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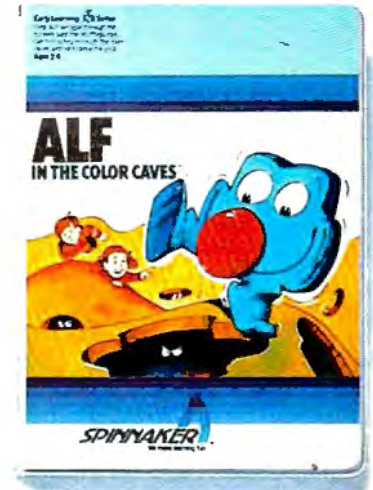
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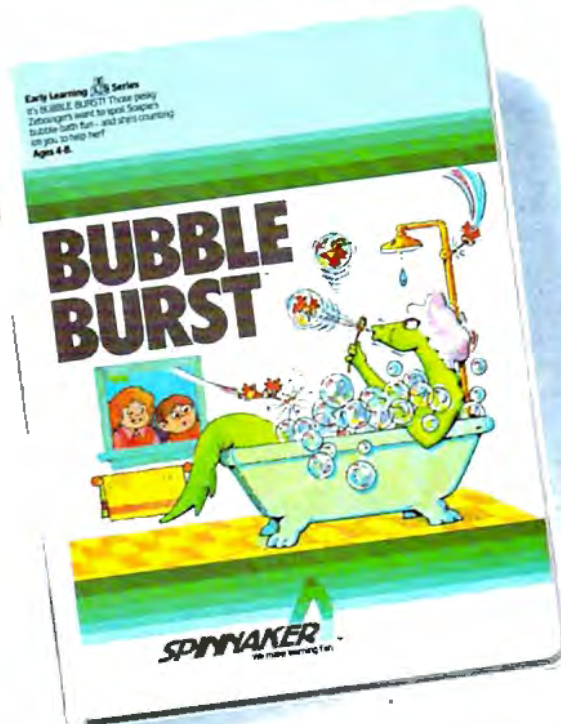
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EDITOR'S NOTES

In a surprise announcement, Commodore President and Chief Executive Officer Jack Tramiel resigned on Friday, January 13. Tramiel's reported replacement, Marshall F. Smith, is expected to assume his duties in late February. Smith is currently president and chief executive officer of the U.S. unit of a Netherlands-based company, Thyssen-Bornemisza. To Commodore, Smith brings a track record of experience in major manufacturing operations and finance. His U.S. operation had 1982 sales approaching \$1 billion. Smith does not have computer industry experience—it had been anticipated that Commodore Chairman Irving Gould would stress other variables in his selection.

The end of an era? Tramiel's resignation was met with surprise and some consternation within Commodore. His direct, aggressive style has been a critical factor in driving Commodore to its position of preeminence in the low-priced personal computer market. Tramiel was quoted as saying the company needed a "professional executive" to head it, given that the company has now reached the billion dollar sales mark.

What price stability? Commodore has had a series of senior

management turnovers during the years of its growth as a personal computer manufacturer. All have been subordinate to Tramiel, and most who were brought in at the level of president had short-lived tenures. Tramiel's aggressive, active intervention in most facets of the company's operations and planning caused some internal conflict, visible externally in the high turnover.

Growth of the sort that Commodore has experienced can be damaging to a poorly run company, yet Commodore weathered its growth well, given that its annualized sales have increased by a factor of roughly 25 times in the last six or seven years. At the same time, Commodore has experienced some hardware problems, the most recent example centering around last fall's delays and disputed defects in the company's 1541 disk drive. Mr. Smith will bring to this situation experience in multisite manufacturing operations, and seasoned talent as the head of a company of roughly comparable revenues.

Tramiel, perhaps not considering himself a "professional executive," did run the company with a ruthless understanding of the marketplace. The year of the computer (1983) in many ways

became the year of Commodore in the low-end market, as Tramiel's aggressive product introduction and pricing forced Texas Instruments out of the market and, at least temporarily, damaged Atari's position.

While we can now anticipate more internal stability at Commodore, and perhaps streamlined manufacturing operations, our concern will be the impact of Tramiel's absence on the company's aggressive stance. We've already heard rumors of a push to increase prices. Depending on the extent of such increases, Commodore might well find itself moving away from a market it opened up, and eventually trading market share to competition from overseas. Time will, of course, tell. We wish Mr. Tramiel well, and thanks for those 25 years of Commodore. And we welcome Mr. Smith, who's taking on a two-fisted job.



Robert Lock
Editor In Chief

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READERS' FEEDBACK

The Editors and Readers of COMPUTE!

Can Your Computer Tattoo A TV?

I am considering purchasing a VIC or 64, and I plan to use the family TV with the computer. Do the images from a computer damage a TV by leaving imprints on the screen?

Timothy J. Prusinski

The problem you are describing is known as image burn-in. It usually affects a video unit on which the same message is displayed continuously in the same place on the screen. This practice causes uneven wear in the screen's phosphor coating, which eventually results in the message being visible on the screen even when the unit is turned off. Using your TV with a computer will not cause image burn-in, unless you leave your computer on and continually display the same pattern on your TV for a very long time—several days, at least.

Easy Memory For The 64?

I recently purchased a 64, and discovered that only about 38K of BASIC RAM are available for my use. I have found a POKE that increases it by 5888 bytes. After turning your 64 off, then on, try the following:

```
PRINT FRE(0)
POKE 56, 137
PRINT FRE(0)
```

After entering these commands in the direct mode, the first result was -26627. After the POKE, the result was -32515, a difference of 5888 bytes.

My question is, why does it do this? Does it have any harmful side effects?

Jeff Lewis

The memory location you POKEd (byte 56) is one of two bytes (55 and 56) that tell the operating system the highest address used by BASIC.

*As you discovered, these locations can be POKEd with new values. By POKeing location 56, you told the 64's operating system that the top of BASIC memory had been changed. The normal values for 55 and 56 are 0 and 160 respectively, signaling that the top of BASIC memory is 40960 (0 + 256*160). If you POKEd a value higher than 160 into location 56, you would be telling the computer it has more memory than it actually does.*

When you POKEd 56 with a value of 137, you actually lowered the top of BASIC memory, which

decreased the amount of RAM available for use. This is a legal POKE, and might be used, for example, if you wanted to protect a machine language program in high memory.

This won't damage your computer. To reset the pointers to normal, simply turn your 64 off, then back on. However, POKeing values into the memory pointers can cause strange RUNs if you're using a BASIC program.

TI-99/4A And COMPUTE!

I would like to know if you will still be writing games and other programs for the TI-99/4A, even though Texas Instruments has discontinued production.

Curtis Tsui

We'll continue to support the TI-99/4A.

Mysterious Commodore SYS

Our users group, Richmond Area Commodore Enthusiasts, would like to find out all about the SYS command. We know that SYS 64802 will cold start the VIC. Is there any publication, book, or article that has a list of all the SYS commands? Our computer manuals give the definition of the SYS command, but other than a few examples, offers nothing further.

E. M. Rexrode

The SYS command is used to transfer control from a BASIC program to a machine language program. The format for the SYS command is SYS NNNNN, where NNNNN is any memory location. The computer will start executing the machine language at the address specified by NNNNN.

SYS is user-controlled. That is, in the VIC and the 64, you can SYS to any memory location between 1 and 65535. The memory location can be the start of a machine language program in user RAM, or an ML routine within BASIC or Kernal ROM. The SYS command is not a prewritten package of routines.

There is only one SYS command, but it can access many routines within the computer (such as "cold start," which simulates turning the computer on). To learn these addresses you need a map of your computer's memory. These maps are found in various COMPUTE! Books such as COMPUTE!'s First Book of VIC,



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Atari Background Music

I recently bought an Atari 1010 program recorder. I have several Atari programs that play music while loading. I was wondering if it is possible to do this to my own programs.

Chris Seay

The Atari cassette system is based on two-track stereo. One track is used to record programs and data by means of audio tones (one frequency for 1, another for 0). The other track can be used to record and play back normal audio. You need to do your recording on another cassette recorder, as there is no provision for the 1010 (or 410) recorder to accept a microphone.

You can turn on or off the cassette motor from a BASIC program with two POKES: POKE 54018,52 to turn the motor on, and POKE 54018,60 to turn the motor off. When the motor is on, any sound on the audio track will begin to play through the TV speaker. You can use timing loops to synchronize your program with the recorded sound.

The audio track can also be heard during tape operations such as CLOAD, but will be mixed with the normal tones you hear during CLOAD. Use POKE 65,0 to turn off the sound of the data track. You will need to use a stereo cassette recorder to mix programs and sound on the same segment of tape.

You can find more information in COMPUTE!'s First Book of Atari: "Adding a Voice Track to Atari Programs."

A Disk Disaster

I own a VIC and a 1541 disk drive. In the three years I've had them, I've written and saved many programs on a certain disk. But now the disk won't give me access to all my programs. When I ask for the directory, it gives me either the first half of it, or just garbage. Then I get the message 23 READ ERROR 1807.

I think I've found the problem. There's a scratch about a centimeter long in the middle of the disk. How can I get to the programs beyond the scratch? Is there any way to fix my disk or make it work more than it does now?

Mike DiPiero

Since you are getting a READ ERROR when you access the directory, the scratched area probably includes some sectors of track 18, where the directory is stored. The LOAD command uses the directory to locate files on the disk; if the directory information for a file is destroyed, the file cannot be LOADED.

There is no way to fix your disk, because the scratch has destroyed the magnetic coating as well as the information that was stored on it. To make the best of a bad

situation, format a new disk, and transfer to it any programs which will still LOAD from your damaged disk. Also, to avoid a similar disaster in the future, it's a good idea to make a backup copy of your salvaged programs, because floppy disks do not last forever. Even if used infrequently in an absolutely dust-free, cool environment, a disk will eventually wear out. When that happens, you will have all your programs intact and safe on your backup copy. And before you press your backup into service, make another backup disk, in case of accidents.

More On 64 Video Cable

I own a 64 and recently purchased the 1702 monitor. However, to my chagrin, I soon discovered that the 8-pin cable packed with the monitor is not compatible with my 64, which has a 5-pin video output.

In COMPUTE!, November 1983, Jim Butterfield wrote an article on how to improve the 64's video quality. He said that a 5-pin cable is available to access the 1702's rear three inputs. Where can I buy this cable?

Steve M. Walsh

Any store with a good supply of video or electronics parts should have the cable you want. Be sure the cable has a 5-pin DIN connector on one end, and at least three RCA connectors on the other end.

A Fifth Voice For Atari

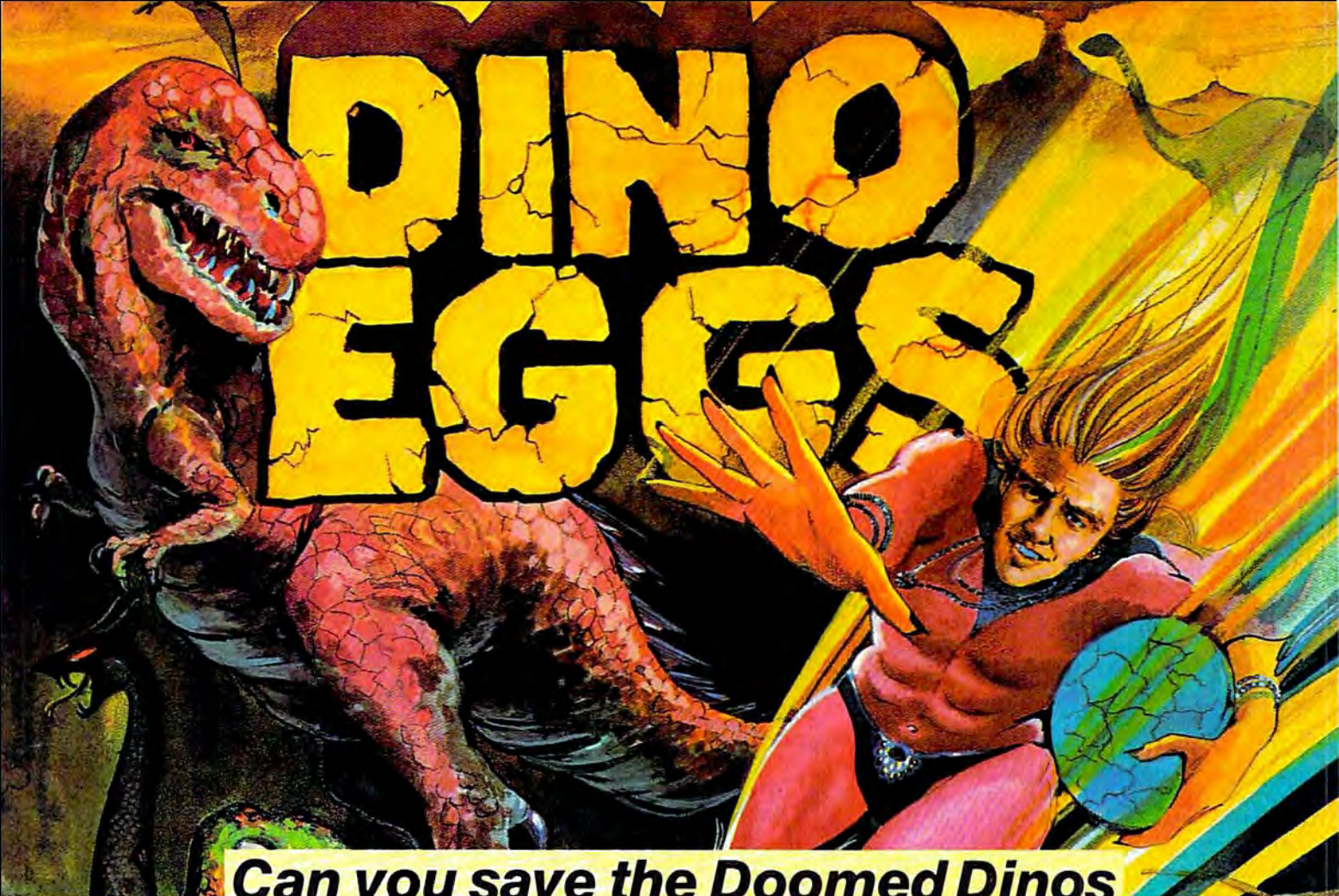
I have had an Atari 800 for quite a while now, and love it. Also, being a musician, I like working with the Atari sounds and *Music Composer*. One thing that intrigues me is the Apple's ability to produce sounds through its internal speaker. Even though I have no need for this on the Atari, I want to know if this is possible, perhaps to produce a fifth voice, or even stereophonic sound.

Freddie Scudiero

The internal speaker on the Atari 400 and 800 can be programmed in much the same way as the Apple. If you POKE 53279 with a 0, the internal speaker will emit a small click. The operating system turns off the speaker within 1/60 second, during the periodic vertical blank. Every time you POKE 53279,0 to pop out the speaker, the OS (operating system) pops it back in.

If you disable the vertical blank, you can push or pop the speaker at your own rate. Machine language is required to click the speaker fast enough to generate tones. An article and program to use the internal speaker as a "fifth voice" can be found in COMPUTE!'s Second Book of Atari: "The Atari Keyboard Speaks Out."

Incidentally, the new XL computers do not have an internal speaker. All access to location 54018 is routed to the TV or monitor speaker.



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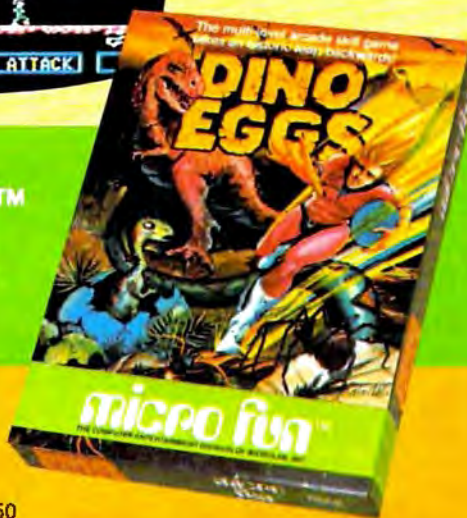


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ASM 3

Taking Your Computer Abroad

I am the owner of a Commodore 64 computer and a 1541 disk drive. Being in the military, and changing duty stations often, I need to know how to change the frequency of the internal timer from 60 hertz to 50 hertz while using a step-down transformer to reduce voltage from 220 to 110 volts. The *Commodore 64 Programmer's Reference Guide* touches upon this, but doesn't go into any detail. I believe this is done with a POKE, but I'm not entirely sure what to change. You're my last hope; can you help?

Louis D. Steinritz

We've received many inquiries lately about European computing. To change the North American model of the 64 to successfully operate in Europe, the VIC-II chip and a crystal have to be changed from the standard 60 hertz model to one that operates at 50 hertz. Unfortunately, the 50 hertz VIC-II chip is not for sale to the public. However, there is another way to use your U.S. model 64 in Europe. If you take an American monitor with you, you should have no problems. As long as the 64 and the monitor are compatible, the change from 50 to 60 hertz shouldn't affect performance.

For VIC-20 owners, however, the VIC chip is available in the 50 hertz version, so conversion should be simple. For more information, contact your local Commodore service representative.

Atari Cassette LOADs

I am very eager to expand my Atari 400 computer from 16K to 48K. But, I've heard rumors that doing this sometimes messes up the cassette buffer, causing the 410 recorder only to load 50 percent of the time. Is this rumor true? Is there any other way the expansion changes the computer and its memory?

Mike Cohen

We've never heard that rumor, and can't see how it could be true. Unless the upgrade was improperly engineered so as to cause timing problems, it should merely add more memory. The cassette buffer is located in the lower 16K of memory anyway. However, there is a problem with SYSTEM RESET. Pressing SYSTEM RESET can sometimes leave the cassette improperly initialized. Atari recommends that you issue a LPRINT command (with or without a printer) before you try to CSAVE a program.

Synthesizer Check Routine For TI "Crazy Climber"

Here is a neat trick to use on TI computer programs (Extended BASIC only) that have CALL SAY statements. (See "Crazy Climber" for the TI-99/4A,

COMPUTE!, November 1983.) If there is no speech synthesizer attached, the program stops at line 320 with an error message, because the computer can't talk without its talker.

COMPUTE! puts in a REM about removing the CALL SAY if no synthesizer is attached, but there is an easier way. Edit lines 110 and 320 to read:

```
110 CALL PEEK(-28672,SP)::GOTO 140
320 T=1::V=2::CALL DELSPRITE(#1)::
IF SP=96 THEN CALL SAY ("UHOH")
```

Here's how it works:

In the TI editor/assembler manual, page 354, there is a way to check to see if the synthesizer is attached or not. Without going into machine language (which I don't understand that well), it boils down to CALL PEEK(-28672,SP). This PEEK should be placed ahead of any CALL SAY statement and need be executed only once.

When the program runs, the PEEK looks to see if the synthesizer is attached. It sets the variable SP to 0 if not attached, and 96 if attached.

Try this two-liner:

```
100 CALL PEEK(-28672,@)::CALL CLEAR
110 IF @ THEN CALL SAY("HELLO, HOW ARE YOU") ELSE DISPLAY AT(12,3): "NO SYNTHESIZER ATTACHED."
```

No, I didn't goof by using the @ for a variable name—it is valid.

After running the above, you will get the message one way or another. Try it with and without the synthesizer.

Caution: Do not attach or remove the synthesizer with your console power on. Lockup will occur, and you will have to turn the console power off, then on again, to recover.

Jim Pate

Thank you for the suggestion.

Speakers With Monitors

I understand that an unshielded speaker's magnets will cause problems with a video monitor. But rather than buy an expensive shielded speaker, I prefer to buy an inexpensive, bookshelf speaker for the audio output from my 64. Can you tell me what is considered a safe distance to place a small speaker from a monitor?

Russell Baksic

The speaker will probably not affect your monitor unless you place it directly above or beside the monitor.

Smooth Scroll On The 64

I own a 64 and do a lot of programming in BASIC. I know that this computer is able to perform a smooth scroll in four directions. After consulting my *Programmer's Reference Guide* and several COM-



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PUTE! articles, I figured out how to do this, but only seven pixels each way. Only when I was scrolling up was I able to scroll more than seven pixels. There is a noticeable flicker when going from the seventh pixel to the first. Is there a way to get a truly smooth scroll?

Andrew Werth

Because BASIC is relatively slow, you will always have a flicker when you scroll from one character to the next. To achieve a truly smooth scroll, you need to write a routine in machine language, which is far faster than BASIC.

64 Tape LOADs With Supermon

I have one of the many versions of Supermon64 (COMPUTE!, January 1983), which I have been running on my Commodore 64. I have used it successfully to assemble and run some simple machine language subroutines to move sprites.

My problem is, I cannot successfully save a BASIC program that includes these subroutines.

According to my *Programmer's Reference Guide*, I should be able to load the machine language routines from within the BASIC program by using LOAD "Machine Language Name",1,1. When I try this, it says PRESS PLAY, stops at the proper place, and says FOUND Machine Language Name. However, when I press the Commodore key, it won't load properly. It will run to the end of the tape if left alone. This leads to the following questions:

1. Does the Supermon program record the machine language programs in the proper format to be loaded as above?

2. Is there a way to force the Commodore key character into the keyboard buffer so as not to have that interruption?

3. I have a *Frogger* cassette from Sierra On-Line that has you load the program the same way that Commodore recommends for machine language, with LOAD "Frogger",1,1. Yet this program does seem to have a short BASIC program with a SYS command as part of it, that can be loaded in the normal BASIC way. How do they make both the BASIC and machine language sections load sequentially with the same LOAD command? And how do they make the program come up running, even though only a LOAD command was used?

Furthermore, is there a way that the Supermon program can be relocated, perhaps at the top of memory, so that the BASIC program can be written after the machine language is complete? As it is now, the beginning machine language parts of Supermon seem to come in just above the BASIC program section, at around \$0880. I have been able to resave the Supermon program on another tape without the problems mentioned earlier.

Also, I have seen in many programs the use of the memory location at 197 (decimal) to determine which key on the keyboard is being pressed. Although I see in my reference guide that this location holds the value of the key being pressed, that value does not correspond to either ASCII or screen display codes. I must assume that this is some sort of keyboard scan code, but I don't find a key to that anywhere in the reference guide. Can you outline this decoding for me?

John A. Schmitz

Jim Butterfield replies:

1. The .S (Save) command in Supermon64 writes program tapes which may be loaded from BASIC. Some special considerations:

a) Tape is written in a special "nonrelocatable" format, so that a simple LOAD "NAME" will return the program to the addresses from which it was saved. It is not necessary (but doesn't hurt) to say LOAD "NAME",1,1 since the tape format means that the program will never be relocated. By the way, this format tape may be read on VIC or 64, but not on PET/CBM.

b) Commodore machines have a bug that makes it virtually impossible to write tape from addresses above 32766 (hex 7FFE). Supermon doesn't fix the bug, so you cannot write useful tapes from high addresses.

c) If you have a BASIC program that contains a command to LOAD a machine language program, the load will take place correctly, but then the BASIC program will go back and start to execute from its first statement. This can give the impression that the computer is "locked up." The coding to get around this is quite easy:

```
100 IF A=1 GOTO 200
110 A=1
120 LOAD "NAME"
200 ... continuing
```

2. No. The computer looks at the "keyswitch" indicator (address 145) to see if you are holding down the key. In any case, the Commodore key doesn't ever go into the buffer; it's a type of shift key.

