,208,41,254,162,0,
   141,16,208,142,0,208,96
1110 DATA 173,16,208,9,1,141,16,208,96
1200 DATA 32,0,192,32,0,192,32,0,192,32,0,192,9
   6,32,0,192,76,5,193
```

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# Assembly Language And The PET

R. D. Wink

*Designed for those as yet unfamiliar with machine language programming, this tutorial presents a detailed analysis of a simple machine language program which computes factorials.*

Interested in machine language programming? Find the books tough going? This article could be for you!

As a PET owner who is fairly competent in BASIC, I have often wanted to try my hand at writing machine language programs. Yet, as I worked through several texts on the topic, I found that they are apparently written for readers who already have a good grasp of the basics. Perhaps I'm a little slow at catching on, so this article is written for those who, like me, might be interested in a line-by-line analysis of a simple program. The program calculates the factorial function to a precision in excess of 80 digits and is written in 6502 assembly language. Hex dumps and a BASIC loader program are provided for those who do not have access to an assembler.

The factorial is a mathematical function useful in probability studies. N factorial (written N!) is defined as:

**N! = N x (N-1) x (N-2) x...2 x 1**

As an example, 5! = 5x4x3x2x1 = 120. A few moments thought will show that as N gets bigger, the value of N! rapidly becomes vast. Indeed 69! is of the order of ten to the 99th. This function was chosen because it is complicated enough to require multiple-precision (see below), yet it avoids the problems that decimal fractions cause the machinne language programmer.

Since the 6502 microprocessor does not have a built-in multiplication function, multiplication must be accomplished by repeated addition. Also, since the 6502 is an eight-bit processor, the largest number it can handle in one operation is 255 – not a very promising start for a number like 69!. In fact, using only a single eight-bit word (byte), the largest factorial that can be computed is 5! or 120. 6! is 720, and this is too large to be held in a single byte. Obviously, it will be necessary to use a series of consecutive bytes to represent the big numbers involved and then to handle these numbers a byte at a time. This is what is meant by the term "multiple precision."

We shall first write a BASIC program which computes factorials (though only to nine-digit precision), and then we shall make a line-by-line comparison between this and the assembly code version. The first version in Program 1 uses multiplication. Line 5 sets the initial value of the product P to one. Line 10 calls the required factorial (e.g., 3! means that N is 3). Lines 15 to 25 multiply the existing product value by values of N which are reduced by one each time around the loop. The first time through line 15, P is three. The next time P is 3x2 or six, and the last time P is 3x2x1 which is still six.

We shall now replace the multiplication in line 15 with a subroutine which does the same job, but by using repeated addition (Program 2). This subroutine requires the use of two new variables C and M. C is a counter which is set equal to N at the start of the subroutine. It is used to count the number of additions which have taken place. M is a variable which holds the successive sums needed in the multiplication process.

For example, suppose the routine is to do the multiplication 7x6 where P = 7 and N = 6. Lines 110-120 cause the number seven to be added to the variable M six times:

**7+7+7+7+7+7=6 x 7**

The result, 42, is stored in the variable P prior to a return to the main program. The reader should understand that the product (line 15) P = P*N has been replaced by an equivalent subroutine which uses only addition.

As we discuss the assembly language version of the program, we shall make frequent reference to three registers in the microprocessor. The contents of any byte of memory may be copied into the accumulator, the X or the Y register, with the

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appropriate load instruction, LDA, LDX, or LDY. The contents of these registers may be sent to any memory location using the store instructions STA, STX, and STY. Moving a number between these registers is managed with the transfer instructions (e.g., TXA moves the contents of the X register into the accumulator). Arithmetic is done using the accumulator. The contents of a memory location may be added to the contents of a memory location may be added to the contents of the accumulator using the ADC or "add with carry" instruction. The result of the addition remains in the accumulator, and, if the sum exceeds 255, a special bit called the carry flag is set so that on the next addition the "carry one" is added in.

We are now ready to translate the BASIC program (Program 2) into a single precision assembly language program. A corresponding BASIC method is in parentheses in the comment column.

| | |
|---|---|
| 1. *=$33A | An assembler instruction that sets the start of memory into which the machine code is to be assembled. Hex 33A is the start of the second cassette buffer, which is usually not used and is a "safe" location. |
| 2. SED | Puts the 6502 into decimal mode. Easier for us beginners to work with than hex. Each byte contains a two-digit decimal number less than 100. |
| 3. JSR INITP | Jump to subroutine "INITP" which initializes P (5 P=1). |
| 4. FOUR LDA FACT | Put the value of the required factorial into the accumulator (10 INPUT N). |
| 5. STA C | Store the contents of the accumulator in the variable C (100 C=N). |
| 6. JSR ZERM | Jump to subroutine ZERM which initializes the variable/memory location M (105 M=0). |
| 7. THREE JSR ADD | Jump to subroutine ADD (110 M=M+P). |
| 8. DEC C | Decrement the value of C (115 C=C-1). |
| 9. BNE THREE | If the last value operated on (C) is not zero, then branch to label THREE, line 7 above (120 IF C<>9 THEN 110). |
| 10. JSR MTOP | Jump to subroutine M TO P (125 P=M). |
| 11. DEC FACT | Decrement the value of FACE (20 N=N-1). |
| 12. BNE FOUR | Branch to label FOUR if the last operand "FACT" is not zero (25 IF N<>0 THEN 15). |
| 13. CLD | Clear decimal mode. If we don't return microprocessor to its normal hex mode, PET throws a fit on return to BASIC. |
| 14. BRK | (35 STOP) |

Now the four subroutines referenced above:

| | |
|---|---|
| 15. INITP LDA #1 | Place 1 in the accumulator. |
| 16. STA P | Place 1 in P. |
| 17. RTS | Return. |
| 18. ZERM LDA #0 | Place zero in the accumulator. |
| 19. STA M | Place zero in M. |
| 20. RTS | Return. |
| 21. ADD CLC | Clear the "carry" flag prior to addition. |
| 22. LDA M | Load the accumulator with contents of M. |
| 23. ADC P | Add to the contents of the accumulator the contents of P. |
| 24. STA M | Store the result of the addition in M. |
| 25. RTS | Return. |
| 26. MTOP LDA M | Copy the value of M into the accumulator. |
| 27. STA P | Store the value in location P. |
| 28. RTS | Return. |
| 29. FACT .BYTE 4 | Assembler instructions which reserve space for the variables. |
| 30. C .BYTE 0 | FACT, C, P, and M. (The precise method of doing this varies depending on the assembler used.) |
| 31. P=* | |
| 32. M=*+1 | |
| 33. .END | |

The program listed above can be assembled and run, though it is probably not worth the trouble of typing it all in and assembling it, merely to have the number 4! or 24 appear in the byte which P represents. Program 3 contains the assembled code, and the reader may wish to use the resident monitor in the Upgrade ROM PET to test the program. Type SYS 4 and press RETURN in order to call the monitor. Display the appropriate memory locations by typing M 033A, 037A RETURN. The screen should fill with hex codes, which should be carefully replaced by those listed in Program 3. At the end of each line, be sure to press RETURN in order to enter the code into memory.

After 037A has been completed, type G 033A, RETURN in order to run the program from the start. After a moment, the microprocessor registers should be displayed and the reader will note that the accumulator (AC) contains the number 4! or 24 where 4 was the number placed in the variable FACT. The memory locations can be relisted by moving the cursor back up to the line M 033A, 037A and pressing RETURN. Watch the location 0379, which is P, change to 24. The location 0377, immediately after hex code 60, is FACT. Use the cursor controls to change it from 00 to 05. Press RETURN, cursor down to G 033A and press RETURN, again. Relist the memory locations 033A, 037A and note that P (0379) now contains the number 20, which is the last two digits of 5! or 120. Code X will return control to BASIC.

It is fairly simple to compare the assembled code in Program 3 with the assembly language program. Looking at the line.: 033A F8 20 59 03 AD 77 03, we may interpret the codes as F8=SED, 20=JSR, 59 03 is address 359 where subroutine INITP starts, AD=LDA, and 77 03 refers to location 377, which is FACT.

This article has so far described a simple assembly language program which computes factorials. Since the routine is only single precision, the largest factorial that can be handled is 5! or 120. The reader will have noticed that subroutines were extensively used; although this slows down the execution time, it will now make program revision much simpler.

The rest of the article describes the modifications necessary to incorporate multiple precision

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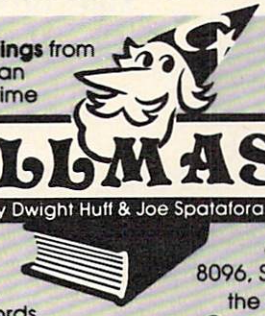

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and a way of linking the machine code to a simple BASIC program which displays the results in a more palatable form.

We shall extend the precision to 40 bytes (or 80 significant decimal digits) merely by altering the subroutines. The mainline program is unchanged. Eighty-digit precision was chosen as being the maximum that could be fitted into the memory available in the second cassette buffer.

The variables, P and M, should now be considered as 40 consecutive bytes each, rather than as the single byte allowed in the previous subroutines. Each of the bytes in P can be addressed as P+0, P+1, P+2...P+39, and similarly with M. In order to avoid massive duplication of code, a technique called "indexed addressing" will be used.

Consider the subroutine INITP, which originally had the function of initializing P to a value of one. In the multiple precision scheme, we shall need to place 00 in locationns P+0, P+1...P+38 inclusive, and 01 in the least significant byte P+39. In this way P is initialized to 000000000000 000000000000000000000000000000000000000000000 00000000000000000000001.

A loop is used to place the zeros in the first 39 bytes, together with the instruction STA P,X. This instruction copies the contents of the accumulator into location P+X of the variable P, where X is the contents of the X Index register. If X is initialized to 38, and the accumulator contains zero, then the instruction STA P,X will place zero in the location P+38. The value of X can then be decremented (reduced by one) each time around the loop so that P+37, P+36, etc., will each have zero copied into them.

```
INITP  LDX #39     Place 39 into the X index register.
       LDA #0      Place zero into the accumulator.
ONE    DEX         Decrement the X register (first value=38).
       BMI FIN     If the X register contents is less than zero,
                   branch to label FIN.
       STA P,X     Store zero in byte P+X.
       JMP ONE     Go to label ONE.
FIN    LDA #1      Place one in the accumulator.
       STA P+39    Store one in the byte P+39.
       RTS         Return.
```

Subroutine ZERM sets the value of M equal to zero and so must be modified to place 00 in each of the bytes M+0, M+1, M+2...M+39.

```
ZERM   LDY #40     Place 40 into the Y index register.
       LDA #0      Place zero into the accumulator.
TWO    DEY         Decrement the Y register (first value=39).
       BMI RET     Branch on a negative value of Y to label RET.
       STA M,Y     Store zero in byte M+Y.
       JMP TWO     Go to label TWO.
RET    RTS         Return.
```

Subroutine ADD first loads the accumulator with the least significant byte of M (M+39). The least significant byte of P (P+39) is added to it, and the carry flag is set if the result exceeds 99. The sum is then placed in byte M+39, replacing the previous contents. The process is then repeated with bytes M+38 and P+38, except that the "carry" will be added in if appropriate. The addition of corresponding bytes continues for P+37, P+36, etc., all the way down to P+0.

```
ADD    LDY #40     Place 40 in the Y register.
       CLC         Clear the carry flag prior to addition.
LOOP   DEY         Decrement the Y index register (first
                   value=39).
       BMI DONE    Branch on a negative value of Y to label DONE.
       LDA M,Y     Place the contents of byte M+Y in the
                   accumulator.
       ADC P,Y     Add (with carry) the contents of P+Y to
                   accumulator.
       STA M,Y     Place the sum in byte M+Y.
       JMP LOOP    Go to label LOOP.
DONE   RTS         Return.
```

Subroutine MTOP transfers the contents of all 40 bytes of M to the corresponding 40 bytes of P.

```
MTOP   LDX #40     Place 40 in the X register.
SIX    DEX         Decrement the X index register (first
                   value=39).
       BMI FIVE    Branch on a negative value of X to label FIVE.
       LDA M,X     Place byte M+X in the accumulator.
       STA P,X     Copy the contents of the accumulator into
                   byte P+X.
       JMP SIX     Go to label SIX.
FIVE   RTS         Return.
```

These subroutines, together with the original mainline program, can be assembled and run using the resident machine language monitor. An assembled version is listed in Program 4, and it can be entered using the monitor. Location 039C contains FACT and this is set to a value of six in Program 4. The 40 bytes from 039E to 03C5 are the variable P. If the program is run with the instruction G 033A and memory listed using M 039E, 03C5, then the answer 720 can be seen in the least significant bytes.

The required factorial should be converted to hex and placed in location 039C prior to running the program. If 20! is to be computed, then hex value 14 (16+4) is placed in this byte. The answer will appear in decimal form when M 039E, 03C5 is listed. For 20!, the result is 2432902008176640000 and the largest factorial which can be displayed fully is 58! (hex 3A). If it is required to link the program to BASIC, the BRK instruction (00) must be replaced by RTS (60) in location 0358. You can then save the routine using the monitor and write a BASIC program which calls it using SYS 826.

Program 5 is a BASIC listing which obtains the machine codes from data statements and POKEs them into the second cassette buffer. Note that each hex code has been converted into its decimal equivalent as required by the POKE instruction. The second portion of the program requests the required factorial and prints the answer in two lines on the screen.

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code will have to be assembled into the high end of RAM memory, so that a BASIC calling program can be used. The end of BASIC pointer can be lowered and the precision extended up to 255 bytes or 510 digits. I hope that readers will find this article a simple way of getting their feet wet exploring 6502 machine and assembly language.

## Program 1.

```
5  P=1
10 INPUT N
15 P=P*N
20 N=N-1
25 IF N<>0 THEN 15
30 PRINT P
35 END
```

## Program 3.

```
033A F8 20 59 03 AD 77 03 8D
0342 78 03 20 5F 03 20 65 03
034A CE 78 03 D0 F8 20 70 03
0352 CE 77 03 D0 E7 D8 00 A9
035A 01 8D 79 03 60 A9 00 8D
0362 7A 03 60 18 AD 7A 03 6D
036A 79 03 8D 7A 03 60 AD 7A
0372 03 8D 79 03 60 04 00 00
037A 00 00 00 00 00 00 00 00
```

## Program 2.

```
5  P=1
10 INPUT N
15 GOSUB 100
20 N=N-1
25 IF N<>0 THEN 15
30 PRINT P
35 STOP
100 C=N
105 M=0
110 M=M+P
115 C=C-1
120 IF C<>0 THEN 110
125 P=M
130 RETURN
135 END
```

## Program 4.

```
033A F8 20 59 03 AD 9C 03 8D
0342 9D 03 20 6C 03 20 7A 03
034A CE 9D 03 D0 F8 20 8D 03
0352 CE 9C 03 D0 E7 D8 00 A2
035A 27 A9 00 CA 30 06 9D 9E
0362 03 4C 5D 03 A9 01 8D C5
036A 03 60 A0 28 A9 00 88 30
0372 06 99 C6 03 4C 70 03 60
037A A0 28 18 88 30 0C B9 C6
0382 03 79 9E 03 99 C6 03 4C
038A 7D 03 60 A2 28 CA 30 09
0392 BD C6 03 9D 9E 03 4C 8F
039A 03 60 06 00 00 00 00 00
```

## Program 5.

```
10 DATA 248 , 32 , 89 , 3 , 173 , 156 , 3 , 141
15 DATA 157 , 3 , 32 , 108 , 3 , 32 , 122 , 3
20 DATA 206 , 157 , 3 , 208 , 248 , 32, 141 , 3
25 DATA 206 , 156 , 3 , 208 , 231 , 216 , 96 , 162
30 DATA 39 , 169 , 0 , 202 , 48 , 6 , 157 , 158
35 DATA 3 , 76 , 93 , 3 , 169 , 1 , 141 , 197
40 DATA 3 , 96 , 160 , 40 , 169 , 0 , 136 , 48
45 DATA 6 , 153 , 198 , 3 , 76 , 112 , 3 , 96
50 DATA 160 , 40 , 24 , 136 , 48 , 12 , 185 , 198
55 DATA 3 , 121 , 158 , 3 , 153 , 198 , 3 , 76
60 DATA 125 , 3 , 96 , 162 , 40 , 202 , 48 , 9
65 DATA 189 , 198 , 3 , 157 , 158 , 3 , 76 , 143
70 DATA 3 , 96
75 FOR K = 826 TO 923
80 READ A:POKE K,A
85 NEXTK
90 :
95 REM BASIC CALLING PROGRAMME.
99 :
100 INPUT"FACTORIAL";N
105 POKE 924,N
110 SYS826
115 FOR K = 0 TO 39
120 A=PEEK(926+K)
125 H=INT(A/16)
130 L=A-H*16
135 A=10*H+L
140 IF A<10 THEN A$="0"+RIGHT$(STR$(A),1):GOTO 150
145 A$=RIGHT$(STR$(A),2)
150 S$=S$+A$
155 NEXT K
160 PRINT S$:S$=""
165 GOTO 100
170 END
```

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# Simple OSI Graphics

Donald Pitts

*OSI beginners can get started with graphics and games by following the suggestions in this tutorial on memory mapped graphics for the C4P and C1P.*

The new OSI owner need not shy away from graphics simply because there are no special commands for its use.

Many beginning programmers might not consider using graphics, because of the large number of PEEKs and POKEs required. My object here is to help you visualize the way in which graphics works so that the initial barrier will be broken, enabling you to better utilize the potential of your computer.

First, look at the CRT and envision it as separated into little boxes similar to those on graph paper. In each box you may put one symbol from a table of 255 symbols, ranging from numbers and letters to cars and airplanes. Suppose that a symbol is placed in a box that previously contained a different symbol. The new symbol appears, and all traces of the other symbol are lost. You may erase a symbol in a box by putting a blank symbol there.

Now that you have a basic understanding of the concepts involved, we can begin to discuss the actual commands that can be used in graphics. This is where the POKE command comes into play. The POKE command is used essentially as a statement that says "Put this symbol in that box." The POKE command generally takes this form:

```
POKE /address/ , /ASCII number of character/
```

The address is usually a number from 0 to 65,535 that indicates a specific place in memory. The OSI screen is *memory mapped*, meaning that the screen display is a representation of the contents of a certain area in memory.

The way in which the memory is interpreted is straightforward. The first byte of the screen memory is shown on the upper left corner of the screen. The consecutive bytes move their way across the upper row from left to right. The byte following the one in the upper right of the screen is represented as the box just immediately below the box in the upper left corner. Thus, the memory is shown in a manner resembling the way you might read a page in a book. (See Figure 1.)

**Figure 1.**

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 |
| 29 | 30 | 31 | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |

**A theoretical 14-column screen in which the numbers within the boxes represent the byte's position in screen memory**

Now for some tangible evidence that what I have been talking about works on your computer. Program 1 fills all of the screen's memory with a single symbol. It moves slowly from one box to another and puts the character into each box. Type it in and RUN it to watch it work.

## ASCII And POKE

By now either you already know what an ASCII number is, or you are rather perturbed with me for not defining it for you. It is a standard way of representing characters as numbers. ASCII stands for American Standard Code for Information Interchange. Some quick examples are "A"-65, "1"-49, "P"-80, and "*"-42.

Another statement that is practical in graphics is the PEEK command. This acts similar to a window in which you can see what is displayed in a certain memory location. It has the form:

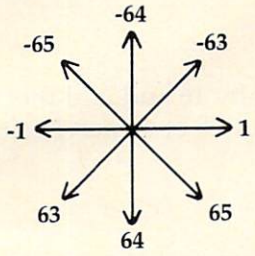
```
X=PEEK ( /address/ )
```

X could be any variable, and an address such as 54016 could be used. Please note that the parentheses are part of the command and are necessary to avoid a syntax error. After the statement is executed, the variable on the left will contain the ASCII number of the symbol located in the address specified. The realistic uses of PEEK range from checking to see if a tank has been blown up to detecting whether a ball has hit the boundary. Program 2 will first place on the screen the number of men that you specify and then will count how many are on the screen by searching every location in the screen memory for the symbol 240.

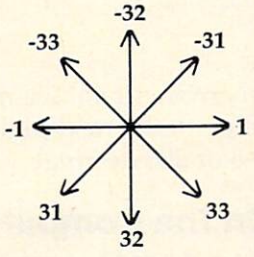
Suppose the variable X is assigned to be the location of a car that you have just POKEd on the screen. Now, how do you create the illusion of movement? First we must erase the old car with

the statement POKE X,32. The number 32 is the ASCII code for a blank. You must change X to the new location of the car on the screen and then POKE X, 0 since 0 is the number for a car. When you change the car's position, you simply execute the statement X=X+Z, where the variable Z depends upon the direction you wish to move and whether you are using a C1P or a C4P. Here are the values:

## Figure 2.




C4P




C1P

Thus, if we wanted to move down, the statement would be X=X+64 for a C4P and X=X+32 for a C1P. Program 3 uses these constants from their tables to move a cross in random directions. The program does not check for the edges of the screen to see if the cross has travelled past its boundaries, so if you don't press CTRL-C before it goes far, the program might hang up.

## Program 1.

```
10 REM FILL SCREEN WITH AIRPLANE
20 P=PEEK(57088):REM LOOK AT KEYBOARD
30 ST=53315:EN=54205:REM C1P VALUES
40 IFP<129THENST=53376:EN=55295:POKE56832,1:R
   EM C4P VALUES
50 FORLO=STTOEN:POKELO,236:NEXT
60 GOTO 60
```

## Program 2.

```
10 REM PUT SPECIFIED NUMBER OF MEN ON SCREEN
15 REM AND COUNT THEM. THERE IS AN INCREASING
    AMOUNT OF ERROR
17 REM AS THE NUMBER OF MEN IS INCREASED DUE
   TO THE FACT THAT
18 REM THE MEN ARE PUT IN THE SAME BOX AS ONE
    ANOTHER.
20 SU=0:ST=53315:EN=54205:X=24:Y=28
30 IFPEEK(57088)<129THENST=53376:EN=55295:X=6
   4:Y=30:POKE56832,1
40 INPUT"NUMBER OF MEN";ME:FORCO=1TO30:PRINT:
   NEXT
50 FORCO=1TOME:POKEST+INT((EN-ST)*RND(1)),240
   :NEXT
60 FORCO=STTOEN:IFPEEK(CO)=240THENSU=SU+1
70 NEXT:PRINT"THERE WERE";SU;"MEN ON THE SCRE
   EN."
```

## Program 3.

```
10 REM MOVE CROSS
20 FORX=1TO8:READP(X):NEXT:LO=54016
30 IFPEEK(57088)>128THENFORX=1TO8:READP(X):NE
   XT:LO=53775
40 DATA1,65,64,63,-1,-65,-64,-63
50 DATA1,33,32,31,-1,-33,-32,-31
55 FORX=1TO30:PRINT:NEXT
60 POKELO,219:FORX=1TO30:NEXT:POKELO,32
70 LO=LO+P(INT(RND(1)*8+1)):GOTO60
```

# COMPUTER CALCULATORS

Jim Butterfield, Associate Editor

*Number conversion, masking, even translations of floating point variables are possible when you use the more sophisticated "programmer's calculators." Here are some techniques for using various types of calculators when your computer is doing other things.*

Why have a calculator when you already have a computer? Indeed, why would you need a special calculator when the simple four-function units will do all the arithmetic you might need?

The answer is: convenience. It's sometimes handy to be able to zip through a quick calculation and get the results in binary, hexadecimal, octal, or whatever. If your computer isn't handy (or someone is playing space invaders on it at the moment), there are questions you can work through if you have a calculator to help.

But make no mistake about it: the sophisticated machines are not indispensable. You can do the job with no calculator at all. You can use a simple four-function unit. You can do useful calculations with a simple programmable unit, entering programs to do the work. Or you can get a "programmer's calculator."

## No Calculator

Honest, there are still people out there who add and subtract – and even multiply and divide – without a calculator of any sort. There are programmers who know how to add and subtract in hexadecimal or octal. It's probably good for you to know number systems from firsthand experience.

For example, to convert a decimal number to hexadecimal, divide the number repeatedly by 16. The remainder from each division is a hexadecimal digit; you'll generate the digits from right (low order) to left. So 200 decimal is converted as follows: 200 divided by 16 gives 12 with a remainder of 8. Our last hex digit is 8. Continuing: 12 divided by 16 gives nothing with a remainder of 12. Our next hex digit is 12, which we write as C. The hex value: C8.

Going the other way – from hexadecimal to decimal – is just as easy. We take the digits from the left. After we pick a digit, we see if there are any more. If so, we multiply by 16 and add the value of the next digit. So hex C8 becomes 12x16 +8 or 200 decimal.

## On The Computer

It's not hard to write a program to do the conversions. The problem is this: we usually have a program half-written on our machine at the moment we wish to convert something. Loading a program is out; we'd lose our work in progress. For this reason, we usually use direct statements.

From hex to decimal, we usually multiply by powers of 16. Thus, the hex address 027A is evaluated by the direct statement PRINT 0*4096 +2*256 +7*16 +10. 4096 is 16 to the third power; 256 is 16 squared.

From decimal to hex, there's no fixed method. Some people divide the number by 4096 to get the first digit. For example, 59468 divided by 4096 yields 14.5185547 – 14 is a letter E, our first digit. After that, there are a variety of methods: subtracting out the high amount (59468 - 14*4096) is one way, and using the fractional value (.5185547 x 16) is another. In either case, a little work starts to reveal the following digits.

## The Four Function Calculator

Most calculators aren't very good at giving you remainders after a division. They will happily tell you that 59486 divided by 16 is 3716.75, rather than that it gives 3716 with a remainder of 12. For this reason, many users like to work decimal to hex conversions from the high-order end.

For a 16-bit number (0 to 65536), divide by 4096. Repeat four times: note the integer value, which is your hex digit; subtract that value to give a fraction; and multiply by 16.

So for 59468 we divide by 4096 to get 14.5185547. Subtract the 14 – that's E, our first digit – and multiply by 16 to get 8.296875. Subtract the 8 – now we have E8 as the start of our hex value – and multiply by 16 to get 4.75. Subtract the 4 – our number is almost complete at E84 – and multiply by 16 one last time. Our final digit will be close to 12, hex C, so we may write our final hexadecimal value as E84C.

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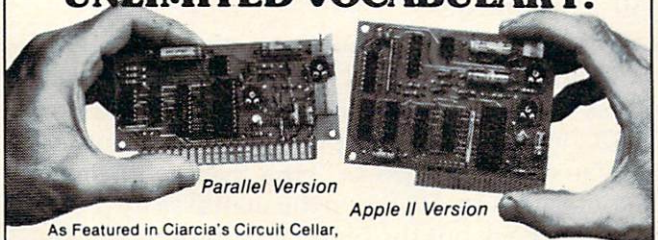

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Hexadecimal to decimal is much easier. Take the first digit's value. If there are any more digits, multiply by 16 and add the next digit. Keep going until you have the value. Hex E84C works quickly to its decimal value via these numbers: 14, 232, 3716 and finally 59468.

## The Programmed Calculator

With a programmable unit, we can place the above calculations into a program and have the steps done automatically for us.

Many programmable units have a FRAC function which simplifies the sequence of steps. FRAC is the opposite of the INT function. For example, FRAC of 8.296875 yields .296875 and allows us to save a subtraction step in the conversion.

Since most programmable calculators can't input, calculate, and display hexadecimal digits, it is not possible to show (or enter) a value such as E84C. The usual way to overcome this problem is to use a "double digit" hex display, so that E84C will be displayed as 14080412 – the 14 standing for E, the 08 for 8, and so on.

## The TI Programmer

The Texas Instruments Programmer is a special-purpose calculator which allows input and display of decimal, hexadecimal, and octal numbers, together with easy conversion between them. Simple four-function arithmetic can be performed, plus logical functions such as AND and OR.

The calculator is not programmable. It has a memory which allows storing a number or accumulating a total. In decimal mode, fractions can be entered – for example, 36.25 – but no fractions can be used in the other number bases.

Relative branch address calculations can be performed by simple subtraction. And the conversions are very simple – just push a button.

## The Hewlett-Packard 16C

The H/P 16C is a more expensive calculator, but has many more features. Not only does it have all the logical functions (AND, OR, XOR, and NOT), but it also has an extensive set of Rotate and Shift commands, including a Carry flag. There are commands to set, clear, or test individual bits within a number, and functions which create a "mask" of any number of high bits or low bits.

Conversion of numbers is simple, of course. The 16C will copy with negative numbers, if you wish. You may set it to: unsigned numbers; twos-complement signed numbers (the "usual" way of holding signed numbers); and ones-complement signed numbers, a relatively rare way of representing negative values. We may limit the calculator to a specific number of bits, so that -1 will be shown as hex FFFF in 16 bits or FFFFFF in 24 bits.

The 16C has an "integer" side, with decimal, hexadecimal, octal, and binary display modes; and a "floating" side, which allows decimal numbers complete with fractional parts. The floating mode is good for conventional calculation, although it has no scientific functions.

A remarkable thing about this calculator is that it allows you to convert between floating point numbers and floating binary notation. This is a good trick, since it involves generating an exponent and a mantissa. Not everyone needs this feature, but it's surprising to see such a powerful calculation available.

## Floating Point To Decimal

Let's work through this calculation on a variable in Microsoft BASIC. Somewhere in BASIC is a floating-point value stored as hex 81 49 0F DA A2. The 81 is the exponent, and the rest is the mantissa. Let's find its decimal value. Press "f" "2's" to ensure that the machine is in twos-complement signed mode; press "HEX" 30 "f" "WSIZE" to put us into the hexadecimal mode with enough bits to work on.

Now we enter the mantissa: 490FDAA2. Microsoft drops the high bit from positive numbers; we must put it back by pressing "ENTER" 1F "f" "sb" (for set bit 1F, or bit 31). Now we should see C90FDAA2, our corrected mantissa. Now for the exponent: type in the 81. To adjust for differences between Microsoft and Hewlett-Packard, we must subtract hex A0: type "ENTER" A0 "-" (minus).

The display will show something like FFFFFFE1, our adjusted exponent. We're all ready: press "f" -"FLOAT" -8 and we'll see the value: 1.57079633, or one-half pi. We can go the other way just as easily: press "HEX"; adjust the exponent by adding A0; flip to the mantissa by pressing "X-Y"; knock out the high bit by typing 1F "f" "CB". Easy. Remarkable.

The 16C is programmable. The above sequence of operations, or any other, may be entered as programmed instructions so that a simple key sequence (for example, GSB A for GOSUB A) will trigger the whole computation. The calculator has continuous memory; even if it's switched off, the program – and for that matter the data – will remain.

The calculator has many memory locations. How many? That depends on two factors. First, the size of the programs you have stored, if any. Each program instruction takes away from memory space. Second, the "word size" that we have selected. If we decide to work only with eight-bit numbers, for example, we'll have a very large number of memory locations – up to 203. With the maximum size number – 56 bits – or floating

point numbers, we get up to 29 memory registers. Up to 32 registers can be accessed from the keyboard, and all registers can be reached via indirect addressing.

Substantial memory plus programming can yield quite powerful systems. It's not too hard to store dozens of 16-bit addresses in a memory table, and look them up as desired. The bit manipulation capabilities can be used to good effect for chip register decoding. Where is the screen and character table for a given VIC configuration? Just type in the appropriate VIC register contents and let the calculator work it out.

Do you need a calculator that's this good? It depends on what kind of work you do. It's an expensive toy, but could be an invaluable work tool.

It's probably good for you to work out things by hand, once or twice. You will understand the mechanism better, and appreciate your calculator/computer more.

Simple calculators or your computer will do number conversion jobs for you nicely at minimum expense. You'll need to remember the proper procedures, but they are not difficult.

The specialized calculators cost more. They do a nice job. You'll have to decide whether the work you do merits the investment. ©

## Part I:

# Commodore 64 Video — A Guided Tour

Jim Butterfield, Associate Editor

*We're about to embark on a guided tour of the 6566 chip, which gives the Commodore 64 its video. It's called the VIC, for Video Interface Chip; that's the same name used for the 6560 chip in the VIC computer, but the 6566 is a whole new story. Along the way we'll stop for lots of experiments, tricks for you to type in to see the effects of manipulating this remarkably versatile part of your computer.*

Before setting off on our expedition, we need to establish a few landmarks which will place the chip within the Commodore 64 architecture.

## Memory And Video

The 6566 chip relates to memory in two ways. First, the chip's control registers are accessible in addresses 53248 to 53294, or if you'd rather, hexadecimal D000 to D02E. We'll change these registers if we want to change the behavior of the chip.

The chip itself looks directly into memory as it generates video. It is usually looking for at least two things: what characters to display, and how to display them. It finds what characters to display in an area called "screen memory," or, more formally, the "video matrix." It finds out how to display the characters by looking at the "character generator" table, or the "character base."

Since the chip generates a lot of video, it looks at memory a great deal. Most of the time, it can do this without interfering with the processor's use of memory; but every five hundred microseconds or so, it needs to stop the processor briefly in order to get extra information. This doesn't hurt anything: the pause is so short that we don't lose much processing time.

But occasionally, the microprocessor is engaged in timing a critical event and does not want to be interrupted. In this case, it shuts off the 6566 chip until the delicate work is over. Ever wondered why the screen blanks when you read or write cassette tape? To give the computer an extra edge while timing tape, that's why.

## Charting The 64

When the video chip goes to memory for its information, it has a special problem: it can reach only 16K of memory. That's OK for most work. For example, the screen (or video matrix) is usually located at 1024 to 2023 (hex 0400 to 07E7), so we'll use it there. But if we wanted to move screen memory to a new location, say 33792, we would need to work out some details, since the chip would not normally be able to reach addresses so high in memory.

We are given some help in doing this by the 64 architecture itself. There are two control lines called VA15 and VA14 which allow us to select which block of 16K memory we want the video chip to use. Note that once we've selected a block, the chip must get all its information from that block: we can't mix and match.

The control lines are available in address 56576 (hex DD00) as the two low-order bits. The memory maps you get are:

- **POKE 56576,4** the chip sees RAM from 49152 to 65535. There's no character generator; you'll have to make your own.
- **POKE 56576,5** the chip sees RAM from 32768 to 36863 and from 40960 to 49151. The ROM character generator is in the slot from 36864 to 40959.
- **POKE 56576,6** the chip sees RAM from 16384 to 32767. No character generator.
- **POKE 56576,7** the chip sees RAM from 0 to 4095, and from 8192 to 16383. The ROM character generator is in the slot from 4096 to 8191. This is the normal Commodore 64 setup.

Also note that the chip never has access to RAM at addresses 4096 to 8191 and 36864 to 40959. You will not be able to put screen memory or sprites there.

Be careful with these. If you move the chip's memory area, you'd better be sure to move the screen. For example, try the following:

```
POKE 648,132:POKE 56576,5
```

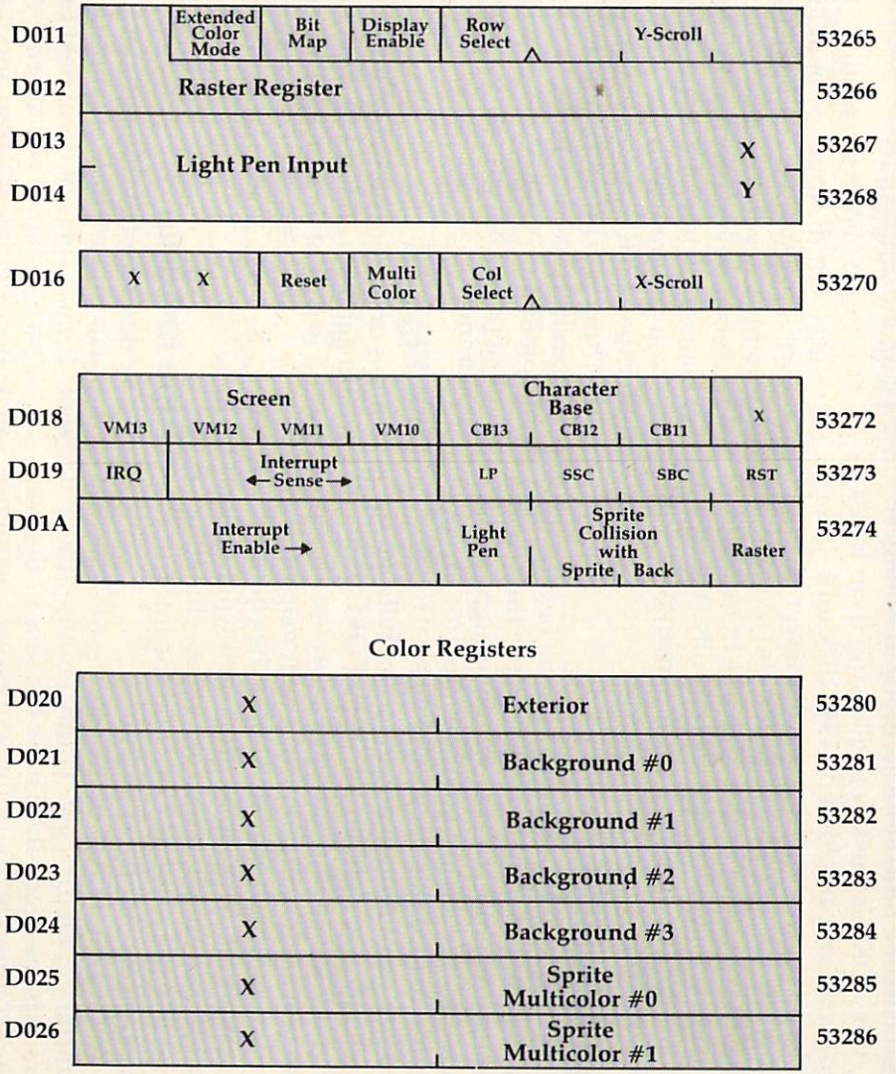
You'll find yourself transferred to a new, alternate screen. The new screen will be "dirty" – it hasn't been cleaned up. Typing a screen clear will make things look neat, and you may then play around with an apparently normal machine. When you're finished, turn the power off for a moment to restore your machine to the standard configuration.

## The Chip: Video Control

Now for the 6566 chip itself. We'll go through the registers, but not in strict numeric order.

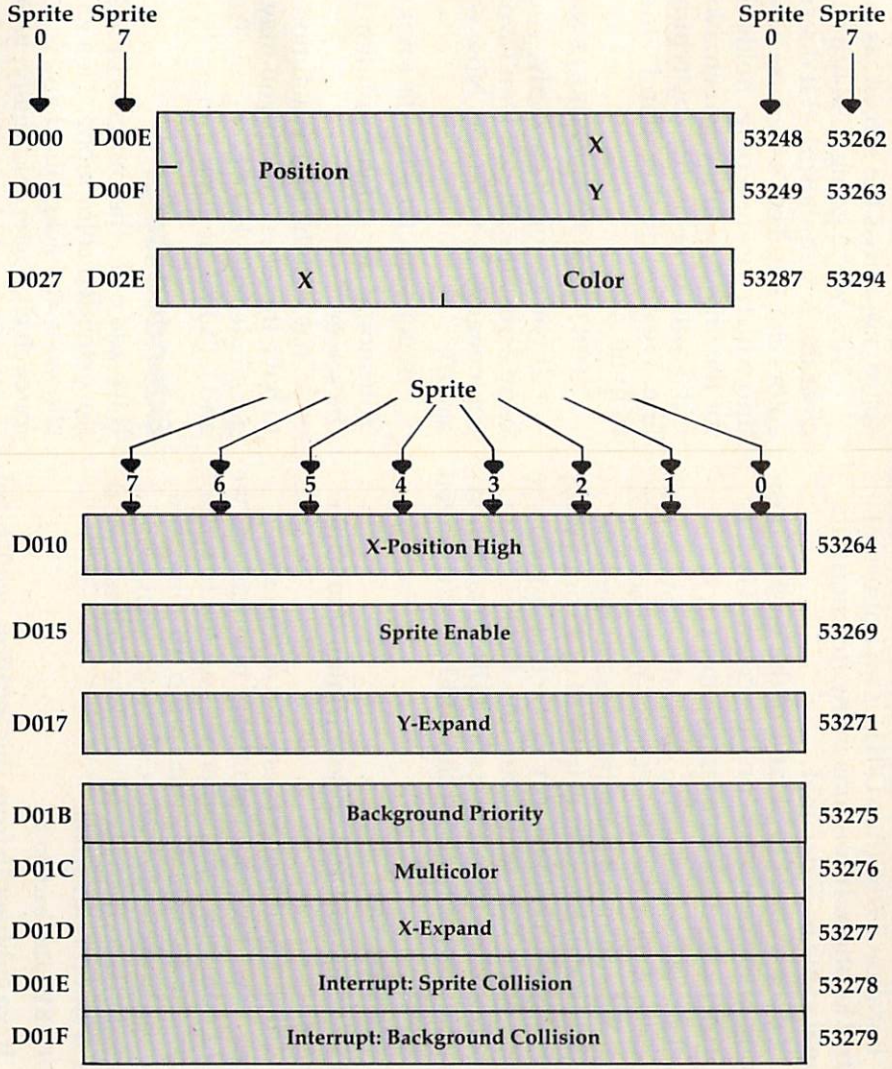
## Table 1:

### 6566 Video Chip
### C64 Control and Miscellaneous Registers




## Table 2:

### 6566 Video Chip
### C64 Sprite Registers



Location 53265 (hex D011) is an important control location. It contains many functions; its normal value is 27 decimal.

Values from 24 to 31 control the vertical positioning of the characters on the screen. Try this:

```
FOR J=24 TO 31:POKE 53265,J:NEXT J
```

You'll see the screen move vertically, leaving an empty spot near the top. POKE 53265 back to 27.

If we subtract 8 from the value in the 6566, the screen will lose a line: instead of 25 lines we'll have only 24. The best way to see this is: clear the screen; write TOP on the top line, BOTTOM on the bottom line (don't press RETURN!) and then move the cursor to about the middle of the screen and type:

```
POKE 53265,19
```

You'll see the top and bottom trimmed to half a line each.

Think about using these two features together. If we have a screen full of information, we would normally scroll when we wanted to write more – the characters would jump up a line. But if we can switch to 24 lines, slide the characters up gently, and then switch back to 25 lines, we'd have a smoo-ooth scroll.

```
POKE 53265 back to 27
```

If we subtract 16 from this location, we'll blank the screen. We mentioned this before: it will give the processor a little more accuracy in timing. In fact, this POKE is the key to allowing us to LOAD a program from an old-style 1540 disk unit. If the disk hasn't been modified, it will deliver bits slightly too fast for the computer. But we can bridge the gap with POKE 53265,11:LOAD and the loading will take place successfully. When the load is complete, we can get the screen back with POKE 53265,27.

## High Resolution

The next control bit – value 32 – switches the display to pure bits. No more characters: the screen will be purely pixels as we switch to high resolution mode. We'll use a lot of memory for this one: memory to feed the screen will be 8000 bytes.

High resolution needs to be carefully set up, but let's plunge right into it. Type POKE 53265,59 and you'll see an intricate pattern on the screen. What you are looking at now is a bit map of RAM memory addresses 0 to 4096, plus the character generator area. The top of the screen will twinkle a little: those are the page zero values changing – things like the realtime clock and the interrupt values are constantly in motion.

In the bottom half of the screen, we'll see the character generator itself. Oddly enough, the characters are readable. That's because of the way high resolution bit mapping works: each sequence of eight consecutive bytes maps into a character space, not across the screen, as you might think.

Now we're going to play around a little. First, clear the screen. Surprise! It doesn't clear, but the colors change. That's because screen memory, into which we are typing, holds color information for the high resolution screen. Now, we'll clean out a band of hi-res data by typing in a BASIC line. We must do this "blind"; the screen won't help us. Type:

```
FOR J=3200 TO 3519:POKE J,0:NEXT J
```

If you've typed correctly, you'll see a blank band across the screen. Don't worry about the color change as you type. Now we'll enter (blind again):

```
FOR J=3204 TO 3519 STEP 8:POKE J,255:NEXT J
```

You should see a high-resolution line drawn across the screen.

That's all the high resolution fun we're going to have this session, but you may be starting to get an idea of what's going on. Turn off the power, and let's look at other things.

## Extended Color

If we add 64 to the contents of 53265, we'll invoke the extended color mode. This will allow us to choose both background and foreground colors for each character. Normally, we may only choose the foreground: the background stays the same throughout the screen. You lose some colors, but get better combinations.

Try POKE 35265,91. Nothing happens, except that the cursor disappears, or at least becomes less visible. Why? We've traded the screen reverse feature for a new background color. Try typing characters in reverse font, and see what happens. Try choosing some of the specialized colors – the ones you generate with the "Commodore" key rather than CTRL. See how you like the effect. Think how you might be able to use it.

Extended color is purely a screen display phenomenon. POKE 35265,27 will bring all the characters you have typed back to their normal appearance.

## The High Bit

There's one more bit in location 53265, the one we would get if we added 128. Don't do this now: this bit is part of a value we'll discuss later: the "raster value." You won't use this one out of BASIC, but it can be handy at machine language speeds.

## Tune In Again

We've done a lot of things so far, using only one control location. There are more locations, and we'll discuss some of them next time.

It's a big chip. It will take a lot of time to digest all its possibilities. It's fun, and it can create remarkable effects. ©

# Bi-directional VIC Scrolling

Charles Saraceno

*How would you like to be able to check and debug your VIC programs by turning your screen into a window which can move anywhere over the listing, stop or start at will, and even move upwards toward the start of the program? All this can be achieved by just touching different keys when using this clever "controlled scrolling" program. If your VIC has the 3K RAM memory expander plugged in, use POKE 44,4 (instead of POKE 44,16) in the instructions in the final paragraph.*

Now that memory expansion modules are readily available, it is possible to write longer VIC programs. This does make it harder, however, to edit the contents without a hard copy from a printer to examine for typing errors. Screen editing is time consuming, to say the least; with 22 characters per line, you are limited to four or five lines at a time between LIST commands. A very useful LIST would scroll the screen and stop or continue when you want it to. The ideal LIST would also scroll backwards.

This small program efficiently accomplishes all these tasks. Line 63001 determines the starting address (SA) for any memory installed into the VIC. Line 63002 calculates the line number (LN) of your program. Line 63003 sets your screen up to perform the tasks needed to list the line, then continues the program. It is written in white so you won't see the commands and keeps the screen uncluttered for reviewing the listed line.

Once a "list" has been initiated in a program, the program will end. This is where the keyboard buffer commands in line 63004 both control the list and then continue the program with the "go to" 63010 command. Lines 63010-63030 let you review the line just listed and wait for you to press the "+" key to advance to the next line or the "-" key to back up to the previous lines listed. Line 63100 looks for the next "0" in BASIC, which indicates the end of that BASIC line, and then sends you back to calculate the next line number. Line 63200 is the routine that looks for the end of the previous line. You have to eliminate the possibility of finding a "0" in the addresses that determine the line number by disallowing a "0" in either of those two addresses.

One other little trick will let you avoid having to type in this program after each main program has been entered. Find the end of BASIC by typing in:

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

Now type the following line which moves the beginning of BASIC to two bytes less than the end of the program (either a null or a "0" is needed to start loading in a new program):

```
POKE 43, PEEK (45)-2:POKE 44,PEEK (46)
```

Now load in "+/- LIST" program, reset BASIC pointers (POKE 43,1; POKE 44,16, for VIC with no expansion). Start editing by typing in RUN 63000. You will be able to scrutinize your program on a line-by-line basis. Any mistakes discovered should be noted on paper and corrected after your review.

```
63000 REM**  +/- LIST  **
63001 SA=PEEK(44)*256+PEEK(43)-1
63002 LN=PEEK(SA+3)+PEEK(SA+4)*256
63003 PRINT"{CLEAR}{WHT}GOTO 63010":PRINT"LIST
    ";LN;
63004 POKE631,19:POKE632,17:POKE633,31:POKE634
    ,13:POKE 635,19:POKE636,13:POKE 198,6:E
    ND
63010 IF PEEK(197)=5 THEN 63100:REM TEST FOR "
    -" KEY
63020 IF PEEK(197)=61 THEN 63200:REM TEST FOR
    "+" KEY
63030 GOTO 63010
63100 IF PEEK(SA+5)<>0 THEN SA=SA+1:GOTO 63100
63110 SA=SA+5:GOTO 63002
63200 SA=SA-1:IF PEEK(SA)=0 AND PEEK(SA-4)<>0
    AND PEEK(SA-3)<>0 THEN 63002
63210 GOTO 63200
```

# INSIGHT: Atari

Bill Wilkinson

*This month we will examine the possibility of a "default" drive number under DOS. There is also a tidbit about initializing DOS disks from BASIC. Next month, we will begin what will be a three- or four-month series on how to write your own BASIC interpreter.*

## Deriving The Drive

First, let me state that I do *not* recommend this section to the relative novice. While it is true that you can perform the operations I am about to describe entirely from BASIC, it is also true that you can destroy memory very nicely if you slip up. Enough warning. To begin:

Have you ever (often?) grumbled over the fact that you have to specify not only the file name, but also the disk name and drive number (e.g., "D2:MISSILE.CMD")? I sure have. In fact, I hate it so much that when we did OS/A+ for the Apple II, we allowed the user to supply a default device specifier (e.g., "D2:"), which is automatically prefixed to all file names which do not specify a device. (Consequence: you *must* use a colon when you really want a device; "P" is seen as "D2:P", though "P:" works fine.)

This concept is not new or unique; even in the micro world, such giants as CP/M use default drive assignments. Usually, the advantage of such defaults is that people with multiple disk systems need not always run a given program in a certain drive. Or the user might choose which drive will receive his data files via a simple set of keystrokes at system powerup. Suffice it to say that those who get used to default drives love them.

Unfortunately, as much as I would like to do the same thing for the Atari, I can't. The initial device name determination under Atari's OS is done in the OS ROMs, and Atari OS simply looks at the first letter of any file name and assumes that it is the device name.

However... (You knew there was a "however" lurking, didn't you?) At least we could modify the File Manager System (also known as FMS, DOS, or even OS/A+) to understand the concept of a default device NUMBER. In other words, we could have the FMS inspect the file name and assume a particular drive number if "D:..." were coded. Then we could have some means of telling the FMS what the "current" drive was (and, in fact, such means already exist in OS/A+), and the system would automatically insert the correct drive number.

And yet, I am reluctant to adapt such an approach with Atari DOS. Too many programs have been written which assume that "D:..." is equivalent to "D1:...", and I am loath to introduce more confusion than is necessary. So, if you really would like to modify your copy (copies?) of FMS to allow "D:" to represent "Dn:", let me just point you in the right direction. For this purpose, I will presume that you have a copy of *Inside Atari DOS* (**COMPUTE! Books**, 1982).

There is a routine labeled FNDCODE (File Name DeCODE) which begins on page 83 of the book and is the heart of the entire disk file name processing. Lines 4101 through 4106 start at the third character of the name and search from there backwards for the colon (':') which terminates the device specifier (and ignore the comments in the listing...they are flat out irrelevant). Obviously, it would be no big deal to check to see if the character before the colon is the 'D' and, if so, assign a default device number.

## Changing FMS

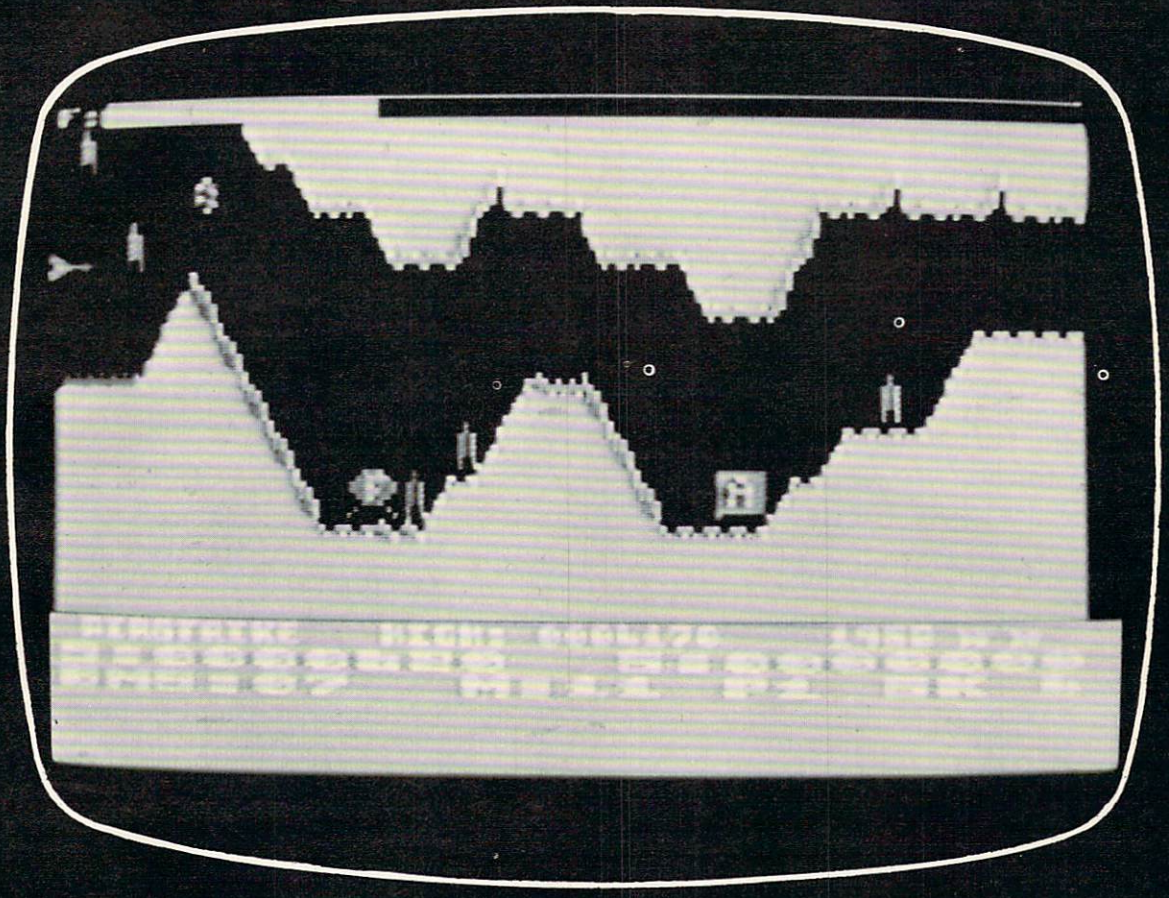
Now, for the rest of you, I have an alternate proposal. How about changing FMS so that, if it sees a file name of "D0:..." it assigns the default device instead. I chose "D0:" because there should be no conflict with existing software. And, yet, it is a legal device specifier which is easily detectable and changeable.

Since the OS ROMs have already decoded the device number by the time FMS gets control, we don't need to look at the file *name* at all. Instead, we look at the field labeled ICDNO (or, in zero page, ICDNOZ), the device number as set up by the OS ROMs. And, conveniently, FMS is already manipulating this number in a single, well-defined place, the "SETUP" routine (as listed on page 92 of *Inside Atari DOS*). Currently, the code sequence is simply:

```
LDY ICDNOZ ; move device number...
STY DCBDRV ; ...to device control block
```

What we want instead is something like the following:

# Very, very, difficult!



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```
        LDY     ICDNOZ      ;get device number...
        BNE     OKDNO       ;...if wasn't "D0:", it is OK
        LDY     DEFAULT     ;otherwise, change 0 to default
OKDNO
        STY     DCBDRV      ;in either case, set up DCB
```

Now I can't think of a much simpler change than adding two instructions, but how do we make such a change? The solution is to use what is known as a "patch." Generally, there are two kinds of machine language patches: those that fit into the original code space and those that don't. The former kind are easy; simply overlay the old code with the new. The latter are not so easy. Naturally, this change falls into the latter category.

With a 6502, the usual method of installing out-of-line patches is to try to replace a three-byte instruction with a JMP or JSR to the patch (failing this, you must replace two or three instructions, which may involve putting a NOP before or after the JSR or JMP). Luckily, we do indeed have a three-byte instruction that we can replace (the STY DCBDRV uses three bytes, since DCBDRV is not in zero page).

So our patch will look like this:

```
DCBDRV  = $301      ;object of the STY
        *=  $1176   ;address of the STY instruction
        JSR PATCH

        *=  PATCH
        BNE OKDNO   ;non-zero device number
        LDY DEFAULT ;replace zero device number
OKDNO
        STY DCBDRV  ;the patched-over instruction
        RTS
```

So far, so good. It makes sense, I hope. But there are two locations undefined in the above listing: we don't know where PATCH and DEFAULT are going to be located. Again, we will refer to the book for some clues as to where they should be.

As it turns out, there is no patch space at all within the main code space of FMS. However, if we look at the very end of the listing (page 98 in the book), we find that FMS (including its internal buffers, etc.) ends at $1500. But remember that "DOS.SYS" consists of more than just FMS. In the case of OS/A+, DOS also includes "CP," the console processor, and actually ends at $1D00. For Atari DOS, version 2.0S, DOS.SYS ends at $1A7C (to accommodate "MINI-DUP," the routine which handles MEM.SAV and loads the main DUP.SYS).

But, fortuitiously, whether by design or by chance, both MINI-DUP and CP begin at $1540. Thus, we have locations $1501 through $153F for patch space. Not a huge patch space, but patch space nevertheless. So, I would suggest that you add the following two lines to the front of the listing given above:

```
DEFAULT = $1501
PATCH   = $1502
```

This means, then, that you *must* put a valid disk drive number (1 through the number of drives you have) into location $1501 *before* using a drive specifier of "D0:".

So, how do we make and save this patch? If you have an assembler capable of doing memory-to-memory assemblies (e.g., the cartridge, EASMD, MAC/65, etc.), I would suggest typing in the lines given and actually assembling the code directly in place. (Doing the memory-to-memory assembly avoids doing FMS accesses while patching FMS...safety first!) Then, with the patch in place, use the Write-DOS-Files option (of Atari DOS, or use INIT to rewrite DOS.SYS with OS/A+) to save your patched system.

Does it work? Sure does. I wrote all the above and then went over to the machine and typed it in. Worked first time! Is it handy? Only time will tell.

And one more point. If you do have OS/A+, you will note that the Command Processor (CP) already supports the concept of a default drive. Why not use that same default drive specifier for our "D0:" trick? The only difference is that CP stores that default specifier as an ASCII character ('1', '2', etc.), so we must look at only the low order bits of the default (and we must obtain it from its memory location according to OS/A+ rules). So here's another version of the same patch, specifically for OS/A+, version 2:

```
PATCH   = $1501
CPALOC  = $0A
DEFAULT = 8
DCBDRV  = $301

        *=  $1176
        JSR PATCH

        *=  PATCH
        BNE OKDNO       ;drive # is non-zero
        LDY #DEFAULT    ;offset to default drive #
        LDA (CPALOC),Y  ;gets default in ASCII
        AND #$0F        ;just the lower bits
        TAY             ;where FMS expects drive #
OKDNO
        STY DCBDRV      ;the patched-over code
        RTS             ;back to the original
```

And, as a postscript to all this, I would like to comment on the whole subject of adding things to DOS. So long as you can patch in place or use the limited patch space starting at $1501, you should have no problems. If, however, you want to add significant code to DOS, it will not be easy if you are using Atari DOS.

If we look at pages 94 and 95 of *Inside Atari DOS*, we will see the routine which begins with the label "WD0". It is this routine which actually writes the file "DOS.SYS" to the disk. And, if you look at lines 5441 through 5449, you will see that what is written out is all of memory from $7CB

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through the contents of location "SASA" (which are usually $1A7C or $1D00, as noted above).

Sidelight: in a way, this is poor design, since SASA also specifies the beginning address of the disk buffers. If you move the disk buffers (e.g., to the top of memory) and then try to write the DOS file(s), you might be writing out much more than you bargained for. You might want to change those compares to

"CMP #..."

if you are doing hefty modifications.

Anyway, with Atari DOS, you can't really add on to the end of the DOS.SYS since DUP.SYS begins immediately after it in memory and would overwrite your additions. With OS/A+, though, you could add stuff at $1D00 (or wherever SASA points to) and move SASA up (which not incidentally will thus move the buffers out of the way of your addition).

## The Rites For Right Writes

I was reminded by all of the above of another "feature" of Atari DOS (and, yes, OS/A+) which is not well documented. In particular, would you like your program (including one written in BASIC) to be able to write (or rewrite) the "DOS.SYS" file? In the unlikely case that your answer is "yes," read on.

Strange but true: when you OPEN the file named "DOS.SYS" for output (i.e., mode 8 only), *right then and there* the FMS will automatically write the complete boot (sectors 1, 2, and 3) and the file "DOS.SYS" to the disk! You do *not* have to copy anything from memory to disk, from disk to disk, or what have you. FMS does it all! (And that explains why Atari DOS won't let you copy *to* a file called "DOS.SYS".)

Thus, from BASIC, you could initialize a disk AND write the DOS.SYS file via the following simple code:

```
10 XIO 254,#1,0,0, "Dn:"
20 OPEN #1,8,0,"Dn:DOS.SYS"
30 CLOSE #1
```

Of course, the "n" can be any valid disk number (including 0, if you applied the patches discussed in the first section of this column). Also, you can omit line 10 if you don't want to initialize the disk.

Unfortunately, this procedure will not place "DUP.SYS" on the disk if you are using Atari DOS, so you will still have to somehow copy it. (But you can use AUTORUN.SYS based systems without DUP.SYS, of course.) Again, though, if you are using OS/A+ you don't (and can't) use a DUP.SYS file, so the above little program will perform all you need to initialize a master, bootable disk.

*Postscript:* If you really *need* to copy a "DOS.SYS" file from one disk to another (because, for example, you don't want to boot the version that you are copying), you can simply rename "DOS.SYS" to something else ("GORP.SYS", for example), perform the copy, and then rename both the old and new "GORP.SYS" back to "DOS.SYS". Thanks to the peculiarities of FMS, this method will even cause the three boot sectors to be updated to point to your new DOS file. ©

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# MACHINE LANGUAGE

Jim Butterfield, Associate Editor

# The New 6500 Chips

The 6502 is a member of a family of chips. The original family included the 6501 (long since extinct), the 6502, 6503, 6504, 6505, 6506, and 6507. A parallel branch of the family comprised the 6512, 6513, 6514, and 6515; these were identical to their 650x counterparts except for the external clock circuitry.

