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COMPUTE!

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The Leading Magazine Of Home, Educational, And Recreational Computing

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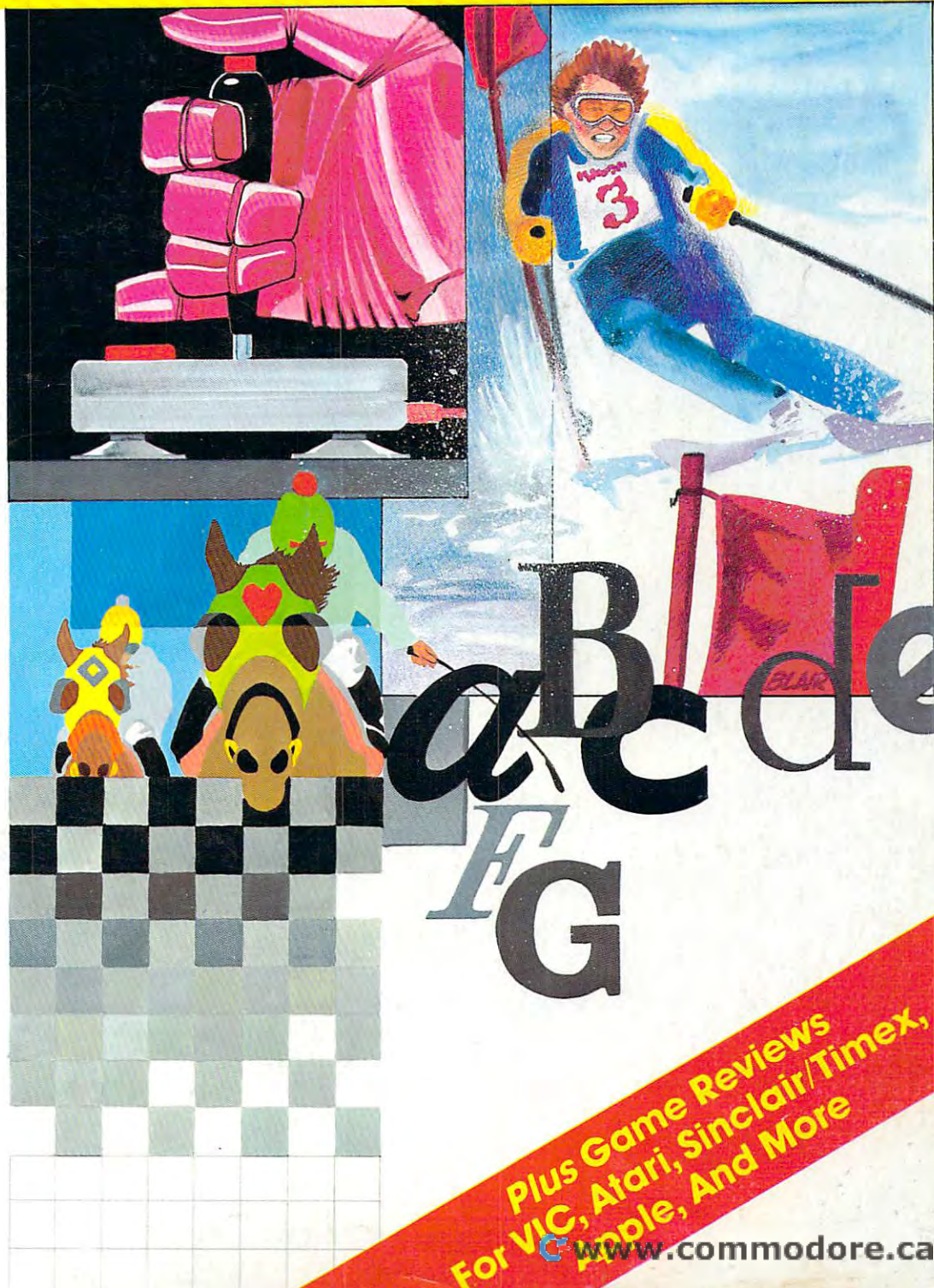
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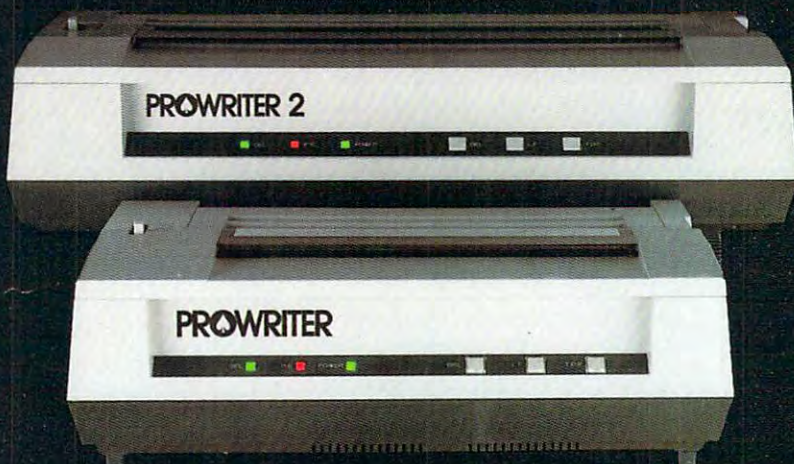
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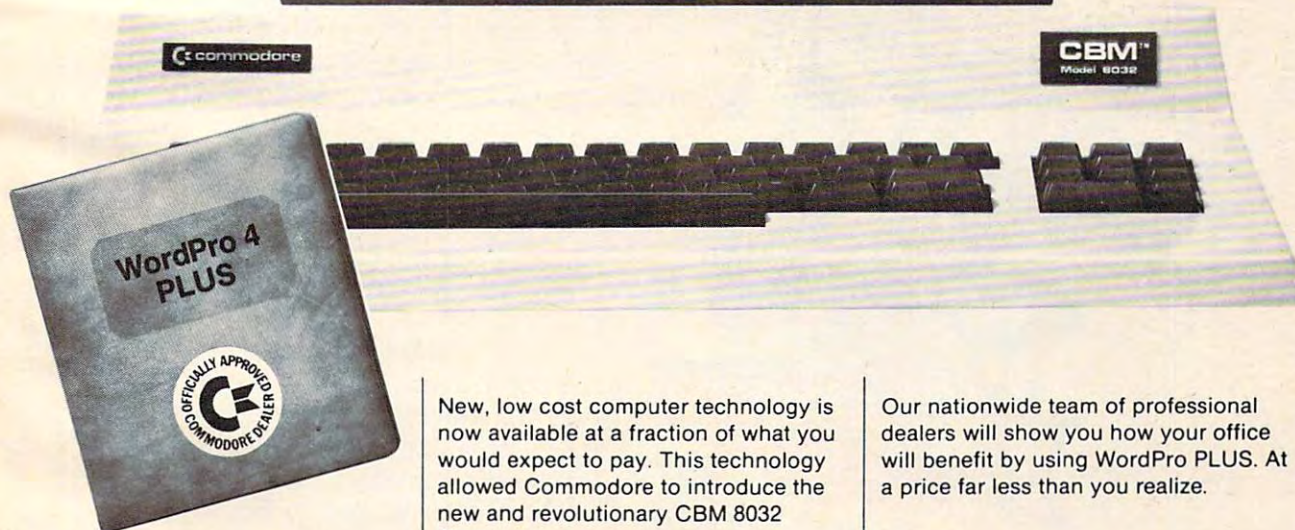


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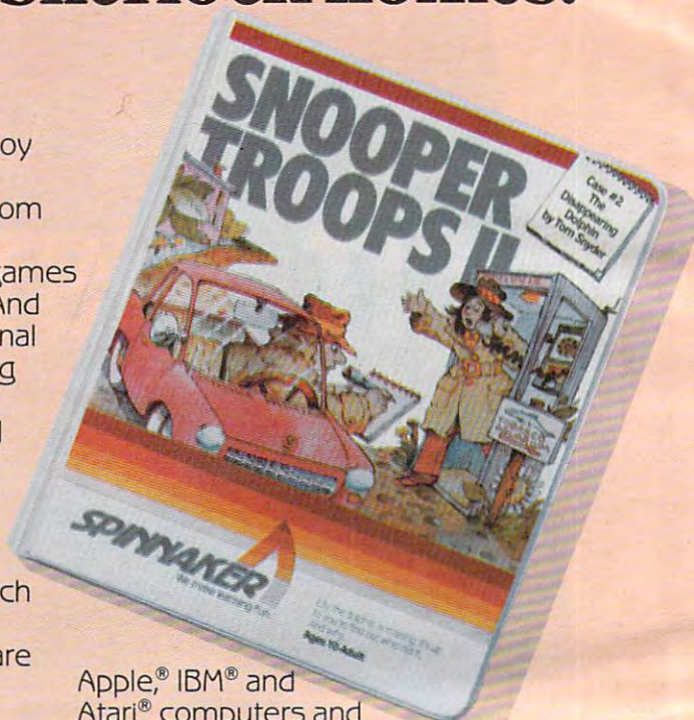
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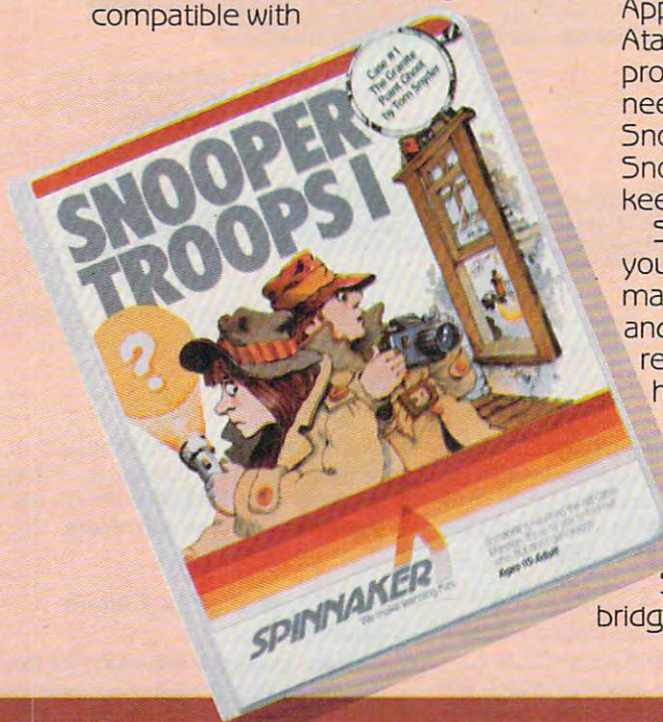


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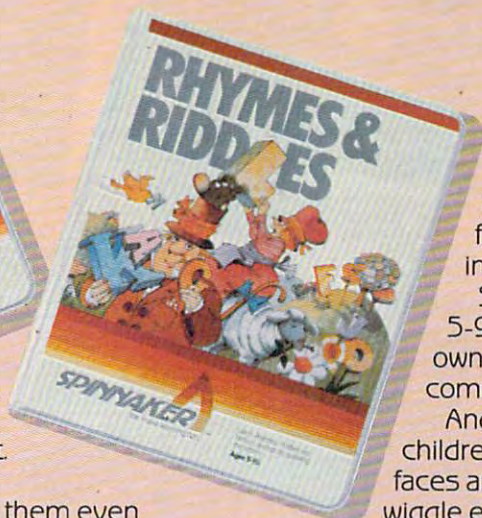
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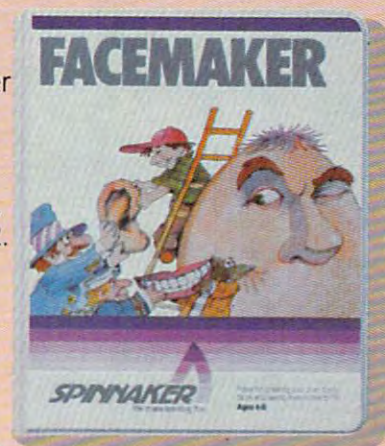
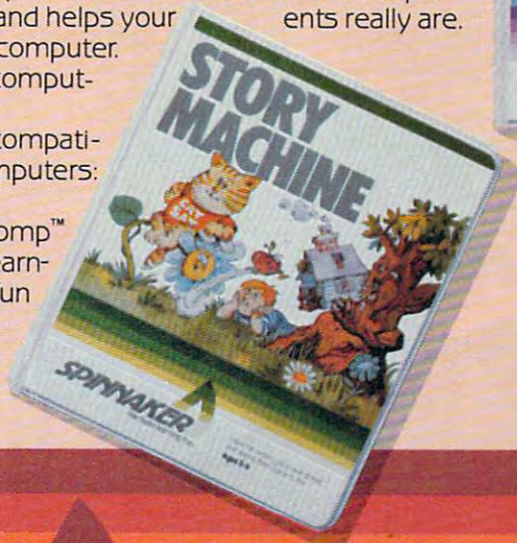
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before typing in
programs.**

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TI,V,CC
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FORTH

AP Apple, **AT** Atari, **P** PET/
CBM, **V** VIC-20, **O** OSI,
C Radio Shack Color Com-
puter, **64** Commodore 64,
ZX Sinclair ZX-81, * All or
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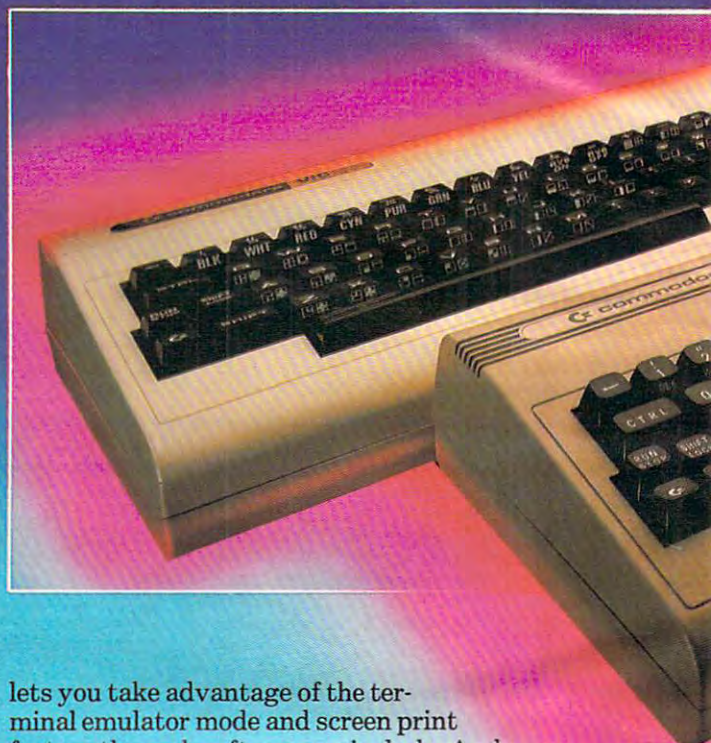
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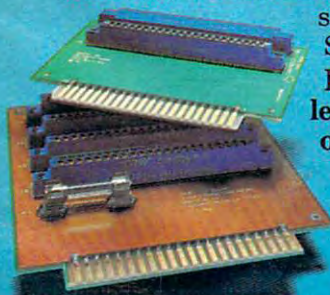
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EDITOR'S NOTES

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, Commodore 64, etc.