Newer models of the Commodore 64 will automatically continue a Load after a pause of a few seconds. Only the early models wait forever for you to tap a key.

3. Machine language can be "batched" together with BASIC so that both may be loaded in one shot. The most popular methods are:

a) Placing machine language directly above the BASIC program. Programs constructed in this way handle as easily as simple BASIC programs: They can be loaded or saved easily with no special knowledge. But the BASIC program must not be changed once the whole thing has been put together.

b) Placing machine language below BASIC. Programs constructed in this way must usually be loaded with LOAD "NAME",1,1 to avoid relocation problems.



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They are difficult to save, since the user must know the address at which the machine language program begins. An extra feature that can be implemented with this method: We can change some of the computer's "pointers" that lie below BASIC, and cause the machine to change its behavior. For example, pointers can be changed to make the computer "come up running."

Other questions:

Once you run Supermon, it will automatically relocate itself to the top of memory. You are free to return to BASIC and load new programs. Supermon may be recalled with SYS 8.

The value in 197 on VIC and 64 indicates the key being pressed as part of a keyboard x-y grid. Any value less than 64 indicates a key; 64 is no key.

It's probably best to use PEEK(197) together with the GET command. GET tells you which key; 197 tells you if it is still being held down.

"Atari Softkeys" Printer Utility

I've grown tired of typing myriads of CHR\$(X) printer control commands, and looked for something better. I checked through my files, and rediscovered Bill Wilkinson's program "Atari Softkeys" ("Insight: Atari," COMPUTE!, May 1982). This program is an ideal solution to my problem, except for the caution that the equates to the OS routines are for the Revision A ROMs.

I suspect that most people now have Revision B ROMs, so could Wilkinson (or someone) please provide the equate changes necessary for the program to run with Revision B ROMs.

G. J. Marrs

True, the majority of Atari owners now have the new upgraded Operating System (and many may not even know they do). The improvements required some changes, primarily in the interrupt handling system. Fortunately, both operating systems are fairly compatible, as long as no illegal calls are made. The Softkeys program required patching into some of those illegal entry points, so Wilkinson warned that his equates were for the Revision A ROMs.

As it turns out, none of the entry addresses required by the Softkeys program changed; Softkeys will run on either Revision A or Revision B ROMs. It won't run on the 1200XL, and likely won't run on any of the newer XL series computers, since more drastic changes have been made to their operating systems.

Load Errors With 64 CP/M

I have a 64 with a 1541 disk drive, and have just bought a Commodore 64 CP/M Cartridge. While making a backup copy of the CP/M System, I got a READ ERROR message. This error occurred on every attempt. I finally made a copy on my dealer's

disk drive. I don't have any problem with my disk drive in loading and saving other programs.

Also, while using the Editing Command such as ED SAMPLE.TXT to create a new file, I got BDOS ERROR ON A: BAD SECTOR, no matter which disk drive was used.

Would you please answer these questions:

1. Do I have a bad disk drive or a bad diskette of the CP/M System?

2. I intend to add a second 1541 disk drive instead of using a CBM 4040 dual disk drive. Will CP/M recognize them as Drive A & B?

3. Do I have to specify the computer and disk drive I use when ordering a COBOL Compiler?

W. P. Ling

1. This sounds like an alignment problem. If your 1541 is only slightly out of alignment, you may still be able to access most files without getting read or write errors. Alignment problems are more likely to show up when the drive accesses the innermost and outermost tracks of the disk. This is because the read/write head is at the limits of its range, and CP/M stores its system files on tracks 1 and 2, the outermost tracks. Since the system files are accessed frequently, correct alignment is critical if CP/M is to operate properly.

2. On the 4040, the drives are designated drive 0 and drive 1, which CP/M recognizes as drives A and B. However, if you connect two 1541 disk drives to your 64, both are designated as drive 0, with different device numbers (usually 8 and 9). Since CP/M looks at the drive number and not the device number to find drive A or B, it will not accept the second 1541 as drive B.

3. Yes. However, we know of no COBOL compilers currently available which operate under CP/M for the 64.

Return To BASIC From Machine Language

I am a VIC computerist, proficient in BASIC and learning machine language. I have a question.

When I have a BASIC program with machine language subroutines and control is transferred between them, what ways are there to transfer back from the machine language routines besides using BRK?

Drew Jenkins

The machine language instruction you want to use is RTS (ReTurn from Subroutine). The RTS command (\$60 or decimal 96) is a single-byte instruction that will transfer control of a machine language program back to BASIC.

It works like this. When a SYS command (branch to machine language program) is issued from within a BASIC program, the operating system automatically pushes necessary information onto the stack that tells the computer which BASIC line is to be executed next.

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Control of the program is then transferred to the machine language subroutine.

When an RTS is encountered within a machine language program, this "return address" information is pulled off the stack, and control is transferred back to the BASIC program at the proper place.

PET Printer TAB Solution

My computer system consists of a 2001 series BASIC 4 PET, MX100 printer, and 2130 disk drive. Most of my software was obtained from magazines, especially COMPUTE!. By extracting portions of many programs, I developed the programs I needed to keep track of rental property, income tax, and other business applications.

One problem I have is with tabulation. Tab works fine on the CRT, but poorly on the printer. However, I find my printer will tab properly if I include the line `A$=CHR$(141)` in the program and insert the variable, in this case `A$`, before the TAB statement.

When the variable is used, the printer tabs from the beginning of the line, and without the variable the printer tabs from the last cursor position.

Ernest R. Walker

```
5 REM SAMPLE PROGRAM :rem 243
10 OPEN130,4:CMD130 :rem 41
20 A$=CHR$(141) :rem 236
30 REM LINE WITH VARIABLE A$ :rem 86
40 PRINTTAB(10)"COMMODORE";A$TAB(20)"PET"
;A$TAB(24)"COMPUTER" :rem 155
50 PRINT :rem 242
60 REM LINE WITHOUT VARIABLE A$ :rem 81
70 PRINTTAB(10)"COMMODORE";TAB(20)"PET";T
AB(24)"COMPUTER" :rem 212
80 PRINT#130:CLOSE130 :rem 240
```

Calculating Branches

I have just started programming my VIC-20 with machine language. I don't have an assembler/monitor and I don't know how to calculate the offset for branch instructions. Could you please clear this up for me?

Keith Stout

The "offset" branches you've asked about (which include BCC, BCS, BEQ, BMI, BNE, BPL, BVC, and BVS) are easily calculated. The format for the commands is OPERAND / OFFSET, where OPERAND is the desired branch command (BEQ, BNE, etc.) and OFFSET is a single-byte value.

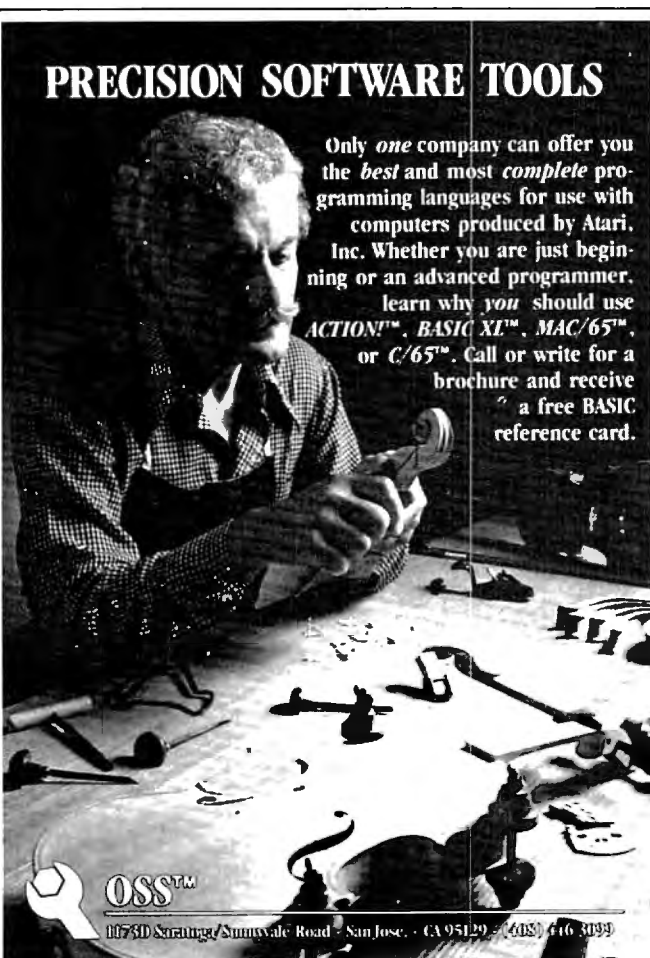
Whether branching forward or backward, the offset is calculated by counting from the next byte after the offset byte of the branch instruction. For an example, take a look at the following program sample.

```
1000 LDA $C000
1003 STA $FB
1005 CMP #$FF
1007 BNE $1000
1009 BEQ $1011
100B JSR $2000
100E JSR $3000
1011 RTS
```

The branch (BNE) at address 1007 is calculated by counting backward starting at address 1009 (the byte following the offset value). In this case, the offset value would be 256-9 or 247. Backward branches are calculated by subtracting the offset value from 256. The forward branch (BEQ) at address 1009 is accomplished by counting forward from byte 100B. In this case, the offset byte's value is 6.

Because the offset type of branch instruction uses a single byte for the offset value, the distance you can branch within the program is limited to 128 bytes backward and 127 bytes forward.

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



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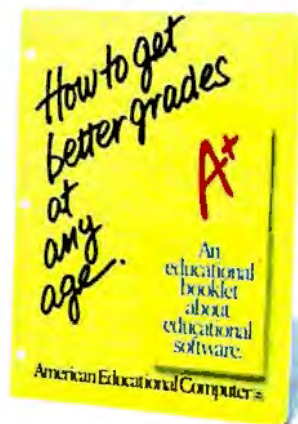
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All About Adding Peripherals

Ott's R. Cowper, Technical Editor

In the November 1983 issue we examined some of the factors to be considered when purchasing computer peripherals. This month, let's look at some add-ons available for home computers, how they work, and why you might want them.

Tape And Disk Drives



Mass storage devices—disk drives and tape recorders—are a necessity unless you're only planning to use cartridge software.

Tape units and disk drives really aren't luxury items—you've got to have one or the other, unless you're using only cartridge software or you're willing to type in a program every time you want to use the computer. The drives are called mass storage units because they allow you to store large amounts of information for later use.

Despite their different appearances, tape and

disk drives use a similar technology. Both create and interpret specific magnetic patterns on a special recording medium, the same process used in audio recordings.

In a tape drive, the recording and reading head is fixed, and the tape moves past it. As the tape goes by, the head can either create a new magnetic pattern on the tape (record) or interpret the magnetic pattern currently on the tape (read). A tape drive is a sequential device; to get to the last program on a tape you have to wait for all the preceding programs to pass by.

The Head Moves In A Disk Drive

You may understand a disk drive better if you think of the diskette as a circular slab of recording tape, which is just what it is. In a disk drive, the head is not fixed, but can move back and forth across the surface of the disk. The advantage of this is that the disk head, unlike a tape head, doesn't have to wait for the desired part of the recording to come along. Instead, it can jump directly to the spot on the disk where the desired information is stored. The drawback is that the disk drive's moving head must be positioned very precisely, to within a small fraction of an inch. It is this added degree of precision that makes disk drives more expensive than tape units.

Which storage device you choose is to some extent a matter of personal preference and to some extent is determined by your planned application. If you're only planning to store programs and small amounts of data, and you feel that waiting a little longer for programs to load is a good trade-off for a much lower price, a tape unit will probably

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The two slide-out shelves put the keyboard at the proper operating height while allowing easy access to the disk drives.

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The printer sits behind a fold down door that provides a work surface for papers or books while using the keyboard. The lift up top allows easy access to the top and rear of the printer. A slot in the printer shelf allows for center as well as rear feed printers.

Behind the lower door are a top shelf for paper, feeding the printer, and a bottom shelf to receive printer copy as well as additional storage.

Stand fits same computers as the CS-1632 as well as the Apple I and II, IBM-PC, Franklin and many others.

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A touch of genius.

be sufficient. Using tape might also be a good idea if children are the primary users of the computer. Cassettes, unlike diskettes, are sturdy and can withstand quite a bit of abuse.

On the other hand, if you are handling large amounts of data or if you don't want to wait several minutes for long programs to load, a disk drive is the obvious choice. For word processing, most users choose the disk drive because of the volume of data which must be stored and retrieved.

Also, if you will be purchasing software on a regular basis, consider the format in which most software for your computer is available. For example, most commercial software for those computers which do not accept cartridges is available on disk, which would necessitate a disk drive.

Disk And Tape Alternatives

Alternatives to tape drives and disk drives are available. For example, there's the stringy floppy, or wafer tape drive. Stringy floppies store data on tape, but the tape is in a loop and operates much faster than standard cassette. These devices usually cost more than tape drives, but less than disk drives.

For the really high-volume user who must handle very large amounts of data at very high speeds, there is the hard disk. The technology is the same as for diskettes, except that the recording medium is bonded to a metal plate that rotates at very high speeds.

Most hard disks are permanently mounted in their drives, although a number of models have been recently introduced for which the disk is in a removable cartridge. Many diskettes would be required to hold the amount of data which can be stored on a single hard disk, and the data can be stored and retrieved much faster. However, hard disk drives tend to be quite expensive, so they are common only among the most serious home computer users.

Game Controllers

Despite all the claims of utilitarian applications, most home computers are at least occasionally used to play games. Almost all games require the player to control some sort of action on the screen. While the keyboard is useful for entering programs into the computer, you will, unless you have exceptionally nimble fingers, find it only marginally acceptable as a game controller. Fortunately, there is a wide range of alternatives.

The most common game controllers are the ubiquitous joysticks. These come in two basic types. In joysticks for the Atari, Commodore, TI, and Coleco computers, moving the handle of the joystick closes one or two of four switches. If only one switch is closed, one of the four horizontal or vertical directions has been selected (left, right,



Game controllers come in a variety of styles, each of which has a different "feel." Shown here are paddles, a joystick, a trackball, and a pressure-sensitive controller.

up, or down). Pulling the handle in one of the four diagonal directions causes two of the switches to close simultaneously. Thus, these joysticks allow you to select one of eight directions.

Directional vs. Positional

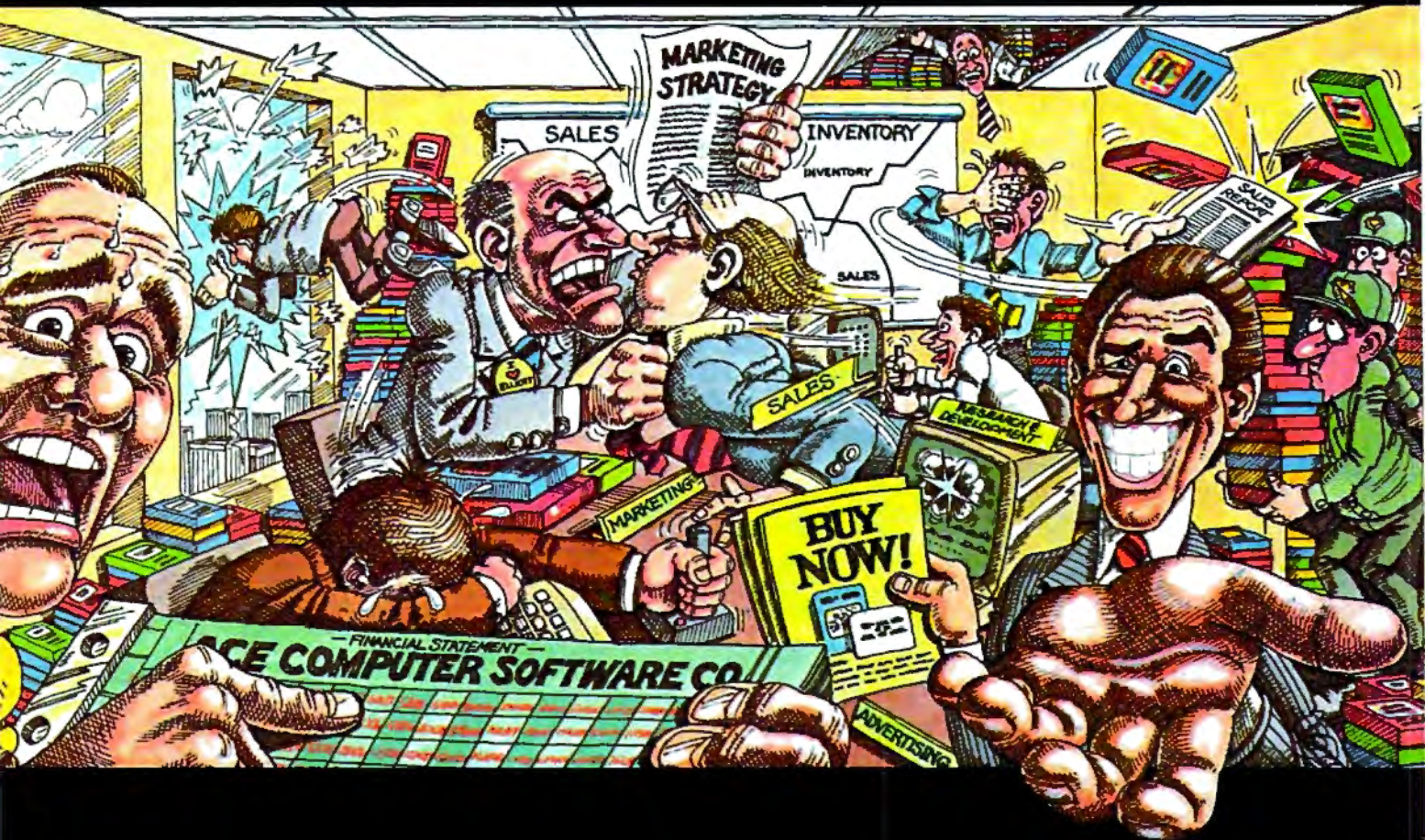
If we call the previous type a directional joystick, then the type used on the Apple, TRS-80, and IBM is a positional joystick. Moving the handle changes the setting of a pair of variable resistors, one on the horizontal axis and one on the vertical axis. This has the effect of changing the voltage level of the joystick output.

Though the switches in a directional joystick can be read directly as a number by the computer, additional circuitry is required to measure the voltage levels from a positional joystick and to calculate an appropriate value for the horizontal and vertical (X,Y) position of the handle. In a typical positional joystick, holding the handle in the upper-left corner produces a reading of 0,0. The upper-right corner is 0,255; the lower-left 255,0; and the lower-right 255,255. Values for other positions fall somewhere in this range, the center being around 127,127.

Many varieties of both types of joysticks are available, and choosing among them is strictly a matter of taste. Some joysticks have huge hand-grips, some have slim handles, and others have knobs on top. Some have a push button on the base of the unit, others have one on the handle, and others offer you a choice of either. Some people prefer heavy joysticks with firm handle motion; others prefer lightweight models with handles that move freely. Before selecting a particular joystick, it's wise to go to your local computer products dealer and take a few "test drives."

The next most common type of game controller is the paddle. A paddle is essentially half of one of the positional joysticks described above.

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The knob on the paddle controls a variable resistance, hence a variable voltage, which is translated by computer hardware into a number that reflects how far left or right the paddle is turned. Paddles are generally used in those games which involve only left-right or up-down movement, but not both. Paddle controllers usually come in pairs, but are not available for all computers.

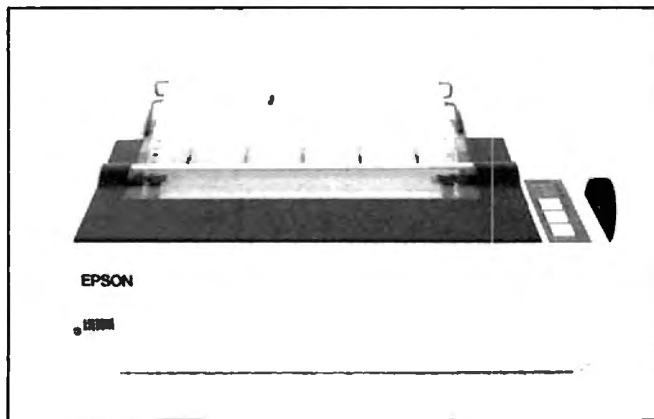
Some Specialized Controllers

The other types of game controllers tend to be highly specialized. For example, there is the trackball, which can be used in place of a directional joystick. Briefly, spinning the ball activates circuitry which produces the same effect as rapidly pushing the joystick in the direction that the ball is spun. Thus, the trackball can be a good replacement for a joystick in games that require rapid movement all over the screen.

Before you buy any game controller, take a minute to measure just how far from the computer you'd like to sit when you're playing a game. Then, when you pick out a controller, make sure its cord is long enough. Of course, if the one you want comes up short, joystick extension cords are available. Or, if you want to free yourself from all those wires, Atari has a joystick with no wires at all. A small radio transmitter, built into the base of the joystick, signals to a receiver which you plug into the computer's joystick port.

Printers

Printers are among the most popular peripheral devices, and most computer owners plan to add one sooner or later. Printers allow you to make permanent copies of program listings and output, as well as copies of screen displays and graphics patterns. As with all other peripherals, the avail-



A printer, among the most popular of peripheral devices, allows you to make permanent copies of program listings and program output.

able printers vary widely in price and quality.

There are three basic types of printers for home computers: thermal, dot matrix, and daisywheel. All function by accepting character

codes and translating them into printer commands to place the image of the desired character on the page. They differ in how the character images are produced.

The printhead of a thermal printer consists of a horizontal or vertical row of small electrodes. As the printhead moves across the paper (or, depending on the printer, as the paper moves past the printhead), the electrodes burn a tiny dark spot in the specially coated surface of the paper. The printer creates the dots in patterns that form the various alphanumeric characters, just as characters are formed on the video screen by lighting up tiny dots.

The advantages of thermal printers are that they are quiet, durable, and inexpensive. The disadvantages are that the special paper required is more expensive and usually a bit more difficult to find than regular printer paper, and some types of the paper tend to turn dark with age.

Dot-Matrix Printers

The concept behind dot-matrix printers is similar to thermal printers—in both the printed characters are formed from patterns of dots. However, rather than burning the dots into special paper, the printheads of dot-matrix printers have a vertical row of tiny wires or *needles* that strike an inked ribbon against standard paper. The number and size of the dots produced per character determine the printing quality.

The characters to be printed are formed within a grid, like the eight-by-eight grid used for designing characters on most home computer screens. A common arrangement is nine dots high by five dots wide. More dense arrangements allow for better character definition and hence better looking characters.