The 6502 is the big member of the family; it has a full 40 pins. The 6503 to 6507 are cut-down versions of the same chip, with only 28 pins. Internally, the chips are the same: the programmer will use exactly the same instructions regardless of which chip is involved. The practical difference is how the chip is wired, and how much memory it is able to address.

If the same chip goes into a 6502 and, say, a 6504, why not take the fully-featured processor every time? The answer is this: if you don't need the extra pins, you can save money by going for the small one. Process controllers often need very little memory; savings in board space and a lesser number of connections can be quite worthwhile.

## Quick And Easy

The 6502 burst onto the microprocessor scene in 1976. It was remarkably inexpensive and seemed to have a very simple internal structure. The architecture was closest to Motorola's 6800 microprocessor series, and many users suspected that the 6502 was a cheap imitation. This proved to be untrue: the 6502 had special features which made it a landmark in microprocessor design.

The technique which gave the 6502 speed is called "pipelining." It means that information rolls into the processor as if it were on a conveyer belt. Before the last piece of information is digested, the next one is coming in. For the first time, the microprocessor didn't need to "stop and think": new information was rolling in as the old was being digested. The result: no wasted memory cycles, and amazing speed.

The small number of registers within the 6502 seemed to be a limitation. It proved not to be: registers could be loaded and used so quickly that the small number seldom gave problems. In addition, page zero of memory could be used to hold 16-bit pointers for "indirect addressing" – in a sense, this provided an extra 128 registers for the programmer's use.

The 6502 used the same style of instructions as the 6800 – the simple, traditional data processing instructions: load, store, add, and test. Programmers found the instructions easy and natural. The 6502 is relatively easy to program.

## The New Processors

Recently, new 6500-family processors have come into production. They are still familiar: the instruction set is the same as before and the addressing modes haven't changed. But there are new features, and you'll be meeting them in the VIC and in forthcoming Commodore products.

## The 6510

The 6510 is a 6502, except that addresses 0000 and 0001 have special functions. There's an input/output port built into the chip: eight pins marked P0 to P7 are available on the microprocessor chip itself. Address 0000 is used as the direction register of the I/O port, and 0001 is the port itself. Otherwise, the 6510 is identical to a 6502.

What does this mean in the Commodore 64? First of all, locations 0000 and 0001 are no longer RAM. PET uses these locations to hold the USR jump; on the Commodore 64, this jump has been moved to address hex 0310 (784 decimal).

Second, you may use address 0001 to test and control some of the 64's activities. Refer to the memory map in **COMPUTE!**, October 1982, for details. For example, you can sense if the cassette tape switch is down by checking PEEK(1) AND 16. The three lowest-order bits are used for switching out ROM and switching in RAM. Don't ever do this from BASIC, and use prudence if you do it from machine language. More on these bits in a moment.

A little more information on memory control from address 0001: bit 0, mask 1, controls the BASIC ROM in addresses A000-BFFF. Switch this bit to zero and the BASIC ROM is gone: in its place is RAM. Now you can write your own language. Bit 1, mask 2, controls the Kernal ROM in addresses E000-FFFF. Switch this bit to zero and the Kernal is gone; be very careful, since you've just switched away all of the programs that support interrupts, keyboard, screen, and so on. If you

switch off both bits 0 and 1, you will get a 64K RAM machine: the I/O block will be switched out, too.

## The 6509

The 6509, too, is a 6502 with a change to addresses 0000 and 0001. In this case, the changes are more profound: they cause a switch to a new memory bank. The 6509 is expected to be used in the newest CBM products: the PET II (P128) and the CBM II (B and BX series).

Both addresses 0000 and 0001 are used to provide access to memory beyond the normal 64K limitation. These addresses are used to "bank switch" to one of 16 memory banks, each of which is 64K in size. Thus, the 6509 can access over one million memory locations.

If we place a value of zero to 15 in address 0001, we will influence only one kind of address: indirect, indexed. So if we code LDA #$01:STA $01 we are selecting bank one for indirect addressing. Now, if we code LDA ($F0),Y we will perform the following steps: go to addresses 00F0 and 00F1 in the current bank and get the new address stored there; add the contents of the Y register to this new address; and finally, load the A register with the contents of the resulting address, from bank one. Indirect addressing is generally used to obtain or store data; the extra capability provided with address 0001 allows us to obtain or store a very large amount of data.

Address 0000 changes the bank from which we obtain instructions. If we code LDA #$01:STA $00 we will immediately start executing instructions from bank one. This is tricky: we have not jumped, so we will start executing from precisely the same address we left in the other bank. We must carefully write "synchronized" programs so that when we leave one bank, there will be a program in exactly the right place in the new bank to allow processing to continue. It's a good trick, but it can be done.

The new chips are still 6500 style. They use the same instructions in exactly the same way. But they open up new possibilities, and we'll need to learn how to cope with them.

# PET Dynamic Bookkeeping

Ron Kushnier

*This bookkeeping program saves data with a program on tape. Using the "dynamic keyboard" technique and other modifications, it illustrates a useful subroutine for those who want extra power from a tape-based system.*

It was my objective, after several years of enjoying my 8K PET, to create a program which I could incorporate into my everyday activities at home. I decided on the proverbial bookkeeping program. Entering all those numbers was a job of which I was not overly fond, but it was all too necessary for income taxes.

This program would have to be practical. It would have to be fast, with easy access, and it would have to do more than could be done by just entering the same information on 3x5 cards.

I tried to consider all the options. Sure, it would be easy if I bought a disk system and something like VisiCalc, but that wouldn't be much of a challenge.

## Trial And Error

I took stock of what I had available: standard 8K PET with Upgrade ROMs, and a ROM Toolkit mounted on a PC board which plugged into the PET Expansion socket.

The first thing I did was to buy the Rabbit ROM from Eastern House Software. This high speed cassette firmware improved my access time tremendously. By making a simple modification to the Toolkit board, I was able to change the address of the existing extra socket to that of the Rabbit ROM(A000).

But I ran into two problems. The first was that the Rabbit would not work with the PET's internal tape drive. And since Commodore, at that time, could not supply me with an updated PC board replacement, it was necessary to switch to a whole new CBM cassette unit. The second problem was that the Rabbit could not be used for data files. This meant that I would have to do something really tricky.

The original program was stored with the Rabbit. The data was stored with conventional Commodore data files on another tape. No good! *It took forever*! The time had come for the tricky part.

Again, I explored the options. I could convert array information to data statements. It had been done before. But there was the conversion time both back and forth. The idea was unappealing.

I started fooling around with a dynamic keyboard approach, but without much success. The dynamic keyboard is a method that lets the computer modify the program in memory by POKEing to the keyboard buffer. See lines 58000 on.

It was not until a co-worker, Howard Bicking, came along that the solution was found. He managed to write a small tag-along routine that could be added, which would save all variables and array data along with the program. This was a real breakthrough. I was now able to save 10K worth of program and data in under one minute.

The bookkeeping part of the program is fairly straightforward. It consists of menu-driven, nested arrays of information which allow for easy update and display. Some protection routines were written into the program so that mistakes could be easily corrected.

Obviously, the program must be tailored to the individual user. Its modular construction should make this a fairly easy job.

## The Special SAVE

There is a little procedure which must be followed when using the SAVE routine.

After you have entered the bookkeeping program or a modification of the program, it is necessary to run it in order to initially set up the various parameters and pointers. Start the run after the 0 statement number. This is accomplished with a:

```
RUN10
```

Then just follow the program instructions printed on the screen. When all the data is entered, you will want to do a SAVE. The dynamic keyboard will take over, change pointers, and will then display that it is OK to save in a conventional manner.

The next time the program is to be used, a normal RUN will bring in the works.

The SAVE program can be added to any program as the last thing to be done. As a result, self-learning programs can be saved with an ever-increasing library of entries.

```
0 GOSUB59010:GOTO1000
10 DIM Q(3,6,12),M$(12)
1000 PRINT"{CLEAR}";"BOOKKEEPING PROGRAM
1010 FORH=1TO500
1020 NEXTH
1030 GA$(0)="CASH
1040 GA$(1)="AMOCO
1050 GA$(2)="ARCO
1060 GA$(3)="GULF
1070 GA$(4)="SHELL
```

```
1080 UT$(0)="PECO
1090 UT$(1)="BELL OF PA
1100 BL$(0)="CHARGES
1110 BL$(1)="GASOLINE
1120 BL$(2)="UTILITES
1130 BL$(3)="MISCELLANEOUS
1140 CH$(0)="BAMBERGERS
1150 CH$(1)="GIMBELS
1160 CH$(2)="PENNEYS
1170 CH$(3)="PNB
1180 CH$(4)="SEARS
1190 CH$(5)="STRAWBRIDGES
1200 CH$(6)="WANAMAKERS
1210 MI$(0)="MORTGAGE
1220 MI$(1)="TAX
1230 MI$(2)="PAPER
1240 MI$(3)="EXTERMINATOR
1250 MI$(4)="AUTO EXPENSE
1260 MI$(5)="ENTERTAINMENT
1270 M$(1)="JAN
1280 M$(2)="FEB
1290 M$(3)="MAR
1300 M$(4)="APR
1310 M$(5)="MAY
1320 M$(6)="JUN
1330 M$(7)="JUL
1340 M$(8)="AUG
1350 M$(9)="SEP
1360 M$(10)="OCT
1370 M$(11)="NOV
1380 M$(12)="DEC
1390 Z1$="RECORD ALL DATA?(Y/N)
1400 Z$="DO YOU WANT TO CHANGE THE LIST?(Y/N)
1410 PRINT"{CLEAR}";"BILLING LIST":PRINT"-------
    ------"
1420 FORI=0TO3
1430 PRINTI+1;BL$(I);" (";BL(I);")"
1440 NEXTI
1450 PRINT" 5 END PROGRAM
1460 T=5
1470 GOSUB2440:REM* LIKE TO SEE*
1480 F=A-1:ONAGOTO1490,1720,1950,2200,2430
1490 GOSUB 2880:REM* PRINT BILLING LIST COMPONE
    NT *
1500 FORI=0TO6
1510 PRINTI+1;CH$(I);"(";C(I);")"
1520 NEXTI
1530 PRINT" 8 BACK TO BILLING LIST
1540 T=8
1550 GOSUB2440:REM* LIKE TO SEE*
1560 IFA=8THEN1410
1570 I=A-1
1580 PRINT"{CLEAR}";CH$(I);"(";C(I);")":PRINT"-
    --------
1590 GOSUB2770:REM* MONTHLY PRINTOVERFLOW*
1600 GOSUB2910:REM* "CHANGE LIST?" *
1610 IF F1<>0THENF1=0:GOTO1490
1620 GOSUB2630:Q(F,I,A)=V+Q(F,I,A):REM* INPUT A
    MT*
1630 C(I)=0:GOSUB2970:C(I)=X:REM*ADD TOTALS *
1640 BL(F)=0:FORK=0TO T-2
1650 BL(F)=BL(F)+C(K):NEXTK
1660 GOSUB2840:REM * PRINT MONTH-AMT *
1670 PRINT:PRINTZ1$:REM* "RECORD?"*
1680 GOSUB2510:REM* YES-NO*
1690 IFA$="N"THENGOTO1490
1700 GOTO58000
1710 GOTO1490
1720 PRINT"{CLEAR}":PRINTBL$(F);"(";BL(F);")"
1730 FORI=0TO4
1740 PRINTI+1;GA$(I);"(";G(I);")"
1750 NEXTI
1760 PRINT" 6 BACK TO BILLING LIST
1770 T=6
1780 GOSUB2440
1790 IFA=6THEN1410
1800 I=A-1
1810 PRINT"{CLEAR}";GA$(I);"(";G(I);")":PRINT"-
    --------
1820 GOSUB 2770:REM* MONTHLY PRINTOVERFLOW*
1830 GOSUB2910:REM* "CHANGE LIST?" *
1840 IFF1<>0THENF1=0:GOTO1720
1850 GOSUB2630:Q(F,I,A)=V+Q(F,I,A):REM* INPUT A
    MT*
1860 G(I)=0:GOSUB2970:G(I)=X:REM* ADD TOTALS *
1870 BL(F)=0:FORK=0TOT-2
1880 BL(F)=BL(F)+G(K):NEXTK
1890 GOSUB2840
1900 PRINT:PRINTZ1$
1910 GOSUB2510
1920 IFA$="N"THENGOTO1720
1930 GOTO58000
1940 GOTO1720
1950 GOSUB 2880:REM* PRINT BILLING LIST COMPONE
    NT *
1960 FORI=0TO1
1970 PRINTI+1;UT$(I);"(";U(I);")"
1980 NEXTI
1990 PRINT" 3 BACK TO BILLING LIST
2000 T=3
2010 GOSUB2440:REM* LIKE TO SEE*
2020 IFA=3THEN1410
2030 I=A-1
2040 PRINT"{CLEAR}";UT$(I);"(";U(I);")":PRINT"-
    --------

2050 GOSUB2770:REM* MONTHLY PRINTOVERFLOW*
2060 GOSUB2910:REM* "CHANGE LIST?" *
2070 IF F1<>0THENF1=0:GOTO1950
2080 GOSUB2630:Q(F,I,A)=V+Q(F,I,A):REM* INPUT A
    MT*
2090 U(I)=0:GOSUB2970:U(I)=X:REM*ADD TOTALS *
2100 BL(F)=0:FORK=0TOT-2
2110 BL(F)=BL(F)+U(K):NEXTK
2120 GOSUB2840:REM * PRINT MONTH-AMT *
2130 PRINT:PRINTZ1$:REM* "RECORD?"*
2140 GOSUB2510:REM* YES-NO*
2150 IFA$="N"THENGOTO1950
2160 GOTO58000
2170 GOTO1950
2180 GOTO58000
2190 GOTO1950
2200 GOSUB 2880:REM* PRINT BILLING LIST COMPONE
    NT *
2210 FORI=0TO5
2220 PRINTI+1;MI$(I);"(";MI(I);")"
2230 NEXTI
2240 PRINT" 7 BACK TO BILLING LIST
2250 T=7
2260 GOSUB2440:REM* LIKE TO SEE*
2270 IFA=7THEN1410
2280 I=A-1
2290 PRINT"{CLEAR}";MI$(I);"(";MI(I);")":PRINT"
    ---------

2300 GOSUB2770:REM* MONTHLY PRINTOVERFLOW*
2310 GOSUB2910:REM* "CHANGE LIST?" *
2320 IF F1<>0THENF1=0:GOTO2200
2330 GOSUB2630:Q(F,I,A)=V+Q(F,I,A):REM* INPUT A
    MT*
2340 MI(I)=0:GOSUB2970:MI(I)=X:REM*ADD TOTALS *

2350 BL(F)=0:FORK=0TOT-2
2360 BL(F)=BL(F)+MI(K):NEXTK
2370 GOSUB2840:REM * PRINT MONTH-AMT *
2380 PRINT:PRINTZ1$:REM* "RECORD?"*
2390 GOSUB2510:REM* YES-NO*
2400 IFA$="N"THENGOTO2200
2410 GOTO58000
2420 GOTO2200
2430 GOTO58000
2440 REM*** WHAT WOULD LIKE TO SEE ***
2450 PRINT: PRINT"WHAT WOULD YOU LIKE TO SEE? I
    NPUT 1 TO";T
2460 GETA$:IFA$=""THEN2460
2470 A=VAL(A$)
2480 IFA<1ORA>TTHEN2460
2490 RETURN
2500 :
2510 REM*** YES- NO QUESTION ***
```

```
2520 GETA$:IFA$=""THEN2520
2530 IFA$<>"Y"THENIFA$<>"N"THEN2520
2540 RETURN
2550 :
2560 REM*** WHAT MONTH ***
2570 PRINT:PRINT"WHAT MONTH? INPUT 1 TO 12":PRI
     NT"THEN HIT RETURN KEY
2580 GOSUB2650
2590 A=V
2600 IFA<1ORA>12THEN2580
2610 RETURN
2620 :
2630 REM *** INPUT AMOUNT ***
2640 PRINT:PRINT"INPUT AMOUNT. THEN HIT RETURN
     KEY
2650 AA$=""
2660 OPEN1,0
2670 GET#1,A$
2680 IF A$<>CHR$(20)THEN2710
2690 IFLEN(AA$)-1 <0THEN2670
2700 AA$=LEFT$(AA$,(LEN(AA$)-1)):PRINT"{LEFT} {
     LEFT}";:GOTO2670
2710 PRINTA$;
2720 AA$=AA$+A$
2730 IFA$<>CHR$(13)THEN2670
2740 V=VAL(AA$)
2750 CLOSE1:RETURN
2760 :
2770 REM*** MONTHLY PRINTOVERFLOW ***
2780 FORJ=1TO6
2790 PRINTJ;M$(J);"...";TAB(9);Q(F,I,J);TAB(20)
     ;(J+6);M$(J+6);"...";TAB(28);
2800 PRINTQ(F,I,J+6)
2810 NEXTJ
2820 RETURN
2830 :
2840 REM*** PRINT MONTH-AMT ***
2850 PRINTM$(A);"...";Q(F,I,A)
2860 RETURN
2870 :
2880 REM***PRINT BILLING LIST ***
2890 PRINT"{CLEAR}":PRINTBL$(F);"(";BL(F);")":R
     ETURN
2900 :
2910 PRINT:PRINTZ$:REM*"CHANGE LIST ?"*
2920 GOSUB2510:REM* YES-NO*
2930 IFA$="N"THEN F1=-1:RETURN
2940 GOSUB2560:REM* WHAT MONTH*
2950 GOSUB2840:RETURN
2960 :
2970 REM *** ADD TOTALS ***
2980 X=0
2990 FORJ=1TO12
3000 X=X+Q(F,I,J):NEXTJ:RETURN
3010 FORK=0TO T-2
3020 BL(F)=BL(F)+C(K):NEXTK
3030 RETURN
3040 :
3050 :
58000 REM-SAVE PROGRAM BY HOWARD BICKING
58010 PRINT"{CLEAR}{02 DOWN}":FORI=2TO6 STEP2
58020 N4=I*5:GOSUB58190:N5$=N4$
58030 N4=PEEK(40+I):GOSUB58190:N6$=N4$:N4=PEEK(4
     1+I):GOSUB58190
58050 PRINT"59"+N5$" POKE"40+I","N6$":POKE"41+I"
     ,"N4$:NEXT
58060 PRINT"58130 POKE42,"N6$":POKE43,"N4$":END
58080 PRINT"GOTO 58110
58090 POKE 158,5:FORI=0TO7:POKE623+I,13:NEXT:PRI
     NT"{HOME}":END
58110 PRINT   :PRINT"{CLEAR}{REV}{03 DOWN}{03 RI
     RIGHT}YOU MAY NOW SAVE THIS PROGRAM
58130 POKE42,016:POKE43,032:END
58190 N4$=RIGHT$("00"+RIGHT$(STR$(N4),LEN(STR$(N
     4))-1),3):RETURN
58200 GOSUB 59010:END
59010 POKE 42 ,187:POKE 43 ,022
59020 POKE 44 ,057:POKE 45 ,023
59030 POKE 46 ,016:POKE 47 ,032
59090 RETURN
```

# VIC High-res Plotter

Sal Raciti

*If you need to illustrate something graphically, few options are superior to plots. This program, especially useful to students studying algebra, creates a high res olution picture of a mathematical equation. After seeing a plot, press the RUN/STOP and RESTORE keys at the same time to return the screen to its normal state.*

"Y = F (X) Plot Program" is a high resolution plot program for a 5K VIC-20. It plots equations in the form Y = F (X), e.g., Y = SIN (X). It is basically written as a high school level educational program to allow a student to select an equation, envision how it plots, and select the X and Y axes limits. If the student selects the axes limits incorrectly, he can try again. The program builds VIC's custom characters "on the fly" as values of Y are computed. Prior to the plot, it draws on the screen the X and Y axes limits selected by the student.

The program breaks the VIC-20 screen into 20 columns of characters, 20 characters high, in the upper left corner of the screen. It further subdivides each character column into eight dot columns, creating a matrix of 160 dots by 160 dots, or a total of 25,600 dots.

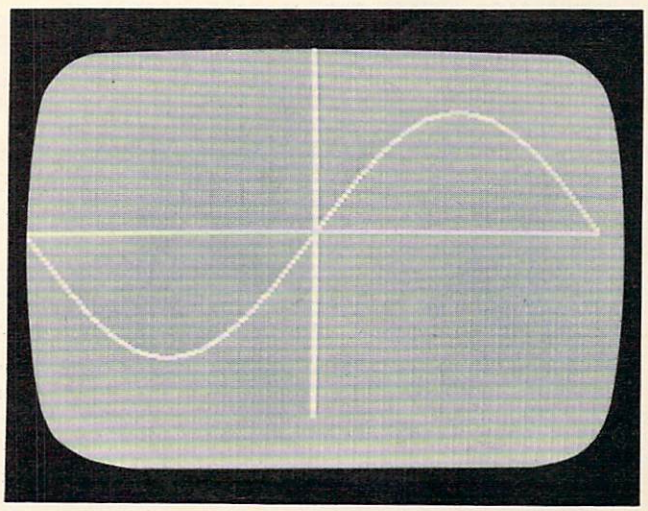
Lines 1 through 7 are the initial setup of the program. Lines 3 and 4 clear the custom character section of the RAM to all blank characters, i.e., 512 locations starting at 7168. Lines 6 and 7 set up the screen to allow selection of the equation to be plotted at location 550. *The program is restarted by typing RUN 9.*

Lines 9 through 47 allow selection of X and Y axes limits by the user through the use of INPUT prompts. These steps also do reasonableness checks on the inputs and prompt if there is an error. Lines 30 and 40 enter the X axis limits as string variables C$ and D$. This was done because of an idiosyncrasy of the VIC-20 that does not accept the $\pi$ key as a numeric entry. Subroutine 5000 is used to convert the allowed values of $\pi$ to numerics. Line 47 activates subroutine 6000 when Y is typed. Subroutine 6000 will be explained below.

Lines 48 through 230 plot the X axis using the INPUTted values of A, B, C and D from lines 10, 20, 30 and 40. Lines 50-80 calculate the numeric distance between horizontal dots. Line 90 tests if the axis is off the screen and skips to line 191. Lines 92-130 calculate the position of the X axis in numbers of characters from screen bottom and number of dots left over. Lines 140-230 create the 0 "TH" custom character and POKE it across the screen. Line 85 selects the screen and border color. Line 192 and 195 select character color (in this case, dot color). Line 191 invokes the custom character RAM locations.

Lines 240-440 plot the Y axis. Line 250 skips the entire routine if the Y axis is off the screen. Lines 255-330 create the 1 "TH" custom character, i.e., a vertical line at the correct dot column. Lines 340-440 POKE the 1 "TH" custom character vertically at the correct screen position. As this is accomplished, each POKE location is tested to see if it's not blank, that is, to test where the crossing of the X axis occurs. When this is sensed, the 1 "TH" custom character is logically ORed with the 0 "TH" custom character to create the 2 "TH" character. This is accomplished by lines 380-430.

The equation's high-resolution plot is executed by lines 490-780. Calculation of Y amplitude (YA) is treated as dot columns within character columns. For each character column, custom characters are made up "on the fly" as necessary by lines 520-770. The amplitude of Y (YA) is calculated by line 560 in numbers of dots from screen bottom. Line 570 finds the number of characters from screen bottom and 580 finds the excess number of dots. 600 calculates the character screen position and the dot row at the dot column being processed. 610-765 logically OR this dot with any other dots on the screen at the character location



*Tracking a sine wave on the VIC-20 with "Hi-Res Plotter."*

being processed. These dots were on the screen from previous calculations of Y or the X and Y axis plot.

## Avoiding Screen Clutter

If at line 47 Y was typed, then line 775 invokes subroutine 6000. The VIC-20 is limited to 64 custom characters. If the equation to be plotted is very complicated, e.g., Y=SIN (2X), the 64 characters are used up; then the program starts using screen RAM locations as custom locations, and the screen clutters. Subroutine 6000 starts a search of the screen RAM to see if any custom characters with character column just completed are identical to previously generated characters; if so, they are replaced by the earlier generated character. Subroutine 6000 finds the last custom character ("N"TH) created and sets the scan direction. Subroutine 8000 is called by 6000 and does the actual character comparisons and replacement.

*Note: The π(pi) characters in lines 25 and 5000-5110 are obtained by holding down the SHIFT key and typing the ↑(up arrow) key.*

```
1 REM INTIALIZATION
3 FORG=7168+32*8 TO 7168+32*8+7
4 POKEG,0:NEXTG
6 PRINT"{CLEAR}";:PRINTSPC(1);:PRINT"Y=F(X) ~
    PLOT PROGRAM"
7 PRINT"{03 DOWN}";:PRINT"ENTER Y=F(X) @ 550
    AND THEN RUN9"
8 LIST550
9 PRINT"{CLEAR}";:PRINTSPC(1);:PRINT"Y=F(X) ~
    PLOT PROGRAM{02 DOWN}"
10 INPUT"Y-MIN VAL";A
20 INPUT"Y-MAX VAL";B
23 IFA>=BTHENPRINT"{03 DOWN}AXIS INCORRECTLY ~
    INPUT-START OVER!":STOP
25 PRINT"{02 DOWN}REM TRIG FUNC LENGTH  OF X-
    AXIS <=2π. SELECT +OR-2π,π,π/2, OR NU
    M-BER.
26 PRINT"{02 DOWN}"
30 INPUT"X-MIN VAL";C$
40 INPUT"X-MAX VAL";D$
43 GOSUB5000
45 IFC>=DTHENPRINT"{03 DOWN}AXIS INCORECTLY I
    NPUT-START OVER!":STOP
47 INPUT"PLOT BREAK? TYPE Y  N{03 LEFT}";Z$
48 REM X-AXIS PLOT
50 YS=ABS(B-A)
60 XS=ABS(D-C)
80 XD=XS/160
85 POKE36879,104
90 IF(A<0ANDB<0)OR(A>0ANDB>0)THENGOTO191
92 AA=ABS(A)
95 YA=INT(24+8*20*(AA)/YS)
121 T=7168:V=7175:GOSUB2000
127 NB=INT(YA/8)
130 ND=YA-8*NB
140 N=7175-ND
150 POKEN,255
190 CD=22-NB
191 POKE36869,255:PRINT"{CLEAR}"
194 FORG=38400TO38905
195 POKEG,1:NEXTG
197 IF(A<0ANDB<0)OR(A>0ANDB>0)THENGOTO250
200 Q=7680+CD*22
210 FORQ=QTOQ+19
220 POKEQ,0
230 NEXTQ
240 REM Y-AXIS PLOT
250 IF(C<0ANDD<0)OR(C>0ANDD>0)THENGOTO500
255 CC=ABS(C)
260 XA=INT(8*20*CC/XS)
270 NB=INT(XA/8)
280 ND=XA-8*NB
290 T=7176:V=7183
310 GOSUB4000
320 FORM=TTOV
330 POKEM,R:NEXTM
340 FORZ=7680+NBTO8098+NBSTEP22
350 IFPEEK(Z)<>32THENGOTO380
360 POKEZ,1
370 GOTO440
380 FORS=0TO7
390 Y=PEEK(S+7176)
410 X=PEEK(7168+S)
420 POKE(T+8+S),(XORY)
425 NEXTS
430 POKEZ,2
440 NEXTZ
490 REM Y=F(X) PLOT
500 N=2
510 X=C-XD
520 FORD=0TO19
525 R=256
530 FORE=0TO7
535 R=R/2
540 X=X+XD
550 Y=(X*X)
560 YA=INT(20*8*(Y-A)/(B-A))
570 NB=INT(YA/8)
580 ND=YA-8*NB
590 IFNB>=20ORNB<0THENGOTO770
600 Z=8098+D-22*NB
605 ND=ND+1
610 O=PEEK(Z)
620 IFO<NORO=32THENGOTO720
640 IFPEEK(Z)=NTHENGOTO750
720 N=N+1
723 IFN=32THENN=N+1
734 FORM=0TO7
735 J=PEEK(7168+8*O+M)
736 POKE(7168+8*N+M),J
737 NEXTM
750 J=PEEK(7168+8*N+8-ND)
760 POKE(7168+8*N+8-ND),(JORR)
765 POKEZ,N
770 NEXTE
775 IFZ$="Y"THENGOSUB6000
780 NEXTD
930 END
2000 FORW=TTOV
2010 POKEW,0:NEXTW
2020 RETURN
4000 R=256
4010 FORP=1TOND
4020 R=R/2:NEXTP
4030 RETURN
5000 IFC$="-2π"THENC$="-6.2832
5010 IFC$="-π"THENC$="-3.1416"
5020 IFC$="-π/2"THENC$="-1.5708"
5040 IFD$="π/2"ORD$="+π/2"THEND$="1.5708"
5050 IFC$="π"ORC$="+π"THENC$="3.1416"
5060 IFD$="2π"ORD$="+2π"THEND$="6.2832"
5070 IFC$="π/2"ORC$="+π/2"THENC$="1.5708"
5080 IFD$="π"ORD$="+π"THEND$="3.1416"
5100 IFD$="-π/2"THEND$="-1.5708"
5110 IFD$="-π"THEND$="-3.1416"
5200 C=VAL(C$):D=VAL(D$):RETURN

6000 MM=0
6010 IFMM=0THENQQ=0:SS=418:TT=22
6020 IFMM=1THENQQ=418:SS=0:TT=-22
6030 FORBB=QQTOSSSTEPTT
6040 CC=8098+D-BB
6050 DD=PEEK(CC)
6060 IFDD=32ORDD<3GOTO6090
6070 IFDD<NANDDD>2ANDMM=0THENBB=418:NEXTBB:MM=1
    :GOTO6020
6080 IFDD=NANDDD>2THENGOSUB8000
6090 NEXTBB
```

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```
6100 RETURN
8000 FORGG=DTO0STEP-1
8003 IFMM=0THENUU=0:VV=19:WW=1
8004 IFMM=1THENUU=19:VV=0:WW=-1
8010 FORRR=UUTOVVSTEPWW
8020 HH=8098+GG-22*RR
8030 II=PEEK(HH)
8040 IFII=32ORII=NTHENGOTO8120
8050 FORJJ=1TO8
8060 KK=7167+8*II+JJ
8070 LL=7167+8*N+JJ
8090 IFPEEK(KK)<>PEEK(LL)THENJJ=8:GOTO8110
8100 IFJJ=8THENPOKECC,II:N=N-1:IFN=32THENN=31
8105 IFJJ=8ANDMM=0THENRR=19:GG=0
8106 IFJJ=8ANDMM=1THENRR=0:GG=0
8110 NEXTJJ
8120 NEXTRR
8130 NEXTGG
8140 RETURN
```

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# The Atari Cruncher

Andrew Lieberman

*Many longer programs could benefit from this memory-saving technique, which saved 7,000 bytes in the music DATA within the author's music program.*

Programs are written every day using DATA statements. Often the numbers in these statements are for SOUND and PLOT commands, and happen to be in the range of 0 to 255. Frequently, the program loads these numbers into a matrix. This method of DATA storage is inefficient; it wastes *lots* of memory.

There is, however, a way to solve this problem, and an easy way to change already existing programs to a more compact form. Using the "Cruncher," I knocked 7K – that's right, 7000 bytes – off a music program. It took about 40 minutes, and that includes debugging. Many programs can easily be done in half that time.

Each character on the Atari has an ATASCII value ranging from 0 to 255. Look in your *BASIC Reference Manual*, Appendix C. Take, for example, the letter A. Its corresponding number is 65. By using this code, we can convert each number (using one to three digits) to a single character using only one character. It would be a very tedious process if we took each number, looked it up on the chart, and then replaced the number in a program with a single character.

That's where the Cruncher comes in. It won't do all of the work, but it will do most of it. We can further save memory by condensing all of these single characters into one large string instead of a matrix. This is the big memory saver: each character in a matrix takes about seven bytes, but in a string takes only one. So, pull out a program with a lot of numbers and let's get to work. (*Note:* This is a standard procedure. Your program may require modifications of the process of conversion. Read through the procedure and think about what you are doing; otherwise, you may find yourself hopelessly lost.)

First, type the following subroutine into your Atari, and LIST it to cassette or disk. This way you can load it on top of the program to be converted.