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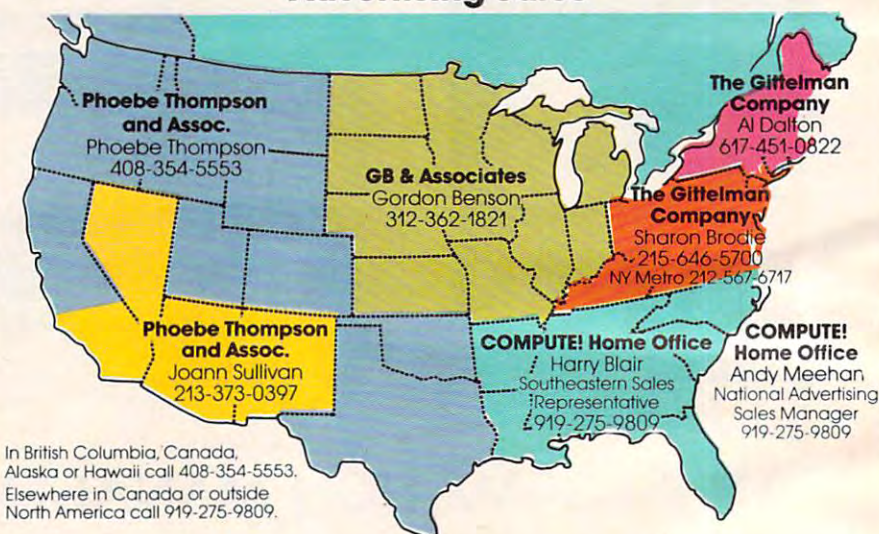
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ASK THE READERS

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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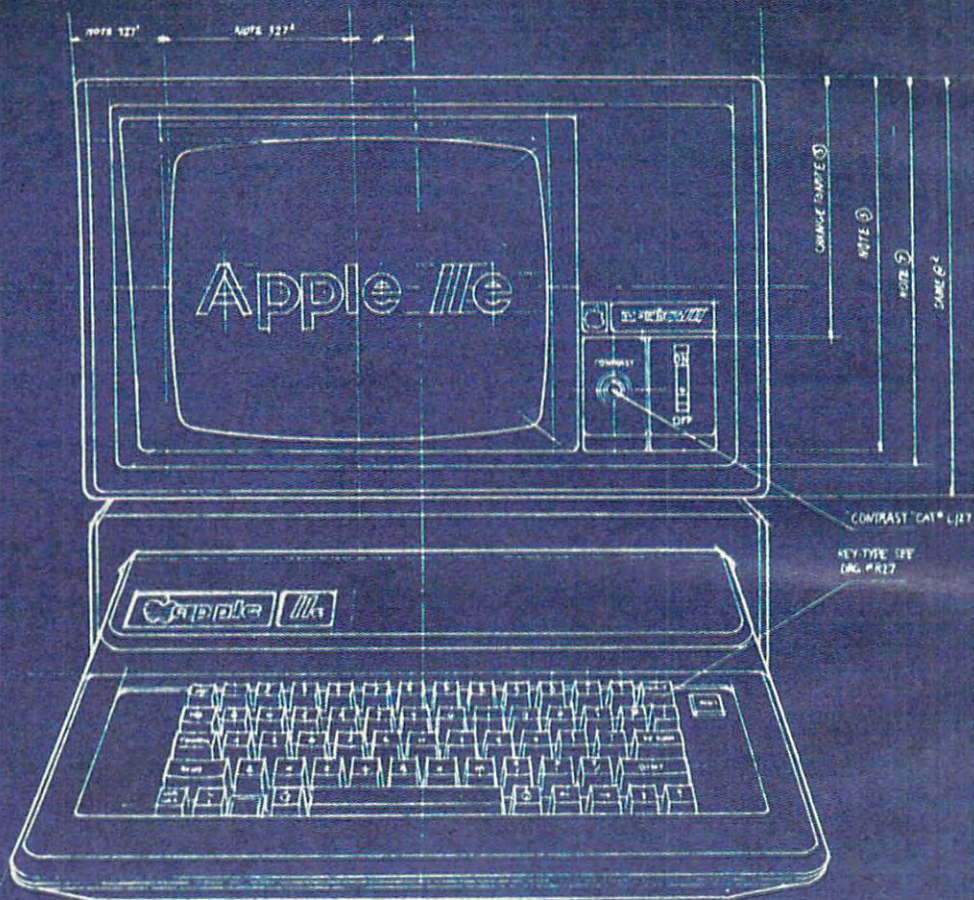
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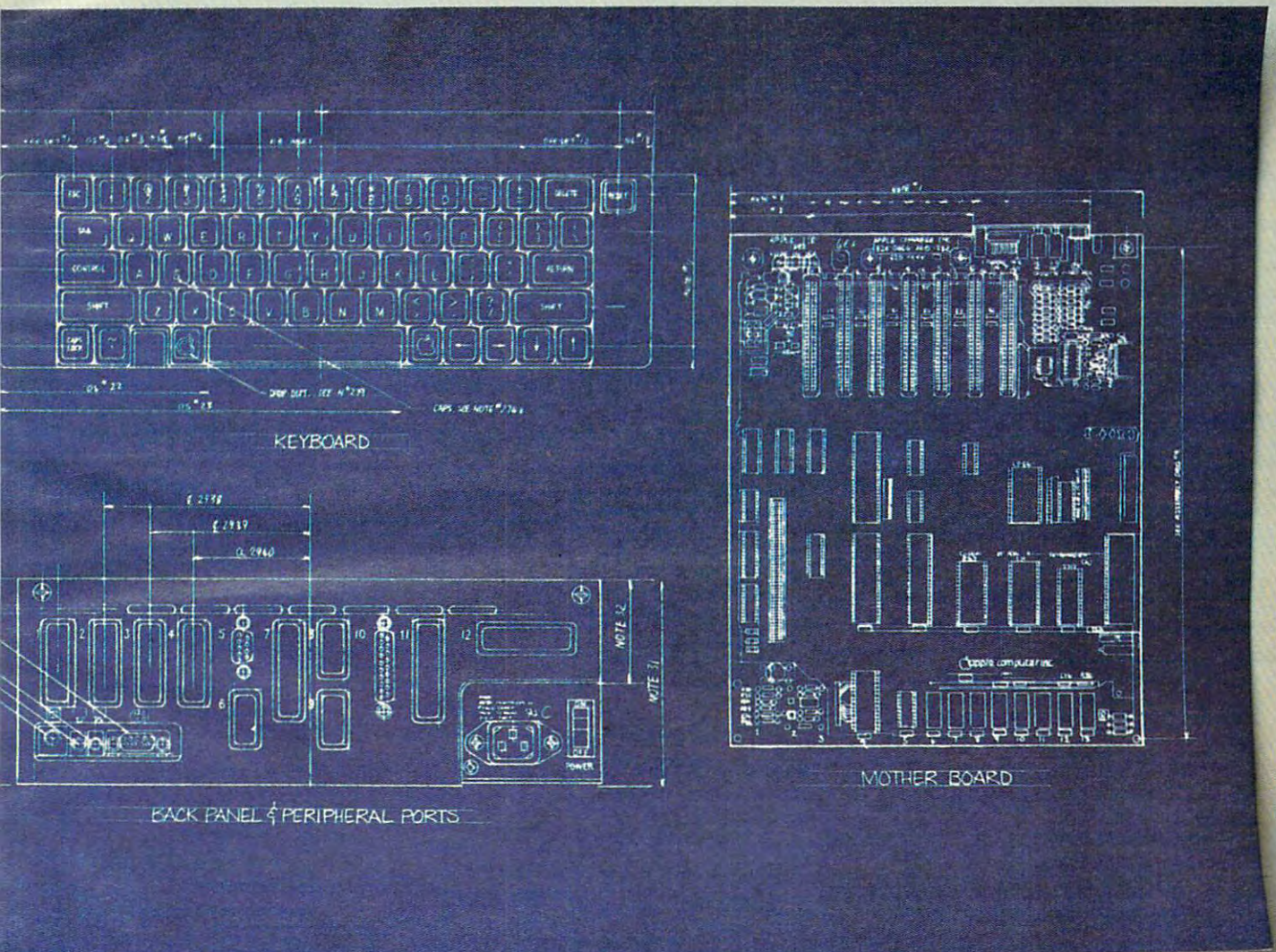
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Also, all three disks have identical command protocols to the 4040 and 8050 disks, except that Copy and Duplicate won't do anything useful on a single disk. If the programs are compatible with the connected computer (this usually means no BASIC 4.0 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 Artifacts

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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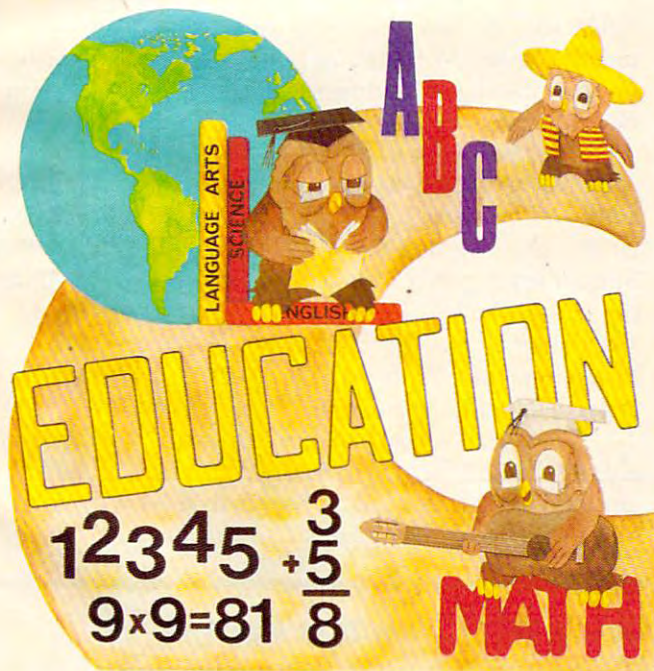
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ning the printing on the screen changes color, not the full word but individual letters, giving the screen a rainbow display. Also, it seems that the width of the letter changes. When the letters become the same color as the screen, it is impossible 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 under-utilized 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 simultane-

ously 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.

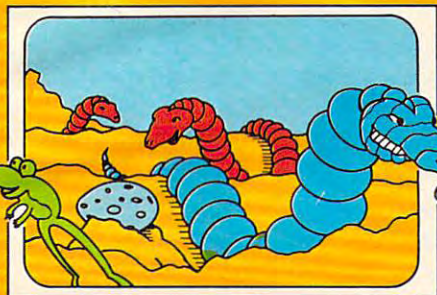
RAM, on the other hand, is memory available to users to temporarily store information and programs. Data stored in RAM can be changed or erased as often as you want. It erases itself when the power is turned off. Both RAM and ROM are measured in *kilobytes*. A *byte* stores one character. A kilobyte 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.

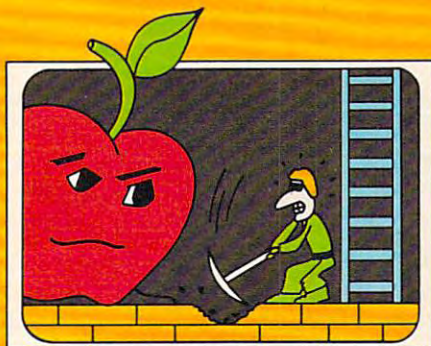
On some computers, you can determine the amount of free memory by typing PRINT FRE(0) and pressing RETURN or ENTER. An unexpanded (5K) VIC-20 has about 3500 bytes; a 16K Atari 400, about 13,300; a Commodore 64, about 38,900; a 48K Atari 800, about 36,000. On other computers, you may be able to discover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

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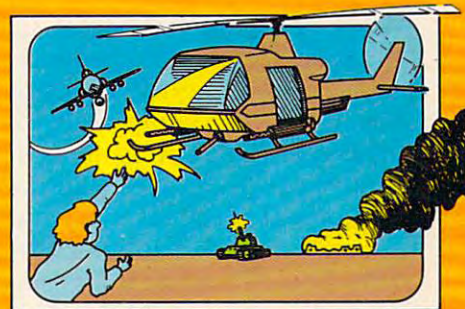
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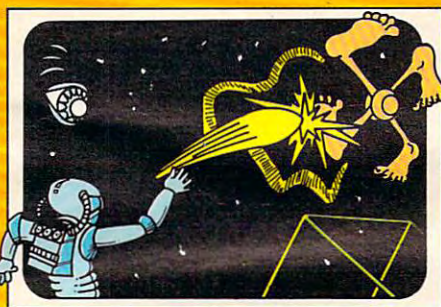
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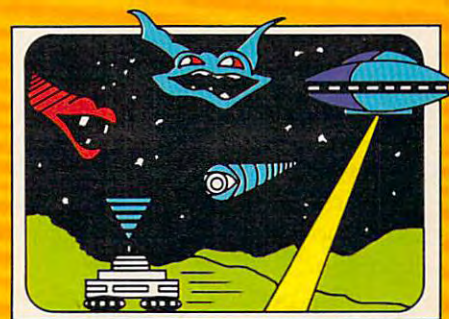


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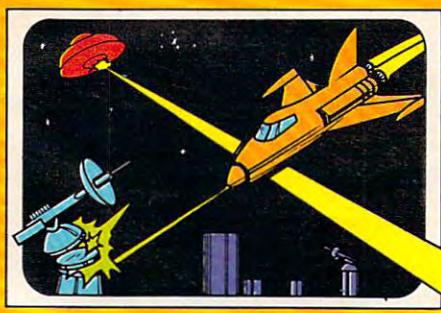


VIDEO MANIA

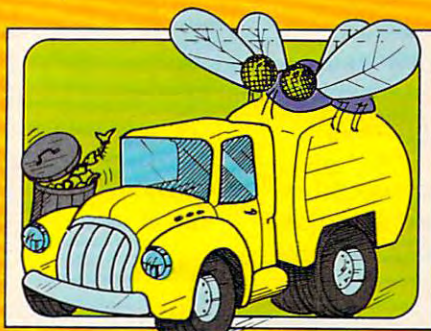
and these
are just
the games!