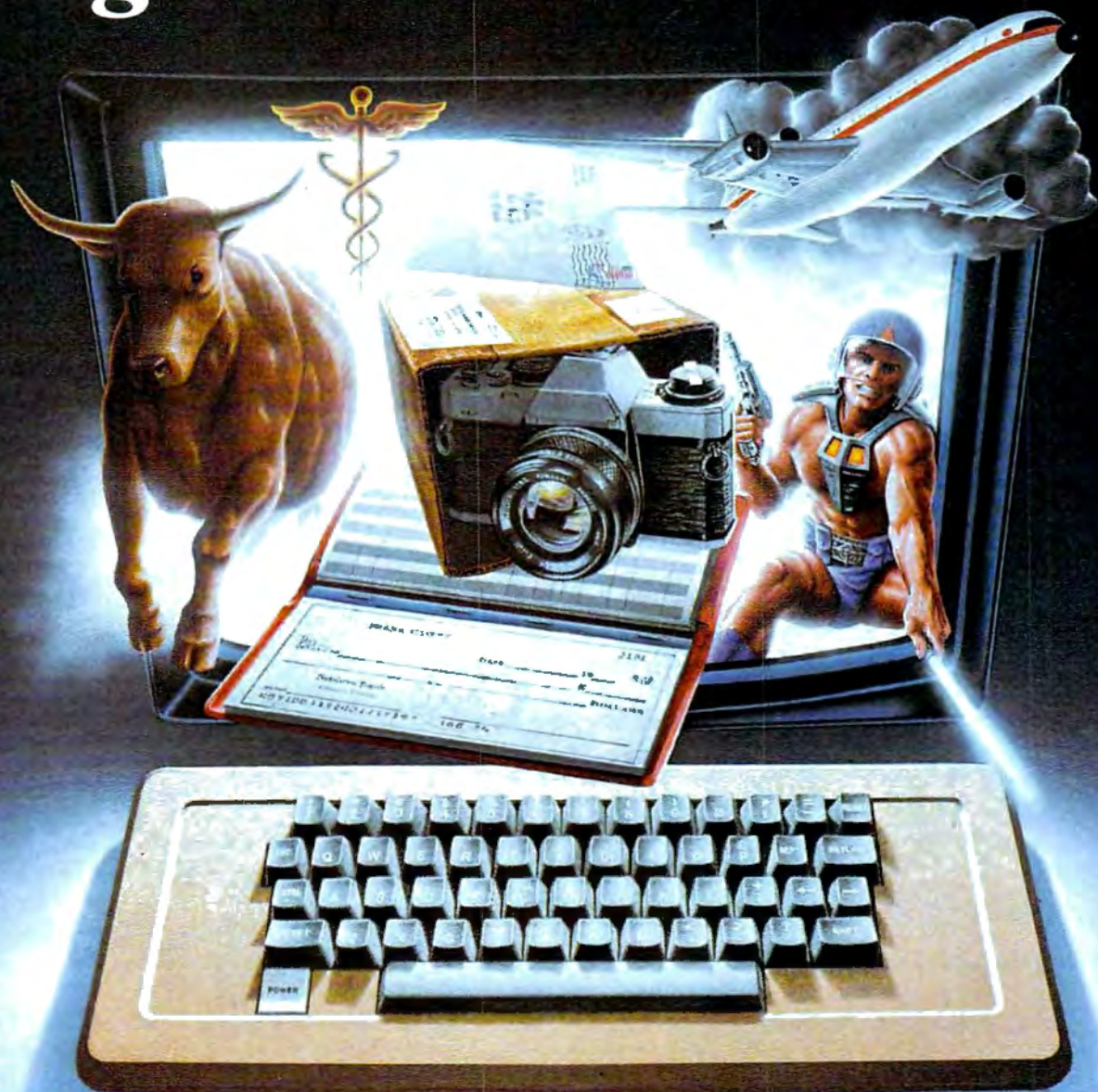
The daisywheel in printers of that type has the characters that can be printed arranged on the *petals* of the printwheel. It's as if someone picked all the letters out of a standard typewriter and arranged them in a circle. To print a character, the printer rotates the printwheel until the desired character petal is at the top, then strikes the petal against an inked ribbon just as in a regular typewriter.

Superior Print Quality

As might be expected, the printing quality of a daisywheel is also similar to that of a typewriter. Balanced against this superior print quality, daisywheel printers are both more expensive and, in general, slower than thermal or dot-matrix printers.

When deciding which type of printer to buy, consider how you will be using the printer. For example, if you simply need to whip out an occasional program listing, an inexpensive 40-column thermal or dot-matrix printer should suffice. If

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you wish to do word processing, you'll probably want a printer that can give 80 or more columns of output so that you can use standard paper. For casual writing or correspondence, a good quality dot-matrix printer is quite acceptable. However, a daisywheel printer is usually required for serious word processing which demands a professional, typewritten appearance. On the other hand, if you're interested in printing out charts and graphs or screen images, you'll need the graphics capabilities of the thermal or dot-matrix printer. In any case, try to see a sample of the printer's output before you buy so that the print quality won't come as a rude shock the first time you use it.

Serial And Parallel Interfaces

There are two methods of sending data to printers, serially (one bit at a time) and in parallel (eight bits at a time). Some computers allow printers to be plugged in directly, but most require special interfaces. You should choose the interface before, not after, you buy the printer, so that you can be assured of being able to connect the printer to the computer.

There's really no compelling reason to choose serial interfacing over parallel or vice versa, except that parallel printers are generally less expensive. Your computer could be a determining factor, since some computers have their built-in printer handling routines set up to prefer one method over the other.

Other types of printers are available. For example, there are dot-matrix printers which can print in a variety of colors. There are ink jet printers which produce exceptionally sharp characters on the page by spraying microscopic droplets of ink in carefully controlled patterns. There are even printers which use a laser to form characters which almost match the quality of typesetting. However, these printers are currently too expensive for most home users.

Modems

Modems (modulator/demodulators) are your computer's link to the outside world. They open to you the world of telecommunications, allowing your computer to exchange information with other computers.

A modem translates digital data from the computer into sound signals that can be transmitted over the phone lines, and converts sound signals from other modems back into digital data for the computer. There are two types: acoustic and direct connect. With an acoustic modem there is no direct connection between the computer and the phone line. The mouthpiece and earpiece on the phone handset fit into cups on the modem.



Modems let your computer exchange information with other computers via telephone lines. Direct connect modems plug directly into the phone line. With an acoustic modem, the telephone handset fits into a pair of soft cups.

A direct connect modem plugs into the phone line. Rather than creating audio signals, it impresses the equivalent electrical signals directly on the phone lines. This prevents the direct connect unit from picking up stray noises as data, which is sometimes a problem with acoustic modems. Plugging into the phone lines also makes possible several advanced features, such as auto-dial and auto-answer, whereby the computer can dial or answer the phone by itself. However, these features are found only on the more advanced direct connect modems.

Who Do You Want To Talk To?

To determine if you can use a modem, you must first ask yourself if there is anyone out there you and your computer want to talk to. There are several companies that specialize in providing telecommunications services to small computer owners, most notably CompuServe and The Source. Many modems come with information on accessing one or both of these services. In addition to the large companies, many computer clubs and user groups around the country maintain electronic bulletin boards that you can call for exchanging information, messages, and perhaps even programs.

If you have a friend with a computer and modem, you can exchange programs and messages directly between your computers. Keep in mind that unless there are a number of services you can use locally, you may find yourself running up excessive long distance charges to make use of your modem.

Memory Expanders

Memory expanders do just what they say: give you more memory for programming and storage. If you find yourself running into OUT OF MEMORY errors on a regular basis, or if you're planning an application which will involve the storage and manipulation of large amounts of data, you may want to consider purchasing one of these units.

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Memory expanders give you additional work room within your computer. Expanders range from simple memory chips to complicated boards with cartridge slots and reset buttons.

On the other hand, if you aren't experiencing these problems, you probably don't need any additional memory, unless you're troubled by the fact that your neighbor has more kilobytes than you.

The simplest memory expanders just give you more of what you don't have enough of, RAM (Random Access, or read/write, Memory) chips, along with the circuitry to determine the addresses of the new memory locations. These are for computers which haven't yet reached their full memory capacity.

There are also more sophisticated memory expanders for computers which already have as much memory installed as their microprocessors can address. These use a special technique called *bank switching*, whereby blocks of memory can share the same addresses as long as only one of the blocks is in use at a time. The blocks of memory that are not switched in will still retain data until they are again selected. This switching, of course, requires extra circuitry and hence extra cost.

Some memory expander packages, especially those for the VIC, add extra features such as cartridge slots and reset buttons. Some memory expander cards for other computers allow you to buy the card with less than the maximum number of memory chips installed, so you don't have to pay for all the extra memory at once, but won't need another card when you purchase additional memory later. Try to buy a card that holds the greatest possible number of memory chips so that future expansion will take no additional card slots. These are the sorts of features that you should consider when shopping for memory expansion.

Additional Input Devices

A number of peripherals are available which make it easier to communicate with your computer. These include the numeric keypad, the light pen, the touch pad, and the mouse. All provide ways

to get information into the computer without touching the keyboard.

Most home computers have keyboards like those of typewriters. This is fine for typing in text, but programming often involves entering lots of numbers. Here the typewriter keyboard fails, because having the number keys in a row across the top slows down your numeric typing. A numeric keypad is essentially a small second keyboard you plug into your computer. It has the number keys laid out in the familiar calculator pattern, with perhaps a few extra keys for additional functions. You'll need a program to allow your computer to read the keys. This add-on will be especially useful in financial applications where many figures must be entered.

The light pen is a device that lets you point to a location on the screen and have the computer know where you are pointing. To understand how it works, a short description of the TV display is in order. A video display is not a static picture. The image on the screen is actually flickering constantly, but at a rate of 60 times per second, which is too fast for your eyes to notice. An electron beam draws a series of stacked horizontal lines on the screen from top to bottom to form the display.

When you hold a light pen to the screen, the computer times how long it takes the beam to draw from its starting position at the upper left of the screen to the point where you're holding the pen. From this, the horizontal and vertical position of the pen on the screen can be calculated.

Using A Light Pen With Menus

Light pens are most often used with screen drawing routines. In fact, this is such a common application that many people don't realize that light pens can be used for anything *except* drawing on the screen. Even the name is somewhat misleading. Light pens are suited for any application which involves getting information on or off the screen. For example, a program in which the user must select an option from a menu on the screen could be set up so the user makes his selection by touching the light pen to the desired option instead of having to type in a letter or number to indicate the choice.

A touchpad is an input device consisting of a tablet with a square sensing surface. If you press down somewhere on the surface, the pad will provide a pair of values that represent the horizontal and vertical location of the point being pressed. The pad uses thin sheets of resistive film instead of a variable resistor, but the principle of operation is otherwise the same as that described for positional joysticks.

As with light pens, touchpads are most often used to create screen drawings. In fact, you've probably seen engineers on TV using very

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sophisticated touchpads and mainframe computers to do very complex designs like blueprints for cars or airplanes. The simple touchpads available for home computers can't match that, but the principle is the same.

The hottest new input peripheral on the computer scene is the mouse. A mouse is essentially a small trackball turned upside down. Mice (or mouses—the proper plural for the computer version has not yet been decided) are used to position



Light pens, touch tablets, and numeric keypads provide alternative ways of entering data into your computer.

a cursor on the screen. Instead of typing cursor control keys, you place your hand on the mouse and roll it up, down, left, or right on the table. The program using the mouse will cause the cursor to move accordingly. The mouse is supposed to be more user-friendly for beginners than the cursor keys, and mice are featured prominently in new software for such computers as the IBM PC and Apple Lisa. Experienced typists may find, however, that taking their hands off the keyboard to move the mouse is more distracting than using the keyboard cursor controls.

Exotic Additions

Speech synthesizers. Talking computers have long been a favorite of science fiction writers. Now it seems that their day has arrived. The production of speech by a computer is similar to the production of musical tones, except that instead of producing notes, the speech synthesizers produce *phonemes*, the sounds which make up basic units of human speech. By stringing these phonemes together, speech synthesizers can produce words. We've even seen packages that allow the computer to sing, play background music, and display a face which moves its mouth in synchronization with the song.

The limitations of speech synthesis in home computers relate largely to memory. The sounds of human phonemes are complex and require extensive programming to simulate. Also, the sound production capability of many of today's home computers is somewhat limited. Nevertheless, speech synthesizers are available now for most home computers, and as units with more

memory and better sound become available, the use of the synthesizers should become more widespread.

Speech recognition units. These are the opposite of speech synthesizers. Instead of allowing the computer to speak, they allow the computer to understand spoken commands. Speech recognition is not yet as advanced as speech synthesis because there are so many subtleties to human speech. For example, regional dialects cause people to pronounce the same word in different ways. Then there is the problem of words with different meanings which are pronounced the same or nearly the same, such as *for* and *four*, *eight* and *ate*, etc.

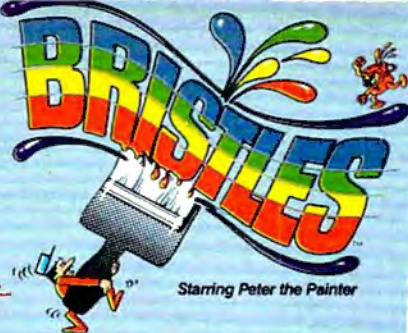
However, speech recognition units are available for several computers, and even a version of BASIC called SpeechBASIC to accept spoken commands. Since so much of human communication is based on the spoken word, the ability to talk directly to your personal computer would certainly make it more personal. Watch for progress in this area.

Plotters. A plotter is essentially a mechanical drawing arm. It consists of a pen which can move horizontally and vertically across a drawing surface under computer control. By carefully controlling the pen's movements, detailed drawings can be created. Sophisticated plotters can even select from several different pens for multicolor artwork. If you're interested in producing graphics of a higher quality than is possible with a dot-matrix printer, you may want to investigate the variety of plotters available. Be forewarned that some serious programming may be necessary to get your computer to produce draftsman-quality work.

Coprocessors. Adding an additional microprocessor to your computer is like giving it a second brain. For example, Z-80 microprocessor add-on boards are available for the Apple and Commodore 64 to allow those computers access to the wide array of software written for the CP/M operating system. A special math processor is available for the IBM PC to increase the speed at which mathematical calculations can be performed.

Many other types of peripherals are available for today's home computers. For example, there are interfaces which allow your computer to turn the lights in your home off and on at programmed times, or to adjust your home thermostat. Other interfaces allow your computer to control video cassette recorders. There's even a peripheral to allow your computer to monitor the temperature, humidity, and barometric pressure to forecast the weather.

This continuing stream of new products shows that we're still far from reaching a limit to what can be connected to a home computer. ©



designed by *Fernando Herrera*

Starring Peter the Painter

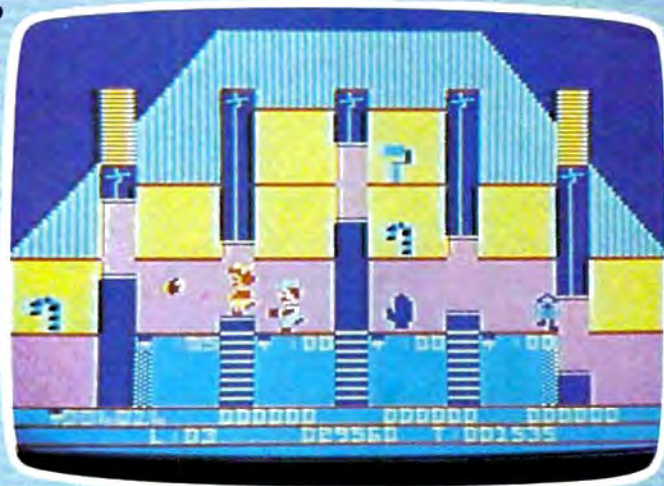
C-64 conversion by Adam Bellin

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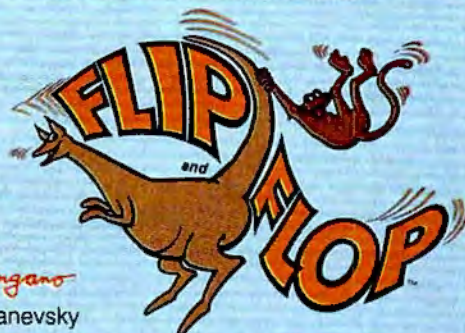
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A Printer In Every Kiosk?

Peripherals In The Year 1999

Kathy Yakal, Editorial Assistant

Is it compatible with my computer? Will I need to buy extra cables? What if I decide to buy a different computer a year from now—can I still use the same modem? The issues of standardization and compatibility are likely to change in the next decade. What's more, new technologies are continually appearing in each new generation of peripherals.

Purchasing the *right* peripherals for your computer can be complicated. The buyer must make some complex technical choices: IEEE-488. Hayes-compatible. RS-232. Requires 80-column card. Requires special cables (available separately). IBM-compatible.

A Package Deal

One possible response to the compatibility problem is to avoid third-party hardware manufacturers and buy everything for your system from the company which made your computer.

Coleco encourages this with their new Adam system. "The reason we're offering a package concept is that we perceived a great deal of confusion in the home market," says Barbara Wruck, director of corporate communications at Coleco. "Many consumers were buying inexpensive CPU's, only to find out that that's all they had—a CPU.

"It's important to give the new computer

owner every piece of equipment that lets them do it immediately, a system that is useful, easy to operate, and affordable." As an Adam owner grows in knowledge and needs new equipment, says Wruck, Coleco will continue to produce "carefully selected peripherals" to expand the power of the system.

Is this the answer to peripheral problems? "I think the consumer is saying that it is," says Wruck. "We believe this is the correct approach."

Like Buying A Stereo

Others disagree with this approach. "I think there will continue to be a niche for people who want to buy things separately and put together a system themselves," says Dan Baker, research manager for disk manufacturer Percom Data. "It might be the way component stereos are," he says. "You have different performance criteria for each piece to fit your needs.

"However, the move toward portable computers is something of a package concept, where you have built-in peripherals. This isn't necessarily a trend—it just shows that you can include storage in the main package."

A Standard

Buying any computer, disk drive, printer, and modem and having them work together at once might seem like high-tech heaven, but it's not

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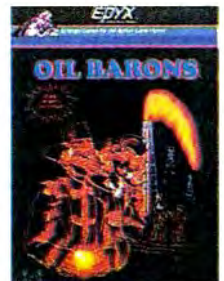
Obstacles like government regulations, well fires, and hurricanes complicate matters, but the fun of increased land holding, striking it rich, and even unloading worthless parcels on the uninitiated, more than make up for the setbacks.

One to eight players, 4 color gameboard and playing pieces included, keyboard controlled.



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Strategy Games for the Action-Game Player



likely to happen. "I have thoughts in both directions," says Robert Pearce, director of marketing for Comrex, a subsidiary of Epson.

"As technology advances, that will wipe out any standardization that existed before," he says. "New technologies generally don't conform to the standards of the previous one. There *could* be standardization for a while, but then a new technology comes along and requires a whole new set of standards."

Next year more modems will be manufactured than have been built to date.

"If some uniform compatibility code does emerge, it will be because the masses force it. That may have to happen in order for computers to have the mass appeal that they lack now. If nothing else, at least in packaging, like Coleco and IBM have done."

Interfacing Your Computer And A Stereo

In 1999, it may be that electronic equipment which we don't now consider computer peripherals will act as such. Home entertainment equipment is an example.

To a degree, you can do some interfacing now. By hooking up a couple of cables, you can play *Missile Command* on your Atari 800 and hear the sound through your stereo.

For more sophisticated kinds of interfacing, special cables or cards may be necessary. Digital Controls, Inc. has a line of interface cards that turn videodisc players into microcomputer peripherals. An Apple II interface card is available for \$500, and a generic RS-232 interface for \$865.

A Different Approach

Telecommunications will most likely be a part of everyone's life by 1999. Presently, a home computer owner has a wide choice of modem, but there is an equally wide variation in compatibility. Some modems are completely compatible with one computer; but require special cables and interfaces for another computer.

B. F. Kessler, president of modem manufacturer Novation, Inc., feels that the answer to

compatibility lies not in hardware, but in software. He points out that technology is changing so rapidly that modem makers are having a difficult time designing one generation of products that is compatible with the next.

"The fact that all modems should be compatible is obvious," he says. "But with an industry still in its infancy, it would seem stifling to set hardware standards that could become obsolete overnight."

Kessler believes that a good programmer is well equipped to solve compatibility problems. The emphasis should be on getting programmers to include software commands for expansion and compatibility with all popular protocols.

"Personal communication via microprocessors is gaining momentum at an amazingly rapid rate," says Kessler. "Next year more modems will be manufactured than have been built to date. Inevitably, new designs and technology will be introduced. And the marketplace will continue to respond positively to appropriate innovations."

"It will be far easier for software programmers to keep up with state-of-the-art than it would be to shackle hardware manufacturers with compatibility standards that undoubtedly would hinder rather than help the growth of the modem marketplace."

Visible Beginnings

Remember the scene in the movie *Blade Runner* when Harrison Ford needs to zoom in on a small area of a photograph and make a reproduction of it? There's nothing resembling an Apple IIe in his apartment, and no keyboard is visible anywhere. He sits down in front of some kind of electronic console, talks to it and tells it what he wants, and he ends up with a blowup of a tiny corner of the original that was barely visible to the naked eye. In seconds. Without touching anything.

High science fiction, certainly. Yet voice recognition is possible now. You can buy a Lang Systems, Inc., unit called the Videoslide 35 that will let you photograph the images on your computer screen and turn them into slides in less than an hour.

"The equipment is already here to accomplish many of the things that won't necessarily be commonplace for many years," says Comrex's Pearce. "We have high-speed modems that can transmit data from urban area to urban area, but it will be a while before we can give that kind of service to rural communities. Whether we continue to use the phone lines or switch to something like satellite communications, we'll still be using something like the modems we're using today."

A printer in every kiosk? "That's already happening to a certain extent, at places like automatic teller machines," says Pearce.

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"I suppose you might find printers in places like phone booths, say to print out time and charges after a call," he says. "But I think it makes more sense to have a credit card number and get a printed bill at the end of the month instead of carrying around all those little slips of paper."

People, Not Peripherals

Emphasis on consumer education will help people deal with compatibility and sophisticated peripherals, Pearce believes. "I would like to see more education of the masses. I'd like to see dealers really taking care of customers.

"The computer is a sophisticated piece of equipment. Consumer confusion is partly the manufacturer's fault. He says, 'Here, just touch this screen, press this button. It's easy to use!' That only frustrates people when they find out it's not.

"I don't think we're going to see the trend of packaged systems go very far. I've always liked the concept of components—they give the consumer limited flexibility. There will always be a peripheral market." ©

This Publication is available in Microform.