```
0 A=PEEK(136)+PEEK(137)*256:? "WHAT L
  INE";:INPUT X:TRAP 32003:GOTO 32000
32000 LI=PEEK(A)+PEEK(A+1)*256:IF LI<
      >X THEN A=A+PEEK(A+2):GOTO 3200
      0
32001 A=A+1:IF PEEK(A)=90 THEN READ D
      :POKE A,D
32002 GOTO 32001
32003 END
```

Second, load the program to be converted. Put in a DIM statement and DIMension a string, say A$, to the number of numbers in the DATA statements. If your program READs the DATA and then puts it in a matrix, get rid of the READ statements. Otherwise, change a routine like this:

```
100 FOR I=1 TO 100:READ A,B:PLOT A,B:
    NEXT I
```

to this:

```
100 FOR I=1 TO 100:A=ASC(A$(I,I)):B=A
    SC(A$(I+1,I+1)):PLOT A,B:NEXT I
```

or better yet:

```
100 FOR I=1 TO 100:PLOT ASC(A$(I,I)),
    ASC(A$(I+1,I+1)):NEXT I
```

If your program handles the DATA in a different way, then it's up to you to figure out the rest of that part on your own.

Now we are almost ready to convert the DATA. Before we can put the characters into A$, we must have an A$. It is already DIMensioned, but we must add space for the characters in the program. Get an idea as to approximately how many numbers are to be converted, say 200. Then type something like this into your program:

```
50 A$(1,50)="ZZZZZZZZZZZZZZZZZZZZZZZZZ
   ZZZZZZZZZZZZZZZZZZZZZZZZZZ"
52 A$(51,100)="ZZZZZZZZZZZZZZZZZZZZZZZZ
   ZZZZZZZZZZZZZZZZZZZZZZZZZZ"
54 A$(101,150)="ZZZZZZZZZZZZZZZZZZZZZZZ
   ZZZZZZZZZZZZZZZZZZZZZZZZZZ"
56 A$(151,200)="ZZZZZZZZZZZZZZZZZZZZZZZ
   ZZZZZZZZZZZZZZZZZZZZZZZZZZ"
58 A$(201,225)="ZZZZZZZZZZZZZZZZZZZZZZZ
   ZZZZ"
```

It doesn't hurt to put in some extras; you can always take them out later. To easily duplicate a line, just type it, press RETURN, move the cursor back to the line number, change it, and press RETURN. (*NOTE:* You *must* use capital Z's.) Once you have done this, type RUN. Tell the computer what line your Z's start at (in our sample, 50). Now, wait while the computer figures everything out. When READY appears, LIST the program and see what happens. Voilà! The Z's now look like a lot of garbage!

Fourth, and last, get rid of any extra Z's and delete line 0, lines 32000 to 32003, and all of the

numerical DATA statements. Now type RUN and watch your program run faster than ever. Sit back and say to yourself, "Gee, that was easy. What program should I fix next?"

## The Mystery Revealed

For those of you who would like to know how this program works, I will explain it step by step. The first thing the computer does is find out where the program is stored in RAM. By PEEKing addresses 136 and 137, the Cruncher finds out the first address of the program. The TRAP is so that when the computer is out of DATA, it ENDs without an error.

Next, the computer finds line X. The first three bits of each line give very important information. The first two tell the line number, and the third tells the length. To check if we are at line X, we first find out at which line we are. If LI isn't equal to X, we must advance the pointer to the next line. We do this by adding the length of the line to our original number and trying again.

Now the conversion process begins. A loop begins that checks each address to see if it is 90, or a Z. If it is, the program READs a piece of DATA and POKEs it into the program. We then loop back and continue the process. When we run out of DATA, the TRAP is sounded and the program ENDs. ©

# Super Shell Sort For PET/CBM

John W. Ross

*There are many programs which would benefit from an extremely fast sorting subroutine. This one is among the fastest ever written for a micro: it sorts 1000 names in less than 30 seconds. The version here is for PET/CBM's with 32K of memory.*

One approach a programmer can take to gain an increase in sorting speed involves the use of more sophisticated sorting algorithms. This approach is useful to a point, but has ultimate limitations, not the least of which is the limit imposed by the use of an interpretive language like BASIC.

Suppose you finally do get around to writing that non-recursive version of Quicksort, and you find that it isn't quick, or at least not as quick as you had hoped.

This is the problem that faced me recently. The answer for me (and you, I hope) turned out to be a switch to machine language programming. This resulted in a really dramatic increase in speed. In one typical application, my sorting time went from 54 seconds to less than two seconds!

There are other machine language sorts around – why should you consider this one? It has several features that I believe make it unique. First of all, it is very convenient to use. It sorts any character array, in place. You do not have to move your data to a special location or assign the array a particular name. It can be incorporated into any program without disturbance.

Second, it uses a Shellsort algorithm which is quite efficient as sorts go – certainly far better than the oft-encountered bubble sort. Finally, it is modular in design – the actual sorting part of the program can be extracted from the framework and replaced with something more efficient if you are feeling ambitious.

To get a feel for how the thing works, let's look at a sample application, such as the one shown in Program 1. (You might want to try this out on your favorite BASIC sort first to establish a benchmark.) Lines 100-220 set up a random array of 1000 elements, each one between one and five characters long. This is the array to be sorted.

Lines 300-330 transfer parameters to the sort program. In lines 300 and 310, we POKE the ASCII codes for the letters of the name of the array we want to sort into memory locations 32160 and 32161. If the array name has only one letter, 128 is POKEd for the second letter. For instance, if we wanted to sort the array CD$ we would use:

```
POKE 32160,67 : POKE 32161,68
```

In lines 320-330 we POKE a two-byte encoding of N into locations 32162 and 32163, where N is the number of elements to participate in the sort. Element zero is never sorted, so it may be used for special applications. That's all there is to it. The subroutine is called in line 350.

An error code is returned in location 32164. This is zero if all goes well, one if the array name cannot be found, and two if an attempt is made to sort a multi-dimensioned array.

You will note that the program lives at the top of user memory, from $7DA0 to $7F5F including variable storage. Thus, before loading the program, you must reset the top of memory pointer – line 130 in Program 2. This sets the pointer to $7D9F (32159 decimal).

## Program 1.

```
100 REM MACHINE CODE SORT TEST PROG
    RAM
110 N=1000
120 DIM A$(N)
125 REM CREATE TEST ARRAY
130 FOR I=1 TO N
140 :  N1=INT(RND(0)*5+1)
150 :  A$=""
160 :  FOR J=1 TO N1
170 :     B$=CHR$(INT(RND(0)*26+65)
    )
180 :     A$=A$+B$
190 :  NEXT
200 :  A$(I)=A$
210 NEXT
220 PRINT CHR$(7)
300 POKE 32160,65
310 POKE 32161,128
320 N2=INT(N/256) : POKE 32163,N2
330 N1=N-N2*256   : POKE 32162,N1
340 T1=TI
350 SYS 32179
360 T2=TI
370 EC=PEEK(32164)
380 IFEC=1THENPRINT"ERROR - ARRAY N
    OT FOUND": GO TO 420
390 IFEC=2THENPRINT"ERROR - DIMENSI
    ON NOT = 1": GO TO 420
400 FOR I=1 TO N : PRINTA$(I) : NEX
    T
410 PRINT:PRINT N"ELEMENTS SORTED I
    N"(T2-T1)/60"SECONDS"
420 END
```

## Program 2.

```
100 REM MACHINE CODE SORT LOADER
110 REM
120 REM LOWER TOP OF MEMORY POINTER

130 POKE53,125:POKE52,159:CLR
140 REM LOAD PROGRAM
150 GOSUB 30000
160 END
30000 READN,L:FORI=1TON:READX:POKEL,X
    :L=L+1:NEXT:RETURN
30010 DATA429,32179
30020 DATA173,160,125,41,127,141,160,
    125,173,161,125,9,128,141,
    161,125
30030 DATA169,0,141,164,125,165,44,13
    3,84,165,45,133,85,160,0
30040 DATA177,84,205,160,125,208,8,20
    0,177,84,205,161,125,240,4
    2
30050 DATA160,2,177,84,141,165,125,20
    0,177,84,141,166,125,24,16
    5
30060 DATA84,109,165,125,133,84,165,8
    5,109,166,125,133,85,197,4
    7
30070 DATA144,207,240,205,169,1,141,1
    64,125,76,224,126,160,4,17
    7
30080 DATA84,201,1,240,8,169,2,141,16
    4,125,76,224,126,24,165
30090 DATA84,105,7,133,84,165,85,105,
    0,133,85,173,162,125,141
30100 DATA177,125,173,163,125,141,178
    ,125,173,178,125,208,12,17
    3,177
30110 DATA125,240,4,201,1,208,3,76,22
    4,126,78,178,125,110,177
30120 DATA125,56,173,162,125,237,177,
    125,141,175,125,173,163,12
    5,237
30130 DATA178,125,141,176,125,162,0,1
    38,141,168,125,141,169,125
    ,173
30140 DATA177,125,141,170,125,173,178
    ,125,141,171,125,238,168,1
    25,208
30150 DATA3,238,169,125,173,169,125,2
    05,176,125,240,4,176,85,14
    4
30160 DATA10,173,168,125,205,175,125,
    240,2,176,73,238,170,125,2
    08
30170 DATA3,238,171,125,160,3,165,84,
    133,88,133,90,165,85,133
30180 DATA89,133,91,24,165,88,109,168
    ,125,133,88,165,89,109,169

30190 DATA125,133,89,24,165,90,109,17
    0,125,133,90,165,91,109,17
    1
30200 DATA125,133,91,136,208,223,32,2
    25,126,173,167,125,240,163
    ,48
30210 DATA161,32,80,127,162,1,76,115,
    126,138,208,129,76,52,126
30220 DATA96,160,0,140,167,125,177,88
    ,141,172,125,177,90,141,17
    3
30230 DATA125,200,152,205,172,125,240
    ,2,176,15,205,173,125,240,
    25
30240 DATA144,23,169,1,141,167,125,76
    ,79,127,205,173,125,240,2
30250 DATA176,64,169,255,141,167,125,
    76,79,127,140,165,125,160,
    1
30260 DATA177,88,133,86,200,177,88,13
    3,87,172,165,125,136,177,8
    6
30270 DATA141,174,125,140,165,125,160
    ,1,177,90,133,86,200,177,9
    0
30280 DATA133,87,172,165,125,177,86,2
    00,205,174,125,208,3,76,24
    0
30290 DATA126,144,180,76,15,127,96,16
    0,2,177,88,72,177,90,145
30300 DATA88,104,145,90,136,16,243,96
```

# Atari Line Range Manipulator

Chuck Beach

*This will enhance your BASIC editor by allowing you to copy, delete, or move entire line ranges. The utility takes about 4K and was written in the upper line range (from 30000 to 31000), allowing you to use the lower 30000 for work.*

The principles involved in this utility have been demonstrated in several **COMPUTE!** publications. An article in *COMPUTE!'s First Book of Atari* ("The Ouch in Atari BASIC") described some Atari BASIC limitations and inspired me to put together a line range manipulation utility. Another article in the same book ("Inside Atari BASIC") showed how to PEEK at the line number of your BASIC program. And it was the June 1982 issue of **COMPUTE!** ("A Self-Modifying P/M Graphics Utility") that first demonstrated to me the technique which let a program manipulate itself.

There are two methods you can use to incorporate this utility in your programs. One way is to simply type up the lines into your program for each and every use. Another, more desirable method is to type up the utility separately, LIST it to a device, then use the ENTER command to merge the LISTed into your BASIC program. Be sure that the line range for the utility is free to use so you don't lose some nifty routine. Another caution: check that your program won't accidentally fall into the utility logic.

## The Options

To use the utility, just enter GOTO 30000. The utility will enter a menu and allow you to select whether you want to Copy, Move, Delete, or Count a range of lines. Select an option and follow the directions.

For the DELETE option, you'll be asked for a range. The specified range is then deleted.

For MOVE, you'll be asked a source range to be moved. After verifying that the range is valid, you'll be prompted for a target line number (where the source range is to be moved) and an increment value. The source range is then copied to the target line number, with each copied line incremented by the value specified. As each line is copied, it is also deleted from the source range.

For the COPY option, you'll be asked for a source range. After verifying that the line range is valid, you'll be prompted for a target line number and an increment value.

For a COUNT operation (spelled KOUNT in the menu), you are asked for a line range. The utility will then return the number of lines within that range.

The END option interrupts the utility with a STOP command. It was designed so you can interrupt the utility, do some other function (further editing, saving the file, etc.), then issue the CONT to reenter the utility menu. Of course, if you execute any other code, this will change the "next line" pointer, and you'll have to reenter the utility through more conventional methods.

For all operations (except COUNT and END), the source range is limited to 100 lines. This was an arbitrary figure. Since line numbers are stored in an array, a larger range capacity would require more storage. The utility already takes up about 4K; if it took up any more, the overhead might make it impractical for an 8K computer. Feel free to expand the arrays by changing the D value in line 30005.

You will find that, unlike other self-modifying programs, this one allows you to watch the modifications in action. Not only do you have something to watch, but you can also get some idea how far along a particular operation is. Don't expect this thing to whiz through a 100 line move in a couple of seconds. In a large program, one line change means a lot of shifted text. In fact, the speed of the changes increases noticeably as more lines are deleted from the program.

## Other Uses

You can also use this utility to renumber program lines. The simplest method would be to MOVE the source range to an unused target range, then MOVE it back using the desired increment. In some instances, however, you can renumber in one operation. The reason is that the MOVE precalculates all source line numbers and moves each line one at a time.

Therefore, if you have a range of lines that is incremented by X, you can safely MOVE that range to the same beginning line number with any increment smaller than X. There are many

situations in which the MOVE can be used as a renumber operation, but try to gain an understanding of just how the utility is doing it before trying anything fancy.

You may also use this utility for interspersing lines. For instance, if the target range starts at 100 and is incremented by 10, you can safely MOVE or COPY to 105 with an increment of 10.

For all MOVE and COPY functions (where the source and target overlap), please remember that the program does not ensure that unintended lines won't be deleted. Back up your file often as you work with this until you get the hang of it.

## Techniques In The Program Itself

Some of the techniques used in this program may not be immediately apparent. If you do not have the **COMPUTE!** articles handy for reference, here is an explanation of some of the tricks used:

- Making the computer accept commands from screen.

  This is done by modifying the IOCB.

  POKE 842,13 – Sets the IOCB to accept input only from the screen starting at the cursor position.

  POKE 842,12 – Resets the IOCB to resume normal input modes.

  If the IOCB is not reset to 12, either by a screen command or, in this case, by the program, your computer will lock up and be slightly less useful than the "MEMO PAD" mode. Not even SYSTEM RESET will help you now. Your only alternative is to re-IPL with the ON/OFF switch.

  To ensure that the IOCB is reset, the last screen command is a CONT instruction. The utility is then reentered at the line following the last STOP instruction. At this point, the IOCB is reset for normal input. (This utility actually puts two CONT statements on the screen as a precaution.)

  One cautionary note: *please* practice with it before using it on something you've spent a while developing. Though errors in programs are always annoying, an error in a self-modifying program can be positively disastrous!

- Finding the BASIC line numbers.

  Location 136/137 of BASIC memory contains the LH (low/high) address of the first line of the program. Each tokenized line contains its line number in the first two bytes in the usual LH format. The third byte contains the displacement from the beginning of the line to the beginning of the next line.

- Trapping and displaying an error number.

  When the TRAP is sprung, the error number may be found at location 195 in memory.

## Program Description

**Lines 30000-30005** – Start of utility. Define arrays. Set variables.
**Lines 30010-30015** – Menu to options.
**Lines 30020-30040** – Determine user selection and branch to desired code.
**Lines 30060-30070** – END option stops and is followed by branch to menu to allow user to enter CONT to continue.
**Line 30090** – Subroutine to set screen up for self-modify code.
**Lines 30091-30092** – Subroutine to invoke self-modification.
**Line 30095** – Subroutine to retrieve next line address and number.
**Lines 30100-30150** – DELETE subroutine.
**Lines 30200-30250** – MOVE subroutine.
**Lines 30300-30350** – COPY subroutine.
**Lines 30400-30490** – KOUNT subroutine.
**Lines 30500-30530** – Subroutine to get source line range.
**Lines 30550-30560** – Subroutine to get target line number and increment value.
**Line 30580** – Error trap.

```
30000 REM --> LINE MANIPULATION UTILI
      TY <--
30005 D=100:DIM A(D),B(D),A$(1),L$(25
      ),ER$(5)
30010 TRAP 30580:? "{CLEAR}":? " LINE
       RANGE MANIPULATION UTILITY":?
      :? :? L$:? :? :L$=""
30015 ? "SELECT (D)ELETE, (M)OVE, (C)
      OPY,":? "{7 SPACES}(K)OUNT, OR
      (E)ND":? :? "SELECT ";:INPUT A$
30020 IF A$="D" THEN 30100
30025 IF A$="M" THEN 30200
30030 IF A$="C" THEN 30300
30035 IF A$="K" THEN 30400
30040 IF A$="E" THEN 30060
30045 L$(1,1)="'":L$(2,2)=A$:L$(3,25)
      ="' UNKNOWN. REENTER.":GOTO 300
      10
30060 STOP
30070 GOTO 30010
30090 ? CHR$(125):? :RETURN
30091 ? :? :? "CONT":? "CONT":POSITIO
      N 0,0:POKE 842,13:STOP
30092 POKE 842,12:? CHR$(125):? :RETU
      RN
30095 ADDR=ADDR+PEEK(ADDR+2):LNUM=PEE
      K(ADDR)+PEEK(ADDR+1)*256:RETURN

30100 REM DELETE
30105 ? :? "DELETE";:GOSUB 30500:IF C
      =0 THEN 30150
30110 X1=INT(C/15):X2=C-(X1*15):IF X1
      =0 THEN 30120
30115 FOR Y1=0 TO (X1-1):GOSUB 30090:
      FOR Y2=1 TO 15:PRINT A(Y1*15+Y2
      ):NEXT Y2:GOSUB 30091:NEXT Y1
30120 IF X2=0 THEN 30130
30125 GOSUB 30090:FOR Y1=1 TO X2:PRIN
      T A(X1*15+Y1):NEXT Y1:GOSUB 300
      91
30150 L$(1,LEN(STR$(C)))=STR$(C):L$((
```

```
      LEN(L$)+1),25)=" LINES DELETED.
      ":GOTO 30010
30200 REM MOVE
30205 ? :? "MOVE";:GOSUB 30500:IF C=0
       THEN L$="NULL RANGE SPECIFIED.
      ":GOTO 30010
30210 ? :? "MOVE TO";:GOSUB 30550
30215 FOR X1=1 TO C:GOSUB 30090:LIST
      A(X1):POSITION 2,3:L1=LEN(STR$(
      A(X1))):L2=LEN(STR$(B(X1)))
30220 FOR Y1=1 TO L1:PRINT " ";:NEXT
      Y1:IF L2<=L1 THEN 30230
30225 FOR Y1=1 TO (L2-L1):PRINT "
      {INSERT}";:NEXT Y1
30230 POSITION 2,3:PRINT B(X1):? :? :
      PRINT A(X1):GOSUB 30091:NEXT X1
30250 L$(1,LEN(STR$(C)))=STR$(C):L$((
      LEN(L$)+1),25)=" LINES MOVED.":
      GOTO 30010
30300 REM COPY
30305 ? :? "COPY";:GOSUB 30500:IF C=0
       THEN L$="NULL RANGE SPECIFIED.
      ":GOTO 30010
30310 ? :? "COPY TO";:GOSUB 30550
30315 FOR X1=1 TO C:GOSUB 30090:LIST
      A(X1):POSITION 2,3:L1=LEN(STR$(
      A(X1))):L2=LEN(STR$(B(X1)))
30320 FOR Y1=1 TO L1:PRINT " ";:NEXT
      Y1:IF L2<=L1 THEN 30330
30325 FOR Y1=1 TO (L2-L1):PRINT "
      {INSERT}";:NEXT Y1
30330 POSITION 2,3:PRINT B(X1);"
      {4 DOWN}":GOSUB 30091:NEXT X1
30350 L$(1,LEN(STR$(C)))=STR$(C):L$((
      LEN(L$)+1),25)=" LINES COPIED."
      :GOTO 30010
30400 REM COUNT
30405 ? "COUNT RANGE (FROM,TO) ";:INP
      UT L1,L2:IF L2>32767 THEN L2=32
      767
30410 IF L2<L1 THEN ? " BAD RANGE. RE
      ENTER.":GOTO 30405
30415 ADDR=PEEK(136)+PEEK(137)*256:LN
      UM=PEEK(ADDR)+PEEK(ADDR+1)*256:
      C=0
30420 IF L1>LNUM THEN GOSUB 30095:GOT
      O 30420
30425 IF L2>LNUM THEN C=C+1:GOSUB 300
      95:GOTO 30425
30490 L$(1,LEN(STR$(C)))=STR$(C):L$((
      LEN(L$)+1),25)=" LINES COUNTED.
      ":GOTO 30010
30500 ? " RANGE (FROM,TO) ";:INPUT L1
      ,L2:IF L2>32767 THEN L2=32767
30505 IF L2<L1 THEN ? " BAD RANGE. RE
      ENTER.":GOTO 30500
30510 ADDR=PEEK(136)+PEEK(137)*256:LN
      UM=PEEK(ADDR)+PEEK(ADDR+1)*256:
      C=0
30515 IF L1>LNUM THEN GOSUB 30095:GOT
      O 30515
30520 IF L2<LNUM THEN RETURN
30525 IF C<D THEN C=C+1:A(C)=LNUM:GOS
      UB 30095:GOTO 30520
30530 L$="RANGE TOO LARGE FOR DIM.":P
      OP :GOTO 30010
30550 ? " RANGE (LINE #,INCRE) ";:INP
      UT L1,L2
30555 FOR X1=1 TO C:B(X1)=L1+(X1-1)*L
      2:IF B(X1)<32768 THEN NEXT X1:R
      ETURN
30560 ? " BAD LINE NUMBER IN RANGE. R
      EENTER.":GOTO 30550
30580 ER$=STR$(PEEK(195)):?"ERROR NU
      MBER ";ER$:POP :GOTO 30060
```

# Easy Apple Editing

Roland Brown

*This editor routine provides a powerful utility for Applesoft programmers: the ability to easily modify BASIC program lines.*

The Apple II+ was created for its advanced BASIC. Programming in Applesoft is much better and easier than with integer BASIC. One main problem, however, with Applesoft is its editing. Some people invest in a ROM editor, others create their programs using a text editor, and others just suffer with the frustrating ESCape codes. Presented here is a 3/4K machine language program for the Apple II+ 48K or equivalent with DOS 3.3.

The BASIC Line Editor will not destroy the current BASIC program, but will destroy its strings. Once saved on disk as a binary file, Editor can be loaded into memory by the command:

```
]BRUN B.L.E.,A$9A00
```

To edit a BASIC program line, type

```
]& (line number)
```

for example,

```
] &100
```

This will clear the screen, display the line, and place the cursor at the top left of the screen. The line is displayed in a different format from Applesoft's. The differences are: the line is continuous instead of centered on the screen, there are no spaces in the line except between quotes, and all control characters are displayed in inverse.

In the Editor numerous commands are available to you. These commands edit the line:

| | |
|---|---|
| CTRL-B | block back |
| -C | convert hex to decimal |
| -D | delete |
| -F | block forward |
| -H | back arrow |
| -I | insert |
| -M | return |
| -S | search |
| -T | truncate |
| -U | forward arrow |
| -V | verbatim |
| ESC | return to BASIC |

CTRL-B moves the cursor back to the previous colon, or if there is no previous colon, the beginning of the line.

CTRL-C clears the bottom of the screen, places a $ prompt on the screen and allows a line to be input. This line is converted to decimal, printed, and the cursor is returned to its original position on the line. This can be used to convert bytes in hex that need to be POKEd/PEEKed.

CTRL-D deletes the character at the cursor.

CTRL-F moves the cursor to the next colon, or if there is no next colon, to the end of the line.

CTRL-H (back arrow) moves the cursor back one space.

CTRL-I inserts a space in the line at the cursor position. Note: CTRL-I will not insert at the top left of the screen.

CTRL-M (return) can be entered at any place in the line and the entire line will be entered into the program.

CTRL-S searches for the next character entered.

CTRL-T truncates the line at the cursor position, so the cursor is at the end of the line+1.

CTRL-U (forward arrow) moves the cursor forward one space.

CTRL-V allows raw control characters to be entered into the line. This can be used to enter returns or backspaces for easier printing control.

ESC will exit the Editor with the line untouched (so if you make a mistake, the line is not lost).

The Editor provides a < at the left side of line 7 as a guide to where BASIC truncates its lines. This will not affect your line if you pass the line through it.

## Typing It In

Program 1 is a BASIC program which loads the machine language for the Editor into memory. If the DATA statements have all been entered correctly, the program will provide instructions for saving the binary file to the disk, which should be done immediately. If an error is detected in the data, the program will stop. If this happens, check your DATA statements carefully, correct all mistakes, and run the program again.

## Program Explanation

Loading the program resets the stack to the same level as BASIC does, sets up the ampersand vector ($3F5), clears the screen, moves the DOS buffers down so it is safe, prints the title and restarts BASIC.

The entry of the program uses BASIC routines to read in the line and find the line in memory. If the line is not there, the program returns to

BASIC.

The line is disassembled into the input buffer ($200-$2FF) by using a modified version of CHRGET. If the character is text, CHRGET places it in the line. If the character is one representing a command, CHRGET looks it up in the table of BASIC commands and puts the command name in the buffer. Once the end of the line is reached, CHRGET enters the edit section of the program.

The edit program displays the line, gets a character from the keyboard, and processes it. Explanations of the different commands would take too long, but fairly adequate documentation of the program's workings can probably be understood by many Apple owners. If you do not understand any of the Editor commands, just experiment with them for a while.