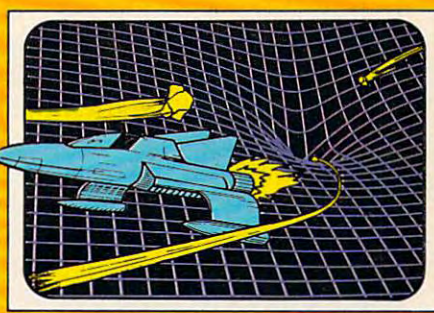
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Computers And Society

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 tile 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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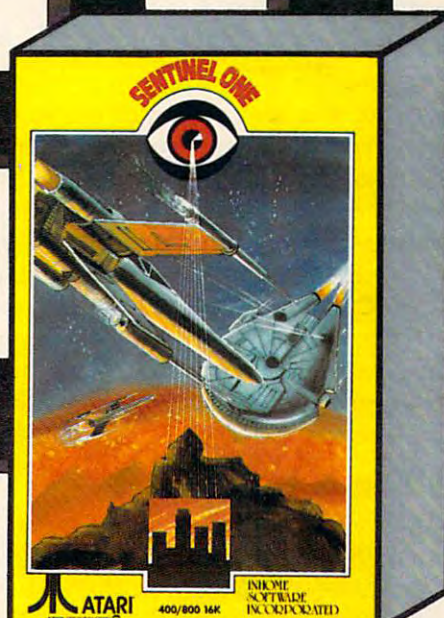
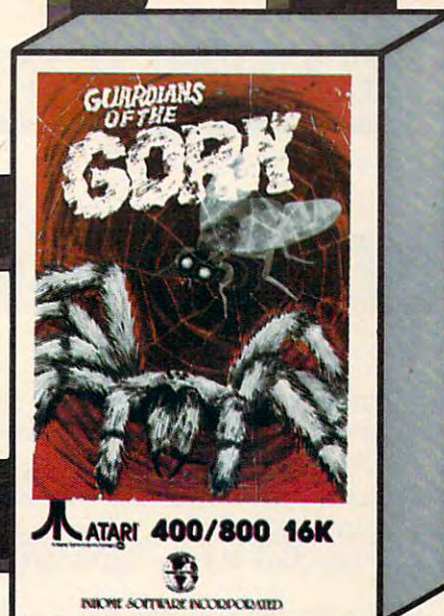
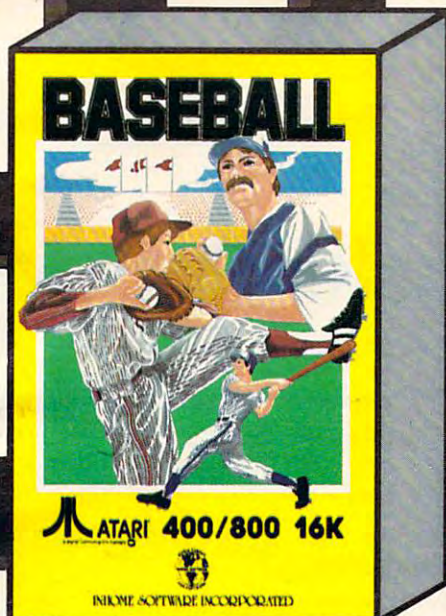


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THE BEGINNER'S PAGE

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.

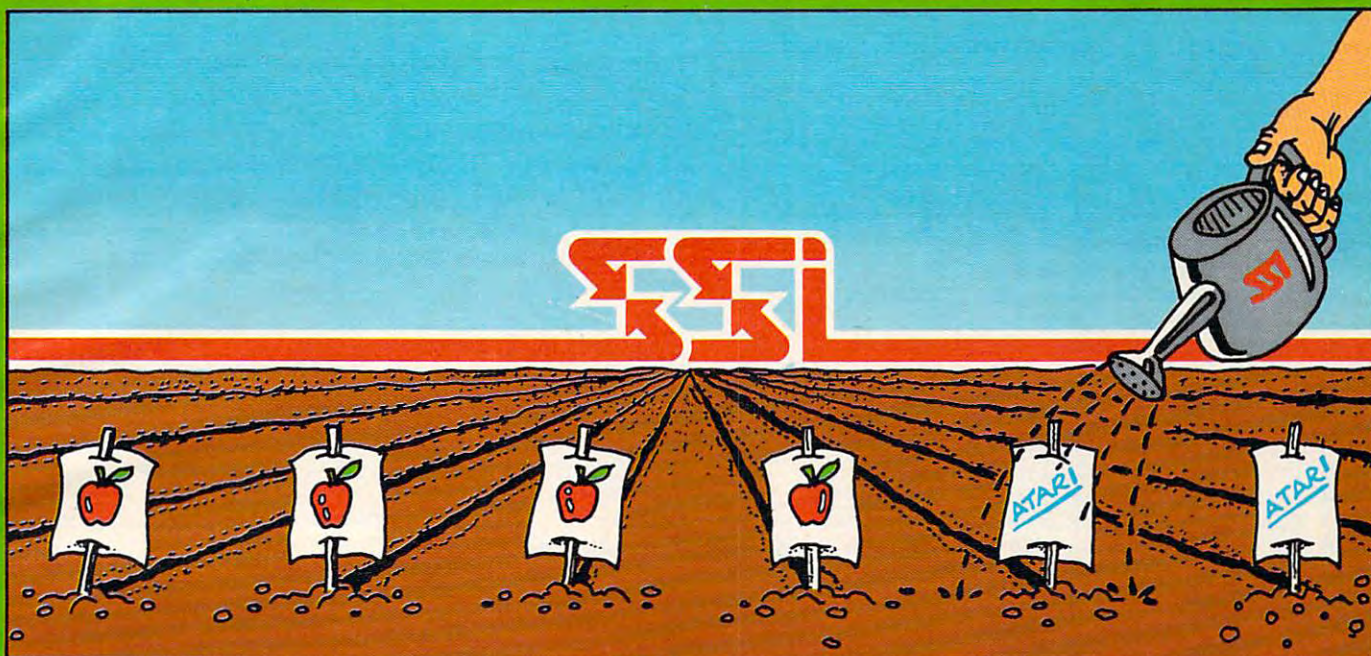
WALL = A solid square that appears when this number is POKED anywhere into SCR.

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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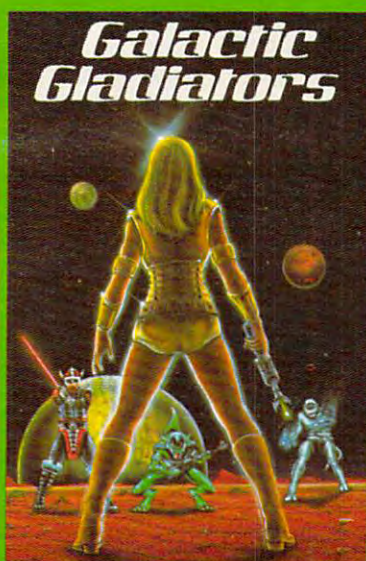


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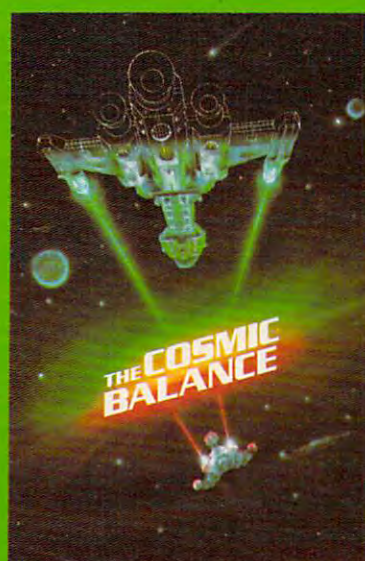
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Program 1: PET, Atari, VIC, and 64 Version

```

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 SCRIN 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 = SCRIN( X + XVECTR,Y + YVECTR): REM
    LOOK AT POINT
150 IF PT=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 I: REM
    YOU COULD USE HLINE 0,39 AT 0
1020 FOR I = 0 TO 39: PLOT I,39: NEXT I
1030 FOR I = 0 TO 39: PLOT 0,I: NEXT I
1040 FOR I = 0 TO 39: PLOT 39,I: NEXT I
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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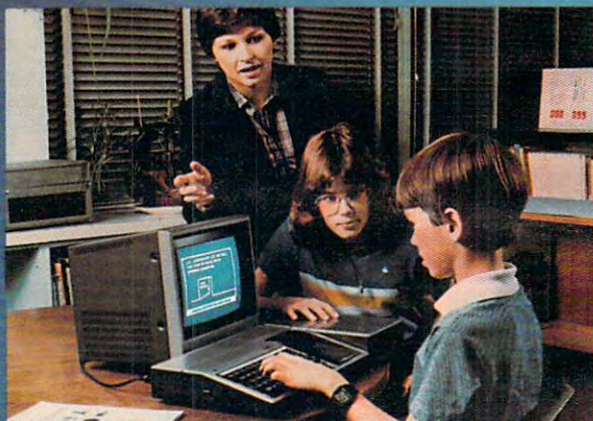
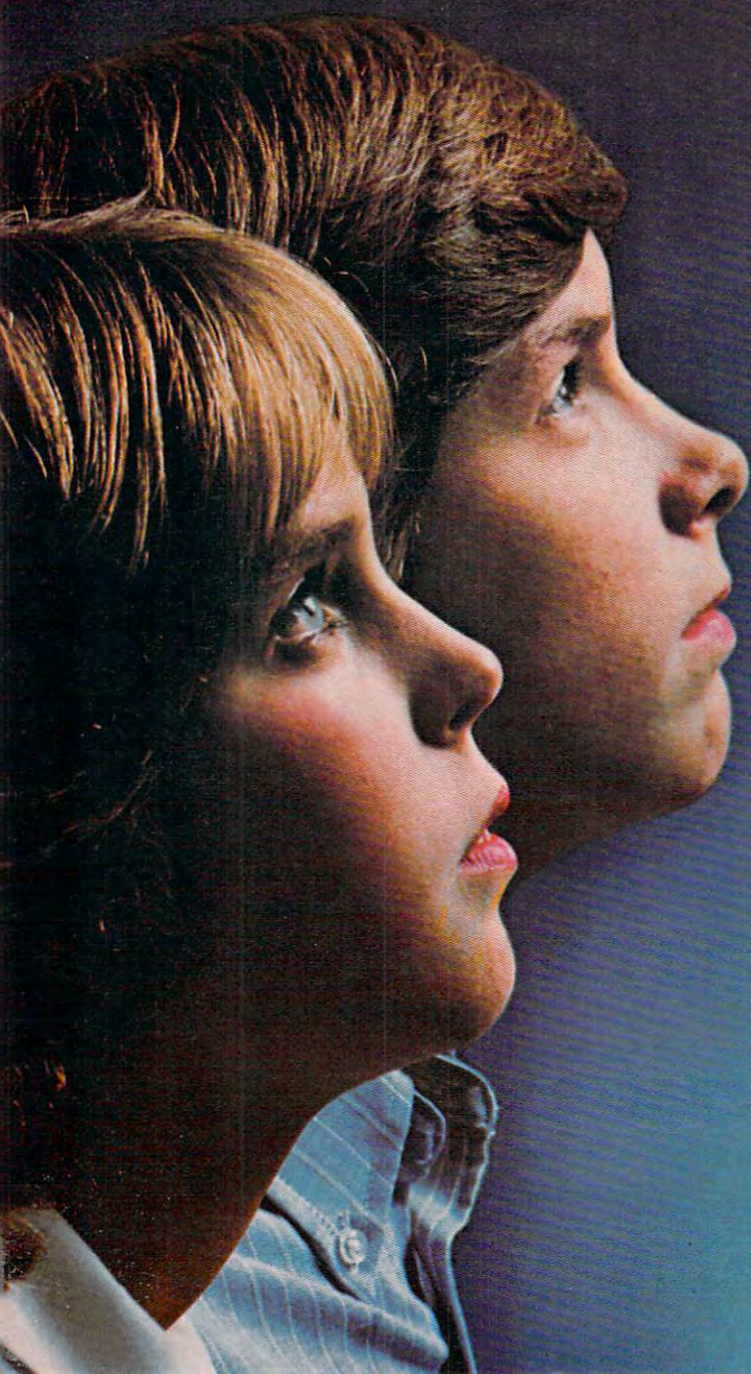


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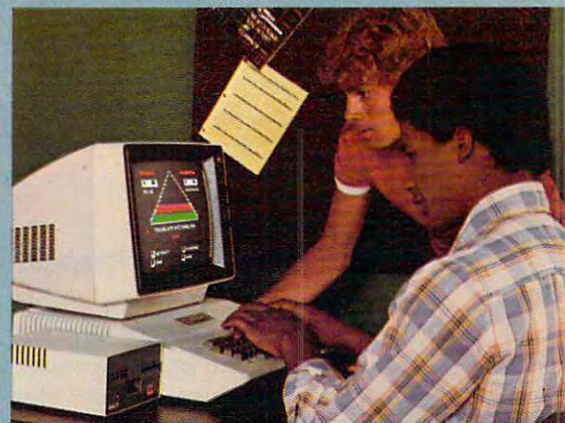
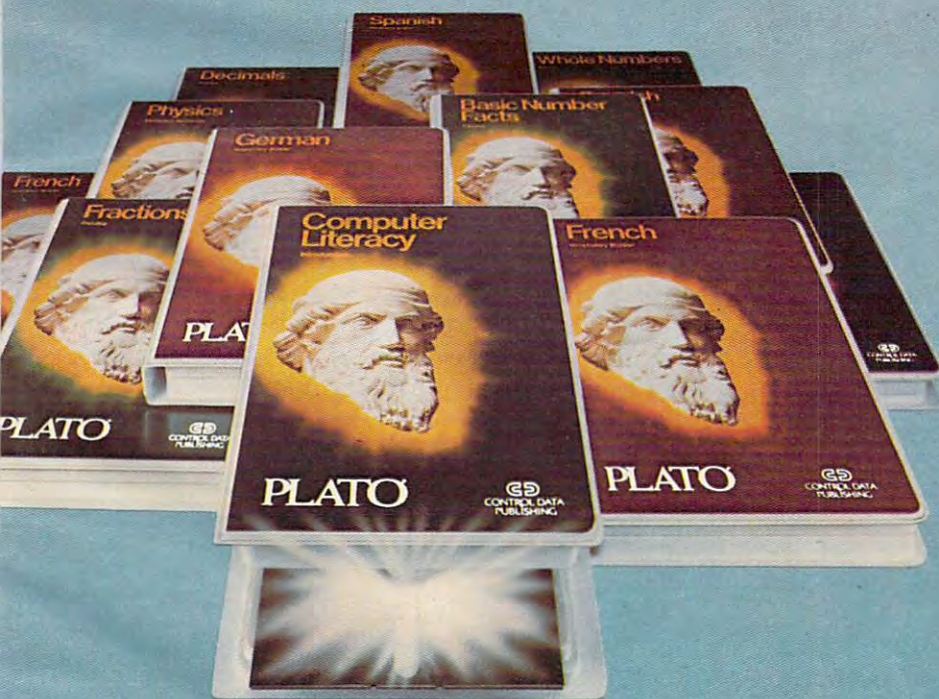
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How The Pros Write Computer Games

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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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 happens 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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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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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 gamers 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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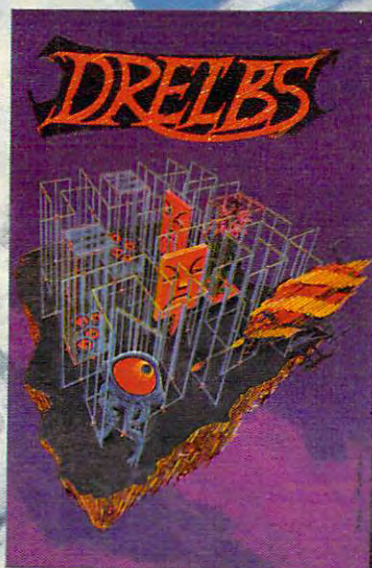


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A Day At The Races

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>=64 THEN ML=(A-64)*8+7168:PRINT ML; "-"; ML
  +7:GOTO 50
40 ML=A*8+7168:PRINT ML; "-"; ML+7
50 GOTO 10
```