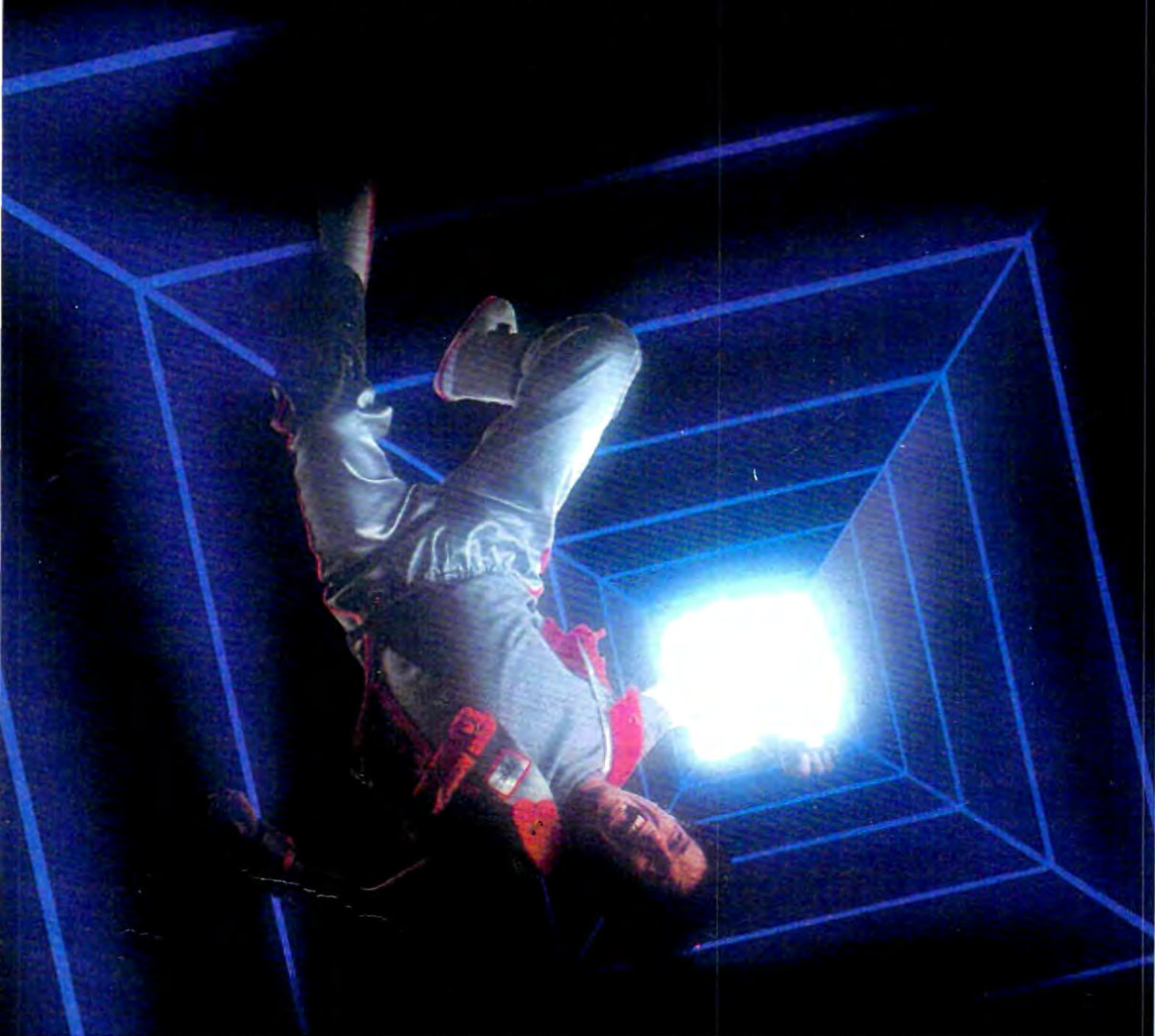
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Modern Memory: The Future Of Storage Devices

Selby Bateman, Assistant Editor, Features

Big business is already using microfloppies, Winchester discs, and laser technology for data storage. As some of these innovations filter down to the home computer market, your tape recorder could become as obsolete as a paper tape punch.

Linda Helgerson was up to her ears in floppy discs. Something had to be done. Three or four hundred of the 5¼-inch discs were stored in her home—row upon row of mailing lists, bibliographical data, and spreadsheet analyses.

"I just didn't have enough storage. My mailing list itself was on five floppies that had to be merged," says Helgerson. "There's just no way I could manage that amount of data using floppies."

After a careful study of her needs, she purchased a 10-megabyte hard disc drive. The result has been dramatic. Since she put her mailing list on the hard disc system, she has added another 6000 names, and there's still plenty of room to spare.

Mass Storage Isn't For Everyone

As head of her own northern Virginia consulting company, which is run out of her home, Helgerson admittedly has extraordinary storage needs. The two TRS-80 Model 3 computers which serve her business, Quarry Hill, Inc., also double as teaching

tools, game machines, and word processors for her two teenage daughters.

Helgerson is one of a growing minority of personal computer users who are finding that their needs are not met by minifloppy disc or cassette tape storage systems. Newer, faster, larger-capacity storage devices aren't yet available for home computer users. But industry observers are seeing the first real stirrings of interest in those products among the more adventurous home computer owners.

Whether you need a different storage system now or not, it's worth knowing about *perpendicular recording, microfloppy discs, interactive videodiscs, and Winchester disc drives*. They'll be increasingly important to future home computing.

First, The Bad News

For those who have mass storage needs like Linda Helgerson's or who are dedicated computer hackers itching to use the latest technological innovations, there is some bad news and some good news.

The bad news, says Jim Porter, editor of the respected annual market study *Disk/Trend Report*, is that advances like microfloppy discs and inexpensive hard discs for the home market are at best several years away. And even then, Porter is doubtful there will be a large enough body of computer users who will want the products.

The good news, he adds, is that somebody

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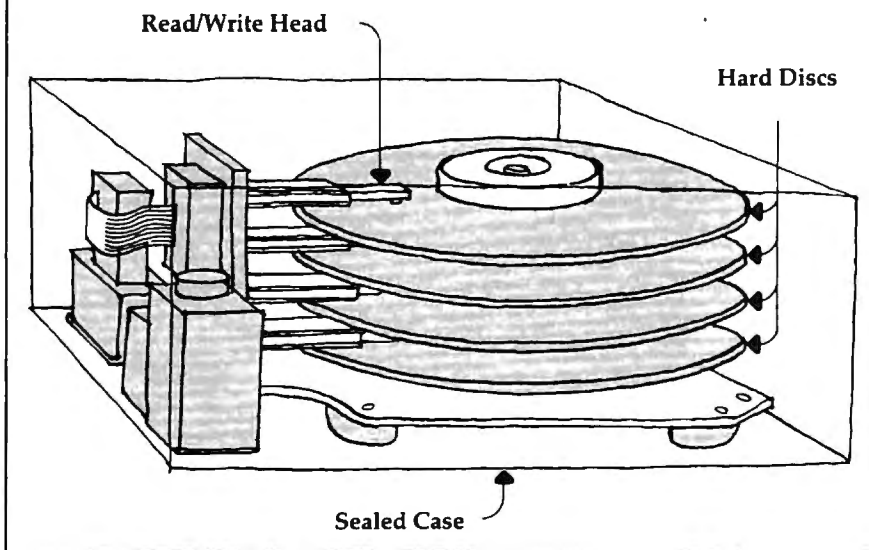


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Figure 1: A Hard-Disc Drive



data storage. The floppy disc (or diskette) is a random access device, in which both the read/write head and the disc move. In its protective paper sleeve, the disc is inserted into a disc drive, where it spins at about 300 revolutions per minute while the head seeks out the requested information anywhere on the surface of the disc.

Hard Choices

A typical 5¼-inch minifloppy disc might contain as much as 350–400K (kilobytes, or 358,400–409,600 characters) if the tracks on which information is stored are on both sides of the disc and densely packed. Many 5¼-inch discs are single-sided, single-density, and hold about half

somewhere is probably working right now on the product you want. "I really think in the small computer area almost every whim will be responded to. And if something has a following there, then the response will be fairly prompt. I've seen it over and over again. It's hard to see how any niche will not be checked out."

Before we look at some of the most important trends in storage, consider where 99 percent of us are today.

Tape Or Disc Most Common

Virtually all home computer users now have either a tape drive system or a floppy disc drive. Both of these devices use a magnetic coating that records the electronic signal from a computer. When you tell the computer to store something on either tape or disc, it writes on the magnetic medium by magnetizing small areas in a form of binary notation, magnetic ones and zeros. Once these areas are magnetized, they have a self-locking mechanism which preserves the integrity of the stored information.

As computer owners quickly find out, a tape recorder is the least expensive memory storage device. But what you save in money you pay for in time. In order to find something, the tape must physically pass in front of the stationary read-write head so the recorder can check each byte of data, in a sequential search.

Computer users did not relish waiting while the tape drive did its work, and that led to the introduction of disc drives for home use.

First developed by IBM in 1965 in an 8-inch format, then adapted by Shugart in 1976 to the familiar 5¼-inch size, floppy discs have quickly become the medium of choice for microcomputer

that much.

Compare that to the hard disc drive, often called a Winchester drive, which Linda Helgerson purchased. Storage capacity for that drive is 10Mb (10 megabytes, more than 10 million characters) of data.

Hard disc drives cost more (Helgerson's was close to \$2000) and have been used almost exclusively in business settings, where large quantities of information must be stored and retrieved quickly. As their name implies, hard discs are rigid. They are made of aluminum (also in 8-inch and 5¼-inch sizes) and are permanently sealed inside a case. Although some hard discs can be removed from the drive, most cannot. The hard disc spins at faster speeds (usually 3600 rpm) than a floppy, and the read/write head actually floats just above the disc rather than directly contacting it as with floppies. Hard discs also have faster access times.

More Interest Than Need

Why not use a hard disc for your home computer?

"We've had more than just casual inquiries about hard discs for the Atari 800," says Bob Gerwer, vice president of marketing for Percom Data of Dallas, Texas. "The people who originally bought the 800 were genuine hackers. And the ones who bought it for four or five hundred bucks have got a lot invested in it. Now, some of those people are interested in hard discs."

Kevin Burr, director of communications for Shugart, a company that has been a leader in the original equipment manufacturing (OEM) industry, reports that his organization has also seen some limited interest in hard disc drives for the home market.

"But it's not a dramatic increase of interest,"

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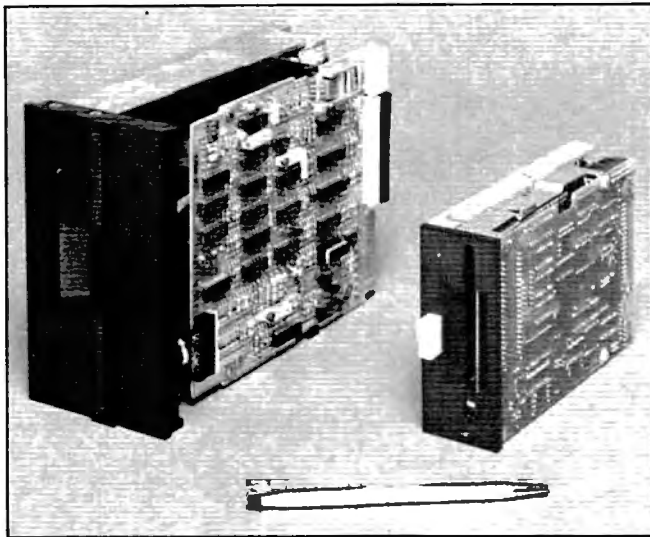
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he cautions. "A home user typically does not need that kind of capacity. I think it's more of a novelty rather than a strong need from those users."

Hard Discs More Delicate

At the Tandon Corporation, which during 1983 reportedly had about a 60 percent market share of the \$4.3 million 5¼-inch floppy disc drive industry, marketing manager Bob Abraham concurs with Burr about the immediate future of hard discs in the home.



Shugart's 3½-inch SA300 (right) is a single-sided microfloppy drive offering 500K bytes of capacity. It is compatible with the standard 5¼-inch minifloppy disc drives.

"The hard disc just doesn't lend itself to the home environment. I think the industry as a whole has to learn and to educate the user about the care and feeding and handling of hard disc systems. It's really a very different ball game."

One of the problems with a hard disc system for home use is that since the head floats just above the disc, it jars easily and is susceptible to crashes. When a floating head is only .0001 of an inch from a disc, a human hair takes on the dimensions of a felled sequoia. Even a puff of smoke could cause a head crash.

"I guess I would have to say that in the long term, there will be ruggedness built-in. The drives will be well-protected and shock-mounted," says Abraham. "And to a large extent, there will be a greater degree of user education. People will just learn that they'll have to be a little more careful with those kinds of things."

Microflopies For The Home

While industry observers are less than optimistic about the future of hard discs in the home, that is not the case for the microfloppy disc.

"There's a great deal of movement in the industry toward smaller devices that won't sac-

rific performance," says Tandon's Abraham.

Adds Shugart's Kevin Burr, "The home market is going to be the key audience for the microfloppy. That's why it was developed."

Microflopies, floppy discs either 3, 3¼, or 3½ inches in diameter, have been a hotly debated topic in the microcomputer industry for several years. Disagreements center not on whether microflopies are a good idea, but on what size should be standard. The question is still open, but the 3½-inch microdisc appears to have an edge.

A Standard Is Emerging

"We feel the standard has now been reached, particularly with the recent signing of Apple and Gavilan in a 3½-inch format," says Burr. "And IBM is rumored to be following suit."

"It is probably already the de facto standard in terms of volume and production. Shugart and Sony are the only two manufacturers currently shipping products in volume. We have a lot more products out there than anybody else."

By the end of 1983, Shugart alone expects to have shipped about 10,000 microfloppy products.

Several Advantages

There are several reasons why microdiscs are attractive for home computer data storage. Because of the ability to pack data magnetically in a more compact area, microflopies can already equal the storage capacities of 5¼-inch or even 8-inch discs. They are less susceptible to temperature and humidity changes and, when packaged in hard plastic-and-metal casings, are less prone to damage. They are particularly suited for use in portable computers where space is at a premium.

While the question of a standard size and available software for the microdiscs may hold back development slightly, there is every indication that microdiscs are on the way to the home. But how soon?

"There will be only a gradual build-up in the total number of microflopies shipped," cautions industry analyst Jim Porter. "And as for their use with the home computer, for the next several years microfloppy drives are not likely to be lower in cost than equivalent quantities of minifloppy drives."

Vertical Recording Devices

Advances in magnetic media technology will also help to prepare the way for microflopies. One of the most promising new developments is in perpendicular, or vertical, recording.

Significant increases in storage capacity can be achieved by aligning the magnetic particles on a disc in a vertical pattern rather than in the longitudinal arrangement presently used. While

A million laughs

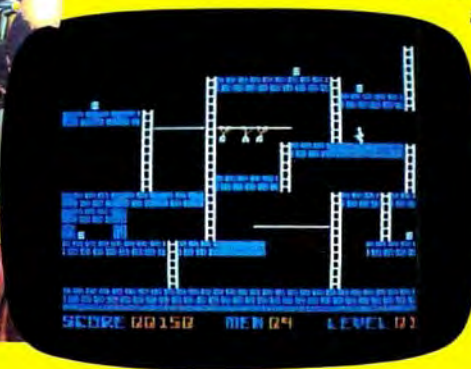
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proponents of vertical recording maintain that products will be on the market within the next year, how soon can owners of home computers expect to find them in stores?

"You're not likely to see perpendicular recording used in products in the home for quite a while," says Jim Porter. "It's probable that flexible disc drives using perpendicular recordings will be shipped by early 1985 in limited quantities. But they'll be the furthest thing from mainstream. There will not be many producers, and the technology is likely to be fussy for quite a while. It probably will end up mainstream, but I think you should be thinking in terms of the end of the decade."

One of the leaders in vertical recording is the Minnesota-based firm, Vertimag Systems. Later this year, the company plans to market a vertical recording system with over six and a half megabytes per 5¼-inch disc. "We're just at the beginning of this technology," says a Vertimag spokesperson. "Just imagine what it will be five or ten years from now."

Although there are very few American companies in the perpendicular recording field, the Toshiba Corporation of Japan is expected to market a vertical recording system, probably sometime in 1985.

An Interactive Dragon On Videodisc

Last year while on a trip, Kent Wood, who directs the Videodisc Innovations Project at Utah State University, glanced into a videogame arcade and saw most of the machines deserted. Around one of the consoles, however, stood a crowd of people watching a new game called *Dragon's Lair*. With color video quality far superior to the surrounding games, *Dragon's Lair* offered 38 short action-adventure scenes with a total of 200 different decisions confronting the player before victory could be achieved.

The crowd around the machine that day didn't surprise Wood. The colorful animated game is based on a Pioneer PR-7820 interactive videodisc system. About 14 minutes of the 30-minute capacity of *Dragon's Lair* is interactive. That is, decisions that a player makes cause the laser beam that reads data off the disc to jump to different positions on the disc itself.

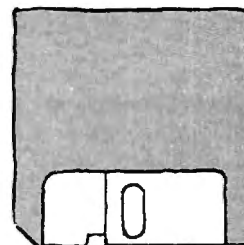
Wood doesn't believe he saw just a crowd around a game machine that day. He believes he saw the future. The next step will be low-cost videodisc systems that will be brought into homes as peripherals for personal computers as well as part of overall home information and entertainment centers.

But first, he says, people must have a greater understanding of the possibilities.

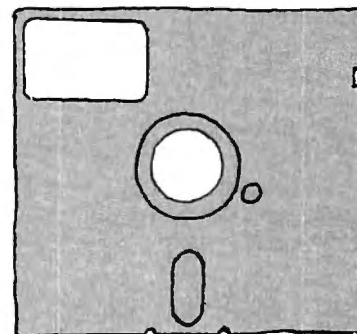
"As the level of sophistication increases in

Figure 2: Common Disc Types

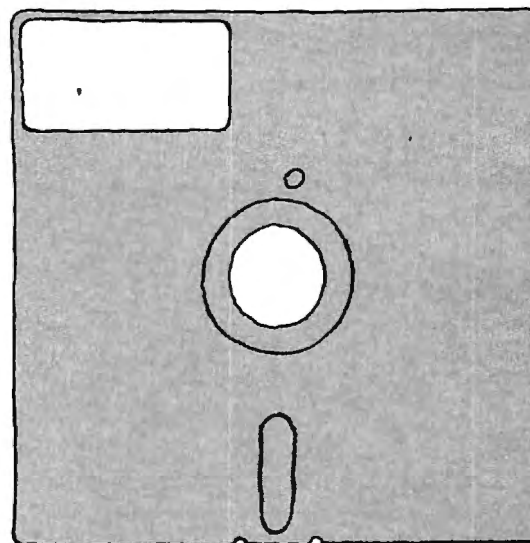
3½-Inch Microdisc



5¼-Inch Floppy Disc



8-Inch Floppy Disc



the home market about the potential of interactive video, it will overcome the people limitation. When we compare 1984 with what we had when we started in 1977 and 1978, the technology has advanced remarkably. And it will continue, though not quite as fast."

Reading The Pits

One of the most promising forms of videodisc technology is optical recording. A laser writes on the disc by burning tiny pits into the surface. A second laser then reads the pits. No head comes in contact with the disc, so wear is reduced. And videodiscs can hold immense amounts of information, say, 4000 megabytes (4 gigabytes, more than 4 billion bytes). An entire set of encyclopedias can be put on a videodisc.

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But to be truly interactive, a videodisc must be able to withstand repeated rewritings, just as magnetic disks do. In burning a pit into the surface of a videodisc, however, the laser eats away some of the material.

Magneto-opticals is one of the possible solutions.

Erasing With A Laser

In magneto-opticals, the laser is used to heat a special coating until it reaches the Curie point (named for Madame Curie), the temperature at which magnetic materials revert to a neutral magnetic orientation. Information is added or erased in this manner. A second, weaker laser, using a polarized filter, then reads the materials. Wedding the laser to magnetic media in this way means vastly reduced wear on the videodisc and allows repeated rewritings.

"It's a strange kind of marriage between optical technology and magnetic technology," says Porter. "Many companies have been working in the area, such as IBM, Phillips, Xerox, and several Japanese companies."

While magneto-opticals and another laser-writing experiment called *phase-change* have been demonstrated in the laboratory, Porter says there are quite a few difficulties in making them producible. Commercial products using either technology are at least several years away.

Videodisc For The Commodore 64

Videodisc systems are being used on a growing basis with computers for job training, education, and data base archives. There are a number of compatible systems currently being marketed, but they can be expensive.

For owners of Commodore 64 computers who want to go interactive, Micro-Ed, Incorporated of Minnesota offers a product called Lasersoft, an interactive videodisc microcomputer instructional system aimed at the low-end market.

The system is designed to work with a Commodore 64 with 1541 disc drive, a color monitor, Pioneer 8210 videodisc player, and the Micro-Ed controller box, which links the computer and the videodisc player. The company plans to make the controller box available for other computers as well.

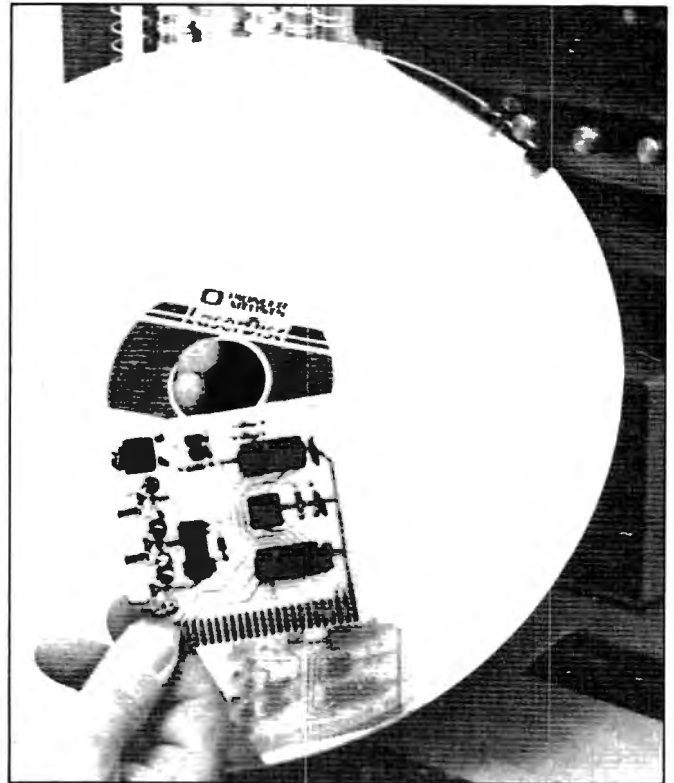
Marketed at under \$200, the controller box enables the computer to access at random any of the thousands of frames on the videodisc and present them on the monitor. (Micro-Ed, Incorporated, P.O. Box 444005, Eden Prairie, MN 55344, (612) 944-8750.)

LaserDisc Interface For Apple

Another company, Anthro-Digital, Inc., offers a \$275 Omniscan LaserDisc interface which connects an Apple computer to a Pioneer, Sylvania,

or Magnavox LaserDisc. Omniscan allows the computer to duplicate the functions of the videodisc control panel, but under programmed control. (Anthro-Digital, Inc., P.O. Box 1385, Pittsfield, MA 01202, (413) 448-8278.)