```
100  FOR I = 39424 TO 40065: READ A:CK = CK +
     A: POKE I,A: NEXT
110  IF CK <  > 88754 THEN  PRINT "ERROR IN
     DATA STATEMENTS": STOP
120  HOME : PRINT : PRINT "BASIC LINE EDITOR
      INSTALLED AT": PRINT "LOCATIONS 39424-
     40065 ($9A00-9C81)": PRINT
130  PRINT "TYPE 'BSAVE B.L.E.,A$9A00,L$282'
     ": PRINT "TO STORE BINARY FILE": PRINT

140  PRINT "TYPE 'CALL 39424' TO ACTIVATE"
150  NEW
200  DATA  162,251,154,169,76,141,245,3
210  DATA  169,43,141,246,3,169,154,141
220  DATA  247,3,32,88,252,169,153,141
230  DATA  1,157,32,212,167,169,12,133
240  DATA  36,169,112,160,156,32,58,219
250  DATA  76,208,3,32,12,218,32,26
260  DATA  214,176,1,96,165,155,133,184
270  DATA  165,156,133,185,32,88,252,32
280  DATA  224,158,104,104,32,95,156,32
290  DATA  95,156,170,32,95,156,32,36
300  DATA  237,162,5,189,0,4,41,127
310  DATA  157,0,2,202,16,245,162,6
320  DATA  134,36,32,95,156,240,61,48
330  DATA  7,157,0,2,232,76,98,154
340  DATA  160,208,132,254,132,255,160,0
350  DATA  41,127,133,253,240,15,177,254
360  DATA  8,200,208,2,230,255,40,16
370  DATA  245,198,253,208,241,177,254,8
380  DATA  200,208,2,230,255,157,0,2
390  DATA  232,40,16,241,41,127,157,255
400  DATA  1,76,98,154,134,252,170,133
410  DATA  250,133,251,32,88,252,160,0
420  DATA  185,0,2,201,32,144,2,9
430  DATA  128,32,240,253,200,196,252,144
440  DATA  239,169,188,141,0,7,165,250
450  DATA  133,36,165,251,32,90,156,32
460  DATA  12,253,201,136,208,22,202,198
470  DATA  250,16,230,160,39,132,250,198
480  DATA  251,16,222,232,160,0,132,250
490  DATA  230,251,240,213,201,149,208,30
500  DATA  164,250,200,132,250,232,228,252
510  DATA  144,7,134,252,169,32,157,0
520  DATA  2,192,40,144,188,160,0,132
530  DATA  250,230,251,76,193,154,201,141
540  DATA  208,20,166,252,169,0,157,0
550  DATA  2,32,81,168,32,88,156,162
560  DATA  255,160,1,76,68,212,201,137
570  DATA  208,39,224,0,240,32,134,249
580  DATA  166,252,230,252,240,20,189,0
590  DATA  2,157,1,2,202,228,249,176
600  DATA  245,232,169,32,157,0,2,76
610  DATA  171,154,166,249,198,252,76,193
620  DATA  154,201,132,208,24,228,252,176
630  DATA  245,198,252,134,249,189,1,2
640  DATA  157,0,2,232,228,252,144,245
650  DATA  166,249,76,171,154,201,130,208
660  DATA  38,224,0,240,18,198,250,16
670  DATA  17,160,39,132,250,198,251,16
680  DATA  9,160,0,132,251,132,250,76
690  DATA  193,154,202,240,250,189,0,2
700  DATA  201,58,208,225,76,193,154,201
710  DATA  134,208,12,228,252,176,232,169
720  DATA  58,32,58,156,76,193,154,201
730  DATA  147,208,11,32,12,253,41,127
740  DATA  32,58,156,76,193,154,201,150
750  DATA  208,18,32,12,253,201,160,176
760  DATA  109,41,127,157,0,2,32,240
770  DATA  253,76,240,154,201,148,208,5
780  DATA  134,252,76,171,154,201,131,208
790  DATA  66,134,249,162,0,189,0,2
800  DATA  157,0,187,232,208,247,169,8
810  DATA  133,37,160,0,32,66,252,169
820  DATA  164,133,51,32,103,253,32,199
830  DATA  255,32,167,255,32,142,253,169
840  DATA  189,32,240,253,165,63,166,62
850  DATA  32,36,237,162,0,189,0,187
860  DATA  157,0,2,232,208,247,166,249
870  DATA  76,193,154,201,155,240,21,201
880  DATA  160,144,11,32,240,253,41,127
890  DATA  157,0,2,76,240,154,32,226
900  DATA  251,76,193,154,32,88,156,76
910  DATA  208,3,133,255,164,250,200,132
920  DATA  250,192,40,144,6,160,0,132
930  DATA  250,230,251,232,228,252,176,7
940  DATA  189,0,2,197,255,208,229,96
950  DATA  169,15,133,37,76,34,252,230
960  DATA  184,208,2,230,185,160,0,177
970  DATA  184,56,233,48,56,233,208,96
980  DATA  194,193,211,201,195,160,204,201
990  DATA  206,197,160,197,196,201,212,207
1000  DATA  210,0
```

# "Stringing" Atari Machine Code

Edward C. Smith

Atari BASIC provides the user with page 6 of memory for storing machine code programs executed via the USR function. Page 6 is by definition hexadecimal locations 600 to 6FF (1536 to 1791 decimal). With the increasing use of machine code, the programmer is sometimes faced with the problem of an overcrowded page 6. (*See "Insight: Atari" this month for further comments on this topic – Ed.*) What are the alternatives?

One solution is to float programs in memory by transferring machine code bytes from data statement lines to an Atari string which then becomes addressable with the ADR function. To qualify for "stringing," the machine code must be fully relocatable – no JMP's, no JSR's and no data tables may be enclosed within it. In addition, the first byte of the machine code must be the start of execution.

This utility (Program 2) provides a means for placing into a string machine language that meets the above criteria. It also inserts necessary statement lines and LISTs the modified version of your program to disk. The procedure for transferring data bytes into a string is based on information on the *Atari Assembler Editor User's Manual.*

The utility should be ENTERed after you have LOADed the program you want to modify. Please note that statement line 1 as well as the region 27000-30000 will be overlaid. Although five variables are dimensioned in line 1, only ML$ (the newly created machine code string) will be used with the modified program. A series of five prompts lead the user through the procedure. After each prompt the program comes to a STOP so that the user may LIST his program to the screen to make indicated changes or determine replies to questions.

To begin with, the user is reminded that the first argument of each USR function must be the address of the machine code string (to make the string fully relocatable) and also that all statement lines that POKE bytes onto page 6 must be deleted. The computer then uses input data to create the string and calculate the number of statement lines that will have to be inserted.

The number of lines is dependent upon the length of the string and the occurrence of two special hex codes: 22 (decimal 34) and 9B (decimal 155). When creating the string, these codes are temporarily replaced with hex code 20 (decimal 32) to avoid confusing the BASIC interpreter. After the statement line defining the string is established, the original values are restored.

Next a suitable location for the insertion of statement lines is requested. Since the first of these lines is a dimension statement, a location near the beginning of the program should be chosen. Care must be taken so that no existing lines are overlaid. Finally, a statement line number for the last line of the modified program is requested. This will allow the user to exclude the data statement lines containing the machine code, provided that they occur at the end of the original program.

## A Practical Test

Program 1 is an example of a program that uses page 6 to store machine code bytes (in this case 70 bytes). To demonstrate the use of the utility program, type Program 1 and SAVE to disk; then type Program 2 and LIST to disk. Next LOAD Program 1 and ENTER Program 2. Now change the first argument of each USR function in lines 62 and 66 from "M" to "ADR(ML$)". Next, delete line 40 and type RUN. Answer "Y" to the first two questions because you have just made these changes.

Respond to the third prompt with "9000" and then "70". Next, you are asked for a starting line number for the insertion of *two* statement lines. In reviewing the listing of Program 1, you will see that there is room for extra lines between line 30 and line 50. Type CONT and respond with "35". Answer the last prompt with "78". The computer will now automatically create Program 3 and LIST it to disk as "D:PROGRAM3.LST". When the LISTing is completed type NEW, then ENTER Program 3 and RUN. The result should be the same as when Program 1 is RUN.

### Description Of Program 2

| Line # | | |
|---|---|---|
| 1 | **DIM ML$(300)** - | allows up to 300 bytes to be placed in a string. At 90 bytes/line, up to four statement lines of machine code can be inserted. |
| | **DIM Q$(300) and DIM R$(300)** | - keep track of the occurrence of ASC 34 (double quotation marks) and ASC 155 (RETURN) in the machine code. Allows up to 100 34's and 100 155's. |

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DIM P$(3) - used for formatting Q$ and R$.
DIM M$(100) - will hold up to three instructions per line for restoring CHR$(34) and/or CHR$(155) in the machine code string.

27100-27625 First three user prompts.
27630-27650 Develop machine code string ML$ with CHR$(32) replacing CHR$(34) and/or CHR$(155).
27660-27690 Determine number of statement lines to be inserted.
27700-27732 Last two user prompts.
27800-27830 Format input value P to a three-byte left-justified value.
29100 Establishes DIM for ML$.
29170-29270 Establish ML$ (90 bytes per statement line).
29330-29800 Develop statement lines for restoring CHR$(34) and/or CHR$(155).
29900-29910 LIST modified program to disk.

## Program 1.

```
30 DIM Y2$(30),Y1$(30)
40 M=1536:FOR I=M TO M+69:READ A:POKE
   I,A:NEXT I
50 Y2$="{4 SPACES}software{5 SPACES}"
   :Y1$="{5 SPACES}title{7 SPACES}"
54 GRAPHICS 18:POSITION 0,0:? #6;"***
   ****************":POSITION 0,10:?
   #6;"**********************"
58 FOR I=1 TO 9:POSITION 0,I:? #6;"*"
   :POSITION 19,I:? #6;"*":NEXT I:I=0
62 I=I+1:A=USR(M,ADR(Y2$),LEN(Y2$),I)
   :POSITION 2,3:? #6;Y2$:GOSUB 78:IF
   I<18 THEN 62
65 SOUND 0,0,0,0:I=0
66 I=I+1:A=USR(M,ADR(Y1$),LEN(Y1$),I)
   :POSITION 2,6:? #6;Y1$:GOSUB 78:IF
   I<18 THEN 66
77 SOUND 0,0,0,0:GOTO 77
78 SOUND 0,230/I,10,10:SETCOLOR 0,I+2
   ,9:RETURN
9000 DATA 104,104,133,204,104,133
9010 DATA 203,104,104,133,205,133
9020 DATA 206,104,104,133,207,201
9030 DATA 1,208,22,160,255,200
9040 DATA 177,203,153,218,6,169
9050 DATA 32,145,203,198,205,165
9060 DATA 205,201,0,240,2,208
9070 DATA 236,216,56,165,206,229
9080 DATA 207,168,162,255,232,200
9090 DATA 189,218,6,145,203,198
9100 DATA 207,165,207,201,0,240
9110 DATA 2,208,239,96
```

## Program 2.

```
1 DIM ML$(300),Q$(300),P$(3),M$(300),
  R$(300):SETCOLOR 2,12,1:GOTO 27000
27000 REM
27010 REM ****************************
27020 REM *{6 SPACES}UTILITY for
      {8 SPACES}*
27030 REM *{6 SPACES}'STRINGING'
      {8 SPACES}*
27040 REM *{5 SPACES}MACHINE  CODE
      {7 SPACES}*
27050 REM *{10 SPACES}by{13 SPACES}*
27060 REM *{4 SPACES}Edward C. Smith
      {6 SPACES}*
27070 REM *{4 SPACES}Harrisburg, Pa.
      {6 SPACES}*
27080 REM *{5 SPACES}OCTOBER 1982
      {8 SPACES}*
27090 REM ****************************
27095 ? CHR$(125);"{TAB}{3 SPACES}UTI
   LITY FOR 'STRINGING':? "{2 TAB}
   MACHINE CODE"
27098 ? :? "This utility program shou
   ld be ENTERedafter program you
   want to modify has  been LOADed
    into memory."
27100 ? :? "1)Has the first argument
    of each USR{3 SPACES}instructi
   on in your program been
   {6 SPACES}replaced with ";
27110 ? "'ADR(ML$)' (Y/N)";:INPUT P$
27112 IF P$<>"Y" THEN ? :? "  Please
   LIST your program and make
   {5 SPACES}the necessary changes
    - then type{5 SPACES}CONT"
27114 IF P$<>"Y" THEN STOP
27120 ? :? "2)Have you deleted STATEM
   ENT LINE(S){4 SPACES}in your pr
   ogram that read DATA and
   {4 SPACES}POKE onto page 6 ";
27130 ? "of memory (Y/N)";:INPUT P$
27132 IF P$<>"Y" THEN ? :? "  Please
   LIST your program and delete
   {3 SPACES}these lines - then ty
   pe CONT":STOP
27610 ? :? "3)Scan program listing to
    determine{5 SPACES}data statem
   ent line number where the  mach
   ine code bytes ";
27612 ? "begin and count{4 SPACES}num
   ber of bytes.":? "  Type CONT t
   o resume program":STOP
27615 ? "  Enter data statement line
   #";:INPUT MACHINECODE
27620 TRAP 27620:? "  Enter NUMBER of
    machine code bytes{4 SPACES}to
    be placed into a STRING ";:INP
   UT NUMBYTES
27625 TRAP 40000
27630 RESTORE MACHINECODE:FOR I=1 TO
   NUMBYTES:READ A
27635 REM CHECK FOR 34 OR 155 DATA BY
   TES AND CHANGE TO A SPACE (32)
27640 IF A=34 THEN P=I:GOSUB 27800:Q$
   (LEN(Q$)+1)=P$:ML$(I)=CHR$(32):
   GOTO 27650
27643 IF A=155 THEN P=I:GOSUB 27800:R
   $(LEN(R$)+1)=P$:ML$(I)=CHR$(32)
   :GOTO 27650
27645 ML$(I)=CHR$(A)
27650 NEXT I
27655 REM DETERMINE NUMBER OF STATEME
   NT LINES TO BE INSERTED.
27660 M$=Q$:GOSUB 27920:NQ=N
27670 M$=R$:GOSUB 27920:NR=N
27680 NN=INT(NUMBYTES/90)+1:IF INT(NU
   MBYTES/90)=NUMBYTES/90 THEN NN=
   NN-1
27690 NUMLN=1+NN+NQ+NR:P$=STR$(NUMLN)
   :FOR I=1 TO LEN(P$):P$(I,I)=CHR
   $(VAL(P$(I,I))+176):NEXT I
27700 ? :? "4)Now scan your program l
   isting to{6 SPACES}determine an
    area where ";P$;
27710 ? " statement{3 SPACES}lines ca
   n be inserted."
27712 ? "  Select an insertion point
   near the{4 SPACES}beginning of
   the program."
27715 ? :? "  Type CONT to resume pro
   gram ":STOP
27720 ? "  Enter  the  FIRST  stateme
   nt  line{4 SPACES}number for th
   is insertion ";:INPUT LN
27730 ? :? "5)Next determine number f
   or LAST state  ment line of mod
```

```
      ified program - then  type CONT
      .":STOP
27732 ? "  Enter number for LAST line
      ";:INPUT LL
27790 GOTO 29000
27800 P$=STR$(P):ON LEN(P$) GOTO 2781
      0,27820,27830
27810 P$(LEN(P$)+1)="  ":GOTO 27830
27820 P$(LEN(P$)+1)=" "
27830 RETURN
27920 IF INT(LEN(M$)/9)=LEN(M$)/9 THE
      N N=LEN(M$)/9:GOTO 27940
27930 N=INT(LEN(M$)/9)+1
27940 RETURN
28000 REM ADD STATEMENT LINES THAT CO
      NTAIN CHR$(34) (QUOTATION MARK
      CODE).
28050 SETCOLOR 2,0,0:? CHR$(125):POSI
      TION 2,2:? M$:? :? :? "CONT":PO
      SITION 0,0:POKE 842,13:STOP
28100 POKE 842,12:RETURN
29000 REM ADD DIMENION LINE DEFINING
      LENGTH AS EQUAL TO THE NUMBER O
      F MACHINE CODE BYTES.
29100 M$=STR$(LN):M$(LEN(M$)+1)="DIM
      ML$(":M$(LEN(M$)+1)=STR$(NUMBYT
      ES):M$(LEN(M$)+1)=")":LN=LN+1:G
      OSUB 28000
29150 REM ADDING STATEMENT LINE(S) CO
      NTAINING 'STRINGS' OF MACHINE C
      ODE.
29170 JM=NUMBYTES/90:IF INT(NUMBYTES/
      90)=NUMBYTES/90 THEN JM=JM-1
29180 FOR J=0 TO JM
29190 SETCOLOR 2,0,0:? CHR$(125):POSI
      TION 2,2
29210 A=90*J+1:B=A+89:IF B>NUMBYTES T
      HEN B=NUMBYTES
29220 ? J+LN;"ML$(";A;",";B;")=";CHR$
      (34);
29230 FOR I=A TO B:? CHR$(27);ML$(I,I
      );:NEXT I
29260 ? CHR$(34):? :? :? "CONT":POSIT
      ION 0,0:POKE 842,13:STOP
29270 POKE 842,12:NEXT J
29300 REM REPLACING 34'S AND 155'S
29330 IF LEN(Q$)=0 AND LEN(R$)=0 THEN
       29900
29335 QQ=34:T=1
29340 IF LEN(Q$)<>0 AND LEN(R$)=0 THE
      N 29400
29350 IF LEN(Q$)<>0 AND LEN(R$)<>0 TH
      EN T=2:GOTO 29400
29360 IF LEN(Q$)=0 AND LEN(R$)<>0 THE
      N QQ=155:Q$=R$
29400 L=0:XM=LEN(Q$)/3
29420 L=L+1:M$=STR$(LN+J+L-1):M$(LEN(
      M$)+1)="ML$("
29440 IF XM>2 THEN A=LEN(Q$)/3-XM+1:B
      =A+2:XM=XM-3:GOTO 29520
29460 IF XM>0 THEN A=LEN(Q$)/3-XM+1:B
      =LEN(Q$)/3:XM=0:GOTO 29520
29500 GOTO 29800
29520 FOR X=A TO B
29550 M$(LEN(M$)+1)=Q$(3*X-2,3*X):M$(
      LEN(M$)+1)=",":M$(LEN(M$)+1)=Q$
      (3*X-2,3*X):M$(LEN(M$)+1)=")="
29560 M$(LEN(M$)+1)="CHR$(":M$(LEN(M$
      )+1)=STR$(QQ):M$(LEN(M$)+1)=")"
29570 M$(LEN(M$)+1)=":ML$(":NEXT X
29600 M$=M$(1,LEN(M$)-5):GOSUB 28000
29650 IF XM>0 THEN 29420
29800 IF T=2 THEN T=0:QQ=155:Q$=R$:LN
      =LN+NQ:GOTO 29400
29900 ? :? "Now LISTing modified v
      ersion of{3 SPACES}PROGRAM 1 t
      o disk as D:PROGRAM3.LST"
29910 LIST "D:PROGRAM3.LST",2,LL
```

# The Expanded/ Unexpanded VIC

Gary L. Engstrom

*As more and more VIC owners add expansion memory to their computers, there is an increasing need for programs which run on all VICs, of any memory size. Here's how to write them.*

The "where's my memory located now" problem can be overcome by careful programming. With or without an 8K or 16K VIC RAM expansion in place, you should be able to run any of your own programs that require 3.58K or less of RAM. Of course, you will have to put up with removing and installing the expansion cartridge when using programs written by others, but you can have the convenience of universal VIC programs you write yourself.

For programs to be universal, they need to fulfill three requirements:

**1.** The program must not need more than 3.58K of memory. You just cannot squeeze more than that into the unexpanded VIC-20.

**2.** The program must contain memory location information for both the expanded and unexpanded VIC-20.

**3.** The program must be able to determine if expansion is in place and be able to choose between the two sets of memory locations.

To understand how a program can conform to these last two requirements, you need to understand that when the VIC-20 is turned on, its operating system goes through an initialization procedure. During initialization, one of the tasks that the operating system does is check to see if memory expansion is in place.

If so, the operating system sets certain pointers to one set of memory locations; if there is no memory expansion, these pointers are set to a different set of memory locations. If you have 8K or 16K RAM memory expansion for your VIC-20, you should be familiar with three of these memory locations (see the table below). The computer uses the correct locations because, during initialization, pointers are set to the correct locations. It is the knowledge of the alternate memory locations and the existence of these pointers that make universal programs possible.

**Table 1.**

| | Unexpanded | Expanded |
|---|---|---|
| Screen Memory | 7680-8191 | 4096-4607 |
| Color RAM | 38400-38911 | 37888-38399 |
| User BASIC Area | 4096-7679 | 4608-* |

*The end of user BASIC Area in an expanded VIC-20 depends on the size of the expansion memory.

## Establish Alternate Values

Memory locations used as pointers can be used by a BASIC program to run on either an expanded or an unexpanded VIC-20. I chose memory location 43-44 ($002B-$002C), the pointer to the start of the BASIC program in memory. When the VIC-20 is not expanded, the decimal value of the high bit (location 44) is 16; when the VIC-20 is expanded, the decimal value of the high bit is 18.

This gives us enough information (using a PEEK statement) to create two paths for alternate memory values in a BASIC program. Thus we can assign the values for the beginning of screen memory and of color RAM for the expanded and unexpanded VIC-20 (see Program 1).

## Program 1: Alternate Values

```
10 PRINT "[CLR]" : REM *SET ALTERNATE VALUES*

20 IF PEEK (44)=18 GOTO 70: IF MEMORY IS IN P
   LACE
30 SM=7680 : REM SCREEN MEMORY FOR UNEXPANDED
    VIC
40 CM=38400 : REM COLOR MEMORY FOR THE UNEXPA
   NDED VIC
50 CS2=242 : REM CHARACTER SET 2 POINTER FOR ~
   THE UNEXPANDED VIC
60 GOTO 110 : REM SKIP
70 SM=4096 : REM SCREEN MEMORY FOR THE EXPAND
   ED VIC
80 CM=37888 : REM COLOR MEMORY FOR THE EXPAND
   ED VIC
90 CS2=194 : REM CHARACTER SET 2 POINTER FOR ~
   THE EXPANDED VIC.
```

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You might have noticed that I threw in an extra value. If you want to POKE characters from Character Set 2 to the screen, you have to POKE the character set pointer to the alternate set. The character set pointer is at memory location 36869. I have included the character set pointer value to demonstrate that you might want to use other alternate values in some of your programs.

## Enter Common Values

After the alternate values have been set, you can set the values that are common to both the expanded and unexpanded VIC-20 (see Program 2). Of course, if you are not going to use a particular value, it can be left out.

### Program 2: Common Values

```
100 REM *SET COMMON VALUES*
110 SB=36879 : REM SCREEN/BOARDER COLOR
120 V=36878 : REM VOLUME
130 S1=36874 : REM SPEAKER 1
140 S2=36875 : REM SPEAKER 2
150 S3=36876 : REM SPEAKER 3
160 S4=36877 : REM SPEAKER 4
```

Another benefit of using this method is that you don't have to constantly look up these memory locations or reenter these numbers each time you are going to use them. Every time you can avoid reentering a number, you are avoiding the possibility of an entry error.

## Crunch And Save

Program 3 is a "crunched" version of Programs 1 and 2. Enter Program 3, then SAVE and VERIFY it on tape. Every time you start a new program, LOAD these four lines before you start to enter your own listing. When you write your program, start with line 100. Lines 50-90 can be used for defining variables and constants for your program.

### Program 3: Lines 10 to 160 "Crunched"

```
10 PRINT"[CLR]":IFPEEK(44)=18GOTO30
20 SM=7680:CM=38400:CS2=242:GOTO40
30 SM=4096:CM=37888:CS2=194
40 SB=36879:V=36878:S1=36874:S2=36875:S3=3687
    6:S4=36877
```

## Try It Out

When all the values have been set, you can start to create your program. Program 4 is a short program that you can enter to demonstrate the flexibility of Program 3.

### Program 4: Demonstration Program

```
100 REM *DEMONSTRATION PROGRAM*
110 POKE SB,120 : REM SET YELLOW SCREEN AND BL
    ACK BOARDER
120 POKE 36869,CS2 : REM POINT TO CHARACTER SE
    T 2
130 SS=INT(RND(1)*128)+128 : REM RANDOM VALUE ~
```





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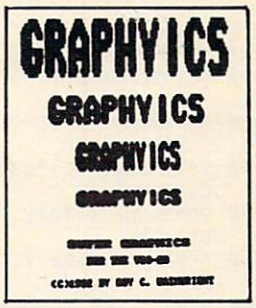


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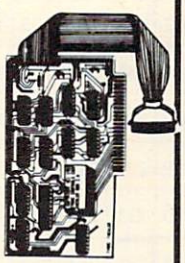

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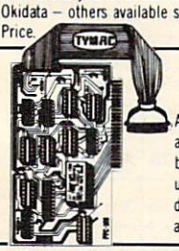


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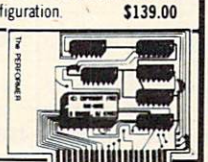

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```
    FOR SPEAKER
140 CV=INT(RND(1)*8) : REM RANDOM COLOR VALUE
150 VS=INT(RND(1)*15)+1 : REM RANDOM VALUE FOR
    VOLUME
160 X= INT(RND(1)*22) : REM RANDOM VALUE FOR X
    COORDINATE
170 Y=INT(RND(1)*23) : REM RANDOM VALUE FOR Y ~
    COORDINATE
180 POKE SM+X+22*Y,95 : REM POKE CHARACTER TO ~
    SCREEN
190 POKE CM+X+22*Y,CV : REM POKE COLOR TO SCRE
    EN
200 POKE V,VS : POKE S1,SS : POKE S2,SS : POKE
    S3,SS : POKE S4,SS : REM SOUND
210 FOR T=1 TO 10 : NEXT T : REM PAUSE
220 GOTO 130 : REM REPEAT
```

Once you have entered Programs 3 and 4, SAVE and VERIFY the resulting program. Then, try it on both your expanded and unexpanded VIC-20. (Don't forget to turn the computer off before installing and removing the memory expander.) The program will adjust to the correct alternate set of values and work correctly with either configuration.

## Practice POKEing

Using labels in place of actual numbers for POKEing might be confusing at first. However, once you get used to the labels, programming will be quicker and more accurate. To help you make the transition, I will explain two ways that labels can be used to POKE color and characters to the screen.

## Method 1: X/Y Coordinates

The X/Y coordinate method for POKEing characters to the screen takes advantage of the 22 columns and 23 rows of the VIC-20 screen. Refer to the chart below. The 22 columns are labeled X and are numbered 0 to 21; the 23 rows are labeled Y and numbered 0 to 22. All of the screen locations can be identified by column (X) and row (Y). For example, the center of the screen is at X=11 and Y=11; the lower left-hand corner is at X=0 and Y=22. To POKE characters to the screen, you

## Table 2: Memory Map

| X= | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Y=0 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| 1 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 |
| 2 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 |
| 3 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 |
| 4 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 | 101 | 102 | 103 | 104 | 105 | 106 | 107 | 108 | 109 |
| 5 | 110 | 111 | 112 | 113 | 114 | 115 | 116 | 117 | 118 | 119 | 120 | 121 | 122 | 123 | 124 | 125 | 126 | 127 | 128 | 129 | 130 | 131 |
| 6 | 132 | 133 | 134 | 135 | 136 | 137 | 138 | 139 | 140 | 141 | 142 | 143 | 144 | 145 | 146 | 147 | 148 | 149 | 150 | 151 | 152 | 153 |
| 7 | 154 | 155 | 156 | 157 | 158 | 159 | 160 | 161 | 162 | 163 | 164 | 165 | 166 | 167 | 168 | 169 | 170 | 171 | 172 | 173 | 174 | 175 |
| 8 | 176 | 177 | 178 | 179 | 180 | 181 | 182 | 183 | 184 | 185 | 186 | 187 | 188 | 189 | 190 | 191 | 192 | 193 | 194 | 195 | 196 | 197 |
| 9 | 198 | 199 | 200 | 201 | 202 | 203 | 204 | 205 | 206 | 207 | 208 | 209 | 210 | 211 | 212 | 213 | 214 | 215 | 216 | 217 | 218 | 219 |
| 10 | 220 | 221 | 222 | 223 | 224 | 225 | 226 | 227 | 228 | 229 | 230 | 231 | 232 | 233 | 234 | 235 | 236 | 237 | 238 | 239 | 240 | 241 |
| 11 | 242 | 243 | 244 | 245 | 246 | 247 | 248 | 249 | 250 | 251 | 252 | 253 | 254 | 255 | 256 | 257 | 258 | 259 | 260 | 261 | 262 | 263 |
| 12 | 264 | 265 | 266 | 267 | 268 | 269 | 270 | 271 | 272 | 273 | 274 | 275 | 276 | 277 | 278 | 279 | 280 | 281 | 282 | 283 | 284 | 285 |
| 13 | 286 | 287 | 288 | 289 | 290 | 291 | 292 | 293 | 294 | 295 | 296 | 297 | 298 | 299 | 300 | 301 | 302 | 303 | 304 | 305 | 306 | 307 |
| 14 | 308 | 309 | 310 | 311 | 312 | 313 | 314 | 315 | 316 | 317 | 318 | 319 | 320 | 321 | 322 | 323 | 324 | 325 | 326 | 327 | 328 | 329 |
| 15 | 330 | 331 | 332 | 333 | 334 | 335 | 336 | 337 | 338 | 339 | 340 | 341 | 342 | 343 | 344 | 345 | 346 | 347 | 348 | 349 | 350 | 351 |
| 16 | 352 | 353 | 354 | 355 | 356 | 357 | 358 | 359 | 360 | 361 | 362 | 363 | 364 | 365 | 366 | 367 | 368 | 369 | 370 | 371 | 372 | 373 |
| 17 | 374 | 375 | 376 | 377 | 378 | 379 | 380 | 381 | 382 | 383 | 384 | 385 | 386 | 387 | 388 | 389 | 390 | 391 | 392 | 393 | 394 | 395 |
| 18 | 396 | 397 | 398 | 399 | 400 | 401 | 402 | 403 | 404 | 405 | 406 | 407 | 408 | 409 | 410 | 411 | 412 | 413 | 414 | 415 | 416 | 417 |
| 19 | 418 | 419 | 420 | 421 | 422 | 423 | 424 | 425 | 426 | 427 | 428 | 429 | 430 | 431 | 432 | 433 | 434 | 435 | 436 | 437 | 438 | 439 |
| 20 | 440 | 441 | 442 | 443 | 444 | 445 | 446 | 447 | 448 | 449 | 450 | 451 | 452 | 453 | 454 | 455 | 456 | 457 | 458 | 459 | 460 | 461 |
| 21 | 462 | 463 | 464 | 465 | 466 | 467 | 468 | 469 | 470 | 471 | 472 | 473 | 474 | 475 | 476 | 477 | 478 | 479 | 480 | 481 | 482 | 483 |
| 22 | 484 | 485 | 486 | 487 | 488 | 489 | 490 | 491 | 492 | 493 | 494 | 495 | 496 | 497 | 498 | 499 | 500 | 501 | 502 | 503 | 504 | 505 |

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must use the following formula: POKE SM+X+22 * Y,N where SM=7680 for the unexpanded VIC-20, SM=4096 for the expanded VIC-20, and N is the character code.

You can POKE color to the screen in the same way: POKE CM+X+22 * Y,N where CM=38400 for the unexpanded VIC-20, CM=37888 for the expanded VIC-20, and N is the color code.

LOAD Program 3 and then enter the following POKE statements (Program 5).

### Program 5: X/Y Coordinate Practice

```
100 X=0 : Y=0 : REM SET VALUES FOR X AND Y
110 POKE SM+X+22*Y,81 : POKE CM+X+22*Y,6 : REM
     BLUE BALL--UPPER LEFT
120 X=21 : Y=0 : REM SET VALUES FOR X AND Y
130 POKE SM+X+22*Y,83 : POKE CM+X+22*Y,2 : REM
     RED HEART--UPPER RIGHT
140 X=11 : Y=11 : REM SET VALUES FOR X AND Y
150 POKE SM+X+22*Y,90 : POKE CM+X+22*Y,0 : REM
     BLACK DIAMOND--CENTER
160 X=0 : Y=22 : REM SET VALUES FOR X AND Y
170 POKE SM+X+22*Y,65 : POKE CM+X+22*Y,4 : REM
     PURPLE SPADE--LOWER LEFT
180 X=21 : Y=22 : REM SET VALUES FOR X AND Y
190 POKE SM+X+22*Y,88 : POKE CM+X+22*Y,5 : REM
     GREEN CLOVER--LOWER RIGHT
```

To make a character move on the screen, add a +1 to the value of X for right movement, add a -1 to the value of X for left movement, add a +1 to the value of Y for down movement, and add a -1 to the value of Y for upward movement. The limits of the screen are defined by X=0 to 21 and Y=0 to 22. Experiment by changing the values for X and Y in Program 5.

## Method 2: Direct Method

There are 506 screen locations for both color and characters. The first location is SM (for Screen Memory) and CM (for Color Memory). The first location is the upper left-hand corner of the screen. The second location is to the right of the first location and has a value of SM+1 (for character placement) or CM+1 (for color placement).

We can continue to add values to the labels until we are at the bottom right-hand corner of the screen, where the values are SM+505 and CM+505. Therefore, any position on the screen can be addressed by adding the values of 0 through 505 to the labels SM or CM (see the memory map). LOAD the Alternate Values Listing (Program 3) and then enter the following practice POKE statements (Program 6).

### Program 6: Memory Location Practice

```
100 POKE SM+0,81 : POKE CM,6 : REM BLUE BALL--
    UPPER LEFT-HAND CORNER
110 POKE SM+21,83 : POKE CM+21,2 : REM RED HEA
    RT--UPPER RIGHT-HAND CORNER
120 POKE SM+253,90 : POKE CM+253,0 : REM BLACK
     DIAMOND--CENTER
130 POKE SM+484,65 : POKE CM+484,4 : REM PURPL
```

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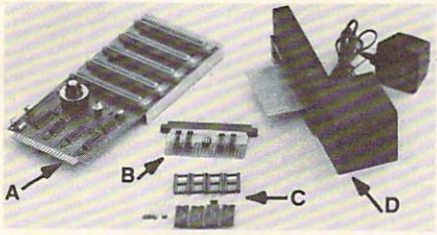


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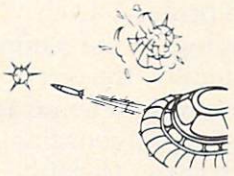

Continuing with their plan to conquer the universe, the CYTRON EMPIRE has chosen your sector as the first target in our galaxy. As COMMANDER of the protective forces, you must manoeuvre your craft, avoiding collision and enemy missiles, to attack and destroy enemy war ships.

The CYCLON fighters relentlessly enter the battle zone, attempting to lure you into making errors that will lead to your destruction. The menacing PULSAR DEATH SHIP also begins to attack, its only purpose to zero in on your location, chase you down, and put an end to your defense of civilization as we know it.

Our future lies with your skill.

CYCLON requires memory expansion to function. When loaded on a system with a 3K expander (or Super Expander) you will play an advanced level game. Loading the cassette onto a system with 8K or more expansion, you will be allowed to choose between a variety of difficulty/game-feature options. The game is controlled with the VIC-20 joystick.