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

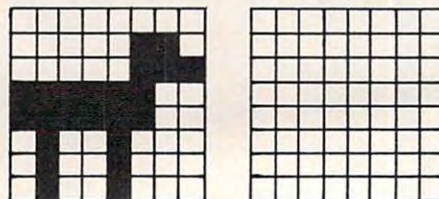
The eight bytes of memory for a character each have eight digits in binary. If you place these eight bytes in binary, each under the previous one, and imagine the 1's are pixel dots and 0's are spaces, you can decide what eight numbers should go into these locations. For example, type:

```
100 FORC=7432 TO 7439:READA:POKEC,A:NEXTC
110 DATA 0,6,7,252,252,72,72,72
```

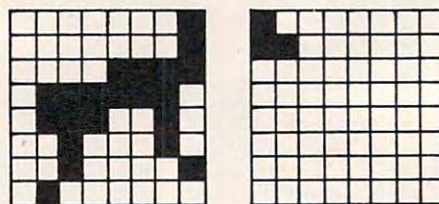
Now RUN. Nothing happens! Now type POKE 36869,255 and everything will turn to garbage. Type a few !'s and you should see a horse. The

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.

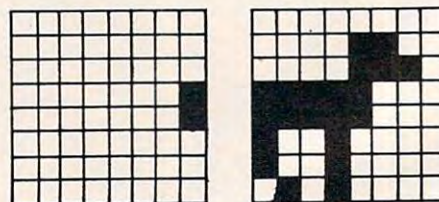
The next trick is to move these programmable characters. Most programs for personal computers in BASIC move their graphics by drawing a character and then erasing it while drawing it again in the next space. This can cause a rather jerky motion. By programming a series of characters, each just one pixel 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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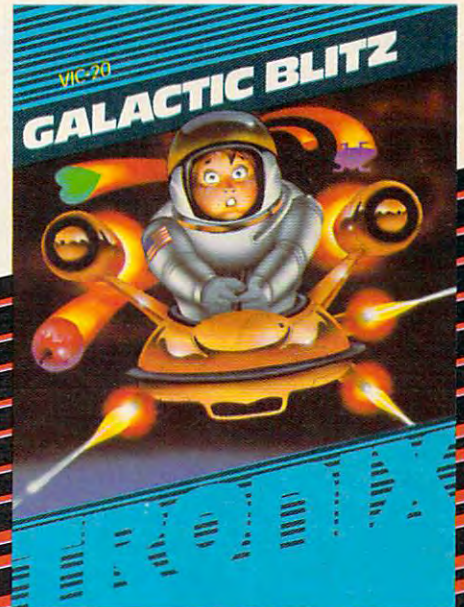
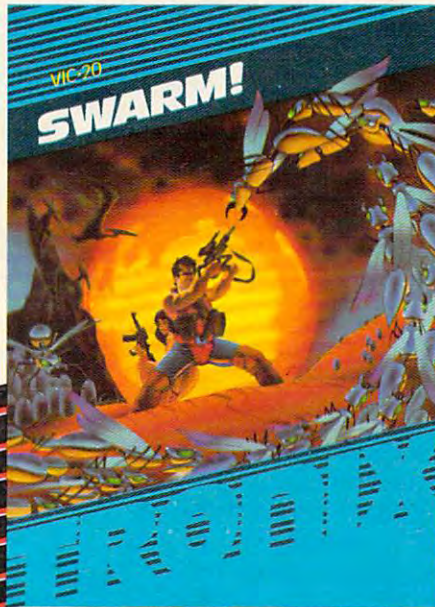
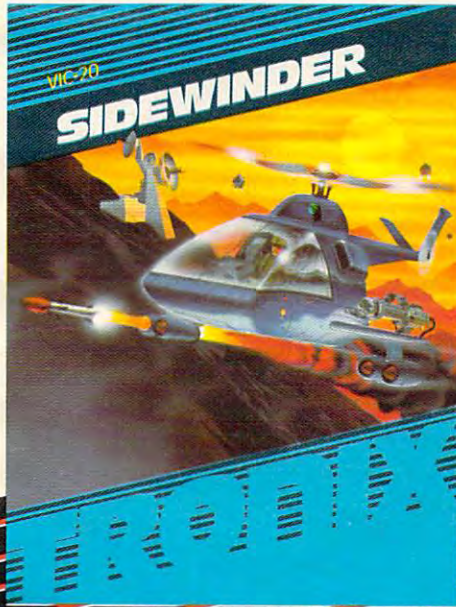
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will provide the programmable characters for the game. All programmable character information will remain in memory until the machine is turned off or the memory location information is changed. The latter can be intentional or it can happen accidentally 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

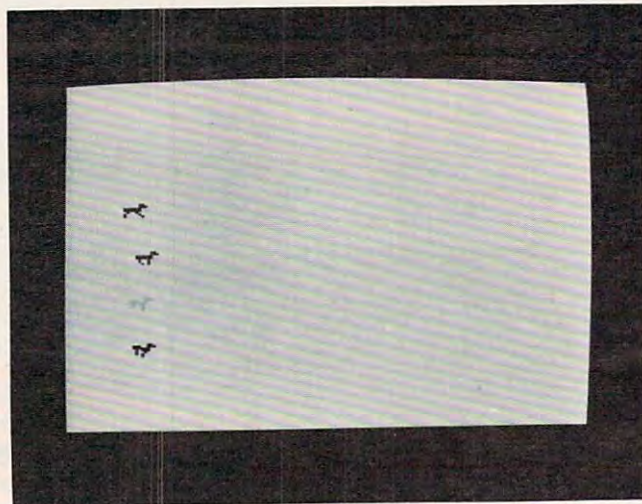
"A Day At The Races" is a game for one to six players. It consists of five races on random track conditions. Each horse is given odds for a particular track in the initialization. These odds are kept throughout the five races. Try to avoid long names for people or horses; they may cause an OUT OF MEMORY 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



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.

the character π as the horses and they were moving one space at a time).

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:REM DATA FOR HORSE
60 DATA0,6,7,252,252,7,72,72
70 DATA0,0,0,0,0,0,0
80 DATA3,3,14,126,116,36,34,32
90 DATA0,128,0,0,0,0,0
100 DATA1,1,7,63,58,17,16,32
110 DATA128,192,0,0,0,0,0
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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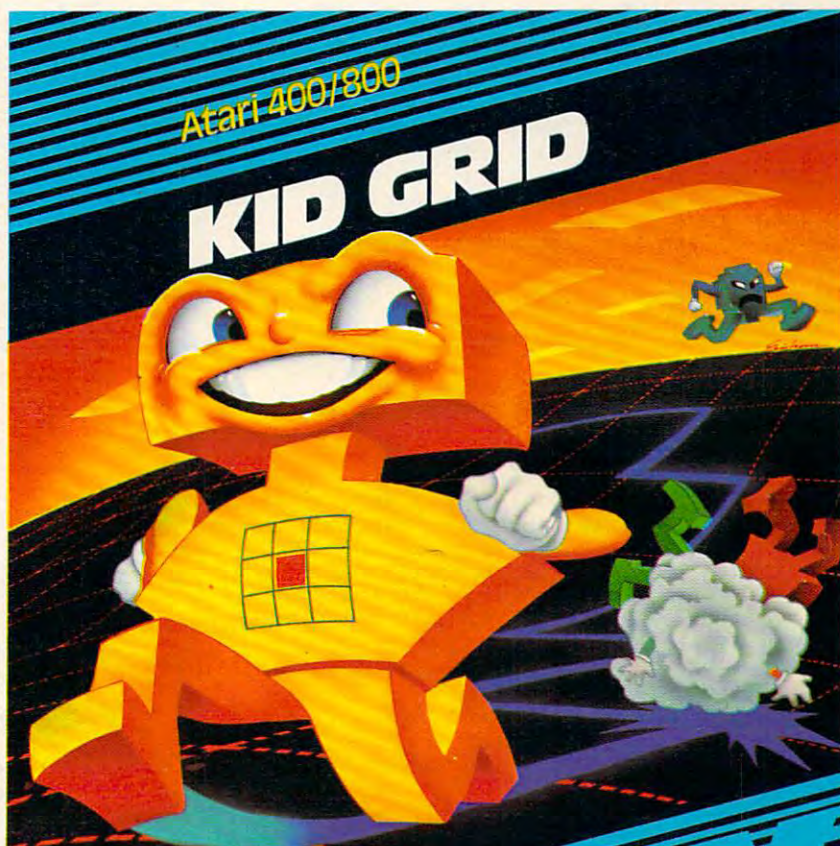
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```

0." : REM SWITCH BACK
310 PRINT "{02 DOWN} A WINNING BET PAYS 3 T
0 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 IF PL > 0 THEN GOTO 150
170 FOR X=1 TO PL:W(X)=500
180 INPUT "{02 DOWN} NAME OF PLAYER";N$(X):NEXT
190 PRINT "{CLEAR} {DOWN} NAME THE FOUR HORSES":
FORX=1 TO 4:INPUT A$(X):NEXT
200 REM SETS TRACK CONDITIONS
210 TR=RND(1)*10:PRINT "{BLK} {CLEAR}"
220 IF TR < 3 THEN COS="DRY":O1=D1:O2=D2:O3=D3:O4=D
4:POKE36879,248:GOTO 260
230 IF TR < 6 THEN COS="TURF":O1=T1:O2=T2:O3=T3:O4=
T4:POKE36879,216:GOTO 260
240 COS="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 ";COS
270 FOR Y=1 TO 4:PRINT TAB(5) A$(Y):NEXT
280 FORX=1 TO PL:PRINT N$(X);W(X):NEXT:PRINT
290 FOR Q=1 TO PL:IF W(Q)=0 THEN B(Q)=0:GOTO 2
98
292 PRINT N$(Q);:INPUT "BETS";B(Q):IF B(Q) <= W(Q
) THEN 296
294 PRINT "CAN'T BET THAT MUCH!":GOTO 292
296 INPUT "ON";B$(Q)
298 NEXT
300 PRINT "{CLEAR}"
310 PRINT "{02 DOWN} ALL BETS ARE DOWN!!!"
320 REM SETS COLOR OF TRACK (PATHS)
330 FORX=S1 TO S1+22:POKE X+30720,0:NEXT
340 FORX=S2 TO S2+22:POKE X+30720,4:NEXT
350 FORX=S3 TO S3+22:POKE X+30720,5:NEXT
360 FORX=S4 TO S4+22:POKE X+30720,6:NEXT
370 READ P:IF P=-1 THEN PRINT "{UP}
":GOTO 390
380 READ P:POKE36876,P:FORX=1 TO D:NEXT:POKE36876
,0:FORX=1 TO 50:NEXT:GOTO 370
390 POKE36869,255:REM PROGRAMMABLE CHARACTER MO
DE
400 REM MOVE HORSES AND HORSES SOUND
410 M1=RND(1)+O1:IF M1 > .9 THEN 440
420 POKE S1+C1-1,32:POKE S1+C1-2,32:POKE S1+C1,Z1
:POKE S1+C1,Z1+1:Z1=Z1+2:H1=H1+1
430 POKE S0,200:POKE S0,0:IF Z1=49 THEN C1=C1+1:Z1=
Z
440 M2=RND(1)+O2:IF M2 > .9 THEN 470
450 POKE S2+C2-1,32:POKE S2+C2-2,32:POKE S2+C2,Z2
:POKE S2+C2,Z2+1:Z2=Z2+2:H2=H2+1
460 IF Z2=49 THEN C2=C2+1:Z2=Z
470 M3=RND(1)+O3:IF M3 > .9 THEN 500
480 POKE S3+C3-1,32:POKE S3+C3-2,32:POKE S3+C3,Z3
:POKE S3+C3,Z3+1:Z3=Z3+2:H3=H3+1
490 POKE S0,130:POKE S0,0:IF Z3=49 THEN C3=C3+1:Z3=
Z
500 M4=RND(1)+O4:IF M4 > .9 THEN 530
510 POKE S4+C4-1,32:POKE S4+C4-2,32:POKE S4+C4,Z4

```

```

:POKE S4+1+C4,Z4+1:Z4=Z4+2:H4=H4+1
520 IF Z4=49 THEN C4=C4+1:Z4=Z
530 REM FIND WINNER
540 IF H1 > 168 THEN J$=A$(1):GOTO 590
550 IF H2 > 168 THEN J$=A$(2):GOTO 590
560 IF H3 > 168 THEN J$=A$(3):GOTO 590
570 IF H4 > 168 THEN J$=A$(4):GOTO 590
580 GOTO 400
590 FORC=1 TO 10:FORX=150 TO 250 STEP 7:POKE36876,X:
NEXT:NEXT:POKE36876,0
600 POKE36869,240:PRINT "{CLEAR} J$ WINS"
610 FORX=1 TO PL
620 IF B$(X)=J$ THEN W(X)=W(X)+B(X)*3:GOTO 640
630 W(X)=W(X)-B(X):IF B$(X) < 0 THEN PRINT "{DOWN}
N$(X) LOSES $";B(X):GOTO 650
640 PRINT "{DOWN} N$(X) WINS $";B(X)*3
650 NEXT
660 REM READY FOR NEXT RACE
670 H1=0:H2=0:H3=0:H4=0:Z1=Z:Z2=Z:Z3=Z:Z4=Z:C1
=0:C2=0:C3=0:C4=0
680 IFR=5 THEN GOTO 710
690 FORX=1 TO 500:NEXT
700 RESTORE:GOTO 200
710 REM ENDING
720 FORX=1 TO 2500:NEXT
730 PRINT "{04 DOWN} HAVE A GOOD DAY! {02
DOWN}":FORX=1 TO PL:PRINT N$(X);"$";W(X)
:NEXT
740 REM SONG DATA
750 DATA 195,50,209,50,219,50,225,50,225,50,225
,50
760 DATA 219,50,219,50,219,50,209,50,219,50,209
,50,195,300
770 DATA 195,50,209,50,219,50,225,50,225,50,225
,50
780 DATA 195,50,195,50,195,50,209,300,-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(RO
M+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:?"HORSE RACE":? :
?: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.