Judith Paris, who edits the quarterly trade publication *Videodisc/Videotex*, believes that the increase in use of videodisc players as microcomputer peripherals depends on the availability of inexpensive generic interfaces and software to control the videodisc player.



Anthro-Digital, Inc.'s Omniscan LaserDisc interface for use with an Apple computer and appropriate videodisc systems.

She estimates that by the end of the 1980s, government agencies and the armed forces will often be using interactive video systems for archival purposes and training devices. Increasingly, large companies are moving to more sophisticated use of integrated information systems with interactive video.

A Solid Market Base

"The videodisc industry is still in search of its identity," says Paris. "But the fact that government is pushing it, and that business systems are developing a lot of uses that will have an impact on home use, means that it will really start coming into its place."

Jim Porter agrees. "There are companies putting together hardware using videodiscs and computers for business to make data bases, store digitalized material for character-by-character retrieval, and sometimes for the creation of im-

ages. These include a lot of training areas and management functions.

"I really doubt that there's much real demand to have, say, the *Encyclopaedia Britannica* available on your personal computer. It's going to take a lot of experimentation and entrepreneurial effort to find out just what people will want to buy."

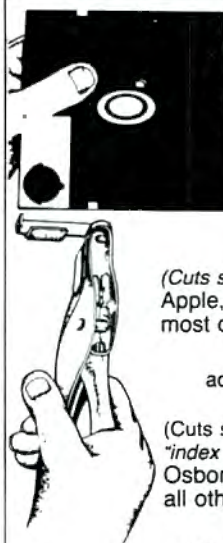
A Cloudy Crystal Ball?

In forecasting computer industry trends, the future must often be measured in months, not years or decades. That can turn even the best crystal ball cloudy. As Porter notes, in the free-market competition of the microcomputer field, anything can happen.

"So-called predictive research is usually not worth the powder to blow it up," he says. "When someone is asked to put up money to buy some specific thing and then that individual establishes his own priorities as to where he's going to spend his money, that's a lot different from saying 'Would you like to have....?' in a questionnaire."

Personal computer owners should have plenty of opportunity to show what they do and don't want in the field of mass storage devices, he concludes. "There are literally hundreds of small operations out there that will do these things. And if they've got what people want, it'll blossom." ©

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Coleco's Adam: A Hands-On Report

Selby Bateman, Assistant Editor, Features
Tom R Halfhill, Features Editor

Coleco's long-awaited Adam, first promised for delivery early last fall, began appearing on retail shelves in limited quantities by mid-October. The company is counting on a combination of low price (initially \$600, now \$700) and attractively bundled hardware/software to capture a significant segment of the home computer market this year. Here's a hands-on look at Coleco's entry into this crowded field.

Since its first appearance at the 1983 Summer Consumer Electronics Show in Chicago, Coleco's Adam has stirred great curiosity among consumers and has forced competitors to change some of their marketing strategies. Suddenly, bundled seemed better. The Adam's grouping of computer, detached keyboard, daisy wheel printer, high-speed cassette drive, joysticks, and software prompted announcements of similar packaging options from Commodore, Atari, and others almost overnight.

Coleco launched the Adam with a multimillion-dollar advertising campaign, including TV commercials and lavish color ads in leading magazines. Unfortunately, the Adam was never shipped in sufficient quantities to satisfy demand before Christmas. A few retail chains reportedly backed away from planned Christmas ads for the Adam because of the delayed deliveries.

Since then, Coleco has run up against quality-control problems and bugs in early production models. One major department store chain, J. C. Penney, announced in December it was not carrying the Adam because of problems with quality control. We'll get to this in a minute.

The System Approach

There are two functionally identical versions of the Adam. You can buy the whole system from scratch for about \$700, or get an expansion package for about \$500 that converts a ColecoVision videogame machine into an Adam. Thousands of ColecoVision owners may be predisposed to buy an Adam instead of another home computer. The Adam even runs all the ColecoVision game cartridges.

When you buy an Adam, getting it home is a challenge because everything comes packed in one huge box that barely fits into today's economy cars. Inside the box is the Memory Console, a low, rectangular enclosure which contains the Central Processing Unit (CPU) and the Digital Data Drive (a high-speed cassette recorder); a 75-key, full-stroke, detachable, typewriter-style keyboard; a letter-quality daisy wheel printer; two joystick controllers with built-in numeric keypads and coiled cords; enough cables to hook everything together; three digital data packs (cassettes); plus three manuals and two reference guides.

Two of the data packs are prerecorded: One contains *SmartBASIC*, the Adam's standard programming language; and the other is *Buck Rogers Planet of Zoom*, an arcade game. The third data pack is a preformatted blank tape. Besides this software, the Adam itself contains a built-in word processing program, *SmartWriter*. Accompanying booklets include *Getting Started: Adam Set-Up Manual* (64 pages); *Programming With Adam: A Simple Guide to SmartBASIC* (222 pages); *Typing With Adam: Using Easy-to-Learn SmartWriter Word Proc-*

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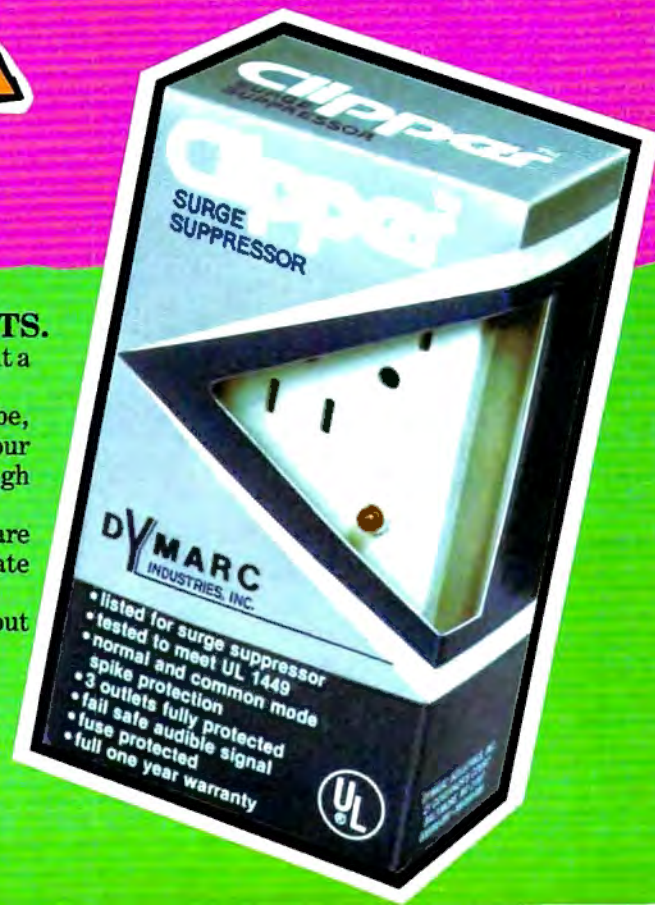
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essing (101 pages); *Adam SmartWriter Easy Reference Guide*; and *Adam Super Game Pack* (instructions for the arcade game).

As the advertisements promise, you get a complete computer system that is ready to run and do something useful when you first get it home. That fact, plus the attractive package price, may well be Coleco's strongest selling point—competitors require you to add some extras separately.

The alternative "separate components" approach to building a home computer system would allow more freedom to choose certain peripherals and software, since you can buy compatible products from independent manufacturers. If assembled correctly, the resulting system may well outperform a comparable system made up of a single manufacturer's components. On the other hand, there are many products available, and compatibility can be hard to ascertain. Many people (especially beginners) feel more comfortable buying a prepackaged system. The Coleco Adam is aimed at the latter market.



The Coleco Adam comes with everything shown here, plus software and manuals.

Adam's Features

For the money, the Adam's features look impressive. It comes with 80K of Random Access Memory (RAM), which Coleco says will be expandable to 144K in the future. A Texas Instruments sound chip and a TI graphics chip endow the Adam with three sound channels, 16 colors, and 32 sprites (programmable screen objects for animation). The Memory Console has three internal expansion slots and one external expansion connector (although no expansion modules are yet available); a topside slot for ROM cartridges and Coleco-Vision games; connectors for the joysticks, printer, keyboard, TV, a monitor, and auxiliary video; and room for a second Data Drive (not yet available).

The keyboard is impressive, particularly given the system's price. The keys are sculpted Selectric-style and have a nice feel. Many keys are specially labeled to work with the built-in word processor. For instance, when the computer is first switched on you can boot up SmartWriter simply by pressing the ESCAPE/WP key in the upper-left corner. Other dedicated keys include MOVE/COPY, STORE/GET, PRINT, UNDO, WILD CARD, CLEAR, INSERT, and DELETE. In addition, there are six special function keys with preprogrammed functions for SmartWriter. Four independent cursor keys are arranged in a convenient diamond pattern around a HOME key. Lightweight and fairly flat, the keyboard can rest in your lap while connected with its coiled phone cord to the Memory Module. A plastic attachment snaps onto the side of the keyboard to hold one of the joysticks.

The Coleco printer has been widely criticized as noisy and slow (ten characters per second is much faster than most people can type, but annoyingly tedious for a printer). However, you'll have to balance these debits against the much

higher cost of buying a daisy wheel printer separately—most of them would cost as much as the whole Adam system.

The Adam's CPU is the widely used Z80A microprocessor chip. Z80-family chips (made by Zilog) are found in TRS-80, Epson, Timex/Sinclair, Osborne, Kaypro, and many other personal computers. An eight-bit chip, the Z80A cannot address more than 64K of memory at a time. Since the Adam has 80K (with room for another 64K), not all of this memory is contiguous. That is, anything above the maximum addressable 64K must be *bank-switched*, or flipped in and out as needed. Usually this is handled by the operating system

for you. Other eight-bit computers overcome their 64K limits the same way (such as the Atari 1200XL and Commodore 64, which each have at least 80K of RAM and ROM).

One advantage of the Z80 over other chips is that it runs an operating system called CP/M (Control Program for Microcomputers), for which a large pool of mostly business-oriented software is available. This means the Adam may work with CP/M someday, although you would still need a way to obtain the software in a format the Adam could read (its data packs are not compatible with other storage media). A CP/M-compatible disk drive is in planning stages.

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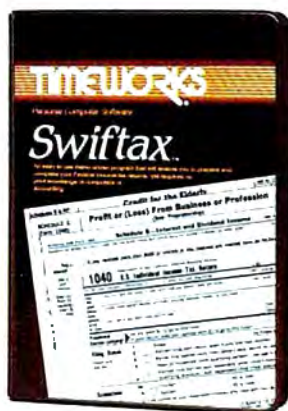
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The data packs appear to be ordinary cassettes, but the plastic shells lack capstan holes and will not fit into a standard cassette recorder. The tape itself is a gamma ferric oxide formulation, similar to the tape in some good-quality audio cassettes. However, Coleco says ordinary audio cassettes will not work, and that blank data packs must be purchased from Coleco dealers for about \$10. Coleco explains that the data packs are specially engineered for high-speed use, and that tape path accuracy is ten times better than with ordinary cassettes. Also, the data packs must be preformatted at the factory—they won't work unformatted.

Coleco compares its Digital Data Drive to the floppy disk drives commonly used with other computers. The digital drive is much faster than an ordinary cassette recorder, but is not quite as fast as most disk drives. Then again, most disk drives cost at least half as much as the entire Adam system.

The file directories for the data packs—analogue to disk directories—are located in the center of the tape to help speed up the searching and loading process.

Each data pack stores 500K (half a megabyte), or the equivalent of about 250 typed pages of text. This *does* compare favorably with disks, since most mini-floppies store perhaps only 1/4 that amount.

Apple Compatible?

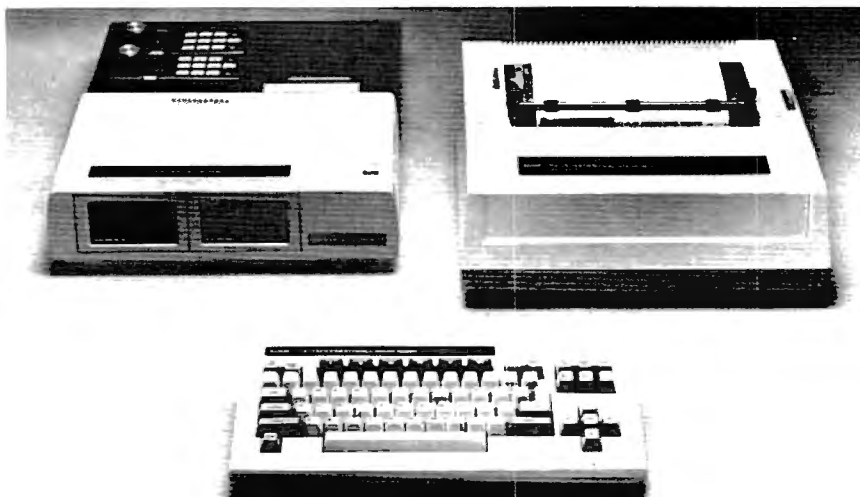
Another interesting feature of the Adam is its *SmartBASIC*. Most home computers have BASIC built into ROM, so it's ready instantly after power-up. Application programs, such as word processors, must be loaded from disk or tape.

Coleco took exactly the opposite approach with the Adam. *SmartWriter* is built into ROM, accessible with a keystroke after power-up, but *SmartBASIC* must be loaded from tape. This takes a couple of minutes. Coleco evidently figured that more Adam users will be interested in word processing than programming.

Coleco says *SmartBASIC* is designed to be compatible with Applesoft, the Apple II/IIe's Microsoft BASIC. This will be welcomed by people who already are familiar with Applesoft. Most of the *SmartBASIC* commands are the same. Since many school systems have Apples, Coleco obviously decided that an Applesoft-compatible BASIC would be an added attraction for purchasers with school-age children.

However, this does not mean you can simply load up an Apple program into the Adam and type RUN. For one thing, you'd have to manually type in the Applesoft listing, since Applesoft programs are not available on Coleco data packs. Also, remember that the Apple has a 6502 CPU instead of the Z80A and an entirely different memory layout. Therefore, Applesoft programs with PEEK, POKE, and CALL statements will not work on the Adam without extensive modifications. (Most Applesoft programs use numerous PEEKs, POKEs, and CALLs.)

SmartBASIC's Applesoft compatibility has another drawback, too. The Adam has advanced features not found on the Apple—such as three-channel sound and 32 sprites. *SmartBASIC*, patterned after Applesoft, does not, however, effectively support all these special features. Con-



This version of the Adam converts the ColecoVision videogame machine into the computer system. It is functionally identical to the regular Adam.

spicuously missing are the many commands needed to manipulate sprites and play music.

Coleco also adopted an Apple-type, line-oriented screen editor. The INSERT, DELETE and cursor keys that are so handy with *SmartWriter* are of little use with *SmartBASIC*. When you mistype a character in a program line, the manual recommends retyping the entire line. Although you can move the cursor up to the typo and fix it on the screen, hitting RETURN wipes out the rest of the line.

Software, Hardware To Come

Aside from the software which comes bundled with the Adam, there isn't much else available—at least not yet. However, Coleco says it is working hard to remedy the situation. A company spokesman said that by early December agreements had already been worked out with such software producers as Spinnaker, Brøderbund, Sierra On-Line, and Infocom. Coleco is encouraging other inde-

pendent software publishers as well, and is preparing its own line of programs. Since all Coleco-Vision cartridges work on the Adam, of course, there is a good supply of game software.

The word processing software built into the Adam is menu-driven and easy to use, although a bit sluggish for fast touch-typists. Margins and column positions are shown at the top of the screen. The letters appear on a black line at the bottom of the screen as you type. They shift above that line when more words are typed. The word processor can also be used in an "electronic typewriter mode" (each keystroke triggers the printer to type one character).

Besides lining up additional software, Coleco also is readying some more hardware. A Coleco spokesman says that, with an expansion module costing about \$70, the Adam will accept videogame cartridges designed for the Atari 2600 VCS game machine. To add a second Data Drive, it would cost about \$150. Other planned options include a CP/M compatible disk drive (about \$350), a memory expansion card (under \$200), a ROM cartridge (about \$30), a telephone modem (about \$125), and an RS-232-C serial interface (approximately \$50).

Quality And Availability

As mentioned, there has been considerable speculation about the quality of the Adam. Partly this is due to skepticism over how Coleco can assemble a complete system for such a low price. Coleco staunchly denies that the Adam's failure rates are greater than any other home computer's. The company maintains that initial failure rates were under ten percent, and that many of those were caused by customer misuse.

However, consistent problems have been reported, both by users and by the industry press. COMPUTE! encountered one of these problems, which reportedly afflicts thousands of new Adam owners (including other magazines doing test reports). After working with the system for several days, we suddenly found that the *SmartBASIC* tape would no longer load. It turns out that switching on the Adam generates a strong magnetic field, strong enough to erase a data pack sitting near the computer or even in the Data Drive. Since there is no way to back up *SmartBASIC* (or any other data pack) without two Data Drives, users can be left without a BASIC language.

To solve this problem, Coleco is making replacement tapes available to those who call the company's toll-free number (1-800-842-1225). Also, Coleco is adding a notice to the manual and a sticker to the computer warning new users about the hazard.

As for the Adam's printer, it's obviously not intended for heavy use. One unusual feature we

noticed is that the power switch for the entire Adam system is on the printer, not the computer; if the printer does break down someday, the computer cannot be turned on until the printer returns from the repair shop.

Regarding availability, Coleco says it plans to increase shipments to 150,000 units a month during the first quarter of 1984. The Adam is being marketed through major retail chains and is still being heavily advertised. It's still too early to tell if the recent price increase will significantly affect sales. (The increase boosted the wholesale cost from \$525 to \$650; retailers are free to charge what they like since Coleco does not suggest a retail price.)

It's also too early to tell which competitor, if any, will be hurt most by the Adam. The Adam still costs less than a Commodore or Atari equipped with a disk drive and dot-matrix printer, and costs much less than a fully configured IBM PCjr or Apple IIe.

The Adam's main impact may well be to change the way manufacturers approach the home computer market. As more and more neophytes take the plunge into home computing, there could be greater demand for bundled packages which take the guesswork (and expense) out of piecing together a workable, useful, personal computer system. ©

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The Automatic Proofreader For VIC, 64, And Atari

Charles Brannon, Program Editor

At last there's a way for your computer to help you check your typing. "The Automatic Proofreader" will make entering programs faster, easier, and more accurate.

We all know it's hard to type in a program correctly the first time. Seemingly trivial typing errors can cause dreaded ERROR messages, or even a *system crash* (the keyboard will not respond to RUN/STOP—RESTORE or BREAK keys). Usually, the only way to recover from such a crash is to reset the computer by turning it off, then on again—wiping out the memory (and all your typing) in the process.

Even when you locate and correct the mistyped lines, there always seem to be more, lurking in the hundred-odd lines of the program. Sometimes you feel like giving up.

Elusive Errors

Some errors are almost impossible to spot, especially for beginners who know little or nothing about programming. For instance, can you spot the mistake in this line?

```
100 C=C+LEN(STR$(VAL(L$)))+1
```

Here's how it should read:

```
100 C=C+LEN(STR$(VAL(L$)))+1
```

Did you catch the difference? A right parenthesis was missing before the +1. (A left parenthesis must always have a matching right parenthesis. If you add up all the parentheses in a statement, you should get an even number.)

An Impossible Dream?

The strong point of computers is that they excel at tedious, exacting tasks. So why not get your computer to check your typing for you?

With "The Automatic Proofreader" nestled

in your VIC-20, Commodore 64, or Atari computer, every line you type in will be verified. It displays a special code, called a *checksum*, at the top of the screen. The checksum, either a number (VIC/64) or a pair of letters (Atari), corresponds to the line you've just typed. It represents every character in the line summed together. A matching code in the program listing lets you compare it to the checksum which the Proofreader displays. A glance is all it takes to confirm that you've typed the line correctly.

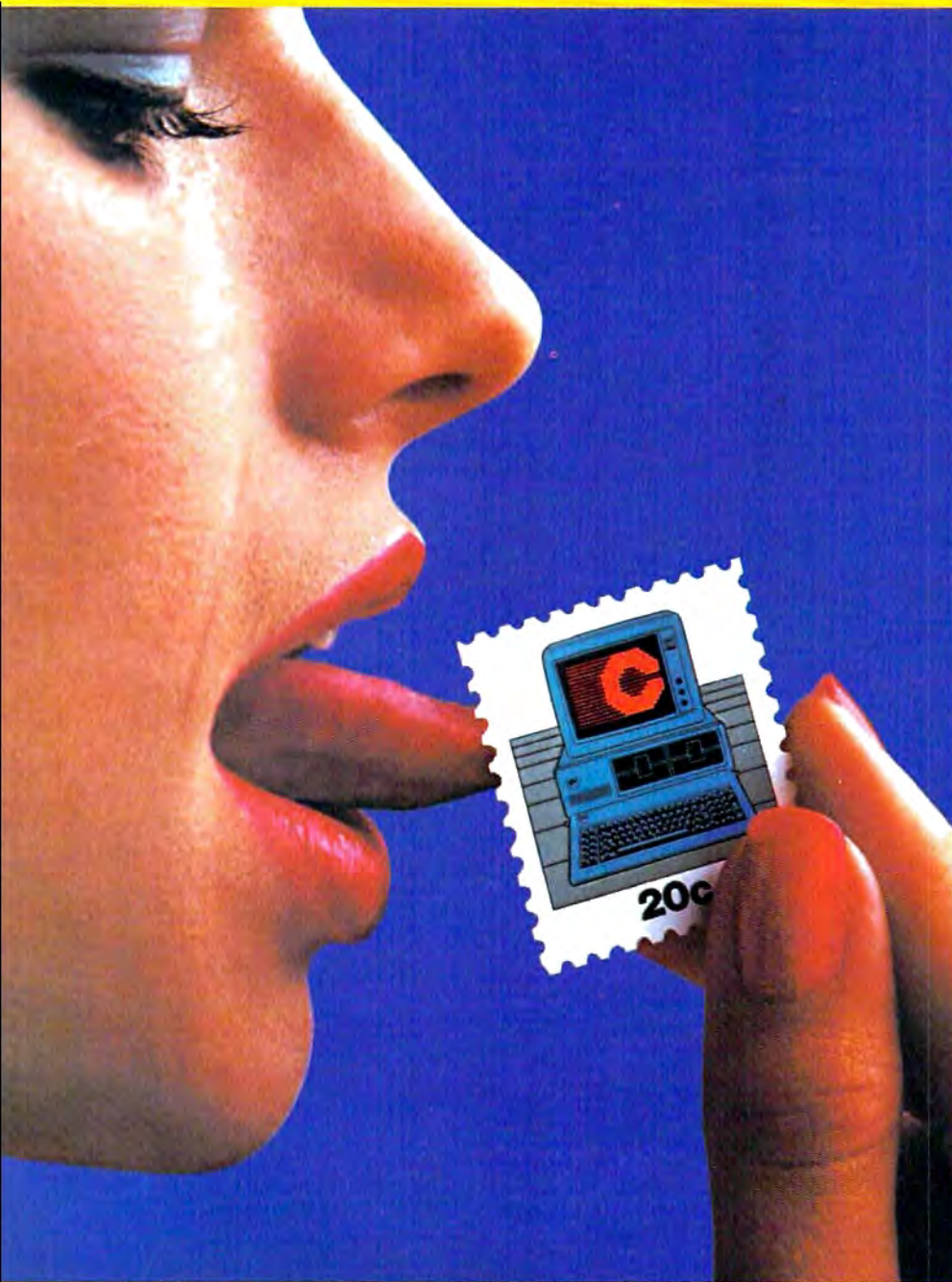
The Automatic Proofreader is a small machine language program that resides in a normally unused area of memory. On the Atari, the program is stored in Page 6 (\$0600), where it will safely remain until you turn your machine off, or run another program that uses Page 6. The Proofreader goes into the cassette buffer on the VIC and 64. Putting the Proofreader here does not use any of your BASIC program memory, but it can cause problems, which we'll cover a little later.