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While inspecting his prize pumpkin patch, Mr. GREENSLEEVES becomes aware of a flock of strange CRITTERS hovering in the sky above. Without warning small groups begin to leave the formation and dive in order to knock him down and STEAL the fruits of his labour. Armed only with a revolver, he must now DEFEND his crop against this new blight.

You will guide Greensleeves in his COURAGEOUS effort to save the patch. Run or crouch in order to avoid the swooping MENACE, and attempt to exterminate the critters before they can loot the entire crop. Most important, once a pumpkin is stolen, destroy the thief before he can reach the flock (taking care not to hit the pumpkin) or his prize will be your loss.

As the struggle progresses, larger flocks will arrive and the speed of their attack will increase. But don't despair. New pumpkins will grow with your point total providing additional opportunities to successfully fend off the raid. When they succeed in clearing the field, the conflict is over.

CRITTERS requires a minimum of 8K memory expansion and is controlled with your VIC-20 joystick.

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```
    E SPACE--LOWER LEFT-HAND CORNER
140 POKE SM+505,88 : POKE CM+505,5 : REM GREEN
    CLOVER--LOWER RIGHT-HAND CORNER
```

To make a character move on the screen, add a +1 for right movement, add a -1 for left movement, add a +22 for down movement, and add a -22 for upward movement. The limits of the screen are defined by SM+505 and SM (for character placement) and CM+505 and CM (for color placement). Experiment by changing the values added to SM and CM in Program 6.

To demonstrate how the direct method works in a program, replace lines 260 through 290 in Program 4 with the following lines (Program 7).

Replace lines 260 through 290 in Program Listing 3 with the following lines:

## Program 7: Alternate To Program 3

```
260 M=INT(RND(1)*505) : REM RANDOM SELECTION O
    F MOVEMENT
280 POKE SM+M,95 : REM POKE CHARACTER TO SCREE
    N
290 POKE CM+M,CV : REM POKE COLOR TO SCREEN
```

## Which Method Is Best?

At this point you may be wondering which method for POKEing should be used. Each method has its place, depending on the requirements of your program. Generally, the direct method requires fewer commands for some applications and runs faster than the X/Y coordinate method. However, it is much easier to define complex screen boundaries using the X/Y coordinate method.

For example, let's place a five-character by five-character square on the screen. We'll use the X/Y coordinate method to place a square in the center of the screen, and the direct method to place a square in the lower left-hand corner. LOAD Program 4 and then enter Program 8.

## Program 8.

```
100 REM X/Y COORDINATE METHOD
110 FOR X=9 TO 13 : FOR Y=9 TO 13 : REM SET VA
    LUES OF X AND Y
120 POKE SM+X+22*Y,160 : POKE CM+X+22*Y,8 : RE
    M POKE CHARACTER AND COLOR
130 NEXT Y : NEXT X : REPEAT
140 REM DIRECT METHOD
150 L=396 : REM BEGINNING VALUE OF M
160 FOR M=L TO L+4 : REM RANGE OF M FOR ONE LI
    NE
170 POKE SM+M,160 : POKE CM+M,8 REM POKE CHARA
    CTER AND COLOR FOR ONE LINE
180 NEXT M : REM REPEAT TO END OF LINE
190 L=L+22 : IF L>488 THEN END : IF AT END OF ~
    LAST LINE END
200 GOTO160: REPEAT
```

When RUNning this program, you might have noticed that the second square was printed a little faster than the first one. In applications where speed is important, it is useful to know that the direct method does run quite a bit faster than the X/Y coordinate method.

This can be best illustrated by Program 9. In this program, the entire screen is filled with characters by using both methods. An added feature is that each segment of the program is timed by the VIC-20 built-in timer. LOAD Program 4 and then enter the following lines:

## Program 9: Fill Screen Test

```
100 REM *FILL SCREEN TEST*
110 REM FILL SCREEN USING SCREEN MEMORY LOCATI
    ONS
120 PRINT "[CLR]" : REM CLEAR SCREEN
130 TI$="000000" : REM ZERO TIMER
140 FOR J=CM TO CM+505 : REM SET VALUES FOR CO
    LOR MEMORY
150 POKE J,8 : REM POKE COLOR
160 NEXT J : REM REPEAT
170 FOR I=SM TO SM+505 : REM SET VALUES FOR SC
    REEN MEMORY
180 POKE 1,160 : REM POKE CHARACTER
190 NEXT I : REM REPEAT
200 T1$ = TI$ : RECORD TIME
210 REM FILL SCREEN USING X/Y COORDINATES
220 PRINT "[CLR]" : REM CLEAR SCREEN
230 TI$="000000" : REM ZERO TIMER
240 FOR Y=0 TO 22 : FOR X=0 TO 21 : SET VALUES
     FOR X AND Y
250 POKE CM+X+22*Y,8 : REM POKE COLOR
260 POKE SM+X+22*Y,160 : REM POKE CHARACTER
270 NEXT X : NEXT Y : REPEAT
280 T2$=TI$ : REM RECORD TIME
290 PRINT "[CLR]" : CLEAR SCREEN AND PRINT RES
    ULTS
300 POKE SB,157 : REM CHANGE SCREEN AND BORDER
     COLOR
310 PRINT "DIRECT METHOD    "T1$ : REM PRINT TI
    ME
320 PRINT "X/Y COORDINATES "T2$ : REM PRINT TI
    ME
330 END
```

As you can see, the direct method RUNs about twice as fast as the X/Y coordinate method. If you are writing a program using a lot of POKEs, you might consider using the direct method wherever possible. This will help to speed up your program. However, the X/Y coordinate method remains the most useful when defining complex screen boundaries.

By using alternate values for screen memory and color memory, you are not only able to POKE characters and colors to the screen easily and accurately, but you will also be able to run your programs (3.58K or less) with or without your 8K or 16K expansion cartridge. ©

# Left-handed Atari Joysticks

P. E. Thompson

*If you're left-handed, ordinary joysticks are awkward to use. A simple adjustment (all you need is a screwdriver) can fix them.*

Several of my friends and family members are left-handed and have complained vociferously about the "right-handed" Atari joysticks. They are especially frustrated when trying to control the spaceship with the left hand, fire at the Zylons with the right hand, and firmly hold the joystick with the other hand (try it sometime, you right-handers!). As the proud owner of the computer which is causing this distress, I am the one who is expected to answer the question, "If you're so smart, why can't you make this thing work right?"

If you, as a right-hander, hold the joystick in the right-handed position (i.e., top away from you), you will see that the fire button is located on the left-hand side. In order to satisfy left-handers, the fire button must be on the right-hand side, which means that the directions of the joystick motions must be rotated as follows:

| Direction | Becomes |
|---|---|
| Forward | Right |
| Backward | Left |
| Right | Backward |
| Left | Forward |

In other words, if you hold a hypothetical left-handed joystick the right-handed way, then when the joystick is pushed for the forward direction, movement would be to the right. Similarly, the directions would change for all other motions.

Before tackling this seemingly simple task of creating a left-handed joystick, I realized that two obstacles stood in the way of possible solutions:

1) A software patch was impossible since my knowledge of assembly language programming can't get past my confusion as to the difference between a bit, a byte, and a nybble.

2) Any sort of hardware fix was impossible since my soldering ability is limited.

At this point, I decided to make do. I took the joystick apart, hoping to figure out some way of rearranging its mechanism, and was indeed able to convert it for left-handed use.

Before starting, make sure that the joystick is disconnected from the computer and then remove the four screws in the bottom which hold it all together.

Once the screws are removed, place the base on a table and carefully lift off the top. (See Figure 1.) Now set aside the pieces of the fire button (the red button and a spring) in a container. The wires inside are attached by slip-on connectors and you can slip them off and on without damaging anything.

Notice that on each side of the circuit board with silver dots are three wires. The left side wires are ORG (orange), WHT (white), and GRN (green), while the right side wires are BRN (brown), BLU (blue), and BLK (black). This color coding of the wires and the circuit board with silver dots is a fortunate feature of the Atari joystick because it provides the guide to proper (right-hand) reassembly of the joystick. After you have connected the wires according to the arrangement shown in Figure 2, the joystick becomes left-handed.

Finally, reassemble the joystick in the reverse order in which it was taken apart. Here's how:

1) Hold the top of the joystick upside down. The top is the part with the stick.

2) Place the red fire button into its hole in the top. It's easy to see that the fire button goes in upside down too, since that's the only way it fits.

3) Put the spring onto the post in the center of the fire button. Make sure that the spring is completely clean of any dust it may have accumulated since it was removed. In this case, the spring doesn't have an upside down since it's the same on both ends.

4) Be sure that all the connectors are firmly attached to the circuit board with silver dots.

5) Lay the circuit board into the top so that the two posts in the top come through the hole in the board. Top and bottom are easy to determine since these pieces fit only one way.

6) Fit the bottom onto the rest of the assembly. Be careful that the wires are not between the circuit board with silver dots and the posts for the mounting screws. These parts also fit together only one way.

**Figure 1.**

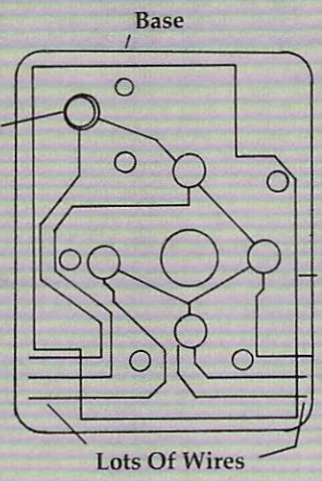
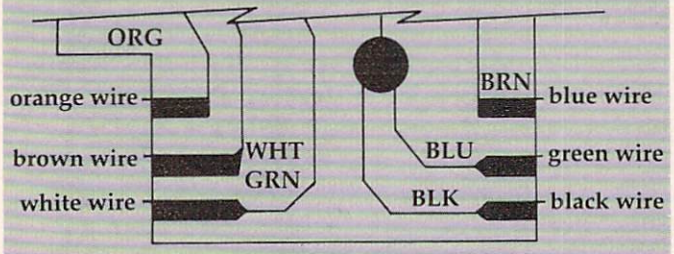



**Figure 2.**




(NOTE: The ORANGE and BLACK wires are not moved.) ©

Beginners: See special program typing instructions on page 249.

# UFO Pilot:

## VIC Custom Characters For Game Graphics

Bud Banis

*The current high score in the game "UFO Pilot" is 3411. While seeing if you can top that, you also have the opportunity to learn a good deal about using the VIC "multicolor mode" in your own games.*

Commodore's VIC-20 has outstanding color graphics capabilities. However, the unexpanded machine has limited memory to take advantage of these capabilities, and the average computerist who is trying to justify "buying more than a video game" has to provide his family with a reasonable amount of entertainment without buying a lot of expensive memory expansion.

Two options have been offered for designing game graphics characters:

**1.** The Commodore graphics keys can be used to build multiple space characters. These take up a lot of space and are cumbersome to move around.

**2.** Custom characters can be drawn if you're willing to give up valuable RAM instead of taking existing characters from ROM. Basically, whole sets of characters are moved from ROM to RAM, and then some of the characters can be redefined by a series of POKEs to RAM. Because the pointer indicating the start of character memory has to be reset (36869), this is an all or nothing process. Any standard characters you want to use must also be relocated from ROM to RAM.

As an alternative, some perfectly acceptable single space characters can be created from standard characters in ROM just by POKEing their screen locations into multicolor mode. This approach uses no memory and gives a wide variety of "new" characters (about four million) to choose from.

This article describes the use of multicolor mode in detail, includes a program to find interesting characters, and concludes with a game demonstrating the technique.

### How Characters Are Stored

In order to explain multicolor mode, it's important to first describe how characters are formed on the screen in the first place. The *VIC-20 Programmer's Reference Guide* (pp. 82-94) has several errors in its description of this process.

Characters are stored in memory as an 8x8 grid of dots. Each dot (bit) is turned either "on" or "off." Each eight-bit line (byte) can be represented by a number which uniquely turns some bits "on" and others "off." Each bit is represented by a number which is a power of two if "on" or by zero if "off." The value assigned to the byte is the sum of the values of its eight bits.

| bit number | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| value of $2^N$ | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 |

Thus, if only bit zero is "on," the value of the byte is $2^0=1$. If only bit four is "on," the value of the byte is $2^4=16$. If bits zero and four are both "on" and all the others are "off," then the value of the byte is $2^0$ and $2^4=1+16=17$. If all eight bits are "on," then the value of the byte is $128+64+32+16+8+4+2+1=255$. A whole character takes eight lines or eight bytes of memory. For example, the letter A is:

| bit no. | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | value of byte |
|---|---|---|---|---|---|---|---|---|---|
| byte 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | $2^4+2^3=24$ |
| 2 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | $2^5+2^2=36$ |
| 3 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | $2^6+2^1=66$ |
| 4 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | $2^6+2^5+2^4+2^3+2^2+2^1=126$ |
| 5 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | $2^6+2^1=66$ |
| 6 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | $2^6+2^1=66$ |
| 7 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | $2^6+2^1=66$ |
| 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Custom characters can be stored in RAM locations by POKEing the desired values into the individual memory locations (bytes).

The unexpanded VIC-20 has room for 5000

bytes in RAM or about 3.6 thousand (K) bytes user available RAM after buffers and screen memories, etc., are allocated. Since each character takes up eight bytes, moving 64 characters from ROM to RAM, available for use or modification in the custom character mode, uses 64 * 8 = 512 bytes of RAM and makes it unavailable for other uses.

## Multicolor Mode

*Storing multicolor characters.* In multicolor mode, characters are stored in the same way, but bits are read two at a time to specify one of four colors in a two-dot space. Taking two bits at a time allows four possibilities, as opposed to the two ("on" or "off") when bits are taken one at a time.

| bit pair | colors selected | memory location (POKE) |
|---|---|---|
| 00 | 16 background colors | 36879, bits 4-7 |
| 10 | 8 character colors | 38400-38911, bits 0-2 |
| 01 | 8 border colors | 36879, bits 0-2 |
| 11 | 16 auxiliary colors | 36878, bits 4-7 |

Thus, if you were custom designing a flag with alternating background color and border color stripes, a character color square in the upper left-hand corner, and an auxiliary color pole, the stored data might look something like this:

| | bit pairs | value of byte (POKE) |
|---|---|---|
| byte | 1 (10) (10) (01) (01) | 128 + 32 + 4 + 1 = 165 |
| | 2 (10) (10) (00) (00) | 128 + 32 = 160 |
| | 3 (10) (10) (01) (01) | 128 + 32 + 4 + 1 = 165 |
| | 4 (00) (00) (00) (00) | 0 |
| | 5 (01) (01) (01) (01) | 64 + 16 + 4 + 2 = 86 |
| | 6 (11) (00) (00) (00) | 128 + 64 = 192 |
| | 7 (11) (00) (00) (00) | 128 + 64 = 192 |
| | 8 (11) (00) (00) (00) | 128 + 64 = 192 |

This character wouldn't be very interpretable in ordinary, single color, mode.

Once a character is stored in memory in this way, in order to print it on screen in its full multicolor glory, we need to first specify multicolor mode in that screen location, then choose the appropriate colors for border, background, character, and auxiliary use. By POKEing these other reference locations, we can make substantial changes in the character. For example, if the auxiliary color is the same as the background color, the flagpole disappears.

## Selecting Colors

Specifying colors is a little more complicated than just POKEing a number into a memory location (byte). The reason is that the color codes use only specific bits, and the rest of the bits in the byte are used for something else. For example, the auxiliary color code uses only bits 4-7 in memory location 36878. The other four bits (0-3) are used for setting volume on the sound. Selection of multicolor mode for a given screen location involves turning on a single bit in the memory for that space on the screen. The other bits hold other information.

## Choosing Border and Background Colors

By now, you should be pretty well versed in this operation, and you have probably tried some of the combinations listed in Appendix E (p. 134) of the book that came with your VIC. It seems simple enough – POKEing a number out of the table into memory location 36879 gives you the indicated combination of screen and border colors. Actually, byte 36879 specifies three things which could be referenced independently.

Border colors are specified by bits 0-2. The decimal translation is values 0-7, to give eight possible choices (0 is all "off," 7 is all "on"): 0 is black, 1 is white, 2 is red, etc., in the same sequence as the color keys. Bits 4-7 specify background, or screen, colors. The values associated with these bits are multiples of 16. For example, if bit four is turned "on," its decimal value is $2^4 = 16$; if all four bits 4-7 are turned "on," the combined decimal value of these bits is $2^4 + 2^5 + 2^6 + 2^7 = 16 + 32 + 64 + 128 = 240$.

A little fooling with the numbers should convince you that these four bits can give you any multiple of 16 from 0 * 16 to 15 * 16, or 16 possibilities. This corresponds to the 16 choices of screen color in the order listed in Appendix E of the book *Personal Computing on the VIC-20* (p. 134). Casual inspection of this table reveals that some possible values are not listed – for example, 0-7, 16-23, etc. The lowest value listed is 8. What this means is that bit number three, decimal value $2^3 = 8$, is always "on" when one of the values in the table is used. If you POKE 36879, X, where X is a value not in the table, bit three is turned "off," and the screen is put in the *inverted* mode, which makes all the printing appear in the reverse.

Thus, byte 36879 contains three separate memory references: bits 0-2 for border color (eight colors); bit 3 for inverted mode (when "off"); and bits 4-7 for screen color (16 colors from 0 * 16 to 15 * 16).

## Setting Character Color And Selecting Multicolor Mode

Character color is specified separately for each location on the screen (see pp. 143-144 in *Personal Computing on the VIC-20*) or can be specified before printing a series of characters by using the control color keys. Character color is specified separately for each screen location by POKEing locations between 38400 and 38905 with values from 0-7 to give the familiar sequence of black to yellow character colors (eight choices). Values from 0-7 represent bits 0-2.

If bit three is turned "on," i.e., values from 8 to 15 are used instead of 0-7, the screen location is put into multicolor mode and the bits are evaluated two at a time to give the results described above

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under "Storing multicolor characters." In multicolor mode, the character color code is (value-8). For example, POKE 38400, 8 puts the first space into multicolor mode with character color black (0). POKE 38422,15 puts the twenty-second space (first space, second row) into multicolor mode with character color yellow (7).

Bits 4-7 are used for something else which is not clear from the manuals. Randomly POKEing these bits eventually gives peculiar results such as "out of memory" errors. This can be avoided by ANDing POKEs with 15.

## Boolean Operators

There is a way to read and write to specific bits within a byte without disturbing other bits which might carry other information. Unless you've been exposed to set theory before, the action of Boolean operators OR and AND may seem strange. These operators are used to combine information from two sets.

When AND is used, the result includes only that information which is included in *both* sets. For example, if all eight bits in a byte were turned "on," the decimal value of that byte would be 255. If another byte had only the first four bits turned "on," its decimal value would be 15. The result from ANDing bytes one and two would have only "on" bits that were "on" in *both* sets. This gives the peculiar result that 255 AND 15=15.

If you wanted to know the status of only a single bit, you could screen out extraneous information by ANDing with the decimal value for that bit: PRINT PEEK (38400) AND 8 would return 8 if the third bit is "on" or 0 if the third bit is "off." The status of other bits doesn't matter.

The OR operator combines sets so that the result includes all bits "on" which were "on" in *either* set. Thus, 255 OR 15=255; 248 OR 15=255. These operators can be used to POKE a given bit "on" or "off" without disturbing other information in the byte. For example, suppose we wanted to POKE bit three (decimal value 8) in 38400 "on." We could do this by POKE 38400, 8 OR PEEK (38400). To turn bit three "off," POKE 38400, 247 AND PEEK (38400). 247 is the decimal value for a byte with all bits "on" except for bit three.

## Setting Auxiliary Color

The fourth color available in multicolor mode is called auxiliary color, and is set by POKEing values into the upper four bits of memory location 36878. The lower four bits are used to set volume on the sound. There are 16 colors available, in the same order as the 16 screen colors. As with the screen colors, values POKEd into the upper four bits are multiples of 16.

For example, POKE 36878, 1 * 16 sets auxiliary color white; POKE 36878, 15 * 16 sets auxiliary color light yellow. These POKEs would also set sound volume to 0. If you wanted to set auxiliary color red at the same time as keeping volume at the maximum, 15, you could POKE 36878, 15+2 * 16, or, to leave the sound volume alone, use the Boolean operators: POKE 36878, 2 * 16 OR (PEEK (36878) AND 15).

## Sampler — A Program To Find Interesting Characters

Given the above detail on multicolor mode, the first program listing, "Sampler," should be self-explanatory. Ten characters are displayed, with the middle eight in multicolor mode to show the range of character colors. The cursor keys can be used to look at the next or previous characters. Cursor down and cursor up act as "fast forward" and "fast reverse," respectively. Cursor right and cursor left can also be used to give a time delay (lines 70 and 90) in the display before changing characters.

After finding an interesting character, press F1 to explore the effects of the 128 different combinations of screen and border colors. The space bar allows a rapid perusal. F3 gives another dimension, again using the space bar (or "any key") to run through the 16 available auxiliary colors. To look at character set 2 (*Personal Computing on the VIC-20*, Appendix H, pp. 139-142), press the SHIFT and COMMODORE keys simultaneously.

Including reverse mode and both character sets, there are about 255 characters which can be modified through use of multicolor mode. With 8 border colors, 16 screen colors, 8 character colors and 16 auxiliary colors, the number of combinations for your selection is roughly 255 * 8 * 16 * 8 * 16 or about four *million* "new" characters to choose from!

## UFO Pilot — A Game Demonstrating Multicolor Mode Graphics

Having progressed through the theory to empirical selection, it seems logical to come to the point of this article. "UFO Pilot" is a game demonstrating the use of multicolor mode to make "new" game graphic characters. The program uses about 2K RAM and the only expansion required is a $9 Atari joystick.

Character 88 (the club) is transformed to a multicolor UFO which you pilot using the joystick. The objective is to achieve the longest flight without running into your own trail of white dots or the warplane (character 62) that's in constant pursuit. A collision results in an explosion (character 42 taken through a series of character color changes in lines 9500-9510) and a return to the demonstration mode at the beginning of the program.

If you don't have anything better to do, you

can watch this display run through all the possible color combinations. The pause in midscreen in which the UFO "flashes its lights" is a demonstration of changing auxiliary colors (line 10). Otherwise, auxiliary color 0 (black) is used throughout the game – specified by POKE 36878, 15 (high volume). If the demonstration mode begins to wear on you and you want to concentrate on the game, change line 9530 to GOTO19.

Fortunately, the warplane erases dots to keep the screen less cluttered and to make higher scores possible. After a few months of high scores in the range of 200-400, my wife discovered a pattern giving the current high of 3411.

If you wish to save the time of typing and prevent possible typographical errors, I'd be glad to copy the programs on tape for you. Send $3, a blank tape, and a stamped, self-addressed mailer to:

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## Program 1.

```
2 PRINT"{CLEAR}SAMPLER,SHOWS SOME     STANDA
    RD CHARACTERS     IN MULTICOLOR MODE.
4 PRINT:PRINT"USE THE CURSOR KEYS    TO CHANG
    E CHARACTERS, F1,F3 TO CHANGE COLORS
6 PRINT:PRINT"HIT A KEY"
8 GETC$:IFC$=""THEN8
10 N=0:GOTO130
20 GETC$:IFC$=CHR$(17)THEN80
30 IFC$=CHR$(29)THEN70
40 IFC$=CHR$(145)THEN100
50 IFC$=CHR$(157)THEN90
55 IFC$=CHR$(133)THEN400
57 IFC$=CHR$(134)THENGOSUB600
60 GOTO20
70 FORTT=1TO300:NEXT
80 N=N+1:IFN=256THEN10
85 GOTO130
90 FORTT=1TO300:NEXT
100 N=N-1:IFN=-1THEN10
110 GOTO130
130 PRINT"{CLEAR}":PRINT
140 FORI=2TO20STEP2
150 POKE7680+22+I,N
160 POKE38400+22+I,((I/2+6)AND15)
170 NEXT
180 PRINT:PRINT"CHARACTER NO.";N
190 PRINT:GOTO20
400 PS=8+16*INT(CC/8)+CS
410 POKE36879,PS:PRINT"{HOME}{05 DOWN}SCREEN C
    OLOR= {LEFT}";PS:PRINT"AUX COLOR=0    ~
    "
420 GETC$:IFC$=""THEN420
430 IFC$=CHR$(134)THENGOSUB600
450 CC=CC+1:CS=CCAND7:IFPS=255THENPOKE36879,27
    :CC=0:CS=0:GOTO20
460 GOTO400
600 FORAN=0TO15
610 POKE36878,16*AN
650 PRINT"{HOME}{05 DOWN}SCREEN COLOR= {LEFT}"
    ;PS:PRINT"AUX COLOR=  {02 LEFT}";AN
660 GETC$:IFC$=""THEN660
670 NEXT:POKE36878,0
680 PRINT"{HOME}{06 DOWN}AUX COLOR=   {02
    LEFT}0"
690 GETC$:IFC$=""THEN690
700 RETURN
```

## Program 2.

```
1 SS=24:POKE36879,63:POKE36878,15:DIMJS(2,2)