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Antimatter Splatter! A more dastardly alien could scarcely be found than one who would wipe out an entire civilization by dropping antimatter 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 "Skyles 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 $";CASH(I);" BET";
440 BET=0:TRAP 450:INPUT BET:TRAP 400
    00
450 IF BET=0 THEN ? "PASS":GOTO 470
460 IF BET<1 OR BET>CASH(I) THEN ? "
    (BELL)TRY AGAIN.":GOTO 420
470 BET(I)=BET:IF BET=0 THEN 510
480 ? "WHICH HORSE? (1-5)":
490 TRAP 510:INPUT T:TRAP 40000:IF T<
    1 OR T>5 THEN ? :? "ONE TO TEN!":
    GOTO 480
500 HORSE(I)=T:?(CLEAR)
510 NEXT I
520 REM START RACE
530 SETCOLOR 2,6,0:SETCOLOR 1,0,12
540 POKE 752,1:?(CLEAR):FOR I=1 T
    0 6
550 COLOR 18:PLOT 2,I*2:DRAWTO 39,I*2
560 NEXT I:PLOT 39,12
570 RESTORE 580
580 DATA 237,100,177,100,140,100,117,
    200,140,100,117,200,140,100,117,2
    00
590 DATA 140,100,177,300,177,500,-1,-
    1
600 READ N,P:IF N=-1 THEN 640
610 SOUND 0,N,10,8
620 FOR C=1 TO P/4:NEXT C
630 GOTO 600
640 POSITION 2,0:?"(3 SPACES)*** THE
    Y'RE OFF !! ***"
650 FOR I=1 TO 50:SOUND 0,I*5,12,8:NE
    XT I:SOUND 0,0,0,0
660 POSITION 2,0:?"(29 SPACES)"
670 FOR I=1 TO 5:POSITION 2,I*2+1:?"
    (C){D}":POSITION 37,I*2+1:?"I;:X(
    I)=0:R(I)=0:NEXT I
680 WHICH=INT(5*RND(0)+1)
690 X(WHICH)=X(WHICH)+1
700 HORSE$="(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

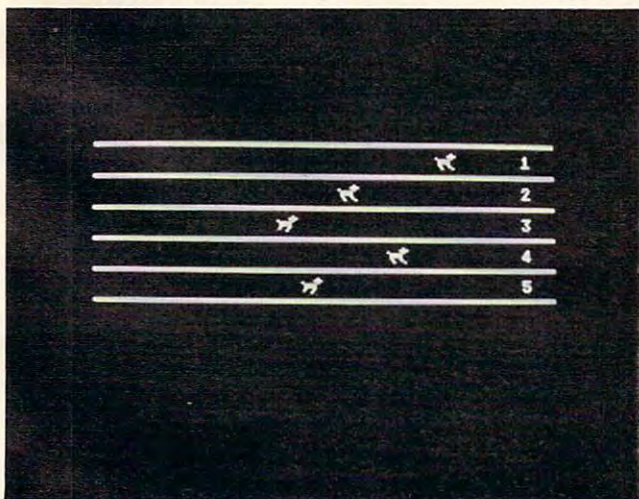
```



```

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$((I-1)*20+1,(I-1)*20+LN(I
));:" WON!!"
1050 ? "YOU BEAT THEM ALL!"
1060 GOTO 1010
1070 GRAPHICS 0:POKE 752,1
1080 DATA HORSE RACE is a simple simul
ation
1090 DATA of the entertaining sport o
f horse
1100 DATA racing. There are 5 horses
1110 N=3:RESTORE 1070:GOSUB 1300
1120 RESTORE 820:FOR I=1 TO 5:READ T$
: ? 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

```



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

```

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: ? " HORSE RACE ":?
: ?
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

```

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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



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.

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.

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.

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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 ATTEMPTS
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 POLAR COORDINATES
6001 REM GIVEN X,Y COORDINATES. RETURN 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) : RETURN
      : 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 CHARACTERS TYPED (PRINTABLE OR NOT)
2001 REM UNTIL ENTER IS HIT (EXCLUDING THE ENTER)
2010 S$ = ""
2020 K$ = INKEY$ :REM GETS SINGLE KEY 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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Graphics Workshop, by Lloyd Ollmann. A collection of utility programs to improve the graphics capabilities of Atari programmers. The PLAYER-MISSILE device handler allows easy set-up and use of player missiles using the Atari BASIC OPEN, PRINT, and PUT commands. GRAPHICS ENHANCEMENTS includes a new graphics mode and bit-map capabilities. Package also includes a character editor, a bit-map editor, and a player missile editor. Requires Atari 400/800 with 48K and one disk drive. **\$39.95**



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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:

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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 HLINE 20,50 TO 30,40 write X1=50:Y1=20:X2=40:Y2=30:GOSUB 2600 where 2600 has the line HLINE 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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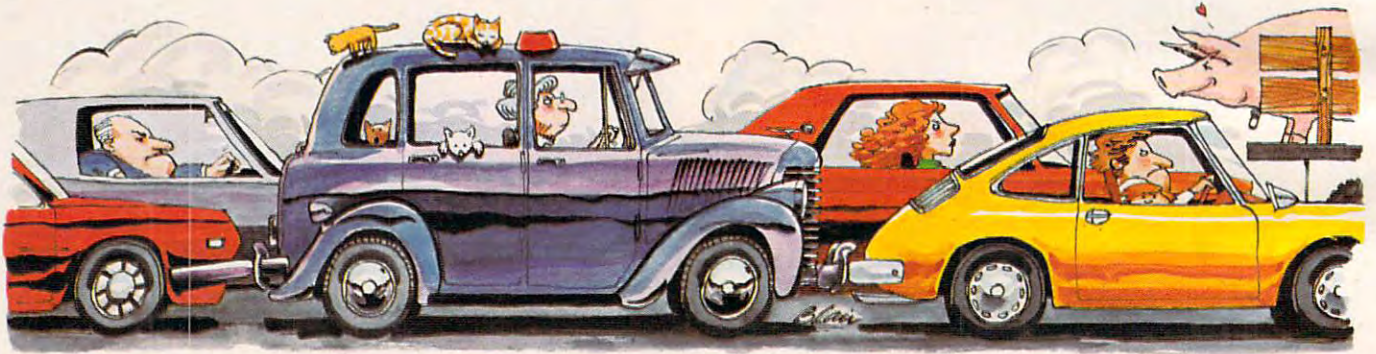


Roklan Software

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Computer Games We'd Like To See

Tom R. Halfhill, Features Editor



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?

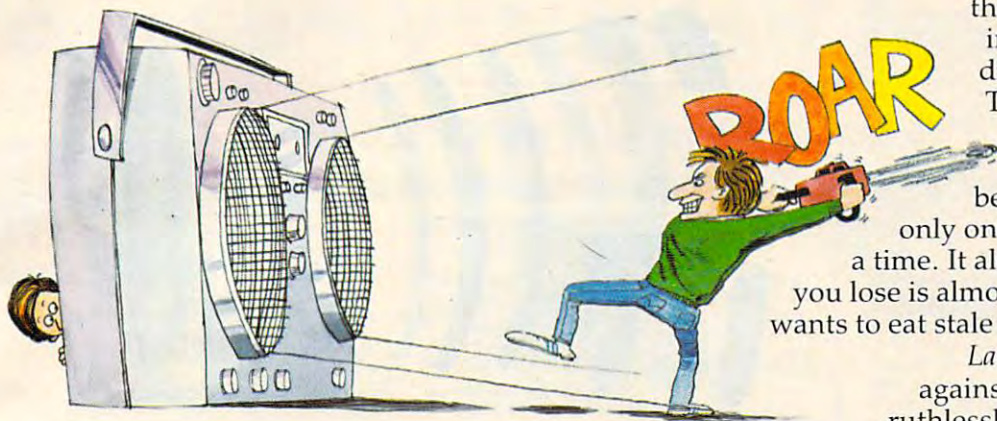
So crank up your computer and get ready to start programming....

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



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.

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,

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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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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For the Atari 400/800 unless specified.

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$:IFAS<>" 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$:A=VAL(AS)-1:IFTI-TA>200THENS=L%(LG):
   GOT0160
150 S=A:IFA=-1ORA>3THEN140
152 LFS=STR$(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(LFS))RIGHT$(LFS,LEN(LFS)-1):
   GOT099
170 PRINT"{HOME}{02 DOWN}"TAB(9)"{YEL}MISS":PO
   KE36878,15:POKE36875,128:R=R+1:FORT=1
   TO400:GETA$:NEXT
175 IFR=3THENFORT=1TO100:NEXT:GOTO2000
180 FORT=1TO600:NEXT:PRINT"{HOME}{02 DOWN}
   ":POKE36878,0:FORT=1TO500:NEXT

190 GOT0120
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$:IFAS=" THENRUN40
2020 IFPEEK(653)>3THENEND
2030 GOT02010
```

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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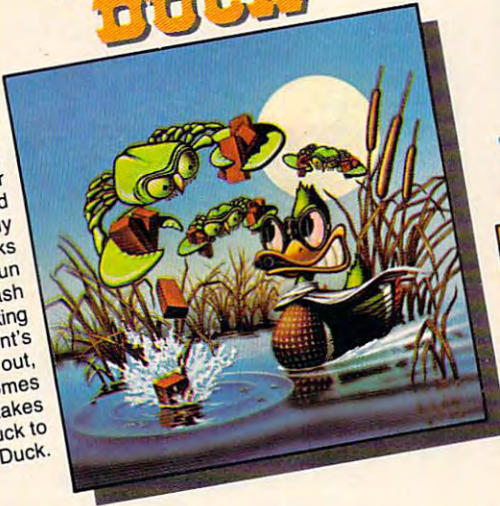
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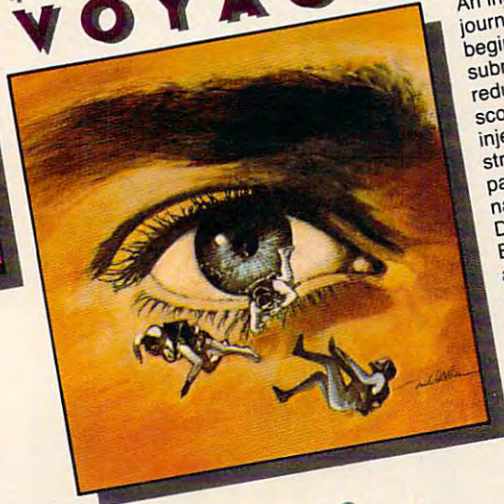


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Those cranky crabs are trying to drive the ducks from their once quiet pond. Imagine, crabs taking to the air armed with bricks and bombs! Luckily, Deadly Duck has a few tricks of his own. His gun barrel bill can unleash a bevy of crab cracking bullets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

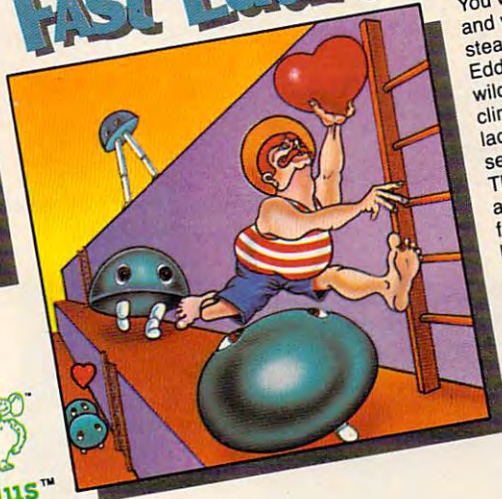


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Notes For Other Machines

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.