Entering The Automatic Proofreader

Commodore (VIC/64) owners should type in Program 1. Program 2 is for Atari users. Since the Proofreader is a machine language program, be especially diligent. Watch out for typing extra commas, or a letter O for a zero, and check every number carefully. If you make a mistake when typing in the DATA statements, you'll get the message "Error in DATA statements" when you RUN the program. Check your typing and try again.

When you've typed in The Automatic Proofreader, SAVE it to tape or disk at least twice *before running it for the first time*. If you mistype the Proofreader, it may cause a system crash when you first run it. By SAVEing a copy beforehand, you can reLOAD it and hunt for your error. Also, you'll want a backup copy of the Proofreader because

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you'll use it again and again—every time you enter a program from COMPUTE!.

When you RUN the Proofreader, the program will be POKEd safely into memory, then it will activate itself. If you ever need to reactivate it (RUN/STOP—RESTORE or SYSTEM RESET will disable it), just enter the command SYS 886 (VIC/64) or PRINT USR(1536) for the Atari.

Using The Proofreader

Now, let's see how it works. LIST the Proofreader program, move the cursor up to one of the lines, and press RETURN. If you've entered the Proofreader correctly, a checksum will appear in the top-left corner of your screen.

Try making a change in the line and hit RETURN. Notice that the checksum has changed. All VIC and 64 listings in COMPUTE! now have a number appended to the end of each line, for example, :rem 123. *Don't enter this statement.* It is just for your information. The rem is used to make the number harmless if someone does type it in. It will, however, use up memory if you enter it, and it will cause the checksum displayed at the top of the screen to be different, even if you entered the rest of the line correctly.

The Atari checksum is found immediately to the left of each line number. This makes it impossible to type in the checksum accidentally, since a program line must start with a number.

Just type in each line (without the printed checksum), and check the checksum displayed at the top of the screen against the checksum in the listing. If they match, go on to the next line. If they don't, there's a mistake. You can correct the line immediately, instead of waiting to find the error when you RUN the program.

The Proofreader is not picky with spaces. It will not notice extra spaces or missing ones. This is for your convenience, since spacing is generally not important. Occasionally proper spacing is important, but the article describing the program will warn you to be careful in these cases.

Nobody's Perfect

Although the Proofreader is an important aid, there are a few things to watch out for. If you enter a line by using abbreviations for commands, the checksum will not match up. This is because the Proofreader is very literal: It looks at the individual letters in a line, not at tokens such as PRINT. There is a way to make the Proofreader check such a line. After entering the line, LIST it. This makes the computer spell out the abbreviations. Then move the cursor up to the line and press RETURN. It should now match the checksum. You can check whole groups of lines this way. Atari users should beware of using ? as an abbreviation for PRINT—they're not the same thing in the Proofreader's eyes.

The checksum is a sum of the ASCII values of the characters in a line. VIC and 64 owners may wonder why the numbers are so small, never exceeding 255. This is because the addition is done only in eight bits. A result over 255 will roll over past zero, like an odometer past 99999. On the Atari, the number is turned into two letters, both for increased convenience and to make the Proofreader shorter. For the curious, the letters correspond to the values of the left and right nybbles added to 33 (to offset them into the alphabet). This number is then stored directly into screen memory.

Due to the nature of a checksum, the Proofreader will not catch all errors. Since $1 + 3 + 5 = 3 + 1 + 5$, the Proofreader cannot catch errors of transposition. In fact, you could type in the line in any order, and the Proofreader wouldn't notice. Anytime the Proofreader seems to act strange, keep this in mind. Since the ASCII values of the number 18 (49 + 56) and 63 (54 + 51) both equal 105, these numbers are equal according to the Proofreader. There really is no simple way to catch these kinds of errors. Fortunately, the Proofreader will catch the majority of the typing mistakes most people make.

If you want the Proofreader out of your way, just press SYSTEM RESET or RUN/STOP—RESTORE. If you need it again, enter SYS 828 (VIC/64) or PRINT USR(1536) (Atari). You must disable the Proofreader before doing any tape operations on the VIC or 64.

Hidden Perils

The Proofreader's home in the VIC and 64 is not a very safe haven. Since the cassette buffer is wiped out during tape operations, you need to disable the Proofreader with RUN/STOP—RESTORE before you SAVE your program. This applies only to tape use. Disk users or Atari owners have nothing to worry about.

Not so for VIC and 64 owners with tape drives. What if you type in a program in several sittings? The next day, you come to your computer, LOAD and RUN the Proofreader, then try to LOAD the partially completed program so you can add to it. But since the Proofreader is trying to hide in the cassette buffer, it is wiped out!

What you need is a way to LOAD the Proofreader after you've LOAded the partial program. The problem is, a tape load to the buffer destroys what it's supposed to load.

After you've typed in and RUN the Proofreader, enter the following lines in direct mode (without line numbers) *exactly* as shown:

```
A$="PROOFREADER.T": B$="{10 SPACES}": FOR
X = 1 TO 4: A$=A$+B$: NEXTX
FOR X = 886 TO 1018: A$=A$+CHR$(PEEK(X)):
NEXTX
```


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 **commodore**

OPEN 1,1,1,A\$:CLOSE1

After you enter the last line, you will be asked to press record and play on your cassette recorder. Put this program at the beginning of a new tape. This gives you a new way to load the Proofreader. Anytime you want to bring the Proofreader into memory without disturbing anything else, put the cassette in the tape drive, rewind, and enter:

OPEN1:CLOSE1

You can now start the Proofreader by typing SYS 886. To test this, PRINT PEEK(886) should return the number 173. If it does not, repeat the steps above, making sure that A\$ ("PROOF-READER.T") contains 13 characters and that B\$ contains 10 spaces.

You can now reload the Proofreader into memory whenever LOAD or SAVE destroys it, restoring your personal typing helper.

Incidentally, you can protect the cassette buffer on the Commodore 64 with POKE 178,165. This POKE should work on the VIC, but it has caused numerous problems, probably due to a bug in the VIC operating system. With this POKE, the 64 will not wipe out the cassette buffer during tape LOADs and SAVEs.

Program 1: VIC/64 Proofreader

```
100 PRINT "{CLR}PLEASE WAIT...":FORI=886TO
1018:READA:CK=CK+A:POKEI,A:NEXT
110 IF CK<>17539 THEN PRINT "{DOWN}YOU MAD
E AN ERROR":PRINT"IN DATA STATEMENTS.
":END
120 SYS886:PRINT "{CLR}{2 DOWN}PROOFREADER
ACTIVATED.":NEW
886 DATA 173,036,003,201,150,208
892 DATA 001,096,141,151,003,173
898 DATA 037,003,141,152,003,169
904 DATA 150,141,036,003,169,003
910 DATA 141,037,003,169,000,133
916 DATA 254,096,032,087,241,133
922 DATA 251,134,252,132,253,008
928 DATA 201,013,240,017,201,032
934 DATA 240,005,024,101,254,133
940 DATA 254,165,251,166,252,164
946 DATA 253,040,096,169,013,032
952 DATA 210,255,165,214,141,251
958 DATA 003,206,251,003,169,000
964 DATA 133,216,169,019,032,210
970 DATA 255,169,018,032,210,255
976 DATA 169,058,032,210,255,166
982 DATA 254,169,000,133,254,172
988 DATA 151,003,192,087,208,006
994 DATA 032,205,189,076,235,003
1000 DATA 032,205,221,169,032,032
1006 DATA 210,255,032,210,255,173
1012 DATA 251,003,133,214,076,173
1018 DATA 003
```

Program 2: Atari Proofreader

```
100 GRAPHICS 0
110 FOR I=1536 TO 1700:READ A:POKE I
,A:CK=CK+A:NEXT I
120 IF CK<>19072 THEN ? "Error in DA
TA statements. Check typing":END
130 A=USR(1536)
140 ? :? "Automatic Proofreader now
activated."
150 END
1536 DATA 104,160,0,185,26,3
1542 DATA 201,69,240,7,200,200
1548 DATA 192,34,208,243,96,200
1554 DATA 169,74,153,26,3,200
1560 DATA 169,6,153,26,3,162
1566 DATA 0,189,0,228,157,74
1572 DATA 6,232,224,16,208,245
1578 DATA 169,93,141,78,6,169
1584 DATA 6,141,79,6,24,173
1590 DATA 4,228,105,1,141,95
1596 DATA 6,173,5,228,105,0
1602 DATA 141,96,6,169,0,133
1608 DATA 203,96,247,238,125,241
1614 DATA 93,6,244,241,115,241
1620 DATA 124,241,76,205,238,0
1626 DATA 0,0,0,0,32,62
1632 DATA 246,8,201,155,240,13
1638 DATA 201,32,240,7,72,24
1644 DATA 101,203,133,203,104,40
1650 DATA 96,72,152,72,138,72
1656 DATA 160,0,169,128,145,88
1662 DATA 200,192,40,208,249,165
1668 DATA 203,74,74,74,74,24
1674 DATA 105,161,160,3,145,88
1680 DATA 165,203,41,15,24,105
1686 DATA 161,200,145,88,169,0
1692 DATA 133,203,104,170,104,168
1698 DATA 104,40,96
```

VIC SOFTWARE 64

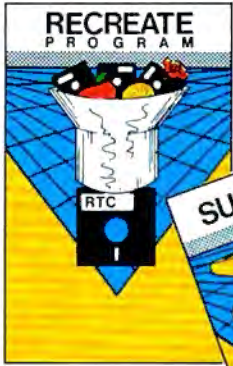
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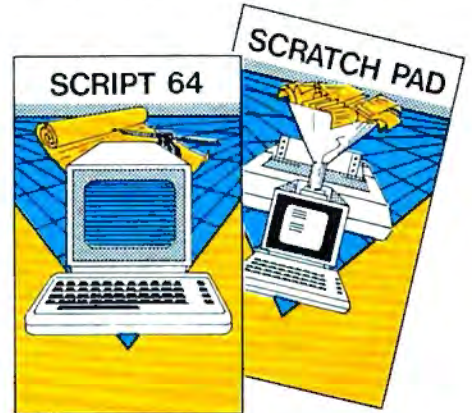
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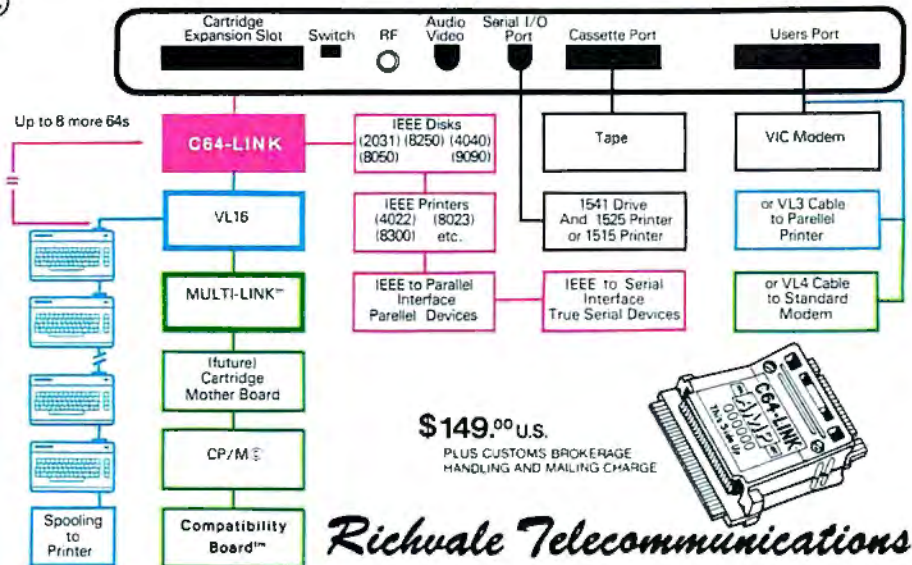
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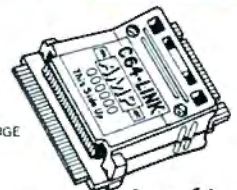
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ROADER

Your driving skills and endurance are put to the test as you careen around curves and dodge highway hazards in "Roader." Versions for Commodore 64, VIC, Atari, TI-99/4A, Apple, IBM PC, and TRS Color Computer. See the "Automatic Proofreader" article on page 60 before typing in VIC, 64, or Atari versions.

The object of "Roader" is to control a car on a winding road while dodging obstacles. As you drive farther, the road becomes more and more narrow, making a crash more likely. The longer you stay on the road, the higher your score.

When you RUN the program, the computer will wait for you to set the level of difficulty, from one to four. One is for the beginner, two is faster, with a more twisted road. Three selects a slower speed and a less curvy road, but one which has obstacles. Four selects a fast, curvy road with obstacles. With these four levels of difficulty, Roader should be challenging for everyone.

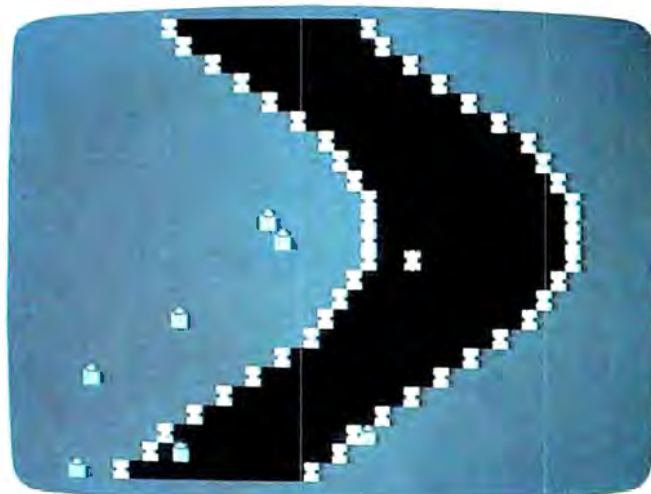
If you hit the side of the road or crash into an obstacle, you'll hear three explosions. The width of the road and your score then appear on the screen.

The car can be steered with a joystick (port 2 on the 64) or with the keyboard. Push the C key to move it left, and the M key to move it right. The instructions for keyboard control are in line 50 of Program 1 and can easily be changed to any other characters of your choice.

Program 1: Roader For The 64

```
0 PRINTCHR$(142):POKE52,48:POKE56,48:CLR :rem 149
1 POKE53280,1:POKE53281,1:PRINT"{CLR} :rem 150
  {RED}{10 DOWN}{10 RIGHT}JUST A MOMENT P
  LEASE" :rem 31
2 GOSUB260 :rem 74
3 POKE53280,15:POKE53281,15 :rem 244
4 PRINT"{CLR}{3 DOWN}{5 RIGHT}{RED}ENTER
  {SPACE}:[7]:PRINT"{3 DOWN}"TAB(12)"
  {BLK}1[4] FOR {WHT}NOVICE[7]" :rem 121
5 PRINT"{3 DOWN}"TAB(12)"{BLK}2[4] FOR
  {SPACE}{WHT}PRO[7]:PRINT"{3 DOWN}"TA
  B(12)"{BLK}3[4] FOR {WHT}EXPERT[7]"
  :rem 157
6 PRINT"{3 DOWN}"TAB(12)"{BLK}4[4] FOR
  {SPACE}{WHT}PERFECT[7]:PRINT"
  {3 DOWN}"TAB(12)"{BLK}5[4] TO {WHT}QU
  IT[7]" :rem 225
```

Brian Foley



The car speeds down an ever-narrowing roadway in the Commodore 64 version of "Roader."

```
7 GETB$:IFB$=""THEN7 :rem 147
8 J=VAL(B$):IFJ<1ORJ>5THEN7 :rem 157
9 L=54272:IFJ=5THENPOKE53272,21:SYS2048 :rem 66
10 IFA$="N"THEN14 :rem 184
11 PRINT"{CLR}{WHT}{6 DOWN}{6 SPACES}USE
  {SPACE}C AND M KEYS TO MOVE LEFT AND R
  IGH T RESPECTIVELY" :rem 178
12 PRINT"{DOWN}YOU CAN ALSO USE THE JOYST
  ICK IN PORT 2" :rem 143
13 FORS=1TO3000:NEXTS :rem 62
14 PRINTCHR$(147) :rem 224
15 POKE650,255:N=1516 :rem 138
16 POKE53280,11:POKE53281,11 :rem 32
17 I=.1:IFJ=2ORJ=4THENI=.2:N=1518:rem 212
18 AM$="DDDDDDDDDDDD" :rem 144
22 FORO=1TO4 :rem 225
23 FORC=13TO0STEP-1 :rem 157
25 FORA=1TO7.2STEP1 :rem 188
26 Y=COS(A) :rem 117
27 F=F+1:R=RND(0) :rem 188
28 IFPEEK(N+40)=65ORPEEK(N-1)=65ORPEEK(N+
  1)=65ORPEEK(N-40)=65THEN110 :rem 39
29 PRINTTAB(10*Y+13);"[8]A";"[BLK]";LEF
  T$(AM$,C);"[8]A_{WHT}":IFR>.5THEN40
  :rem 168
30 IFJ=1ORJ=2THEN40 :rem 151
32 IFF>25THENX=INT(25*RND(1)):POKE1944+X+
  L,3:POKE1944+X,66 :rem 192
40 IFF>=25THENPOKEN+L,1:POKEN,64:FORT=1TO
  50:NEXTT:POKEN+L,0:POKEN,68 :rem 123
42 IFPEEK(N+40)=65ORPEEK(N-1)=65ORPEEK(N+
  1)=65ORPEEK(N-40)=65THEN110 :rem 35
```




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Notes For The VIC, Atari, TI, Apple, IBM PC, And Color Computer Versions

"Roader" is a fast and exciting game, which puts you, the driver, on a difficult raceway. You must control your car skillfully, negotiating sharp turns while avoiding the pylons along the side of the road and the obstacles that appear randomly in levels 3 and 4.

In the VIC and Atari versions, your car is steered with the C and M keys. The TI-99/4A version of Roader uses the < and > keys or joystick 1, while the Apple version uses paddle (0). The TRS-80 Color Computer and the IBM PC versions use the left and right arrow keys to control the movement of the car.

The arrow keys on the TRS-80 Color Computer and the IBM PC should be tapped briskly, and not held down. The Caps Lock key on the IBM PC must be off for proper steering. If you use the joystick with the TI-99/4A version, be sure to release the ALPHA LOCK key.

```

43 IFF>=25THENP=PEEK(56320):D=15-(PAND15)
      :rem 120
44 IFD=4THENN=N-1:GOTO51
      :rem 235
45 IFD=8THENN=N+1:GOTO51
      :rem 238
46 IFD=6THENN=N+39:GOTO51
      :rem 40
47 IFD=10THENN=N+41:GOTO51
      :rem 77
49 GETB$
      :rem 179
50 N=N+(B$="C")-(B$="M")
      :rem 150
51 IFPEEK(N)=66ORPEEK(N+40)=66ORPEEK(N-1)
      =66ORPEEK(N+1)=66THEN110
      :rem 150
80 NEXTA:NEXTC:NEXTQ
      :rem 110
110 POKEN,67:POKEN+L,2
      :rem 52
120 POKEN-1,67:POKEN-1+L,7
      :rem 246
130 POKEN+1,67:POKEN+1+L,7
      :rem 243
140 POKEN+40,67:POKEN+40+L,15
      :rem 137
150 POKEN-40,67:POKEN-40+L,15
      :rem 142
160 V=54296:W=54276:A=54277:H=54273:L=542
      72
      :rem 86
170 FORX=45TO0STEP-1:POKEV,X:POKEW,129:PO
      KEA,15:POKEH,40:POKEL,200:NEXT
      :rem 30
180 POKEW,0:POKEA,0:F=0:D=0
      :rem 89
190 POKEL98,0:PRINT"THE ROAD IS ";C;"FEET
      WIDE"
      :rem 191
200 PRINT"SO YOUR SCORE IS ";INT(10000/C)
      :rem 70
210 PRINT"PLAY AGAIN (Y/N)?...OR FIRE BUT
      TON"
      :rem 141
215 P=PEEK(56320):FR=PAND16:IFFR=0THEN14
      :rem 150
220 GET A$:IFA$=""OR(A$<>"Y"ANDA$<>"N"AND
      FR<>0)THEN215
      :rem 22
230 IFA$="Y"THEN14
      :rem 247
240 IFA$="N"THEN3
      :rem 187
260 POKE56334,PEEK(56334)AND254
      :rem 225
270 POKEL,PEEK(1)AND251
      :rem 55

```

```

280 FORI=0TO511:POKEI+12288,PEEK(I+53248)
      :NEXT
      :rem 232
290 POKE1,PEEK(1)OR4
      :rem 163
300 POKE56334,PEEK(56334)OR1
      :rem 64
310 POKE53272,(PEEK(53272)AND240)OR12
      :rem 41
320 FORC=12800TO12839:READZ:POKEC,Z:NEXT
      :rem 252
330 DATA153,255,189,60,60,189,255,153
      :rem 94
340 DATA255,255,255,60,60,255,255,255
      :rem 89
350 DATA24,60,128,255,255,255,255,255
      :rem 89
360 DATA154,82,0,27,216,0,74,137
      :rem 83
365 DATA255,255,255,255,255,255,255,255
      :rem 204
370 RETURN
      :rem 122

```

Program 2: VIC Roader

```

0 POKE56,28:POKE52,28:CLR
      :rem 225
1 POKE36879,110:PRINT"{CLR}{WHT}{10 DOWN}
      JUST A MOMENT PLEASE"
      :rem 141
2 GOSUB280
      :rem 76
3 POKE36879,59
      :rem 13
4 PRINT"{CLR}{3 DOWN}{BLK}ENTER:":PRINT"
      {2 DOWN}"TAB(6)"{BLK}1{BLK} FOR {RED}NO
      VICE"
      :rem 250
5 PRINT"{2 DOWN}"TAB(6)"{BLK}2{BLK} FOR
      {RED}PRO:PRINT"{2 DOWN}"TAB(6)"{BLK}3
      {BLK} FOR {RED}EXPERT"
      :rem 13
6 PRINT"{2 DOWN}"TAB(6)"{BLK}4{BLK} FOR
      {RED}PERFECT:PRINT"{2 DOWN}"TAB(6)"
      {BLK}5{BLK} TO {RED}QUIT"
      :rem 235
7 GETB$:IFB$=""THEN7
      :rem 147
8 J=VAL(B$):IFJ<1ORJ>5THEN7
      :rem 157
9 L=30720:IFJ=5THENPRINT"{CLR}":END
      :rem 231
10 IFA$="N"THEN14
      :rem 184
11 PRINT"{CLR}{BLK}{6 DOWN}USE C AND M KE
      YS TO{3 SPACES}MOVE LEFT AND RIGHT"
      :rem 158
13 FORS=1TO3000:NEXTS
      :rem 62
14 PRINTCHR$(147)
      :rem 224
15 POKE650,255:N=7908
      :rem 149
16 REM POKE36879,25
      :rem 30
17 I=.1:IFJ=2ORJ=4THENI=.2:N=7905:rem 218
19 AM$=" "
      :rem 252
22 FORQ=1TO4
      :rem 225
23 FORC=9TO0STEP-1
      :rem 114
25 FORA=1TO7.2STEP1
      :rem 188
26 Y=COS(A)
      :rem 117
27 F=F+1:R=RND(1):IFF>23THENPOKE36878,15
      :rem 111
29 PRINTTAB(5*Y+6);"{BLU}$";"{BLK}";LEFT$(
      (AM$,C);"{BLU}$":IFR>.5THEN40
      :rem 23
30 IFJ=1ORJ=2THEN40
      :rem 151
32 IFF>23THENX=INT(23*RND(1)+1):POKE8142+
      X+L,2:POKE8142+X,37
      :rem 15
40 IFF>=23THENPOKEN+L,0:POKEN,35:FORT=1TO
      90:NEXTT:POKEN+L,0:POKEN,39
      :rem 120
42 IFPEEK(N)=36ORPEEK(N+22)=36ORPEEK(N-1)
      =36ORPEEK(N+1)=36THEN110
      :rem 138
49 GETB$
      :rem 179
50 N=N+(B$="C")-(B$="M")
      :rem 150
51 IFPEEK(N)=37ORPEEK(N+22)=37ORPEEK(N-1)
      =37ORPEEK(N+1)=37THEN110
      :rem 142
80 NEXTA:NEXTC:NEXTQ
      :rem 110
110 POKEN,38:POKEN+L,2
      :rem 50
120 POKEN-1,38:POKEN-1+L,7
      :rem 244

```


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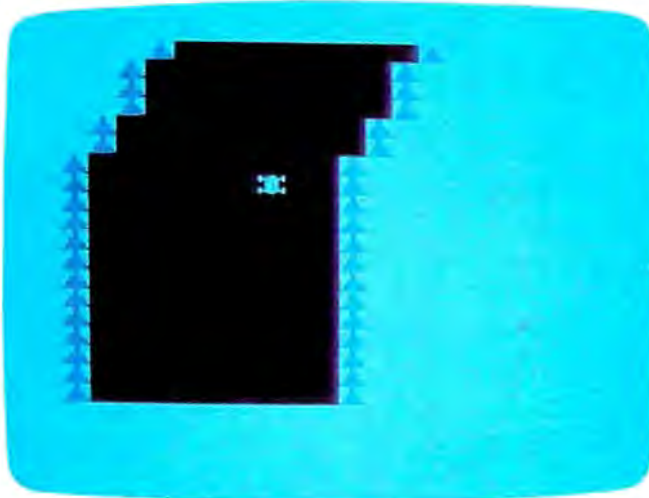
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"Roder," VIC version.