2 PRINT"{CLEAR}":PRINTSPC(5):PRINT"*********
   ****":PRINTSPC(5)
3 PRINT"**{REV}UFO PILOT{OFF}**":PRINTSPC(5)
   "*************":PRINT"     *  7-28-82
    *"
4 PRINTSPC(5):PRINT"*************":PRINT"{DO
   DOWN}      BY BUD BANIS";SPC(8);"BOUR
   BONNAIS,ILL.
5 PRINT"{03 DOWN}  SET DIRECTION OF ":PRINT"
      SHIP WITH THE"
6 POKE37139,0:DD=37154:PA=37137:PB=37152:PRI
   NT"     JOYSTICK"
7 PRINT"{DOWN}  DON'T RUN INTO YOUR":PRINT" ~
     OWN TRAIL OR HIT"
8 PRINT"     THE WARPLANE.":PRINT"{02 DOWN} ~
     HIT FIRE TO START
9 FORAA=0TO21:POKE7812+AA,88:POKE38532+AA,9:
   GOSUB9000:IFFRTHEN19
10 IFAA=10THENFORTY=0TO15:POKE36878,15OR16*TY
   :POKE36874,244:FORM=1TO50:NEXT:NEXT
11 POKE36878,15
12 POKE36874,234+AA:POKE36874,0:POKE7812+AA,3
   2:NEXT:CS=SSAND7
13 FORAA=0TO21:POKE7701-AA,60:POKE38421-AA,9:
   POKE7878+AA,62
14 POKE38598+AA,9:GOSUB9000:IFFRTHEN19
15 POKE36874,215:FORTT=1TO40:NEXT:POKE36874,0
   :POKE36875,255-5*AA
16 FORTT=1TO10:NEXT:POKE36875,0:POKE7878+AA,3
   2:POKE7701-AA,32:NEXT
17 PS=8+16*INT(SS/8)+CS:POKE36879,PS:SS=SS+1:
   IFPS=255THENSS=0
18 GOTO9
19 FORI=0TO2:FORJ=0TO2:READJS(J,I):NEXTJ,I
20 FF=505:PRINT"{CLEAR}{REV}                ~
                              "
22 XX=0:AD=0:GOSUB10000:IFSC>PHTHENPH=SC
24 POKE7680+FF,88:POKE38400+FF,9:GOSUB9000:IF
   JS(X+1,Y+1)=0THEN24
29 SC=0:YY=22:GOSUB10000
30 GOSUB9000:GOSUB8000:QQ=FF:XZ=ZX:ZX=XX+22*Y
   Y
31 PRINT"{HOME}{REV}                    ":PRINT"{
   HOME}{REV}  SCORE=";SC;"  "
32 IFJS(X+1,Y+1)THENAD=JS(X+1,Y+1):POKE36876,
   220
33 POKE36876,0
35 POKE7680+FF,46:POKE38400+FF,1
40 FF=FF+AD:IFFF<44THENFF=QQ:GOTO9500
42 IFPEEK(7680+FF)=62THEN9500
45 IFPEEK(7680+FF)=46THEN9500
46 POKE7680+FF,88:POKE38400+FF,9
47 IFFF=XZTHEN9500
50 IFFF>505THENFF=QQ:GOTO9500
55 BL=(255-INT(ABS(XX+22*YY-FF)/2)OR128)
56 POKE7680+XZ,32:IFPEEK(7680+ZX)=88THEN9500
58 POKE7680+ZX,62:POKE38400+ZX,9
59 POKE36874,BL:POKE36874,0
70 GOTO30
100 DATA-23,-22,-21,-1,0,1,21,22,23
8000 SC=SC+1:XX=XX+1:IFXX=22THENXX=0:YY=INT(FF/
   22)
8020 RETURN
9000 POKEDD,127:S3=-((PEEK(PB)AND128)=0):POKEDD
   ,255
9010 P=PEEK(PA):S1=-((PAND8)=0):S2=((PAND16)=0)
   :SO=((PAND4)=0)
9020 FR=-((PAND32)=0):X=S2+S3:Y=SO+S1:RETURN
9500 POKE36879,138:POKE36877,220:POKE7680+FF,42
   :FORZZ=1TO100
9510 POKE38400+FF,ZZAND15:POKE36878,INT(15-ZZ/7
   ):NEXT:POKE36877,0
9520 XX=0:RESTORE:POKE36879,57:POKE36878,15
9530 GOTO2
10000 PRINT"{HOME}{REV}                    ":PRINT"{
   HOME}{REV}  SCORE=";SC;"  "
10010 PRINT"{HOME}{DOWN}{REV}PREVIOUS HIGH=";PH:
   RETURN
```

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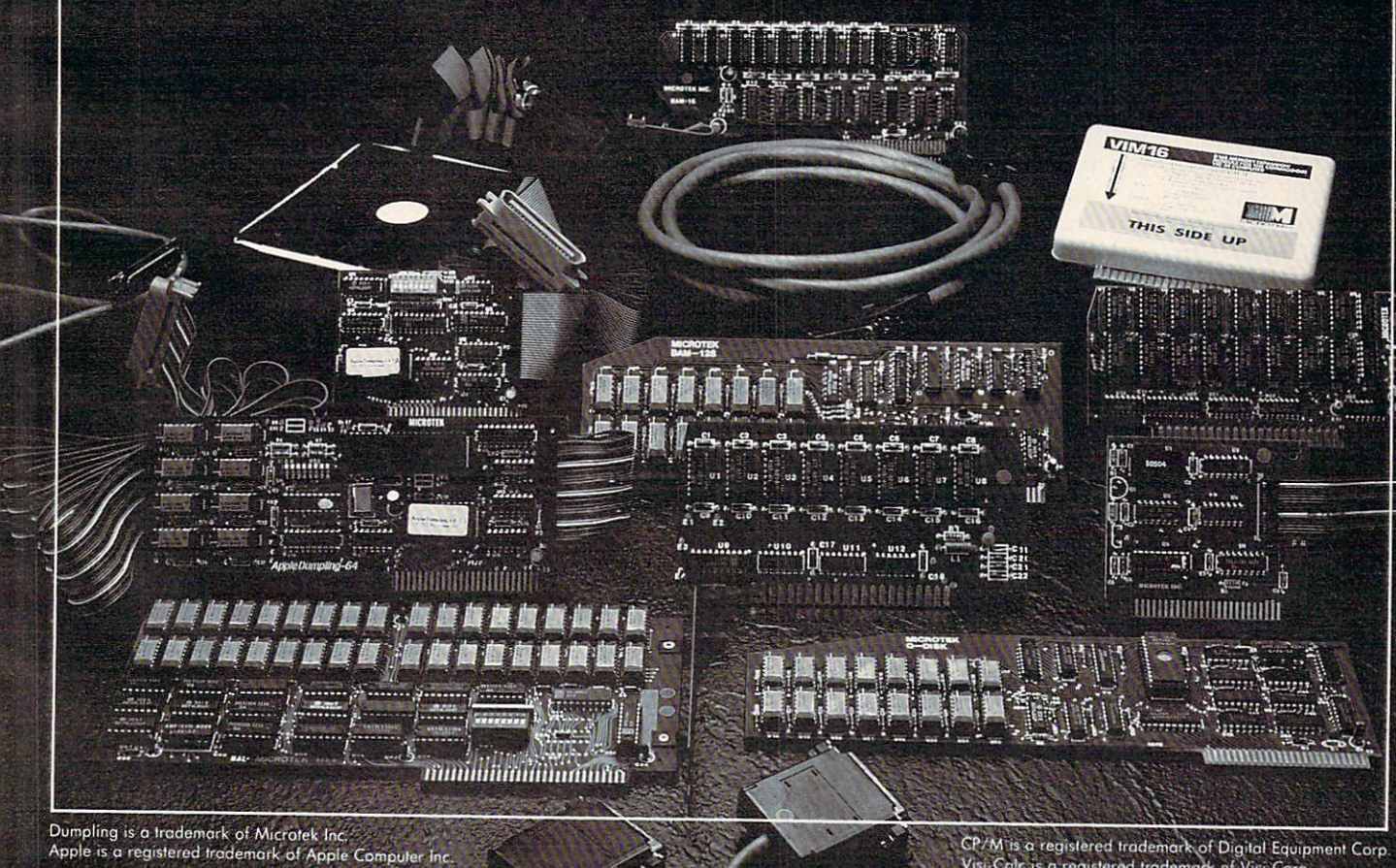

# TELECOMMUNICATIONS

Michael Day

## Part I:
# Communication Errors

*Success in transmitting information reliably can depend on the error-checking scheme being used. This is the first of a two-part column which surveys all of the major error-detection methods.*

The world of telecommmunications is fraught with danger. Computer data is a very precise form of information that is intolerant of any form of distortion. The computer handles the problem internally by using a form of redundancy that provides for an error potential low enough to be ignored. The environment inside the computer can be controlled, and the data can be actively maintained. The environment outside the computer is much different.

Since little can be done to control the communications environment outside the computer, errors in the transferred data are of much greater concern.

Transmitted data can be distorted in a number of different ways, and the resulting types of errors need to be considered.

### Parity Checking

One of these errors is the parity error. A parity error indicates that some portion of the transmitted data is incorrect, but does not say what the error is. The most common parity error check is Vertical Redundancy Checking (VRC). When a character is transmitted, it is sent as a series of on/off bits. When data is transmitted asynchronously, even parity is normally used if VRC is implemented. In even parity, an additional bit is added to the end of each character that is transmitted. If there are an odd number of ON bits in the character, the additional bit is turned ON to make the number of ON bits an even number. If the number of ON data bits is already an even number, then the additional bit will be OFF in order to keep an even number of ON bits.

When data is transmitted synchronously, odd parity is normally used. Odd parity works on the same principle as even parity: the difference is that an odd number of ON bits is desired. Odd parity is used for synchronous transmission to insure that at least one bit in the transmitted character is on, since this helps maintain synchronization in the older modems. (If all the bits of the character were OFF, there would be zero ON bits, an even number. The parity bit would have to be turned ON to make the total count odd.)

Another form of parity checking is the Horizontal Redundancy Check (HRC), sometimes referred to as block parity. HRC is similar to VRC, but, instead of checking vertically through the character, HRC performs a horizontal check through all the characters. Instead of adding up all of the bits on a single character, block parity adds up all of the "1" bits in bit position one of all the transmitted characters. The resulting parity bit forms bit one of the block parity character. (The block parity character is also referred to as the Block Check Character – BCC.) This procedure is repeated for all the bits of the transmitted characters. This form of parity is often implemented along with VRC to obtain a reasonably reliable method of error detection; the two forms complement each other, since each checks for error conditions that the other one ignores.

Spiral Redundancy Check (SRC), a modification of the HRC, adds together successively lower bits of successive characters to form the parity bits. That is, bit one of character one is added to bit two of character two, and so on. Although the SRC is more difficult to implement than the HRC, it more evenly distributes the parity testing throughout the data.

### Improved Detection

Interleaving is not a form of parity, but it is a type of transmission used to increase error detection. In interleaving, a group of characters is re-formed: a new character is formed from the one bits of the characters, another one from all of the two bits, and so on until the entire group has been reformed. Normally used with VRC, this method often includes HRC as well.

Two major types of errors in telecommunications are line hits and noise bursts. A line hit disrupts only a single bit or two, but a noise burst disrupts large groups of bits. HRC and VRC can usually detect errors caused by line hits (the most common type of error) but often have difficulty with errors caused by noise bursts.

SRC increases error detection by spreading out the parity checking to cover a wider area of the transmitted data. Transmitted data tends to have

rather consistent patterns. Unfortunately, communication errors also tend to occur in patterns. If the two patterns match, the error can often go undetected. Interleaving attempts to decrease undetected errors by purposely randomizing the transmitted data to reduce possible patterns.

VRC, HRC, SRC, and interleaving came to be used as means of error detection because they are easily performed in the hardware that actually does the transmission. The error detectors and parity generators were simply added to existing transmitters and receivers. Because SRC and interleaving are more difficult to do, they are not as common as VRC and HRC.

The HRC implementation is now often not found in the hardware, since the function can be easily done in software. The VRC, however, is very easy to do in hardware but somewhat more difficult in software. As a result, VRC is often provided in the hardware, generally a UART (Universal Asynchronous Receiver Transmitter), which converts the characters into the serial (or bit by bit) form needed for transmission over the telephone network or other communications system.

While the VRC can detect about 90% of the errors encountered, it is often desirable to be able to detect a greater percentage of the errors. This can be done by adding one of the previously mentioned error detection schemes, or some other type of error detection.

## Echoplexing Problems

A very popular form of error detection is *echoplexing* (sometimes incorrectly referred to as full duplex). This form of error detection works by having each transmitted character returned to the transmitter by the receiving computer. This allows 100% error checking since each character is returned to the transmitter for verification. There are many disadvantages to this method, however.

First, it can generally be implemented in only one direction: the transmitter can detect any errors in transition, but the receiving computer has no way of insuring that the data it has transmitted is correct. Another problem is that it is a slow procedure – each character must be transmitted, received, processed, retransmitted, received by the originator, and checked for correctness.

Therefore, the actual transmission time (the processing time involved at each end) is reduced by more than one half the physical speed. If a human is at the transmitter end, we can improve things a bit. The human can check for errors and thereby decrease the amount of processing the computer has to do. (We also gain the superior detection abilities of the human.)

The main problem, as stated before, is that we can implement the echoplexing in only one direction. Another problem is that human error detection relies on the ability to detect pattern errors, rather than specific, individual types of errors. Consequently, if we intend to send computer data which is essentially random in nature, we cannot use the detection capabilities of the human and must implement some other form of error detection.

Although one or several of the previously mentioned error detection schemes could be implemented, they are generally not easy to do in software. It is also undesirable to add more hardware to the system to perform the error detection; in many cases, adding hardware is not possible.

## Checksum

Since it is desirable to perform error detection in software, a different form of error detection more suitable to software implementation needs to be considered. A very common software-generated error checking routine is the checksum, a form of HRC that can be easily implemented in software. It is simply a sum without carry of all of the characters transmitted. The second character is added to the first character, the third character is added to the resulting sum, the fourth character is added to that sum, and so on. After all the data have been transmitted, the final sum is transmitted. The receiving computer checks the transmitted sum against the sum that *it* added up. If the two sums do not match, there is an error in the transmitted data. Using the checksum along with the VRC results in detection of approximately 99% of all errors.

An error detection rate of 99% in text is in general quite acceptable. Only about one error in every million characters transmitted over the telephone will get through undetected (about one error every 10 hours at 300 baud). For text this is an acceptable error rate; there will generally be far more errors than that embedded in the text to begin with. ©

# Comets

Chris Williams

*For Applesoft on a 48K Apple II, this simulation of a comet's motion in high-res allows you to alter several variables. You can even send the comet into deep space.*

In this article we'll be concentrating on comets. Comets have a couple of characteristics that make them well-suited to illustrate several concepts embedded in the program.

The first of these is their long periods; you have plenty of time to see what's going on. Comets can take hundreds of years to complete one orbit. Fortunately, we won't have to wait that long.

Second, they have highly elliptical orbits. Large variances in the comet's distance from the star are a visual plus.

The program makes use of both these traits to demonstrate idiosyncrasies of cometary motion. It is written in Applesoft to run on an Apple II+ (48K). The Apple, of course, uses a BASIC interpreter. If areas of code (especially in the main execution loop) look strangely written, it's because the program was designed for speed. REM statements are also placed with speed in mind.

## Newton's Laws

The program, unlike most celestial simulations, does not directly use Kepler's laws. Instead, Newton's gravity equations are applied in two dimensions to drive the movements of a high-res dot which represents the comet.

A delta time interval (DT) of 120 days is used to get things done in a reasonable amount of time. Having a 120 day DT has some interesting ramifications. But we'll touch on that later.

Operation of the program is straightforward. It opens with a brief introduction, and then gives some suggestions for input parameters that will produce a stable, visually pleasing orbit. After the last input parameter is entered, execution begins.

The screen goes into high-res, a sprinkling of stars appears to set the mood, and the update loop starts. A clicking sound with distance-dependent pitch is also produced, again merely for effect.

The values used for constants and variables are not arbitrary. All numbers in the program – those the user inputs and those displayed at the bottom of the screen – have meaning. The mass of the central bright star (cross) is equal to the sun's in all calculations. The comet's mass is a plausible 1000 kgs. The screen scaling is such that its edge represents a radius just outside Pluto's orbit.

One last point of interest. If you input the following parameters:

```
DX=5555
DY=0
VX=0
VY=1
```

you'll see some strange behavior. The comet will curve inbound, pass very close to the star, and then whip right off the screen.

## You Can Lose The Comet

This can be traced back to the 120 day DT value mentioned previously. As the comet gets in close to the star, its velocity increases tremendously. As a result, there are passes through the execution loop in which a very large velocity is applied over 120 days. This yields a relatively large distance traveled from the star at the completion of that pass.

Gravity is an inverse-square relationship. With a large distance *and* a high velocity, there is not sufficient attractive force to keep the comet in orbit.

This doesn't happen in nature. It is simply a peculiar effect of large DTs in numerical integration. There are many cures, but I chose to leave it alone, as a demonstration.

Try it out and experiment. I've found some unusual input combinations that seem to be on the threshold of the above problem. They result in a semi-spiral until the comet gets too close to the star and streaks out of the system.

This doesn't happen in nature either. It's just another illustration of the need for care when creating an accurate simulation.

```
10  REM  *** COMETS ***
11  REM  BY CHRIS WILLIAMS
13  REM  ***************
20  ONERR  GOTO 370
30  HOME
35  REM  GO TO INTRODUCTION SUBRO
     UTINE
40  GOSUB 350
45  REM  ENTER INPUT PARAMETERS
47  REM  AND SET UP THEIR UNITS
```

```
50  INPUT "ENTER DX(X 10^6 KM)";D
    X: PRINT
60 DX = DX * 10 ^ 9
70  INPUT "ENTER DY(X 10^6 KM)";D
    Y: PRINT
80 DY = DY * 10 ^ 9
90  INPUT "ENTER VX(KPS)";VX: PRINT
100 VX = VX * 10 ^ 3
110  INPUT "ENTER VY(KPS)";VY: PRINT
120 VY = VY * 10 ^ 3: HGR
125  REM  PLOT THE CENTRAL STAR A
    S A +
130  HCOLOR= 3: HPLOT 140,80: HPLOT
    141,80: HPLOT 140,81: HPLOT
    139,80: HPLOT 140,79
135  REM  NOW SPRINKLE STARS FOR
    MOOD
140  FOR RD = 1 TO 100:X =  RND (
    1) * 279:Y =  RND (1) * 159:
     HPLOT X,Y: NEXT
145  REM  SET GRAV. EQN. CONSTANTS
146  REM  AND DT=120 DAYS, ALSO
147  REM  HI RES SCALING
150 MS = 329390 * 5.98 * 10 ^ 24:
    G = 6.67 * 10 ^ ( - 11):DT =
    120 * 3600 * 24:SXCALE = 279
     / (2 * (5900 * 10 ^ 9)):SYC
    ALE = 159 / (2 * (5900 * 10 ^
    9))
155  REM  PLACE VARIABLE LABELS
156  REM  AT BOTTOM OF PAGE
160  VTAB 22: HTAB 25: PRINT "VX=
    ": VTAB 23: HTAB 25: PRINT "
    VY="
170  VTAB 22:: PRINT "DX=": VTAB
    23:: PRINT "DY=  "
175  REM  CM IS COMET MASS IN KGS.
177  REM  CR IS SCREEN SIZE IN ME
    TERS
179  REM  OTHER CONSTANTS FOR SPE
    ED
180 CM = 1000:CR = 5900 * 10 ^ 9:
    ZERO = 0:THREE = 3:T2 = 22:T
    3 = 23:FR = 4:T8 = 28:RE = 1
    .49 * 10 ^ 11:TLL = 9 * 10 ^
    11
185  REM  LOOP STARTS AT 190
186  REM  NO COMMENTS WITHIN
187  REM  FOR SPEED
190 SS = (DX * DX) + (DY * DY):SQ
     =  SQR (SS)
200 F = CM * MS * G / SS
210 AX =  - F * (DX / SQ) / CM
220 AY =  - F * (DY / SQ) / CM
230 VX = VX + (AX * DT)
240 VY = VY + (AY * DT)
250 DX = DX + (VX * DT)
260 DY = DY + (VY * DT)
270  VTAB T2: HTAB FR: PRINT DX;"
     ": VTAB T2: HTAB T8: PRINT
    VX: VTAB T3: HTAB FR: PRINT
    DY;" "
280  VTAB T3: HTAB T8: PRINT VY
290  HCOLOR= ZERO: HPLOT XNU,YNU
300 XNU = (DX + CR) * SXCALE
310 YNU = (DY + CR) * SYCALE
320  HCOLOR= TH: HPLOT XNU,YNU
325  GOSUB 700
330  GOTO 190
340  STOP
342  REM  GOSUB 700 AT 325
343  REM  IS "CLICK" ROUTINE
350  HTAB 17: PRINT "COMETS": PRINT
    : PRINT "   THIS PROGRAM IS
    A SIMULATION OF THE": PRINT
    : PRINT "ORBITAL TRAJECTORIES
     CHARACTERISTIC OF": PRINT :
     PRINT "COMETS."
352  PRINT : PRINT "SUGGESTED INP
    UTS:DX=5555,DY=0,VX=0,VY=3":
     PRINT : PRINT
355  REM  360 CONTAINS ASSMBLY
356  REM  LOAD OF CLICK ROUTINE
360  PRINT : PRINT "HIT ANY KEY W
    HEN READY": GET A$: HOME : PRINT
    : PRINT : FOR DP = 771 TO 78
    9: READ DA: POKE DP,DA: NEXT
    : RETURN
365  DATA  173,48,192,136,208,4,1
    98,1,240,8,202,208,246,166,0
    ,76,3,3,96
368  REM  370 IS WHERE YOU GO WHEN
369  REM  ERROR FROM OFF SCREEN
370  HOME : TEXT : FOR YY = 1 TO
    10: PRINT  CHR$ (7): NEXT YY
    : HOME :: PRINT : PRINT "OKA
    Y, PAL.  ONE OF THREE THINGS
     JUST": PRINT : PRINT "HAPPE
    NED.": PRINT
380  PRINT "EITHER YOUR INITIAL V
    ELOCITIES": PRINT : PRINT "W
    ERE TOO LARGE OR YOU PASSED
    TOO": PRINT : PRINT "CLOSE T
    O THE STAR.  PASSING TO CLOS
    E": PRINT : PRINT "TO THE ST
    AR CAUSES PROBLEMS WITH A": PRINT
    : PRINT "120 DAY LOOP INTERV
    AL."
390  PRINT : PRINT "OR PERHAPS YO
    U JUST MESSED UP.": PRINT : PRINT
    "IN ANY CASE, TRY AGAIN.": END
700  POKE 1,3: POKE ZE,(T8 * SQ /
    CR) + FR: CALL 771: RETURN
```

# FORTH PAGE

# A FORTH/BASIC Benchmark Test

Michael F. Heidt

*This article has a twofold purpose. First, it makes a timing comparison between FORTH and BASIC by comparing runtimes for a benchmark program. Second, it demonstrates FORTH's extensibility by the implementation of a simple integer array.*

Benchmarks are frequently used in acceptance testing mainframe computers. The BASIC Benchmarks used by Rugg and Feldman (*Kilobaud*, June 1977) became so popular that they were frequently used in advertising implementations of BASIC. Benchmark 7 from the *Kilobaud* article (Program 1) is the most comprehensive and was chosen for this comparison.

A quick look will show you that the program doesn't actually do much. The variable K is used as a loop counter. M is a simple array into which the values calculated in line 510 are to be stored. The subroutine at line 820 doesn't do anything. The object here is to measure the overhead required by calling a subroutine. The print statements at lines 300 and 700 allow you to start and stop a stopwatch to time the benchmark. Program 2 is the FORTH equivalent of Program 1 (the BASIC program).

## The Results

| BASIC | FORTH |
|---|---|
| 27.43 | 13.58 |

**Benchmark 7 results (seconds)**

The above figures show the speed comparisons for the two versions of Benchmark 7. The measurements were made on an OSI C4-P running a 6502 processor at two megahertz. Each benchmark was run ten times and the results then averaged. This was done to average out variations in reaction time in starting and stopping the stopwatch.

As you can see from the table, the FORTH version is twice as fast as the BASIC version. The FORTH version could be made even faster by leaving out error checking, an option not available in BASIC.

It should be noticed that the FORTH version does not have a GOTO statement. FORTH has no GOTO. The structure of the FORTH program is "bottom up." This means that the most primitive sections are built first, then the next level uses the primitives and so on until the desired functions are built. However, it is possible to do "top down" programming in FORTH.

In fact, this is really how it should be done. For example, I essentially wrote the word B7 first, then added the more primitive routines. By doing it this way, you know what primitives to write, what variables will be needed, and you get some idea of just how big the job is going to be.

If you're not familiar with FORTH, the program presented here may appear complicated compared to the BASIC version. However, you should keep in mind that in addition to creating the benchmark, I have extended FORTH here to include a general integer array capability that can be used by other programs.

### Program 1.

```
10 REM BENCHMARK 7,
   Kilobaud #6 p66
300 PRINT"START"
400 K=0
430 DIM M(5)
500 K=K+1
510 A=K/2*3+4-5
520 GOSUB820
530 FOR L=1 TO 5
535 M(L)=A
540 NEXT L
600 IF K<1000 THEN
    500
700 PRINT"END"
800 END
820 RETURN
```

### Program 2.

```
SCR # 96
  0 ( BENCHMARK 7  WITH INTEGER ARRAYS              MFH 1/11/81)
  1 FORTH DEFINITIONS DECIMAL
  2 : DIM <BUILDS DUP , 2 * 2 + ALLOT DOES> ;
  3 : RANGE DUP ROT DUP ROT @ > ;
  4 : READ RANGE IF ." RANGE ERROR " CR DROP @ (LEAVES MAX DIM
  5   IF ERROR )    ELSE 2 * + 2 + @ ENDIF ;
  6 ( READ WANTS ELEMENT NAME, E.G. E M READ - LEAVES CONTENTS )
  7 : ADD RANGE IF ." RANGE ERROR" CR DROP DROP ELSE 2 * 2
  8  + + ! ENDIF ; ( WANTS VALUE ELEMENT NAME )
  9   0 VARIABLE K 0 VARIABLE A
 10 : START ." START " ; : STOP ." END " CR CR ; : GOSUB ;
 11 5 DIM M ( CREATE ARRAY M WITH 5 ELEMENTS )
 12 : K+ K @ 1 + DUP K ! ; ( INCREMENT VARIABLE K BY ONE )
 13 : B7 START 0 K ! BEGIN K+ DUP 2 / 3 * 4 + 5 - A ! GOSUB
 14        6 1 DO A @ I M ADD LOOP 1000 = UNTIL STOP ;
 15 ;S
```

# The Commodore™ Gazette

The Monthly User's Guide for VIC-20™ and 64™ Personal Computers

*The Commodore™ Gazette*, a monthly publication of **COMPUTE!** Publications, is a layman's guide to consumer computing. Written for beginning and intermediate level owners and users of the Commodore VIC-20 and 64 computers. Regular features include best seller lists for recreational and educational software, reviews, new products, tutorials on home and educational applications, and much more. Written for entertainment as well as teaching, *The Commodore™ Gazette*, while appealing to users wishing to learn more about programming and computers, has continuing appeal for those who simply want to obtain maximum use from their computers in a non-technical way.

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# CAPUTE!

Modifications Or Corrections To Previous Articles

## Commodore 64 Sprite Editor

In the program from the December 1982 issue, (p. 212), the following changes should be made:

```
LINE 74 - {F2} SHOULD BE {F3}
LINE 75 - {F3} SHOULD BE {F5}
LINE 76 - {F4} SHOULD BE {F7}
```

Also, the following modifications allow the menu to reflect changes in the sprite color options:

```
23 PRINT"1  MC 0-"A$(PEEK(V+37) AND 15)
24 PRINT"2  SC  -"A$(PEEK(V+41) AND 15)
25 PRINT"3  MC 1-"A$(PEEK(V+38) AND 15)
```

## Atari TAG

Our thanks to reader Paul Havey who uncovered a bug which causes unpleasant results in the Atari version of TAG (October 1982, p. 76). Line 1090 should read as follows:

```
1090 DATA 26,208,142,9,212,162
```

## VIC Pixelator

In Program 1 (October 1982, p. 144) the following changes should be made:

```
LINE 140 - {F2} SHOULD BE {F3}
LINE 500 - {F2} SHOULD BE {F3}
LINE 510 - {F3} SHOULD BE {F5}
LINE 520 - {F4} SHOULD BE {F7}
```

Also, author James Calloway notes that, in addition to the modifications noted last month in Capute!, the following changes permit the program to run on a VIC with an 8K expander added:

```
3570 IF S2>1 THEN POKE 36869,PEEK(36869) AND NO
    T 15 OR 2:GOTO 160
3580 POKE 36869,PEEK(36869) AND NOT 15:GOTO 160
```

*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 this page, usually within eight weeks. If you have specific questions about items or programs which you've seen in* **COMPUTE!**, *please send them to Ask The Readers, P.O. Box 5406, Greensboro, NC 27403.*

# 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:

**February 1981:** Simulating PRINT USING, Using the Atari as a Terminal for Telecommunications, Attach a Printer to the Atari, Double Density Graphing on C1P, Commodore Disk Systems, PET Crash Prevention, A 25¢ Apple II Clock.

**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.

**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, QuadraPET: Multitasking?

**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, The Voracious Butterfly on OSI.

**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.

**October 1981:** Automatic DATA Statements for CBM and Atari, VIC News, Undeletable Lines on Apple, PET, VIC, Budgeting on the Apple, Switching Cleanly from Text to Graphics on 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: versions for Apple, PET, and Atari), Unscramble Game (multiple computers), Maze Generator (multiple computers), Animating Applesoft Graphics, A Simple Printer Interface for the Apple II, A Simple Atari Wordprocessor, Adding High Speed Vertical Positioning to Atari P/M Graphics, OSI Supercursor, A Look At SuperPET, Supermon for PET/CBM, PET Mine Maze Game.

**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.

**February 1982:** Insurance Inventory (multiple computers), Musical Transposition (multiple computers), Multitasking Emulator (multiple computers), Disassemble Apple Programs from BASIC, Plotting Polar Graphs on Apple, Atari P/M Graphics Made Easy, Atari PILOT, Put A Rainbow in your Atari, Marquee for PET, PET Disk Disassembler, VIC Paddles and Keyboard, VIC Timekeeping.

**March 1982:** Word Hunt Game (multiple computers), Infinite Precision Multiply (multiple computers), Atari Concentration Game, VIC Starfight Game, CBM BASIC 4.0 To Upgrade Conversion Kit, Apple Addresses, VIC Maps, EPROM Reliability, Atari Ghost Programming, Atari Machine Language Sort, Random Music Composition on PET, Comment Your Apple II Catalog.

**April 1982:** Track Down Those Memory Bugs (multiple computers), Shooting Stars Game (multiple computers), Intelligent Input Subroutines (multiple computers), Ultracube for Atari, Customizing Apple's Copy Program, Using PET/CBM In The High School Physics Lab, Grading Exams on a Microcomputer (multiple computers), Atari Mailing List, Renumber VIC Programs The Easy Way, Browsing the VIC Chip, Disk Checkout for PET/CBM.

**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.

**June 1982:** Outpost Game (multiple computers), Apple Pascal Lister, Income Property (multiple computers), VIC Intelligent Videodisc System, Atari Disk Operating Systems, PET/Apple Search, A Self-modifying Atari P/M Utility, Use Atari Joysticks with VIC, VIC/PET Program Transfers.

**July 1982:** Gold Miner Game (Atari and VIC), IRA Planner (multiple computers), Atari Video Graphics, Apple DOS Changer, Super QuadraPET, VIC Overview, Maze Race (multiple computers), Direct Access File Editor (PET and Atari), VIC Super Expander Memory Map, Using The 6560 Video Interface Chip, PET Compactor, Headless FORTH Metacompilation, Test RAM Nondestructively (multiple computers).

**August 1982:** The New Wave Of Personal Computers, Household Budget Manager (multiple computers), Word Games (multiple computers), Color Computer Home Energy Monitor, Intelligent Apple Filing Cabinet, 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, Color Computer Graphics, The Apple Pilot Language, Sprites and Sound on the Commodore 64, Peripheral Vision Exerciser (multiple computers), Banish INPUT Statements (multiple computers), Charades (multiple computers), PET Pointer Sort, VIC Pause, Mapping Machine Language, Editing Atari BASIC With the Assembler Cartridge, Process Any Apple Disk File.

**Home and Educational COMPUTING!** (Fall 1981 and Summer 1981 – count as one back issue): Exploring The Rainbow Machine, VIC As Super Calculator, Custom Characters, Alternate Screens, Automatic Line Numbers, Using The Joystick (Spacewar Game), Fast Tape Locater, Window, VIC Memory Map.

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# 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, {A}.

| 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

Generally, any PET/CBM/VIC program listings will contain bracketed words which spell out any special characters: {DOWN} would mean to press the cursor-down key; {3DOWN} would mean to press the cursor-down key three 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 listing. For example, S would mean to type the S key while holding the shift key. This would result in the "heart" graphics symbol appearing on your screen. Some graphics characters are inaccessible from the keyboard on CBM Business models (32N, 8032).

Sometimes in a program listing, especially within quoted text when a line runs over into the next line, it is difficult to tell where the first line ends. How many times should you type the SPACE bar? In our convention, when a line breaks in this way, the ~ symbol shows exactly where it broke. For example:

```
100 PRINT "TO START THE GAME  ~
    YOU MAY HIT ANY OF THE KEYS
    ON YOUR KEYBOARD."
```

shows that the program's author intended for you to type two spaces after the word *GAME*.

### All Commodore Machines

| | | | |
|---|---|---|---|
| Clear Screen | {CLEAR} | 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} |

### VIC/CBM 64 Conventions

| | | | |
|---|---|---|---|
| Set Color To Black | {BLK} | Function Two | {F2} |
| Set Color To White | {WHT} | Function Three | {F3} |
| Set Color To Red | {RED} | Function Four | {F4} |
| Set Color To Cyan | {CYN} | Function Five | {F5} |
| Set Color To Purple | {PUR} | Function Six | {F6} |
| Set Color To Green | {GRN} | Function Seven | {F7} |
| Set Color To Blue | {BLU} | Function Eight | {F8} |
| Set Color To Yellow | {YEL} | Any Non-implemented | |
| Function One | {F1} | Function | {NIM} |

To enter any color code, hold down CTRL and press the appropriate color key. Use CTRL-9 for RVS on and CTRL-0 for RVS off.

### 8032/Fat 40 Conventions

| | | | |
|---|---|---|---|
| Set Window Top | {SET TOP} | Erase To Beginning | {ERASE BEG} |
| Set Window Bottom | {SET BOT} | Erase To End | {ERASE END} |
| Scroll Up | {SCR UP} | Toggle Tab | {TGL TAB} |
| Scroll Down | {SCR DOWN} | Tab | {TAB} |
| Insert Line | {INST LINE} | Escape Key | {ESC} |
| Delete Line | {DEL LINE} | | |

When you see an underlined character in a PET/CBM/VIC program listing, you need to hold down SHIFT as you enter it. Since the VIC-20 and Commodore 64 have fewer keys than the PET/CBM, some graphics are grouped with other keys and have to be entered by holding down the Commodore key. If you see any of the symbols in the left column underlined in a listing, hold down the Commodore key and enter the symbol in the right column. Just use SHIFT to enter all other underlined characters.

| | | | | | |
|---|---|---|---|---|---|
| ! | K | ← | * | 1 | E |
| " | I | ↑ | PI | 2 | R |
| # | T | . | S | 3 | W |
| $ | @ | - | Z | 4 | H |
| % | G | = | X | 5 | J |
| ' | M | < | C | 6 | L |
| & | # | > | V | 7 | Y |
| \ | - | , | D | 8 | U |
| ; | F | / | P | 9 | I |
| ? | B | * | N | @ | SHIFT* |
| ( | £ | + | Q | [ | SHIFT+ |
| ) | SHIFT-£ | 0 | A | ] | SHIFT- |

## 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.

## TRS-80 Color Computer

No special characters are used, other than lowercase. When you see letters printed in inverse video (white on black), press SHIFT-0 to enter the characters, and then press SHIFT-0 again to return to normal uppercase typing.

## Texas Instruments 99/4

No special control characters are used. Enter all programs with the ALPHA lock on (in the down position). Release the ALPHA lock to enter lowercase text.

## Timex TS-1000, Sinclair ZX-81

Study your computer manual carefully to see how to enter programs. Do not type in the letters for each command, since your machine features single-keystroke entry of BASIC commands. You may want to switch to the FAST mode (where the screen blanks) while entering programs, since there will be less delay between lines. (If the blanking screen bothers you, switch to the SLOW mode.)

# 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 this page, usually within eight weeks. If you have specific questions about items or programs which you've seen in* **COMPUTE!**, *please send them to Ask The Readers, P.O. Box 5406, Greensboro, NC 27403.*

# COMPUTE!'s First Book Of Atari

**Author:** **COMPUTE!** Magazine contributors
**Price:** $12.95
**On Sale:** Now

Since their introduction in late 1979, the Atari 400/800 microcomputers have proven to be among the most popular personal computers ever made. **COMPUTE!** Magazine, one of the top publications in personal computing, was among the first to recognize the potential of the Atari computers and started regularly covering them from the beginning. Since then, **COMPUTE!** has published hundreds of articles on the Ataris and has become an indispensable resource for thousands of Atari users.

Most of those Atari users, however, joined the magazine's readership months after those early issues appeared. Many of those issues are now out of print. To satisfy the demand for those early articles, the magazine's editors have compiled the best of them into *COMPUTE!'s First Book Of Atari.*

In 192 pages, spiral bound for easy access to program listings, *COMPUTE!'s First Book Of Atari* includes chapters such as "Getting To Know Your Atari," "Beyond The Basics," "Graphics," "Programming Hints," "Applications," and "Peripheral Information." Informative articles concisely edited for smooth reading describe how Atari users can design their own graphics modes, add voice tracks to programs, and debug programming errors. There's even the classic article on player/missile graphics by Atari's own Chris Crawford.

As a bonus, the book also includes previously unpublished information such as a memory map.

And like **COMPUTE!** Magazine itself, *COMPUTE!'s First Book Of Atari* is written and edited to be useful to all computer enthusiasts – beginners and experts alike.

At only $12.95, less than most computer manuals, *COMPUTE!'s First Book Of Atari* is among the best resources an Atari owner can buy.



Available at computer dealers and bookstores nationwide. To order directly call TOLL FREE 800-334-0868. In North Carolina call 919-275-9809. Or send check or money order to **COMPUTE! Books**, P.O. Box 5406, Greensboro, NC 27403.

Add $2 shipping and handling. Outside the U.S. add $5 for air mail, $2 for surface mail. All orders prepaid, U.S. funds only.

# COMPUTE!'s First Book Of VIC

**Authors:** **COMPUTE!** Magazine contributors
**Price:** $12.95
**On Sale:** Now

Finally, it's VIC's turn!

Users of other popular personal computers have been enjoying their **COMPUTE! Books**: *COMPUTE!'s First Book Of PET/CBM* ...the *First Book Of Atari* ...the *Second Book Of Atari* ... *Programming The PET/CBM* ... and others.

Now, there's a book devoted exclusively to the Commodore VIC-20 computer: *COMPUTE!'s First Book Of VIC.*

The editors of **COMPUTE!** Magazine – the leading resource for the VIC-20 – gathered together the best VIC-20 articles published since the summer of 1981 and added some new material. The result is more than 200 pages of valuable information – information that goes beyond the instruction manuals. In the **COMPUTE!** tradition, it is carefully edited to be easily understood and useful for beginners and experts alike.

*COMPUTE!'s First Book Of VIC* is spiral-bound to lie flat, and includes ready-to-type program listings and articles such as "The Joystick Connection: Meteor Maze," "STARFIGHT3," "Train Your PET To Run VIC Programs," "Renumber BASIC Lines The Easy Way," "High Resolution Plotting," "Custom Characters For The VIC," "VIC Memory – The Uncharted Adventure," and "A Simple Monitor For The VIC."

At only $12.95, less than most computer manuals, *COMPUTE!'s First Book Of VIC* is among the best resources a VIC user can own.



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Add $2 shipping and handling. Outside the U.S. add $5 for air mail, $2 for surface mail. All orders prepaid, U.S. funds only.

# COMPUTE!'s Second Book Of Atari

After only three years on the market, the Atari 400/800 microcomputers have become among the most popular personal computers ever made. So it was no surprise when *COMPUTE!'s First Book of Atari*, a collection of the best Atari articles published during 1980-81 in **COMPUTE!** Magazine, also became a "bestseller" with Atari enthusiasts. The first printing sold out in just a few months.

That's why we've followed up with *COMPUTE!'s Second Book of Atari*. Available immediately, the *Second Book of Atari* continues **COMPUTE!**'s tradition for personal computer users.

But the *Second Book of Atari* differs from the *First Book* in one important respect – all the articles are totally new and previously unpublished. The *Second Book of Atari* includes such interesting articles as "Page Flipping," "Fun With Scrolling," "Perfect Pitch," "Player-Missile Drawing Editor," and "TextPlot Makes a Game." Whole chapters are devoted to subjects such as "Advanced Graphics and Game Utilities," "Programming Techniques," and "Beyond BASIC." With 250 pages – more than 25 percent thicker than the *First Book* at the same price – the *Second Book of Atari* is crammed with information and ready-to-type program listings. And the book is spiral-bound to lie flat and is fully indexed for quick reference.

Best of all, *COMPUTE!'s Second Book of Atari*, like **COMPUTE!** Magazine itself, is written and edited to appeal to all computer enthusiasts – beginners and experts alike. Priced at only $12.95.



Available at computer dealers and bookstores nationwide. To order directly call TOLL FREE 800-334-0868. In North Carolina call 919-275-9809. Or send check or money order to **COMPUTE! Books**, P.O. Box 5406, Greensboro, NC 27403.

Add $2.00 shipping and handling. Outside the U.S., add $5.00 for air mail, $2.00 for surface mail. All orders prepaid, U.S. funds only.

# COMPUTE!'s First Book Of Atari Graphics

**Authors:** **COMPUTE!** Magazine editors and contributors
**Price:** $12.95
**On Sale:** Now

**COMPUTE!**, the leading magazine of home, educational, and recreational computing, has led the way for Atari owners since the computers were first introduced in 1979. **COMPUTE!** has published scores of articles on Atari graphics, and was the first to divulge many important details on such techniques as redefined characters, custom graphics modes, and player/missile graphics. But those articles are scattered across dozens of issues, many of which are scarce or out of print.

That's why the editors of **COMPUTE!** decided to gather the very best Atari graphics articles published over the past three years into *COMPUTE!'s First Book Of Atari Graphics*. From the fundamentals to advanced techniques, here are some of the most instructive articles ever published for the Atari.

But that's not all. *COMPUTE!'s First Book Of Atari Graphics* also presents articles never before published anywhere, and additional sections written especially for this book. These include "The Basics Of Atari Graphics," an introductory tutorial which prepares beginners for the rest of the book; "How To Design Custom Graphics Modes," which covers the fundamentals of mixing modes on a single screen; and "Introduction To Player/Missile Graphics," a guide to understanding one of the Atari's most advanced features, written by Bill Wilkinson, a **COMPUTE!** columnist and a creator of Atari BASIC and the Atari Disk Operating System.

Numerous other articles include "Designing Your Own Character Sets," a new and improved "SuperFont," "High Speed Animation With Character Graphics," "Animation And Player/Missile Graphics," "The Collision Registers," and "GRAPHICS 8 In Four Colors Using Artifacts." There's even a brand new article by Wilkinson, "The Priority Registers," which for the first time shows how to use player/missile graphics to create a *fifth* player.

In the **COMPUTE!** tradition, *Atari Graphics* is crisply written and edited to be useful to beginners and experts alike. And it's spiral-bound for easy access to its dozens of ready-to-type program listings.



Available at computer dealers and bookstores nationwide. To order directly call TOLL FREE 800-334-0868. In North Carolina call 919-275-9809. Or send check or money order to **COMPUTE! Books**, P.O. Box 5406, Greensboro, NC 27403.

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# NEWS&PRODUCTS

## Speech Synthesizer For The Atari

The I Talk II is a speech synthesizer designed specifically for Atari's 400 and 800 computers. It is a complete unit ready to plug in within seconds of unwrapping. The I Talk II has four voice frequencies and unlimited vocabulary capabilities. Each unit comes with either a diskette or a cassette.

The I Talk II has many features:

**1.** It will speak while action graphics and sound effects are being executed.

**2.** It uses a utility that leaves system memory free for program use.

**3.** Complete, easy-to-read documentation allows beginners to incorporate speech into all their programs.

**4.** *Word Blaster*, an arcade-style educational spelling game, is free with the unit. The game can be easily programmed to challenge all age groups.

**5.** New games and programs for the unit are currently under development.

**6.** Volume and tone controls as well as a power on indicator light are standard.

**7.** The I Talk II never has to be disconnected. It will operate with cassette, disk and other accessories while connected.

**8.** Carries a full 12-month limited warranty.

**9.** I Talk II gives a starter dictionary of some of the most used words in the English language. You can add all the words you want. (This feature is not available on cassette.)

**10.** A complete phonetic speech dictionary to help you make almost any word or sound also comes with the unit.

*Greenbrier Marketing International, Inc.*
*8225 East Rovey Ave.*
*Scottsdale, AZ 85253*
*(602)948-0005*

## Business Application Software For Commodore 64, VIC, And TRS-80

Powerbyte Software has released its application software for business and home use on the Commodore 64, VIC-20, and TRS-80 color computers. Over 64 applications are available on cassette tapes, ranging in price from $8.95 to $34.95. Disc versions are also available. Special emphasis is made for novice programmers with all programs using BASIC.

Available programs include: *The Accountant, Accounts Receivable/Payable, Business Inventory, Order Tracker, My Profit Margin, Business Calendar, Billing Solver, Client Tickler, Cash Flow Model, Linear Regression, Bar Chart, P.E.R.T., Phone Directory, Stock Ticker Tape, Checkbook, Home Budget, Club*

*Lister, Medical Records, Mother's Recipes, Grade My Kids,* and many more business and home utility programs. An advanced word processor for the 64 and VIC-20 is also now available. A free catalog is available upon request.

*Powerbyte Software*
*2 Chipley Run*
*West Berlin, NJ 08091*
*(609)346-3063*

*The price for* Financial Wizard *from Computari was incorrectly stated in the December issue. The correct price is $59.95, which also includes the disk storage case. If there are any questions about the product, call (405)751-2783.*

## Film Series For Computer Literacy

Indiana University Audio-Visual Center recently released *Adventure of the Mind,* a six-film series that provides a step toward computer literacy. The films are available in either a 16mm version or in three video formats – ¾" U-matic cassette, ½" Betamax, and ½" VHS. The 16mm version is available for purchase ($240 each) or for rental ($15 each). The video formats are available for $150 each.

The six titles in the series are:

*The Personal Touch* (#BSC-183) shows the use of computers as personal tools to extend logical functions normally accomplished by the brain. Illustrations range from simple applications such as computer games, to finance control and decision-making, to more complex applications such as the experimental use of micro-electronics to influence the human nervous system through surgically implanted "neuro-pacemakers."

*Hardware and Software* (#BSC-184) begins with a look at the historical origins of the computer. A personal computer is disassembled to show the five major components of modern computers: input, control, arithmetic logic, memory, and output.

*Speaking the Language* (#BSC-185) demonstrates how the user communicates with the computer using BASIC. A simple example shows instructions used to store, list, and average the statistics of a basketball team. The film also briefly mentions other means of communication, such as light pens and voice commands.

*Data Processing, Control, Design* (#BSC-186) defines and demonstrates computer applications in terms of the three major categories indicated in the title. Illustrations include data processing to keep track of inventory and customer billing; buildings using computers to distribute energy efficiently, and an airport using a computer to sense weather conditions and give landing instructions to incoming pilots; and a computer simulation of a complex vehicle traffic problem.

*For Better Or For Worse* (#BSC-187) examines possible advantages and disadvantages resulting from the use of computers. A grocer explores the computer's benefits in eliminating tedious jobs, yet he is concerned about his dependence on the computer and about the possible misuse of his customer file. Another observer discusses concerns about the computer's impact on privacy, the quickly multiplying consequences of errors, and the increased sense of responsibility needed to prevent problems.

*Extending Your Reach* (#BSC-188) emphasizes computer use for special individual needs. Illustrations inside computer-assisted devices for the handicapped and the use of information resources via telephone lines. There is also a demonstration by a poet who uses a computer to explore the structure of his poems.

Preview prints of the films are available to perspective buyers at no cost other than return postage. Those requesting

preview should give a specific date, as well as two alternative dates.

*Audio-Visual Center*
*Indiana University*
*Bloomington, IN 47405*
*(812)335-8087*

## Math Packages For The TRS-80

Bertamax Inc. has converted its math game package *Math Facts Games* I to run on the TRS-80 Color Computer, with 32K of memory. The game package provides practice in addition, subtraction, multiplication, or division, as the user chooses. The user can also select any one of four games to play: Count Down, Mystery Word, Tic-Tac-Toe, and Great Computer Challenge.

The player must correctly respond to each fact in order to take his turn at each game. Speed is important in some of the games, but the user may select the speed.

Each game provides immediate reinforcement of the user's input through the use of high-resolution color graphics, sound, or a combination of the two.

The package requires Extended BASIC, 32K of memory; price for tape is $39.50, for disk, $39.80.

This package is also available for the TRS-80 Model III, Apple II, and the Atari 800. Each program includes an extensive teacher's manual.

Also *Essential Mathematics Series* for grades 6 to 8 has been converted to run on the TRS-80 Color Computer. Already available for Apple and TRS-80 Model III computers, this drill-and-practice program contains lessons in addition, subtraction, multiplication, division, number concepts, fractions, decimals and percent, and pre-algebra skills.

This series features immediate reinforcement, a graded sequence of lessons, the use of skill-building techniques, on-screen directions and examples in key lessons, and sound and color reinforcers.

The series may be purchased as a complete set, or by concept strand. The price of the complete set is $225 for disk, $245 for tape. Each of the four concept strands – fractions, decimals and percent, number concepts, pre-algebra – is priced at $59.80 for the disk, $89.50 for the tape. Prices include the teacher's manual.

*Bertamax Inc.*
*101 Nickerson, Suite 202*
*Seattle, WA 98109*
*(206)282-6249*

## Art Generation For The Apple

Visual Horizons has introduced *Computer Slide Express*, a service to turn any Apple computer into an art generating machine. With this new service, Apple computer owners can convert computerized charts, designs, graphs and graphics to 35mm color slides, standard size or enlarged color or black and white prints, or overhead transparencies.

The information can be transmitted over ordinary telephone lines or mailed to Visual Horizons in the form of a floppy disk which can hold material for up to 35 slides. All material is delivered through the mail.

It is a perfect system for someone who is writing a book and wants black and white or color charts. You can also word process material on your Apple computer, punch in *Computer Slide Express*, and get all the charts and graphs you need in color slide form.

*Visual Horizon's* Computer Slide Express.

*Visual Horizons*
*180 Metro Park*
*Rochester, NY 14623*

## Word Processor For The VIC And Commodore 64

H. D. Manufacturing recently released the *Rapidwriter*, a word processor for the VIC and Commodore 64 computers. *Rapidwriter* gives flexibility to write, save, recall, edit, format, and print any kind of text. There are no limits to document length, or the variety of ways that texts may be mixed and recombined to produce labels, letters, reports, newsletters, scripts, or books.

*Screen features.* VIC-20 screen shows three full lines of text, plus line number and memory still available. CONTROL and OPTION menus display the full selection of control keys. Shows seven full lines of text on the 64, and 15 lines on the VIC with an 80-column board.

*Editing features.* Scrolling up and down; "goto line" to instantly position a line for editing. Uses cursor keys to position the cursor. Line gluing and single key formatting speed editing chores. Holds a full page of text in VIC with 8K expander, two more pages for each 8K, ten pages in the 64. Write, store, recall, move, edit, and print text in any order, at any time, in any quantity. Automatic word wrap-around, line-length cut-off, and line feed, at typing speeds to 80 wpm.

*Printing features.* Versions avoidable for the VIC-1515 printer, and choice of serial or parallel interfacing. Headings centered

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| Frogger | $26.00 |

### BUSINESS SOFTWARE : In Stock

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| Atari Word Processing | $109.00 |
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**PACKAGES**

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| CX481 Entertainer | $69.00 |
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| SUB COMMANDER | $ 36.75 |
| JUMBO JET PILOT | $ 36.75 |
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| Star Warrior | $28.00 |
| Crush, Crumble & Chomp | $23.00 |

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### commodore

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| ALIEN BLITZ | $21.00 |
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*Tape and disk features.* Standard CBM file format. Provides on-screen prompts and advisories for error-free tape and disk handling. Eliminates need for tape footage counter by using fast forward under program control. Disk version uses named files for quick access and overwrite protection.

*Rapidwriter* is written in BASIC, can be used as a data-entry module with other programs and to format printout for other programs, and has a built-in programmable calculator function. The program comes with a complete reference manual and an easy-to-follow tutorial. Ongoing support (newsletter, new add-on programs, etc.) is provided. The cost is $39.95, tape or disk.

*H. D. Manufacturing Inc.*
*91 Long Hill Road*
*Leverett, MA 01054*
*(413) 549-3744*

## Microcomputer Materials Catalog For 1982-83

The 1982-83 edition of the Scholastic Microcomputer materials Catalog has 100 new programs, including 24 new titles produced by the Minnesota Educational Computing Consortium (MECC), as well as top-selling programs like VisiCalc.

In addition to subject areas such as math, science, language arts, computer literacy, and social studies, software is offered in the new subject areas of music, art, and driver's education. A total of more than 300 titles is offered for the Apple, PET, TRS-80, Atari, and Texas Instruments microcomputers.

*Scholastic Inc.*
*50 West 44th Street*
*New York, NY 10036*
*(212)944-7700*

## Maze Game For The Atari

Island Graphics has released *Tax Dodge*, a scrolling maze game for the Atari 400/800. *Tax Dodge*, designed and developed by Jon Freeman and Anne Westfall of Free Fall Associates, has vertical and horizontal scrolling, which allows the maze to be larger than the screen. *Tax Dodge* is written in assembly language.

*Tax Dodge* comes with diskette, manual, and product registration card. It is a 16K program and retails at $39.95 on diskette.

*Island Graphics*
*Box V*
*Bethel Island, CA 94511*
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## THE MONKEY WRENCH
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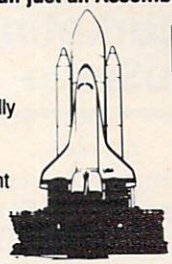

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The CIS "starter kit" contains a three-ring vinyl binder, a user ID number and password for five free connect time hours on CIS, an easy to read *User's Guide*, and an introductory subscription to *Today* magazine. The starter kit also contains local phone numbers for connecting a personal computer to CIS, access instructions, a dictionary of computer terms, commonly asked questions and answers about CIS and rate information.

The starter kit has a suggested retail price of $39.95.

CIS offers shopping and banking at home, electronic mail and realtime communications, current and historical stock market and commodities information, family information and education, up-to-the-minute news and weather, electronic games, bulletin boards, private user groups and computing power for programming activities.

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## Mass Storage Peripheral For Commodore 64 And VIC-20

Exatron has announced its Commodore 64 and VIC-20 compatible Stringy Floppy mass storage peripheral. The new system, named ESF-20/64, consists of two units: a miniature endless-loop tape cartridge and a precise electronically direct-drive transport mechanism which plugs into the serial bus connector on the Commodore 64 and VIC-20.

Major features include reliability, speed, compact size, and easy interfacing with no changes to the hardware or software of either computer. The commands used to operate the ESF-20/64 are incorporated into the Commodore 64 and VIC-20 and are fully explained in the *VIC-20 Computer Guide*.

The tape transport operates at a speed of five inches per second and has memory capacity of up to 64K bytes. Previously stored data is transferable to the ESF-20/64 storage via BASIC programming.

The end-user, single-unit price is $199.50. Starter kits, available for an additional $25, include the user's manual and ten 20-foot wafers (tape car-

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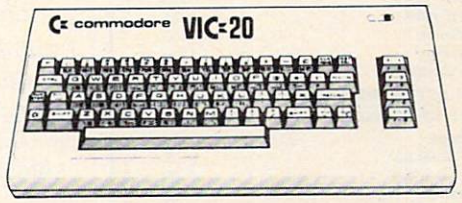


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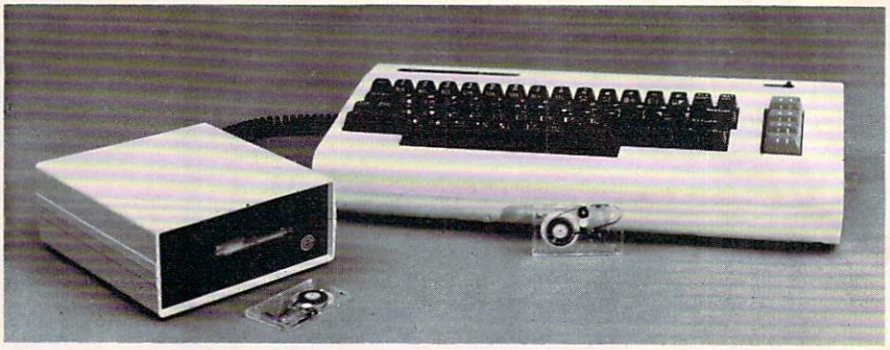

*Exatron's stringy floppy mass storage peripheral for Commodore 64 and VIC.*

tridges). The cost of individual wafers is about $3.

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## Full-stroke Keyboard For The Atari 400

Inhome Software Incorporated has announced the B Key 400 full-stroke keyboard for the Atari 400 computer as an option to the existing membrane keyboard.

This new keyboard for the Atari 400 computer provides home computer users with all of the features of the full-stroke keyboard.

*Inhome Software*
*2485 Dunwin Drive*
*Mississauga, Ontario L5L 1T1, Canada*
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*Inhome Software's B Key 400.*

## DB Master Accessory For The Apple

A statistical software package for *DB Master* users is being introduced by Stoneware, Inc. *DB Master Stat Pak* is an accessory for the *DB Master* data base management program for the Apple II or Apple II Plus.

The *Stat Pak* permits statistical analysis of data contained in *DB Master* files. *Stat Pak* is compatible with both the *DB Master* standard and Special Edition for hard disk systems.

DB Master uses values from any numeric, dollar/cents or computed fields. It also performs tests on selected records in a file, including: mean, standard deviation and standard error, co-efficient of variation, frequency of distribution, un-paired t-test, Mann Whitney U-test, Wilcoxen Paired Sample Test, linear regression, correlation and one-way analysis of variation (ANOVA) with Newman-Keuls Test and Chi Square Test (Chi Square can use alphanumeric data).

The hardware requirements are a 48K Apple or Apple II Plus with a minimum of one disk drive. The introductory price for the new *DB Master Stat Pak* is $99.

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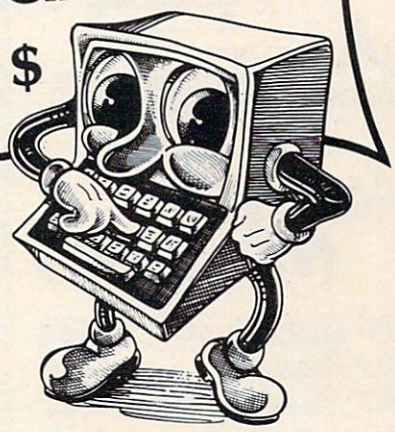

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anyone. Designed by Harry Moneyhun, the program enables the user to create and compile shapes that can be drawn on a medium-res grid in various colors, sizes, and angles. *Shapes in Color* (#13509) can be used to design shapes ranging from unique typography to animation. Shapes can be designed in the high resolution colors of green, violet, white, orange, blue, and black.

Graphic backgrounds can be "painted" with free-hand brushstrokes and then used with moving shapes to generate striking effects. Completed backgrounds and shapes are saved on disk to be reloaded for use in other programs. Detailed documentation describes techniques for writing original programs with the shapes and backgrounds created by the user.

The program requires Apple II disk and 48K, and costs $49.95.

*Hayden Software Company*
*600 Suffolk Street*
*Lowell, MA 01853*
*(617)937-0200*

# CALENDAR

**February 5, 1983, 10 AM-6 PM, Santa Clara County Fairgrounds, San Jose, California.** Computer Swap America show, the first of three scheduled for 1983. Features sellers and buyers, both companies and individuals, from all over America, and from Mexico and Canada. Items sold: computers, consumer electronics, peripherals, software, books, magazines, etc. Admission is $5. Call (415) 494-6862 for Seller's Information Package.

**March 18-20, 1983, Brooks Hall, San Francisco Civic Auditorium.** The West Coast Computer Faire, a personal computing show for vendors and users. Admission is $15.

**March 18-19, 1983, Seattle Pacific University (SPU) campus, Seattle, Washington.** Sixth Annual Computers in Education Conference, designed for elementary and secondary educators and administrators interested in the changing role of the microcomputer in education. Co-sponsors: Pacific Northwest Associates for Computers in Education and SPU. For information or pre-registration forms, contact: Tony Jongejan, Everett High School, 2416 Colby, Everett, WA 98201; (206) 334-6965.

**March 28-30, 1983, Tampa.** Florida Instructional Computing Conference, for administrators and teachers. Conference includes exhibits of hardware and software, workshops on computer literacy, graphics, Logo, courseware evaluation, administrative uses of computers, etc., and program sessions (about 60). Each of the 14 workshops costs $15 in addition to the registration fee. Conference registration fee: $20 before March 15; $25 after March 15. Single day registration, $15. Registration packet includes a resources booklet. For special rates at the new Hyatt Regency Hotel call (800)228-9000. For registration information, write: Dianne Cothran, Florida DOE, Educational Technology Section, Knott Building, Tallahassee, FL 32301. Or call (904)488-0980 or 487-3104 (SUNCOM 278-0980 or 277-3104). Exhibitors call (904)878-4178.

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**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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*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.* ©

# ATARI ™

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| CXL4007 Music Composer | $ 45 |
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| Conversational Languages | $ 45 |
| CX4018 Pilot | $ 59 |
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| CXL4020 Centipede | $ 33 |
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| Deadly Secrets (D) | $ 23 |
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|---|---|
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|---|---|
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| Snake Byte (D) | $ 20 |
| Bandits (D) | $ 23 |
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| The Cosmic Balance (D) | $ 27 |

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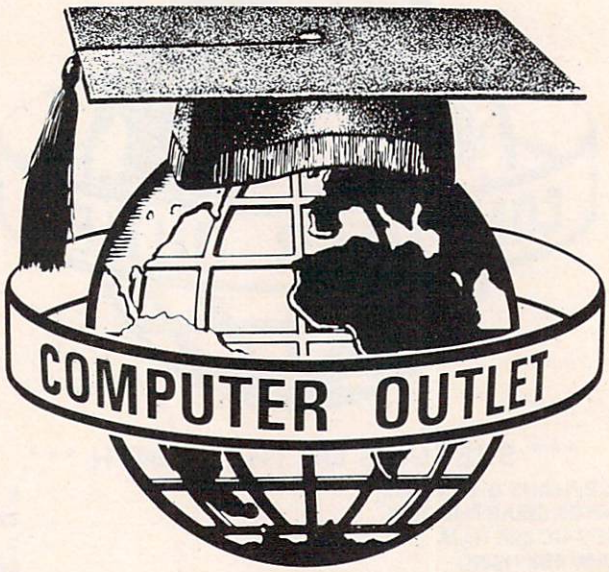


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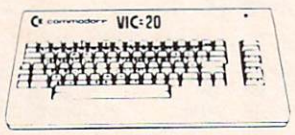


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## *** SPECIALS OF THE MONTH ***

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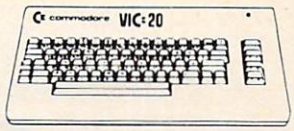


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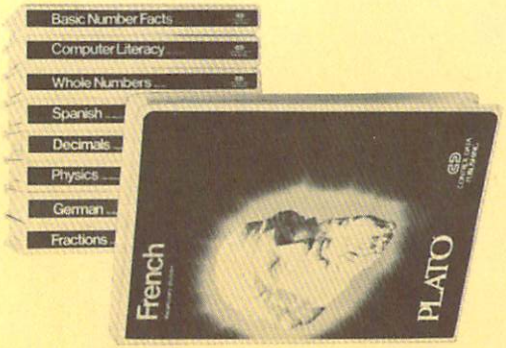


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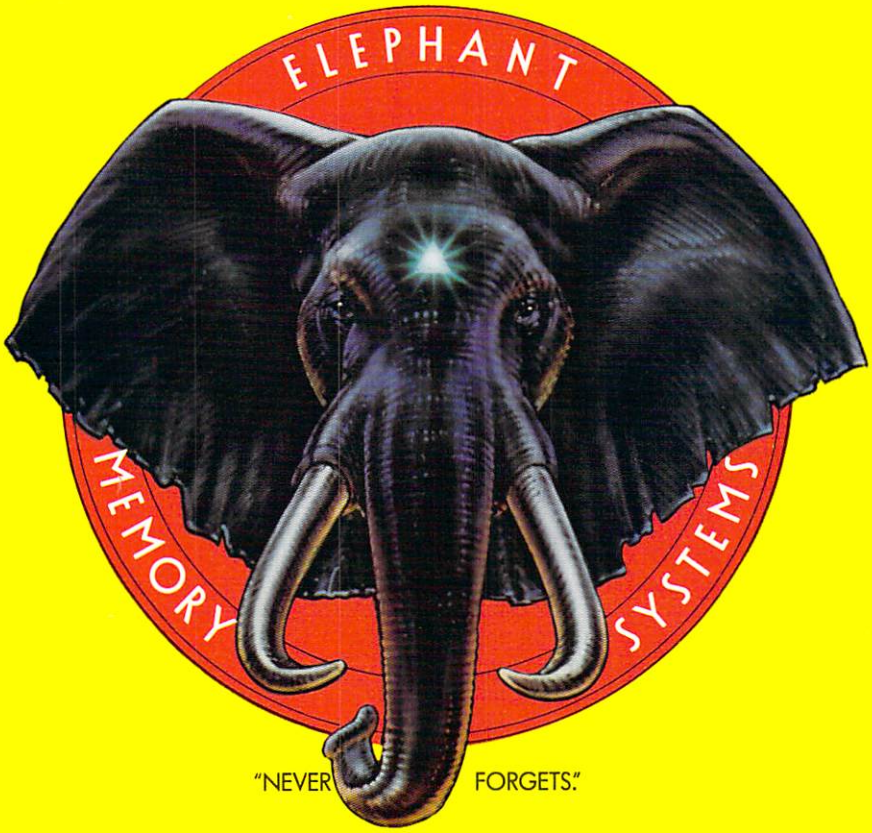


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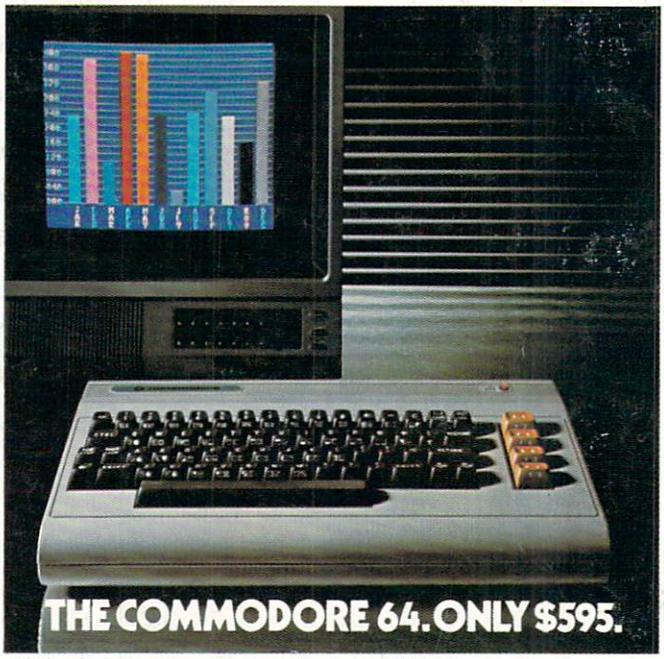


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