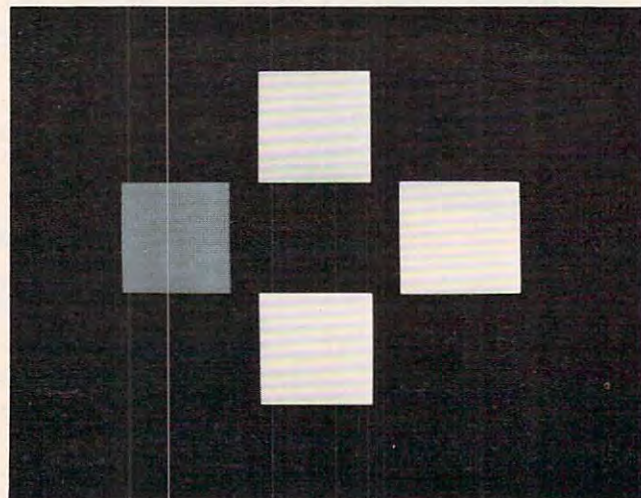
Special Atari Note

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 A}"
300 ? #6;"(8 SPACES){4 A}"
310 ? #6;"(8 SPACES){4 A}"
320 ? #6;"(8 SPACES){4 A}"
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$(I)) THEN 450
420 NEXT I
430 FOR W=1 TO 100:NEXT W
440 GOTO 330
450 SOUND 0,100,12,8:SETCOLOR 4,3,10:
    FOR W=1 TO 200:NEXT W
460 GOSUB 610
470 GRAPHICS 18:SETCOLOR 4,0,14:POSIT
    ION 6,2:? #6;"too bad{A}"
480 POSITION 5,6:? #6;"LENGTH":INDEX
    -1
490 POSITION 3,8:? #6;"difficulty:";D
    IFF
500 POSITION 1,11:? #6;" press fire.
    ."
510 POKE 711,PEEK(53770):IF STRIG(0)
    THEN 510
520 RUN
530 P=PEEK(707+WHICH)
540 HUE=INT(P/16):LUM=P-HUE*16
550 SETCOLOR WHICH-1,HUE,14
560 FOR W=15 TO 0 STEP -1
570 SOUND 0,WHICH*10+50,10,W
580 NEXT W
590 POKE 707+WHICH,P
600 RETURN
610 FOR I=1 TO INDEX
620 WHICH=ASC(WHICH$(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 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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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 SPACE 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 NEXT J
320 NEXT I
325 FOR I=1 TO 4:WHICH=I:GOSUB 530:NEXT
327 FOR W=1 TO 200: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$:IF Z$="" THEN 380
385 WHICH$=WHICH$+(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 TO 100:NEXT
440 GOTO 330
450 FOR I=1 TO 4:CLSI:SOUND I*10,1:NEXT:S
  OUND 1,10
455 CLS0:FOR I=1 TO 4:SO=0:WHICH=I:GOSUB
  530:NEXT
460 SO=1:GOSUB 610
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: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$=INKEY$:IF Z$="" THEN 760
770 DIFF=VAL(Z$)
780 IF DIFF<1 OR DIFF>9 THEN 760
820 RETURN

```

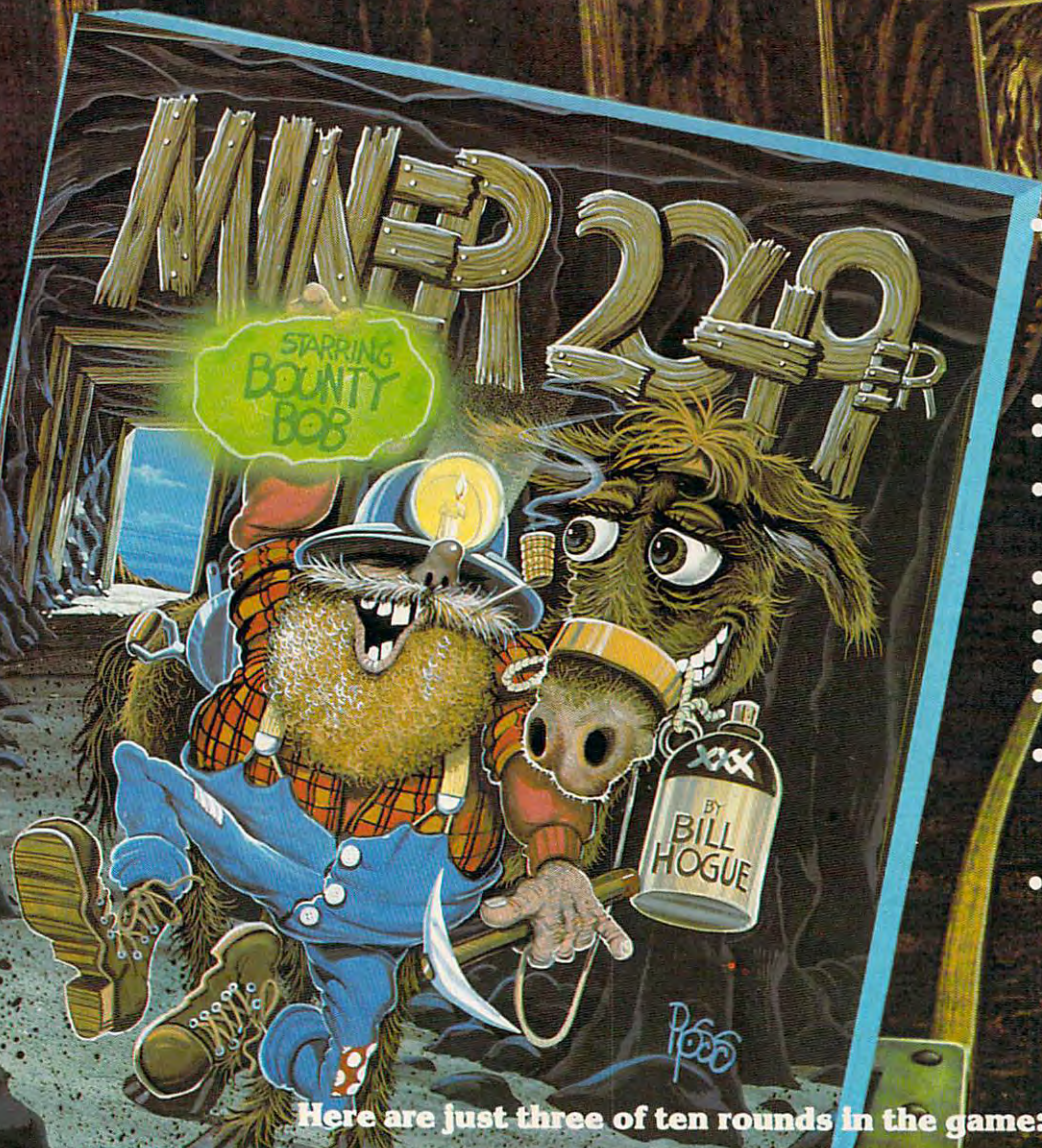
Program 4: Apple II Version

```

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
230 INDEX = INDEX + 1
240 WHICH$ = WHICH$ + CHR$(4 * RND(1) +
  1)
250 GOSUB 610
260 FOR I = 1 TO INDEX
270 IF PEEK(-16384) < 127 THEN 370
280 A = PEEK(-16384) - 128: POKE -1638
  4,0
285 WHICH = A - 72: IF WHICH = 5 THEN WHICH =
  4
290 IF WHICH < 1 OR WHICH > 4 THEN 370
300 GOSUB 530
310 IF WHICH < > ASC(MID$(WHICH$,I)) THEN
  450
320 NEXT I
330 FOR W = 1 TO 100: NEXT
340 GOTO 330
350 FOR I = 1 TO 50: COLOR= INT(16 * RND
  (0))
351 S = -16336: POKE S,0:Z = PEEK(S)
355 HLIN 40 * RND(1),40 * RND(1) AT 40 *
  RND(1)
357 VLIN 40 * RND(1),40 * RND(1) AT 40 *
  RND(1)
358 NEXT
360 GR: FOR I = 1 TO 4:SO = 0:WHICH = I: GOSUB
  530: NEXT:SO = 1: GOSUB 610
370 TEXT: HOME: INVERSE: PRINT TAB(16)
  ;"TOO BAD!"; TAB(39): NORMAL: PRINT:
  PRINT:PRINT
380 PRINT:PRINT:PRINT TAB(15);"LENGTH
  ";INDEX-1
390 PRINT:PRINT:PRINT TAB(12);"DIFFIC
  ULTY: ";DF
395 POKE -16368,0
397 VTAB 23: HTAB 7: INVERSE: PRINT "PRESS
  ";: FLASH: PRINT "SPACE";: INVERSE: PRINT
  " TO PLAY AGAIN: ";: NORMAL: GET A$
400 RUN
401 TM = 10 - DF
402 X = 5 + 10 * (WHICH = 1 OR WHICH = 4) +
  20 * (WHICH = 3)
403 Y = 5 + 10 * (WHICH = 2 OR WHICH = 3) +
  20 * (WHICH = 4)
404 COLOR= LT(WHICH): FOR L = 0 TO 9: HLIN
  X,X + 10 AT Y + L: NEXT

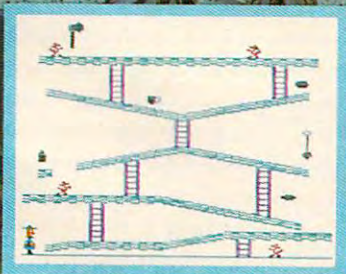
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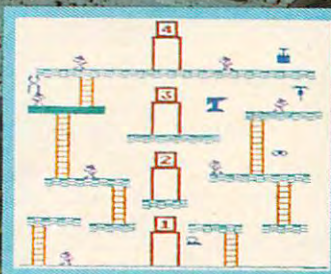


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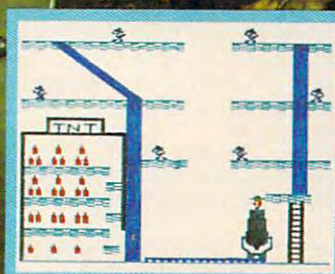
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```

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

```

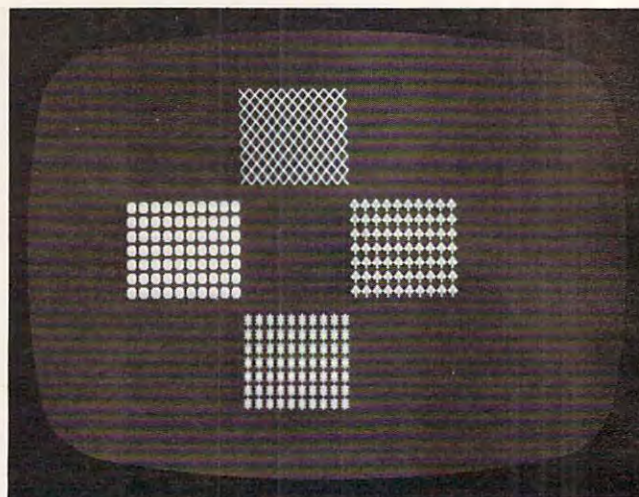
Program 5: PET/CBM Version

```

100 REM PET-CBM COPYCAT
110 GOSUB 5000:REM INSTRUCTIONS
115 PRINT "{CLEAR}";CHR$(142);:POKE59464,12
120 DATA "V","O","X","*"
130 FOR I=1TO4:READ DRK$
150 FOR J=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"ORAS$>"9"THEN5080
5090 DF=VAL(A$):RETURN

```

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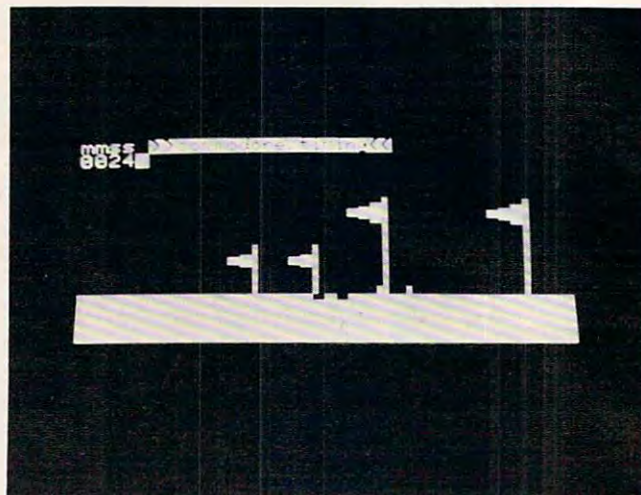
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George Leotti

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Program 1: PET Version

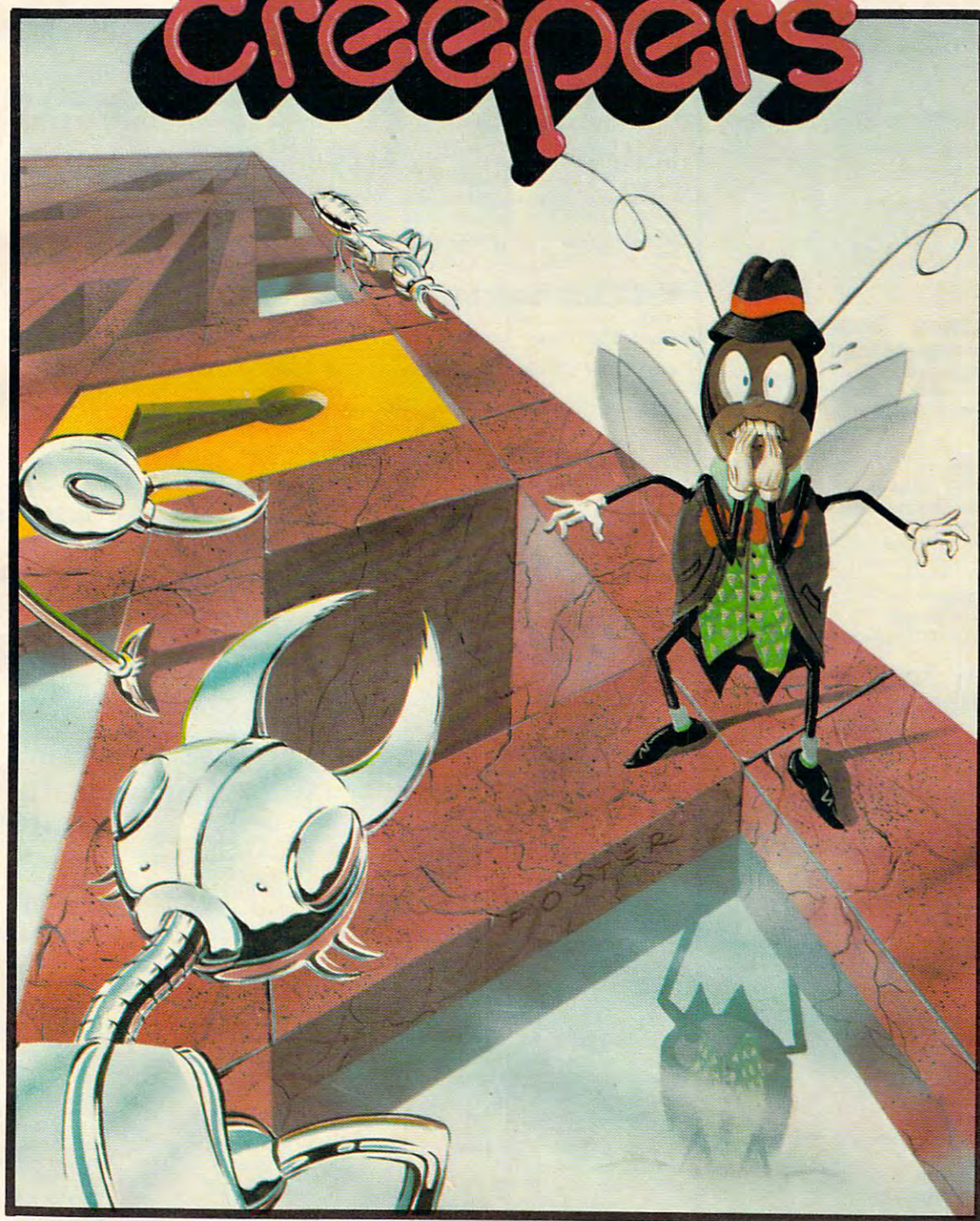
```
100 GOTO440
110 TI$="000000":FORI=1TON:IFI<N-1THENPRINT$(I)B$R$(I+1)M$R$(I+2)L$:GOTO140
120 IFI<NTHENPRINT$(I)B$R$(I+1)M$:GOTO140
130 PRINT$(I)B$
140 FORJ=1TOP:PRINT" {HOME} {DOWN} "RIGHT$(TI$,4)
:NEXT:PRINT$(I)G$
150 GETZ$:IFZ$>" "THENT=ASC(Z$)
155 IFT<>52ANDT<>54THEN180
160 TZ=-((T<55)+(T<54)):S=S+D(TZ):IFS<0ORS>35T
:HENS=S-D(TZ):GOTO180
170 PRINTD$TAB(S)S$:GOTO150
180 IFS>R(I)-1ANDR(I)+9>STHEN210
```

```
190 T=TI:IFR(I)-3>SORS>R(I)+11THENM=M+5:GOTO210
200 IFTI-T<120THENPRINT" {HOME} {DOWN} "RIGHT$(TI$,4):GOTO200
210 IFI<N-1THENPRINT$(I)C1$R$(I+1)C2$R$(I+2)C3$:GOTO240
220 IFI<NTHENPRINT$(I)C1$R$(I+1)C2$:GOTO240
230 PRINT$(I)C1$
240 PRINT" {HOME} {DOWN} "RIGHT$(TI$,4):NEXT:T=TI
250 PRINTD$" {DOWN} {REV} F I N I S H "
260 R=R+1:PRINT" {DOWN} ";:IFMTHENPRINT" {DOWN} PENALTY OF "M"SECONDS;"M/5"FLAGS MISSED"
270 J=T
280 MT$=STR$(INT(T/3600)):MT$=RIGHT$(MT$,LEN(MT$)-1):T=T-VAL(MT$)*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$(T/60),3,2):IFLEN(JT$)=1THENJT$=JT$+"0"
330 IFLEN(JT$)=0THENJT$="00"
340 IFJ=0THENRETURN
350 PRINT" {DOWN} THIS TIME/RUN: "MT$":ST$":JT$":RUN#"R
360 PRINT" {DOWN} {REV} OFFICIAL TIME: ";:T=J+M*60:J=0:GOSUB280
370 PRINTMT$":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$=" {UP} {LEFT} {UP} {LEFT} {UP} {LEFT} {RIGHT} {DOWN} {04 LEFT} {DOWN} {LEFT} {DOWN} {LEFT} {DOWN} {LEFT} "
510 C2$=" {UP} {LEFT} {UP} {LEFT} {UP} {LEFT} {RIGHT} {DOWN} {04 LEFT} {DOWN} {LEFT} {DOWN} {LEFT} {DOWN} {LEFT} "
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- Machine language Pascal Source Editor with cursor oriented window mode
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- Requires 32K Please specify configuration.