The car has crashed in the Atari version of "Roder."

```

130 POKEN+1,38:POKEN+1+L,7      :rem 241
140 POKEN+22,38:POKEN+22+L,4    :rem 85
150 POKEN-22,38:POKEN-22+L,4    :rem 90
160 POKE36877,220:FORT=15TO0STEP-1:POKE36878,T      :rem 19
170 FORM=1TO50:NEXTM           :rem 8
180 NEXTT:POKE36877,0:POKE36878,0:F=0      :rem 194
190 POKE198,0:PRINT"[BLU]{DOWN}ROAD WIDTH";C;"FEET"      :rem 201
200 PRINT"YOUR SCORE IS ";INT(10000/C)      :rem 164
210 PRINT"{DOWN}PLAY AGAIN (Y/N)? "      :rem 113
220 GET A$:IFA$="OR(A$<>"Y"ANDA$<>"N")THEN220      :rem 253
230 IFA$="Y"THEN14              :rem 247
240 IFA$="N"THEN3               :rem 187
280 FORI=0TO511:POKEI+7168,PEEK(I+32768):NEXT      :rem 189
310 FORC=7448TO7455:READZ:POKEC,255-Z:NEXT      :rem 110
320 FORC=7456TO7487:READZ:POKEC,Z:NEXT      :rem 170
330 DATA153,255,189,60,60,189,255,153      :rem 94
340 DATA24,24,24,60,60,126,126,255      :rem 177
350 DATA24,60,128,255,255,255,255,255      :rem 89
360 DATA154,82,0,27,216,0,74,137      :rem 83
365 DATA255,255,255,255,255,255,255,255      :rem 204
370 POKE36869,255:RETURN      :rem 187

```

Program 3: Atari Roder

```

01 10 POKE 106,PEEK(106)-8:GOSUB 400:GOSUB 1500:POKE 708,13
10 20 SCR=PEEK(88)+PEEK(89)*256:DIM AM$(10)
0A 30 POSITION 2,2:?:#6;"(CLEAR)ENTER:":POSITION 6,4:?:#6;"1 FOR NOVICE"
F1 40 POSITION 6,6:?:#6;"2 FOR PRO":POSITION 6,8:?:#6;"3 FOR EXPERT"
PC 50 POSITION 6,10:?:#6;"4 FOR PERFECT":POSITION 6,12:?:#6;"5 TO QUIT"
1C 60 J=PEEK(764):IF JK>24 AND JK>26 A

```

```

ND JK>29 AND JK>30 AND JK>31 THEN N 60
NA 70 IF J=29 THEN POKE 764,255:END
NB 75 IF A=35 THEN 100
0F 80 POSITION 1,10:?:#6;"(CLEAR)USE [G] AND [R] KEYS TO MOVE LEFT AND RIGHT RESPECTIVELY"
0D 90 FOR I=1 TO 2000:NEXT I
JJ 100 ? #6;"(CLEAR)":N=SCR+246
CN 110 I=0.1:IF J=30 OR J=24 THEN I=0.2
MB 120 AM$="(10 SPACES)"
BB 130 FOR Q=1 TO 4
NA 140 FOR C=7 TO 0 STEP -1
PM 150 FOR R=1 TO 7.2 STEP 1
LF 160 Y=COS(R)
QA 165 F=F+1:S=RND(0)
PQ 166 IF F>23 THEN F=23:A=USR(1536)
DL 170 POSITION 4*Y+6,F:?:#6;"$";AM$(1,C):"$":IF S>0.5 THEN 200
FP 180 IF J=31 OR J=30 THEN 200
1B 190 IF F=23 THEN L=INT(420*RND(1))+20):POKE N+L,69
0D 200 IF F=23 THEN POKE N,131:FOR T=1 TO 20:NEXT T:POKE N,0
0N 210 IF PEEK(N)=4 OR PEEK(N+1)=4 OR PEEK(N-1)=4 OR PEEK(N+20)=4 THEN N 275
66 220 P=PEEK(764):IF P=18 THEN N=N-1:GOTO 240
HP 230 IF P=37 THEN N=N+1
0D 240 POKE 764,255
ND 260 IF PEEK(N)=69 OR PEEK(N+1)=69 OR PEEK(N-1)=69 OR PEEK(N+20)=69 THEN N 275
LH 270 NEXT R:NEXT C:NEXT Q
NA 275 FOR M=20 TO 29:SOUND 1,M,8,15:F OR V=1 TO 7:NEXT V
VJ 280 POKE N,198:POKE N-1,198:POKE N+1,198
LI 290 POKE N+20,198:POKE N-20,198:POKE N-19,198:POKE N-21,198
1B 300 POKE N+21,198:POKE N+19,198
CI 310 NEXT M:SOUND 1,0,0,0
VJ 320 REM
LH 330 F=0:POSITION 0,21
LI 340 ? #6;"ROAD IS";" ";C;" "; "FEET WIDE"
0F 350 ? #6;"YOUR SCORE IS";" ";INT(10000/C)
1B 360 ? #6;"PLAY AGAIN (Y/N)? "

```




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```

WJ 370 A=PEEK(764):IF A<>43 AND A<>35
      THEN 370
ED 380 IF A=43 THEN ? #6;"(CLEAR)":N=S
      CR+246:GOTO 140
AG 390 ? #6;"(CLEAR)":GOTO 30
HI 400 GRAPHICS 1+16:POSITION 0,12: ? #
      6;"JUST A MOMENT PLEASE"
AH 405 ST=(PEEK(106)-8)*256
IS 410 FOR K=0 TO 511:POKE ST+K,PEEK(S
      7344+K):NEXT K:POKE 756,ST/256
NL 415 READ Y:IF Y=-1 THEN RETURN
HA 420 FOR X=Y TO Y+7:READ Z:POKE X+ST
      ,Z:NEXT X:GOTO 415
PS 430 DATA 24,153,255,189,60,60,189,2
      55,153
OL 440 DATA 32,255,255,255,60,60,255,2
      55,255
OF 450 DATA 40,24,60,128,255,255,255,2
      55,255
OH 460 DATA 48,154,82,0,27,216,0,74,13
      7
OJ 470 DATA 56,255,255,255,255,255,255
      ,255,255,-1
PA 1500 FOR I=1536 TO 1595:READ A:CK=C
      K+A:POKE I,A:NEXT I
FI 1510 IF CK<>7887 THEN PRINT "Error
      in DATA--check typing."
KI 1520 RETURN
PJ 1536 DATA 24,165,88,133,203,105
PG 1542 DATA 20,133,205,165,89,133
PH 1548 DATA 204,105,0,133,206,162
PI 1554 DATA 23,160,19,177,205,145
PJ 1560 DATA 203,136,16,249,24,165
PK 1566 DATA 205,133,203,105,20,133
PL 1572 DATA 205,165,206,133,204,105
PM 1578 DATA 0,133,206,202,208,227
PN 1584 DATA 160,19,169,0,145,203
PO 1590 DATA 136,16,251,104,96,0

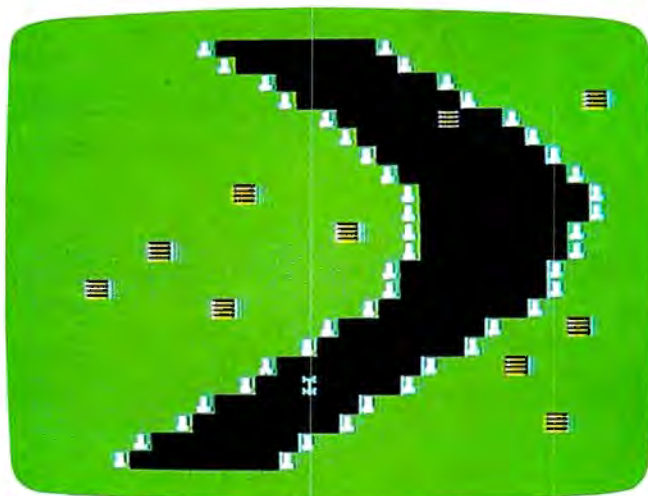
```

Program 4: Roder For The TI-99/4A

```

100 F=12
110 GOTO 200
120 FOR VOL=1 TO 30 STEP 10
130 CALL SOUND(-1000,-7,VOL)
140 CALL SCREEN(INT(VOL/2.5)+1)
150 F=19-F
160 CALL COLOR(9,F,1)
170 NEXT VOL
180 CALL COLOR(9,7,1)
190 RETURN
200 CALL CHAR(99,"223E2A080B2A3E2A")
210 CALL CHAR(100,"447C54100A2E3F7F
  ")
220 CALL CHAR(101,"00080C1E1E3E3F7F
  ")
230 CALL CHAR(104,"00181818183C3C00
  ")
240 CALL CHAR(120,"FFFFFFFFFFFFFFFF
  ")
250 CALL CHAR(128,"00FF00FF00FF00FF
  ")
260 CALL COLOR(9,5,1)
270 CALL COLOR(10,16,1)
280 CALL COLOR(11,9,1)
290 CALL COLOR(12,2,1)
300 CALL COLOR(13,9,2)
310 CALL CLEAR
320 CALL SCREEN(15)
330 PRINT
340 PRINT TAB(8);"c R O A D E R c"
350 FOR T=1 TO 6
360 PRINT

```



"Roder," TI version.

```

370 NEXT T
380 PRINT "STEER WITH THE < AND > K
      EYS"
390 PRINT
400 PRINT TAB(6);"OR USE JOYSTICK #
      1"
410 FOR T=1 TO 5
420 PRINT
430 NEXT T
440 FOR I=110 TO 120 STEP .5
450 CALL SOUND(-150,I,2)
460 NEXT I
470 FOR I=120 TO 110 STEP -.3
480 CALL SOUND(-150,I,2)
490 NEXT I
500 FOR T=110 TO 120 STEP .8
510 CALL SOUND(-75,T,2)
520 NEXT T
530 GOSUB 120
540 CALL SCREEN(15)
550 CALL COLOR(9,5,1)
560 FOR T=1 TO 250
570 NEXT T
580 CALL CLEAR
590 CALL COLOR(9,8,2)
600 OSKILL=1
610 PRINT TAB(2);"ENTER YOUR SKILL
      LEVEL..."
620 FOR T=1 TO 3
630 PRINT
640 NEXT T
650 PRINT TAB(4);"ENTER :"
660 PRINT
670 PRINT
680 PRINT TAB(8);"1 FOR NOVICE"
690 PRINT
700 PRINT TAB(8);"2 FOR PRO"
710 PRINT
720 PRINT TAB(8);"3 FOR EXPERT"
730 PRINT
740 PRINT TAB(8);"4 FOR PERFECT"
750 FOR D=1 TO 3
760 PRINT
770 NEXT D
780 CALL KEY(1,K,S)
790 RANDOMIZE
800 IF S=0 THEN 780
810 IF K<>18 THEN 840
820 SKILL=OSKILL

```




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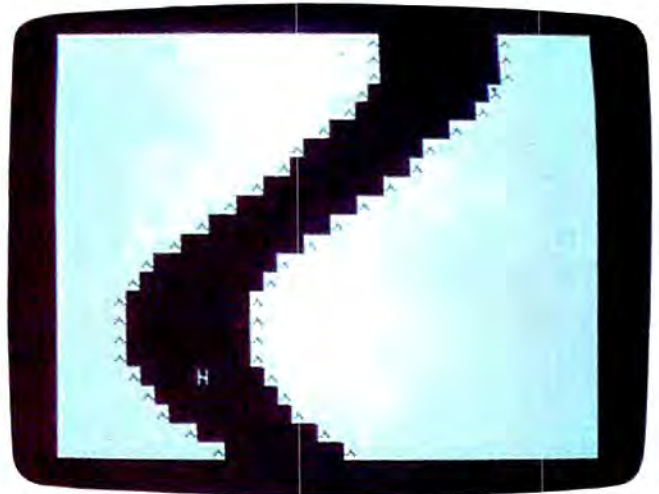
830 GOTO 860
840 SKILL=- (K=19) - (K=7)*2 - (K=8)*3 - (
      K=9)*4
850 IF SKILL=0 THEN 780
860 OSKILL=SKILL
870 PRINT
880 PRINT TAB(8); "HERE WE GO!!!"
890 PRINT
900 PRINT
910 FOR T=1 TO 400
920 NEXT T
930 CALL CLEAR
940 CALL SCREEN(3)
950 I=.1
960 IF (SKILL<>2)*(SKILL<>4) THEN 98
    0
970 I=.2
980 N=24
990 J=0
1000 OLDN=24
1010 B$="xxxxxxxxxx"
1020 FOR C=1 TO 4
1030 PRINT TAB(18); "h"; B$; "h"
1040 NEXT C
1050 FOR Q=1 TO 4
1060 FOR C=9 TO 6 STEP -1
1070 IF C<>9 THEN 1090
1080 B$="xxxxxxxxxx"
1090 FOR A=0 TO 6.25 STEP .1
1100 Y=COS(A)
1110 J=J+1
1120 PRINT TAB(B*Y+10); "h"; B$; "h"
1130 IF (RND>.5) + (SKILL=1) + (SKILL=2
    ) THEN 1160
1140 IF J<25 THEN 1160
1150 CALL HCHAR(23, 28*RND+2, 128)
1160 CALL GCHAR(20, N, 6)
1170 CALL HCHAR(19, OLDN, 120)
1180 IF (G=104) + (G=128) + (G=32) THEN
    1390
1190 CALL HCHAR(20, N, 99)
1200 OLDN=N
1210 CALL KEY(0, K, S)
1220 IF S<>0 THEN 1240
1230 CALL JOYST(1, XR, YR)
1240 N=N+(K=44) - (K=46) + XR/4
1250 NEXT A
1260 B$=SEG$(B$, 1, C-2)
1270 FOR D=110 TO 129-C STEP .5
1280 CALL SOUND(-150, D, 2)
1290 NEXT D
1300 NEXT C
1310 NEXT Q
1320 CALL CLEAR
1330 CALL SCREEN(11)
1340 PRINT TAB(5); "YOU MADE IT, MAR
    IO !!"
1350 FOR T=1 TO 10
1360 PRINT
1370 NEXT T
1380 GOTO 1480
1390 CALL HCHAR(20-1, N, 101)
1400 CALL HCHAR(20, N, 100)
1410 GOSUB 120
1420 CALL SCREEN(3)
1430 FOR T=1 TO 500
1440 NEXT T
1450 CALL CLEAR
1460 CALL COLOR(9, 8, 2)
1470 GOTO 1510
1480 FOR I=1 TO 500

```

```

1490 NEXT I
1500 CALL CLEAR
1510 CALL SCREEN(15)
1520 PRINT TAB(6); "YOUR SCORE IS"; J
    *10*SKILL
1530 FOR T=1 TO 5
1540 PRINT
1550 NEXT T
1560 PRINT TAB(8); "? PLAY AGAIN ?"
1570 PRINT
1580 PRINT
1590 PRINT TAB(4); "<FIRE BUTTON> OR
    <S>"
1600 PRINT TAB(8); "- FOR SAME LEVEL
    "
1610 PRINT
1620 PRINT TAB(4); "<C> - TO CHANGE
    LEVELS"
1630 PRINT
1640 PRINT TAB(4); "<E> - TO END PRO
    GRAM"
1650 CALL KEY(1, K, S)
1660 IF S=0 THEN 1650
1670 IF (K=18) + (K=2) THEN 930
1680 IF (K<>5)*(K<>14) THEN 1650
1690 IF K=14 THEN 580
1700 END

```



"Roder," Apple version.

Program 5: Roder For The Apple

```

100 N$ = " REDAOR":D = 0:A = 0:B = 0
110 HOME
120 FOR I = 1 TO 7:N$(I) = MID$(N$,
    I,1): NEXT I
130 FOR I = 1 TO 7:A = A + .4:N = INT
    ( COS (A) * B)
140 VTAB 24 - D - I: HTAB 20 + N: PRINT
    N$(I)
150 NEXT I:B = B + .4:A = B: IF D = 1
    6 THEN 170
160 D = D + 1: GOTO 130
170 VTAB 12: PRINT " WHAT SKILL LEVEL
    DO YOU WISH TO PLAY?"
180 PRINT : PRINT "1) EASY";: HTAB 26
    : PRINT "2) INTERMEDIATE"
190 PRINT "3) DIFFICULT";: HTAB 26: PRINT
    "4) EXPERT"
200 PRINT : PRINT " USE PADDLE 0 TO
    CONTROL YOUR CAR.": PRINT

```


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Spelling Homework

- 1. magician*
- 2. geography*
- 3. celsius*
- 4. denominator*
- 5. symmetrical*
- 6. received*

Classwork

page 81 (1-26)-even
page 83 (1-10)-even
** test (page 68-79)*

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field trip to the
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```

210 GET LV$:LV = VAL (LV$)
220 IF LV < 1 OR LV > 4 THEN 210
230 C = 0: IF LV = 2 OR LV = 4 THEN C =
    .05
240 C = C + .05:C1 = 14:C2 = 25:A = 0:
    SC = 8
250 N$ = "
    "
260 HOME
270 A = A + C + LV / 16:Y = INT ( COS
    (A) * 10)
280 POKE YLOC,160: INVERSE
290 PRINT LEFT$ (N$,C1 + Y);: PRINT
    "^";: HTAB C2 + Y: PRINT "^";: PRINT
    LEFT$ (N$,C1 - Y + 1);
300 N = INT ( PDL (0) / 7):XLOC = N +
    1360
310 IF PEEK (XLOC) = 30 OR PEEK (XL
    OC) = 42 OR PEEK (XLOC) = 32 THEN
    380
320 NORMAL : POKE XLOC,200:YLOC = XLO
    C
330 IF LV = 1 OR LV = 2 THEN 350
340 G = INT ( RND (1) * 120): IF G =
    1 THEN G = INT ( RND (1) * 39): POKE
    1872 + G,42
350 D = D + 1: IF D / 120 = INT (D /
    120) AND D < 480 THEN C1 = C1 + 1
    :SC = SC - 1
360 IF C < .25 THEN C = C + .001
370 GOTO 270
380 FOR I = 1 TO 20
390 FOR C = 1 TO 15:W = PEEK ( - 163
    36): NEXT C
400 POKE XLOC - 128,220: POKE XLOC -
    128,225: POKE XLOC - 128,239: POKE
    XLOC - 128,223
410 NEXT I: NORMAL
420 HOME : VTAB 5: HTAB 10: PRINT " Y
    OUR SCORE IS ";: INVERSE : PRINT
    INT (10000 / SC): NORMAL
430 VTAB 10: PRINT "HIT THE PADDLE BU
    TTON TO PLAY AGAIN AT": HTAB 10: PRINT
    "THE SAME LEVEL, OR": PRINT
440 PRINT "TYPE (S) TO START OVER, (E
    ) TO END."
450 IF PEEK ( - 16384) = 197 THEN POKE
    - 16287,0: END
460 IF PEEK ( - 16384) = 211 THEN POKE
    - 16287,0: GOTO 100
470 IF PEEK ( - 16287) > 127 THEN 23
    0
480 GOTO 450

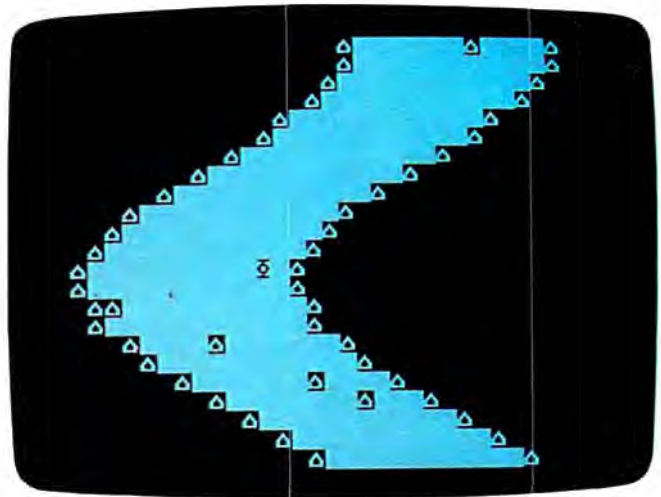
```

Program 6: PC Roder

```

10 DEF SEG=&HB800
20 CLS
30 COLOR 7,0
40 WIDTH 40
50 KEY OFF
60 J = 1000
70 COLOR 2,0:LOCATE 12,13:PRINT "R O A D
    E R"
80 FOR I=1 TO 2000:NEXT I
90 CLS
100 LOCATE 6,7 :PRINT"CHOOSE YOUR SKILL LEVE
    L"
110 LOCATE 10,1 :PRINT"ENTER : "
120 LOCATE 12,15:PRINT"1. FOR NOVICE
    2. FOR PRO"
130 LOCATE 14,15:PRINT"3. FOR EXPERT
    4. FOR PERFECT"
140 A=VAL(INKEY$):IF A<1 OR A>4 THEN 140

```



The IBM version of "Roder" includes plenty of obstacles at higher levels.