EARL for PET (disk file based) \$65

Editor, Assembler, Relocator, Linker

Generates relocatable object code using MOS Technology mnemonics. Disk file input (can edit files larger than memory). Links multiple object programs as one memory load. Listing output to screen or printer. Enhanced editor operates in both command mode and cursor oriented "window" mode.

RAM/ROM for PET/CBM

4K or 8K bytes of soft ROM with optional battery backup.

RAM/ROM is compatible with any large keyboard machine. Plugs into one of the ROM sockets above screen memory to give you switch selected write protectable RAM.

Use RAM/ROM as a software development tool to store data or machine code beyond the normal BASIC range. Use RAM/ROM TO LOAD A ROM image where you have possible conflicts with more than one ROM requiring the same socket. Possible applications include machine language sort (such as SUPERSORT), universal wedge, Extramem, etc.

RAM/ROM - 4K \$75
RAM/ROM - 8K 90
Battery Backup Option 20

SUBSORT by James Strasma \$35

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.

Specify machine model (and size), ROM type (BASIC 3 or 4)

SuperGraphics in ROM \$45

Volume discounts available on ROM version for schools.



for PET/CBM Computers

NEW VERSION II

FLEX-FILE is a set of flexible, friendly programs to allow you to set up and maintain a data base. Includes versatile Report Writer and Mail Label routines, and documentation for programmers to use Data Base routines as part of other programs.

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Record size limit is 256 characters. The number of records per disk is limited only by record size and free space on the disk. File maintenance lets you step forward or backward through a file, add, delete, or change a record, go to a numbered record, or find a record by specified field (or partial field). Field lengths may vary to allow maximum information packing. Both sub-totals and sorting may be nested up to 5 fields deep. Any field may be specified as a key. Sequential file input and output, as well as file output in WordPro and PaperMate format is supported. Record size, fields per record, and order of fields may be changed easily.

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Typical mail records may be packed 3000 per disk on 8050 (1400 on 4040). Labels may be printed any number wide, and may begin in any column position. There is no limit on the number or order of fields on a label, and complete record selection via type code or field condition is supported.

REPORT WRITER

Flexible printing format, including field placement, decimal justification and rounding. Define any column as a series of math or trig functions performed on other columns, and pass results such as running total from row to row. Totals, nested subtotals, and averages supported. Complete record selection, including field within range, pattern match, and logical functions can be specified.

FLEX-FILE II by Michael Riley \$110

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COMPLETE DISK RECOVERY SYSTEM FOR CBM DRIVES

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Furnished on copy-protected disk with manual.

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FORTH for PET

BY L. C. Cargile and Michael Riley

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Features include:

- full FIG FORTH model.
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- 150 screens per diskette on 4040, 480 screens on 8050.
- ability to read and write BASIC sequential files.
- introductory manual.
- reference manual.

Runs on any 16K or 32K PET/CBM (including 8032) with ROM 3 or 4, and CBM disk drive. Please specify configuration when ordering.

Metacompiler for FORTH

\$30

simple metacompiler for creating compacted object code which can be executed independently (without the FORTH system).

PaperMate 60 COMMAND WORD PROCESSOR

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.

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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.

Paper-Mate functions with all CBM/PET machines with at least 16K, with any type of printer, and with either cassette or disk.

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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.

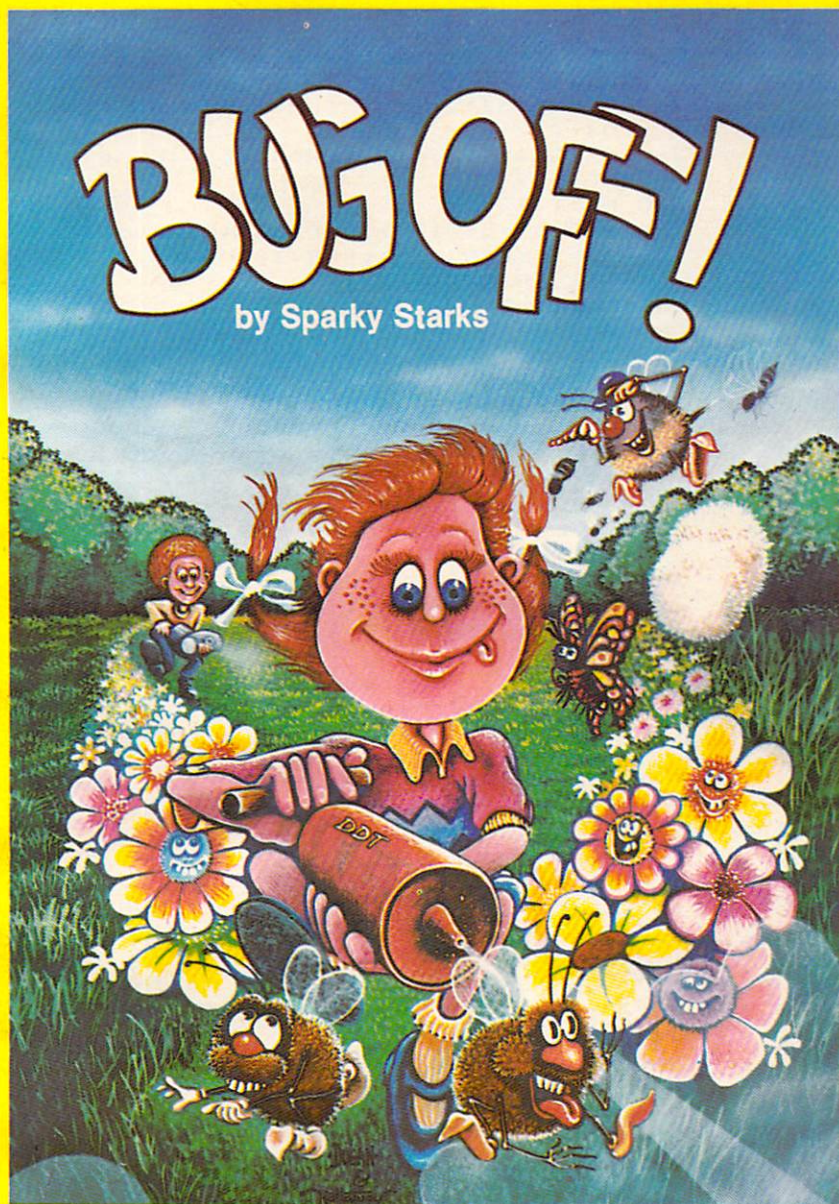
The VBLANK routine will stop scrolling when it runs out of lines, and memory location 1 will hold a zero. You could use the machine language routine in your own programs, but since it is not general-purpose, you will be limited to unidirectional scrolling in GRAPHICS 1. Be sure to use the "disable routine"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

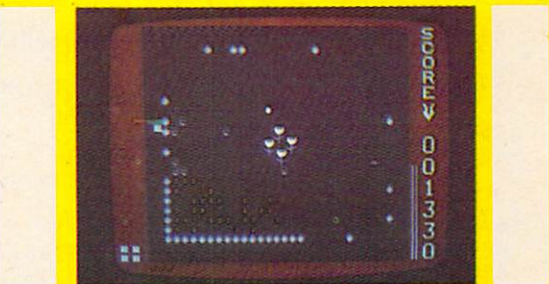
Strings are used extensively in the BASIC program, to prevent memory conflicts. A string is used to hold the display list, the screen memory area, the player/missile memory, and the shapes for the player. The screen memory area and the player/missile address are ensured to be on proper page boundaries 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 ... 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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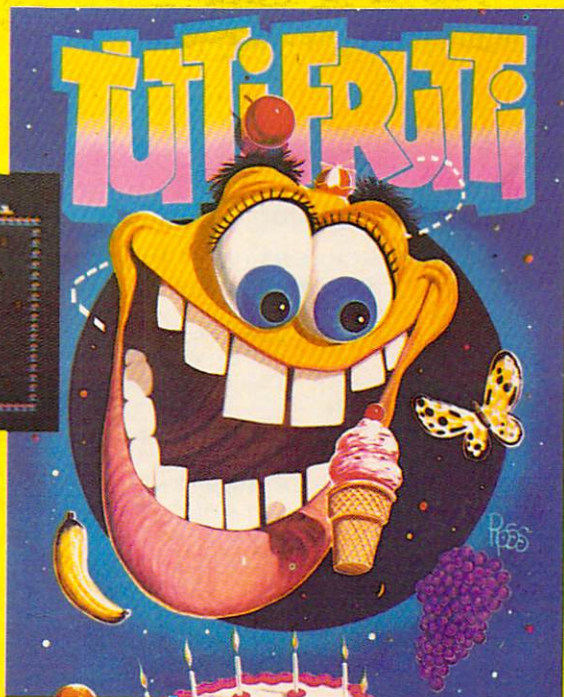
To order, see your local dealer. If he does not have the program, then call 1-800-327-7172 (orders only please) or write for our free catalog.

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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$(184) + " "
550 INPUT "{CLEAR} COURSE LENGTH (10-50)";N
560 IFN>50 THEN PRINT "{HOME}" LEFT$(R$,23) "50
    ":N=50
570 IFN<10 THEN PRINT "{HOME}" LEFT$(R$,23) "10
    ":N=10
580 INPUT "{DOWN} SPEED (1=FAST) TO (9=SLOW)";P
590 IFP>9 THEN PRINT "{UP}" LEFT$(R$,28) "9
    ":P=9
600 IFP<1 THEN PRINT "{UP}" LEFT$(R$,28) "1
    ":P=1
610 IFP>1 THEN P=P*5
620 FOR I=1 TO N:READ R(I):R$(I)=D$+LEFT$(R$,R(I))
    :NEXT I:D$=D$+"{DOWN}"
630 PRINT "{CLEAR}" D$;:FOR I=1 TO 30:PRINT "{REV} ~
    {OFF}";:NEXT
640 S=17:M=0:PRINT D$ LEFT$(R$,S) S$ "{HOME}{DOWN}
    {04 RIGHT}{REV} PRESS ANY KEY"
650 GET I$:IF I$="" THEN 650
660 PRINT "{HOME}{DOWN}{04 RIGHT}
    {HOME} MMSS {REV}>>COMMODORE TIMING<<":
    GOTO 110
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

```

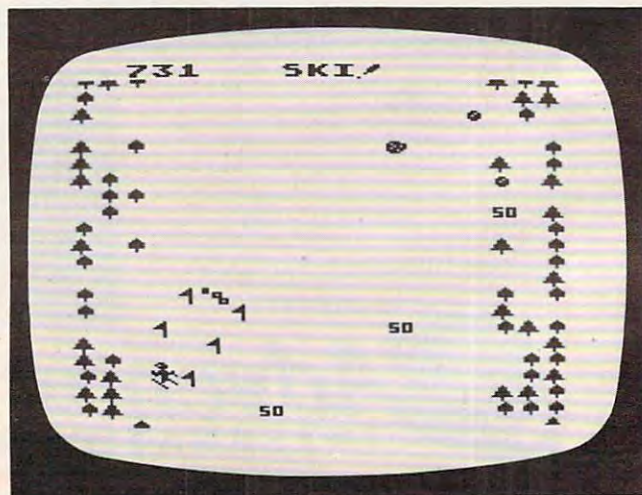
100 DIM SCREEN$(1),PM$(1):GOTO 130
110 REM SKI Line 100 must be type
    d in first!!!
120 HI=INT(A/256):LO=A-HI*256:RETURN
125 POKE 66,1:FOR W=1 TO 10:POKE 5327
    9,0:POKE 53279,8:NEXT W:POKE 66,0
    :RETURN
130 GOSUB 790:REM Initialization rou-
    tines
140 REM PLAYER ROUTINE
150 POKE 559,62:POKE 54279,PMBASE
160 POKE 53277,3:POKE 704,2*16+6
170 P0=1024:YP=180:XP=128
180 PM$(P0)=CHR$(0):PM$(P0+254)=CHR$(
    0):PM$(P0+1)=PM$(P0)
190 DIM LEFT$(20),CENTER$(20),RIGHT$(
    20),CURR$(20),CRASH$(20),ERASE$(2

```

```

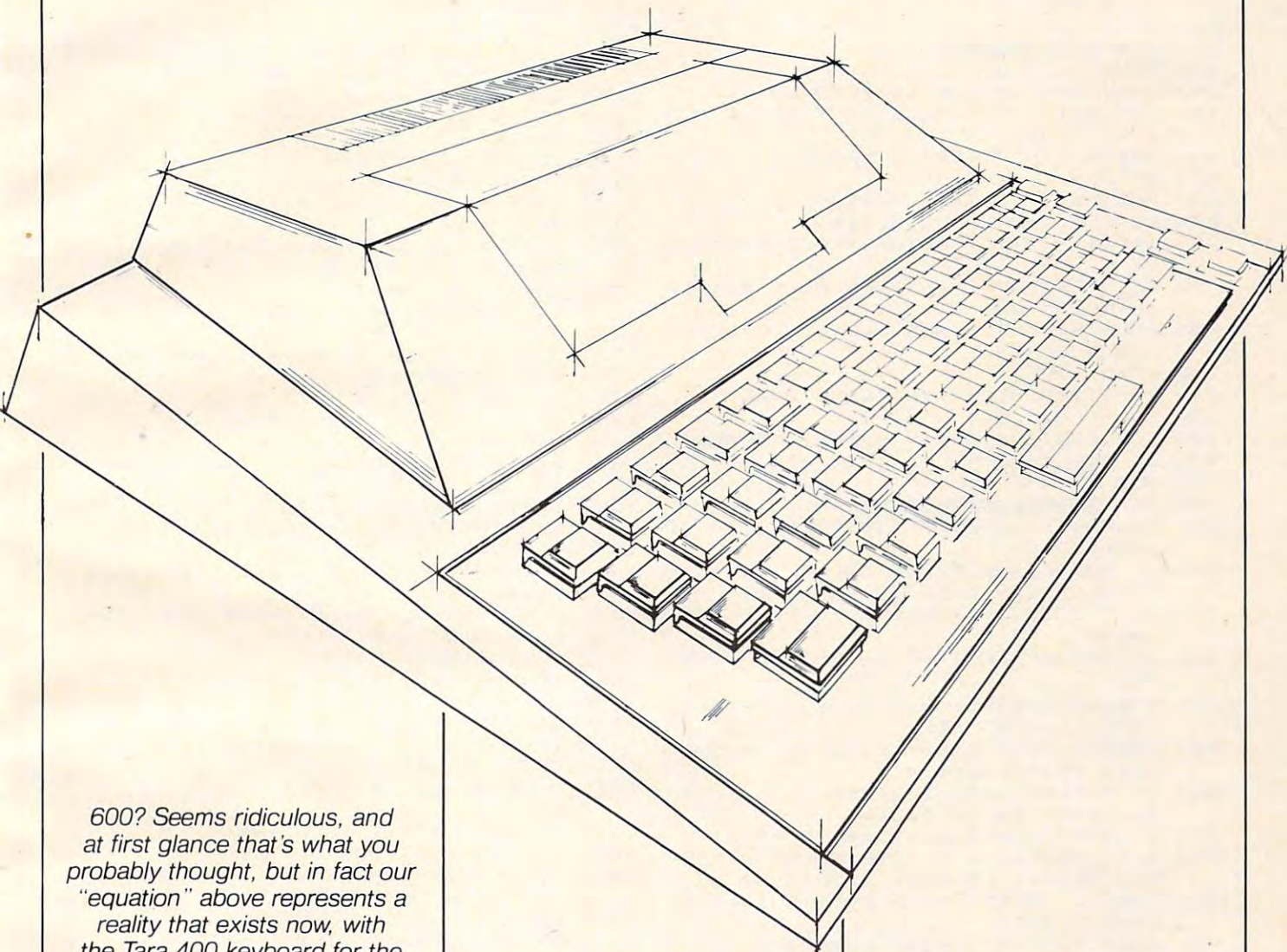
    0),DIR(8)
200 ERASE$=CHR$(0):ERASE$(20)=CHR$(0)
    :ERASE$(2)=ERASE$
210 LEFT$=ERASE$:CENTER$=ERASE$:RIGHT
    $=ERASE$:CRASH$=ERASE$
220 FOR I=0 TO 15
230 LEFT$(I+2,I+2)=CHR$(PEEK(CHSET+20
    8+I))
240 CENTER$(I+2,I+2)=CHR$(PEEK(CHSET+
    224+I))
250 RIGHT$(I+2,I+2)=CHR$(PEEK(CHSET+1
    04+I))
260 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$(P0+YP,P0+YP+20)=CURR$
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<
    >0LR 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$(P0+YP,P0+YP+20)=ERASE$
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

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```

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$(HI)
1070 POKE 88,LO:POKE 89,HI
1080 POSITION 8,0: ? #6: "Skid";
1090 SCREEN$(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

```


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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
1680 DATA 26,0,0,0,12,26,28,8,93
1690 DATA 29,186,89,24,154,170,198,65
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 machine
      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

```

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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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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,"0000000030C30C")
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,"101010101010101")
330 CALL CHAR(141,"000000FF")
340 CALL CHAR(142,"101010F")
350 CALL COLOR(14,13,1)
360 A$=" h h h h h h h h"
370 B$="ajjjjjjjjjjjjjjjjjjj"
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)

```

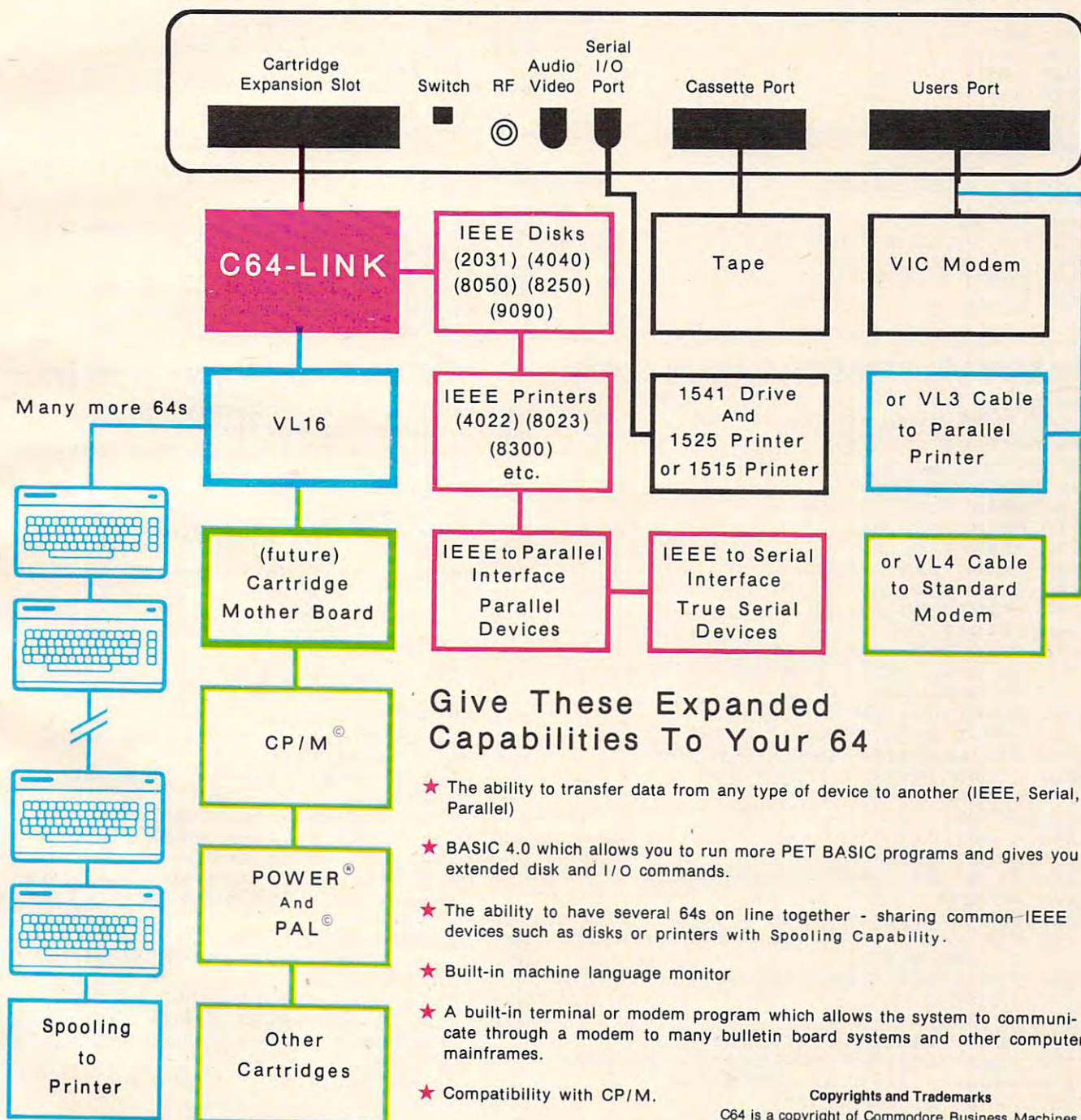

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```

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;02;E;C":RETURN
330 PLAY "L16;02;CEG;L8;03;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 FOR I=1 TO 4: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."

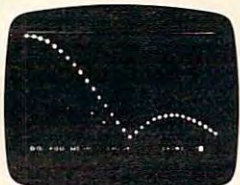
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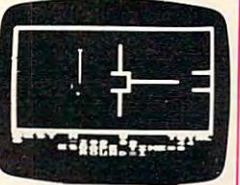
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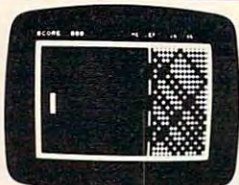
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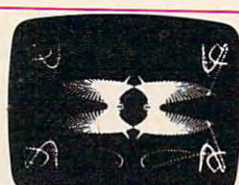
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```

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

```

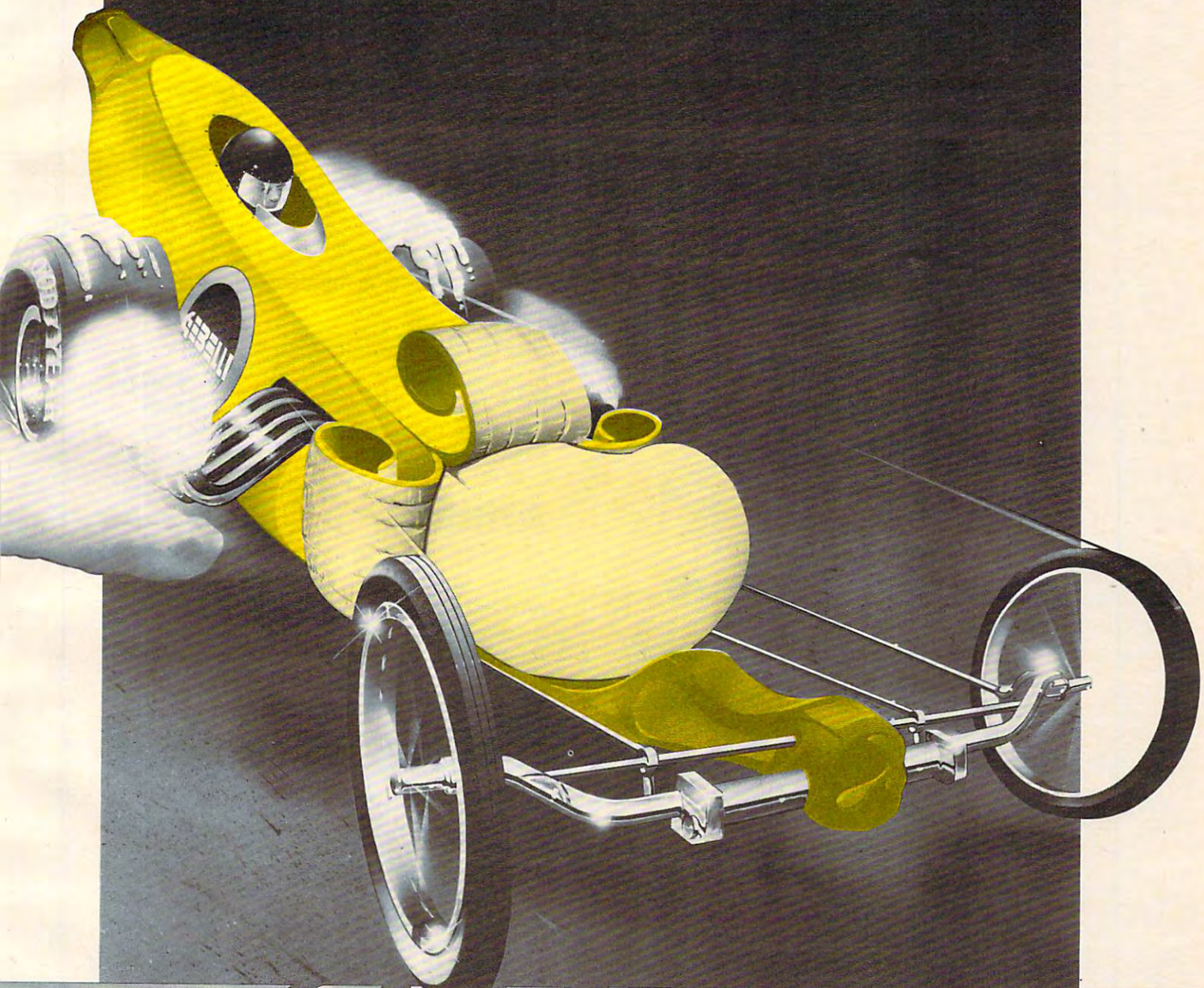
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30 GOSUB90:PRINT"WHERE IS THE POIN
T?":PRINT:PRINT"{BLK}({
RED}?{BLK},{RED}?{BLK})";
31 X=INT(6*RND(0)):Y=INT(5*RND(0))
:GOSUB84:POKEC,81:POKEC1,2
32 GOSUB94
33 GETR$:IFR$=""THEN33
34 IFASC(R$)<48ORASC(R$)>57THEN33
35 POKE8099,ASC(R$):POKE38819,2:X$
=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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```

" 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

```

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Beginners: See
special program
typing instructions
on page 249.

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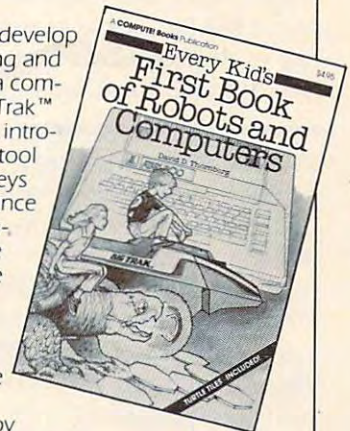
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MASTERMAZE

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.

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 pos-

sibly 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.

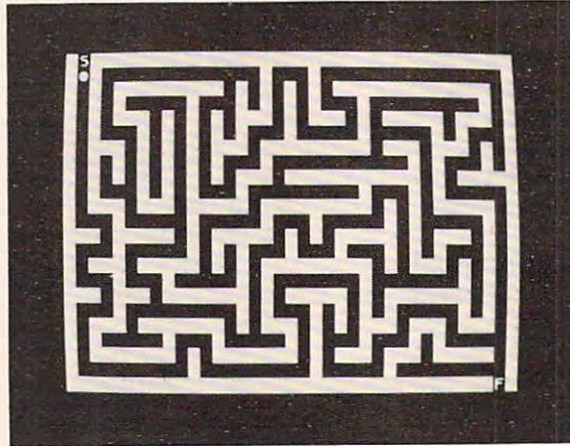
The maximum number of levels on any machine with less than 48K is approximately eight less than the total number of kilobytes of memory you have. For a 48K machine, the BASIC cartridge disables the top 8K, and the program uses the bottom 8K, making the maximum number of levels equal to 32.

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



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