```

150 COLOR 7,0
160 CLS
170 WI = 12
180 FOR T = 0 TO 6.25 STEP A/16 :B$ =STRING$
    (2,255)+CHR$(127)+STRING$(WI,219)+CHR$(127)+
    STRING$(2,255)
190 SOUND T^3+100,.0001
200 IF A >2 AND RND(1)<.05*(A-1)THEN MID$(B$
    ,RND(1)*(LEN(B$)-6)+4,1)=CHR$(127)
210 K= COS (T)
220 PRINT TAB(K*8+14);B$
230 IF Z >50 THEN WI =WI-1:Z=0: IF WI<=3 THEN
    WI=3
240 Z=Z+1
250 POKE J+1,120:POKE J,232
260 GOSUB 290
270 NEXT
280 GOTO 180
290 OF = F :OF2 = F2: F= PEEK(J+80):F2= PEEK
    (J+81)
300 OJ = J
310 I$ = INKEY$:IF LEN (I$)=2 THEN G$=RIGHT$
    (I$,1)ELSE G$=""
320 IF G$ =CHR$(75) AND J >960 THEN J=J-2
330 IF G$=CHR$(77) AND J <1036 THEN J= J+
    2
335 F= PEEK(J+80):F2= PEEK(J+81)
340 IF F = 127 OR F = 255 THEN FOR T = 0 TO
    255:POKE OJ,T :NEXT :SOUND 32767,1: GOTO 37
    0
350 POKE OJ,OF:POKE OJ+1 ,OF2
360 RETURN
370 CLS :LOCATE 8,16:PRINT "Score";INT (1000
    0/WI)
380 LOCATE 14,12:PRINT"Play Again Y or N?"
390 A$ = INKEY$ :IF A$="" THEN 380
400 IF A$<>"y" AND A$<>"n"THEN 380
410 IF A$= "y" THEN RUN
420 END

```

Program 7: Roder For The Color Computer

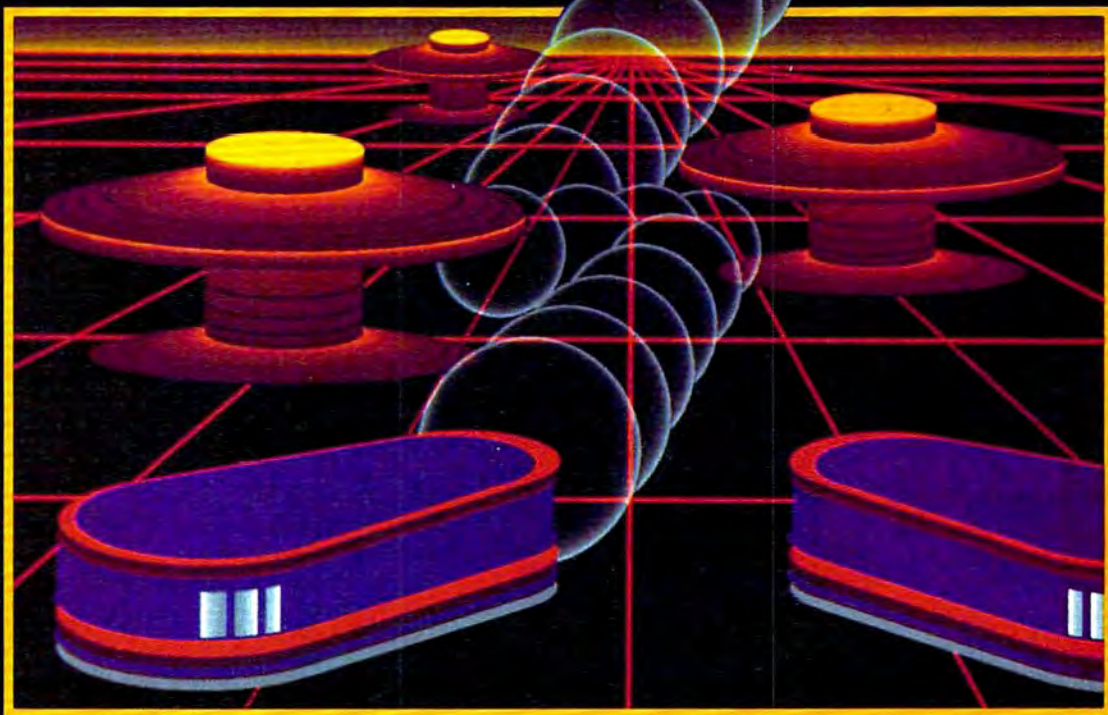
```

100 CLS:A=0:B=0:A$=" REDAOR":D=0
110 FOR I=1 TO 7:A$(I)=MID$(A$,I,1)
    :NEXT I
120 FOR I=1 TO 7:A=A+.25:N=INT(SIN(
    A)*8)
130 PRINT@480-I*32-D*32:PRINT TAB(1
    8+N)A$(I)

```


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```

140 NEXT I:B=B+.4:A=B: IF D=8 THEN
160
150 D=D+1:GOTO 120
160 PRINT@260,"CHOOSE YOUR SKILL LE
VEL"
170 PRINT@288," 1) EASY";:PRINT@304
,"2) INTERMEDIATE"
180 PRINT@320," 3) DIFFICULT";:PRIN
T@336,"4) EXPERT":PRINT
190 PRINT@384,"USE LEFT AND RIGHT A
RROW KEYS TO";
200 PRINT@425,"MOVE YOUR CAR."
210 LV=VAL(INKEY$):IF LV<1 OR LV>4
THEN 210
220 CLS:C=0:IF LV=2ORLV=4 THEN C=.2
:XLOC=328:GOTO240
230 C=.1:XLOC=335
240 C1=14:C2=25:A=0:YLOC=494:D=0:A=
0:B=0:S=8:P=80:YLOC=XLOC:H=0
250 J=144:FOR I=1 TO 9:N$=N$+CHR$(J
):NEXT I
260 FOR I=1 TO 17:A=A+C:Y=INT(COS(A
)*7)
270 PRINT @490+Y,CHR$(191);:PRINT@4
91+Y,RIGHT$(N$,S);:PRINT@491+Y+
S,CHR$(191):NEXT I
280 PRINT@XLOC,CHR$(175);
290 PRINT@5,"HIT (B) TO BEGIN PLAY"
300 K$=INKEY$:IF K$<>"B" THEN 300
310 A=A+C:Y=INT(COS(A)*7)
320 PRINT@490+Y,CHR$(191);:PRINT@49
1+Y,RIGHT$(N$,S);:PRINT@491+Y+S
,CHR$(191)
330 PRINT@YLOC-32,CHR$(144);
340 F$=INKEY$:IF F$=CHR$(8) THEN XL
OC=XLOC-1:GOTO 360
350 IF F$=CHR$(9) THEN XLOC=XLOC+1
360 IFPEEK(1024+XLOC)=96 OR PEEK(10
24+XLOC)=255 OR PEEK(1024+XLOC)
=191 THEN 450
370 D=D+1:IF D/75=INT(D/75) AND S>2
THEN S=S-1
380 PRINT@XLOC,CHR$(175);
390 YLOC=XLOC
400 IF LV=1 OR LV=2 THEN 420
410 G=RND(3):IFG=1 THEN G=RND(31):P
RINT@448+G,CHR$(255);
420 C=C+.00025:P=P-.2:H=H+1
430 FOR I=1TOP:NEXTI
440 GOTO 310
450 FOR I=255 TO 100 STEP -30:SOUND
I,1:NEXT I
460 FOR I=0 TO 105:PRINT@XLOC,CHR$
(143+I);:NEXT I
470 CLS:PRINT@70,"YOUR SCORE IS ";H
*10*LV
480 PRINT@129,"<SPACE BAR> TO PLAY
AGAIN ON":PRINT@169,"THE SAME L
EVEL"
490 PRINT@229,"TYPE (S) TO START OV
ER":PRINT
500 PRINT@296,"TYPE (E) TO END"
510 S$=INKEY$
520 IF S$="E" THEN END
530 IF S$="S" THEN 100
540 IF S$=" " THEN 220
550 GOTO 510
560 END

```


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Barrier Battle

Heath Lawrence

Here's an exciting, challenging game for the VIC, 64, TRS-80 Color Computer, Atari, and Apple. Try to outwit your opponent and plan ahead—things get dicey at the end.

An article about writing arcade-style games (COMPUTE!, February 1983) piqued my curiosity enough to make me write this simple, but challenging game. It uses a redefined character set and the technique of POKEing character locations from that article. I found that toying with the simple commands provided yields some satisfying results.

That tutorial did an excellent job of explaining this method, so I won't go into it in any great detail here.

The following is a basic explanation of the setup of the program and a description of game play. There is also a variable list for anybody who wants a more thorough understanding of the program.

Game Strategy

The object of "Barrier Battle" is to build barriers, using your joystick, and to cut off your opponent so that he or she runs out of room and collides with a wall or barrier.

By pressing the trigger, you can create a hole in your barrier. You can do this five times. This can be a very helpful strategy because escape routes become quite scarce near the conclusion of the conflict. At the bottom of the screen you can see how many holes each player has left.

A player is destroyed when he or she hits one of the side boundaries (the Atari symbols) or one of the player-built barriers.

The end of the game is marked by the appearance of the victorious player jumping for joy in the center of the screen. The winning player's identity is then revealed (in case of a close call) and the option to play again is offered.

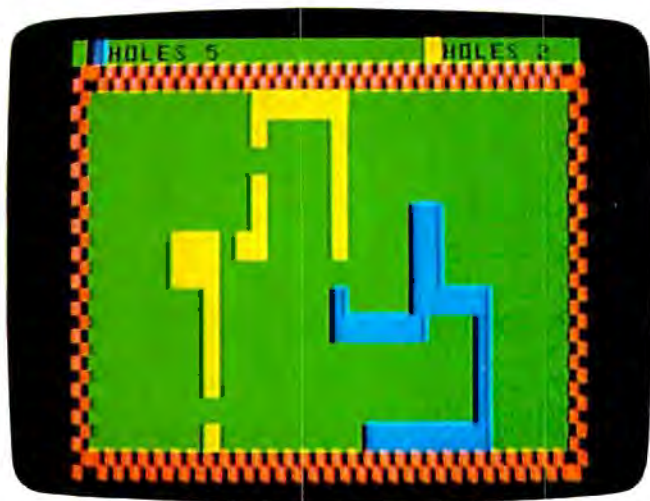
Playing Tips

At the beginning of the game it is a good idea to cut yourself a large part of the playfield to maneuver in. In the long run, it is the player with the most real estate left who is victorious.

When you find yourself out of room, try pressing the trigger and moving back and forth. This will only delay the inevitable, but it may stall long enough for the other player to smash into a barrier.

Variable List

SCR	Screen Memory Start address.
SIDE,WALL,BARR,BLANK	Player wall and blank characters which appear on screen when POKEd into SCR.
LN	Length of a single screen line.
VECTR,DIR	Variables that contain current player distance and direction.
LOC,POS	Current location of players.
M,N	Joystick variables.



"Barrier Battle," Color Computer version.

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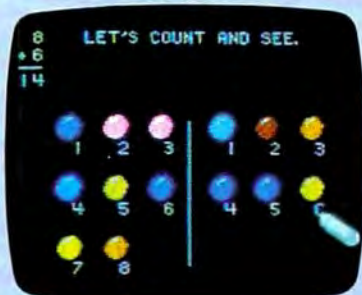
After an incorrect answer our professor uses chalk and a blackboard to work the problem through.

Step by step, he gives



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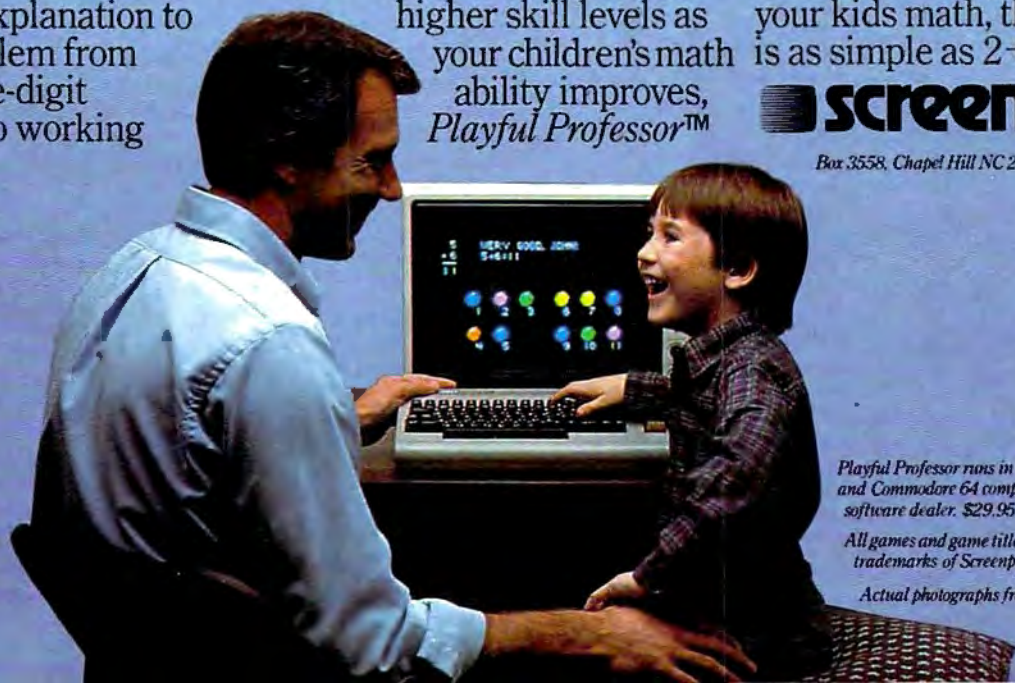
After each correct answer a player moves closer to capturing the key from the ghost and leaving the castle a winner.

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Actual photographs from Commodore 64.

Program Rundown (Atari Version)

Lines 94–115. Set starting address for screen memory. Assign characters to variables. Set start positions and directions for both players. Set line length.

Lines 200–240. Set stick variables. Check sticks and assign direction.

Lines 300–312. Move players. Check for collisions. Check trigger to see if hole should be created.

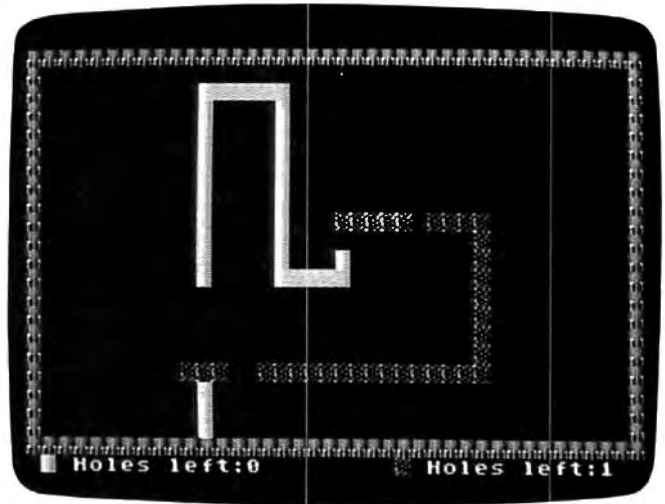
Lines 1000–1016. Routine to alter the character set.

Lines 5000–5006. Boundary routine (from Richard Mansfield's sample program).

Lines 6000–6012. Display winner and display play again?

Lines 6030–6038. Explosion sound and game over display.

Lines 7500–7520. Instructions and opening music.



In the Atari version of "Barrier Battle," the white player is about to crash into the wall.

Program 1: Atari Barrier Battle

BEGINNING PROGRAMMERS

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

```

93 REM INITIALIZE SCREEN
94 LEV=5:GOSUB 1000
96 DIM A$(18),B$(18),S$(10)
98 A$=" {T} {DOWN}{3 LEFT}{B}■{V}
{DOWN}{3 LEFT}{B} {V}":B$=" {G}
{T}{F}{DOWN}{3 LEFT}{B}■{V}{DOWN}
{3 LEFT}{C} {Z}"
100 SIDE=31:WALL=128:BARR=32:BLANK=0
:VAL1=5:VAL2=5
105 SCR=PEEK(88)+256*PEEK(89)
110 LN=40:VECTR=LN:DIR=-VECTR
115 LOC=SCR+LN*10+LN/2:POS=LOC
125 GOSUB 5000
199 REM CHECK STICKS
200 M=STICK(0):N=STICK(1)
205 IF M=14 THEN VECTR=-LN:GOTO 225
210 IF M=13 THEN VECTR=LN:GOTO 225
215 IF M=7 THEN VECTR=1:GOTO 225
220 IF M=11 THEN VECTR=-1
225 IF N=14 THEN DIR=-LN:GOTO 300
230 IF N=13 THEN DIR=LN:GOTO 300
235 IF N=7 THEN DIR=1:GOTO 300
240 IF N=11 THEN DIR=-1
299 REM MOVE PLAYERS
300 FOR SP=1 TO LEV:NEXT SP
302 LOC=LOC+VECTR:IF PEEK(LOC)=WALL
OR PEEK(LOC)=BARR OR PEEK(LOC)=S
IDE THEN P=1:GOTO 6000
304 IF STRIG(0)=0 AND VAL1<>0 THEN P
OKE LOC,BLANK:VAL1=VAL1-1:POSITI
ON 14,22:? VAL1:GOTO 308
306 POKE LOC,WALL:SOUND 1,LOC,10,8
308 POS=POS+DIR:IF PEEK(POS)=WALL OR
PEEK(POS)=BARR OR PEEK(POS)=SID
E THEN P=2:GOTO 6000
310 POKE POS,BARR:SOUND 1,POS,10,8
312 IF STRIG(1)=0 AND VAL2<>0 THEN P
OKE POS,BLANK:VAL2=VAL2-1:POSITI
ON 37,22:? VAL2
314 GOTO 200
999 REM REDEFINE
1000 GOSUB 7500
1002 POSITION 13,17:? "Please wait"
1004 ST=(PEEK(106)-8)*256:IF PEEK(ST
+256)=137 THEN 1012
1006 FOR X=0 TO 1023:POKE ST+X,PEEK(
57344+X):NEXT X
1008 FOR X=0 TO 7:READ A:POKE ST+256
+X,A:NEXT X
1010 FOR X=0 TO 7:READ A:POKE ST+248
+X,A:NEXT X
1012 GOSUB 7510
1014 DATA 137,34,132,17,132,144,68,1
37
1016 DATA 42,42,42,42,107,73,73,73
1018 RETURN
4999 REM DRAW BORDER
5000 ? CHR$(125):POKE 756,ST/256:SET
COLOR 2,0,0:FOR I=0 TO LN-1:POK
E SCR+I,SIDE:NEXT I:FOR I=0 TO
LN-1
5002 POKE SCR+LN*21+I,SIDE:NEXT I
5004 FOR I=0 TO 21:POKE SCR+I*LN,SID
E:NEXT I:FOR I=0 TO 21:POKE SCR
+LN-1+I*LN,SIDE:NEXT I
5006 POSITION 1,22:? "■ Holes left:"
;VAL1:POKE SCR+LN-16+22*LN,BARR
:POSITION 25,22:? " Holes left:
";VAL2
5008 RETURN
5999 REM END OF GAME ROUTINE
6000 GOSUB 6030:GRAPHICS 0:POKE 756,
ST/256:POKE 752,1:SETCOLOR 2,0,
0:POSITION 13,9:? "Player "
6002 IF P=1 THEN POKE SCR+LN-20+9*LN
,BARR
6004 IF P=2 THEN POKE SCR+LN-20+9*LN
,WALL
6006 POSITION 21,9:? " Wins!!"
6008 GOSUB 7000:POSITION 10,11:? "Pr
ess trigger to play"
6010 IF STRIG(0) AND STRIG(1) THEN 6
010
6012 GOTO 100
6029 REM EXPLOSION

```




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```

6030 POKE 752,1:FOR I=15 TO 0 STEP -
0.2:SOUND 0,20,8,I:SOUND 1,75,8
,I+1:SOUND 2,175,8,I+3:SOUND 3,
255,8,I+5:NEXT I
6032 FOR SO=1 TO 3:SOUND SO,0,0,0:NE
XT SO
6034 ? CHR$(125):SETCOLOR 2,0,0
6036 POSITION 14,11:? "GAME
(5 SPACES)OVER"
6038 FOR LOOP=1 TO 5:POSITION 19,10:
? A$:FOR D=1 TO 25:NEXT D:POSIT
ION 19,10:? B$:FOR D=1 TO 45:NE
XT D:NEXT LOOP:RETURN
7000 RESTORE 7002:FOR D=1 TO 8:READ
Z:FOR DEL=0 TO 15 STEP 3:SOUND
1,Z,10,DEL:NEXT DEL
7001 FOR DEL=15 TO 0 STEP -3:SOUND 1
,Z,10,DEL:NEXT DEL:FOR DEL=1 TO
10:NEXT DEL:NEXT D
7002 DATA 162,121,128,121,96,100,121
,108
7004 RETURN
7500 REM INSTRUCTIONS
7502 GRAPHICS 0:POKE 752,1:SETCOLOR
2,0,0:POSITION 9,1:? "** BARRIE
R BATTLE **"
7504 ? :? :? :? :? :? "Use your joys
tick to barricade your
(3 SPACES)opponent into a colli
sion with a wall."
7506 ? :? "You have 5 holes to use.
These can be created by pressin
g the trigger."
7508 RETURN
7510 TRAP 7550:POSITION 9,17:? "Spee
d Level (1-4)":INPUT SK
7511 TRAP 40000
7512 IF SK<1 OR SK>4 THEN FOR I=1 TO
37:POSITION I,15:? CHR$(32):NE
XT I:GOTO 7510
7513 LEV=(SK-1)*10:POSITION 9,15:? "
Press trigger to play"
7514 IF STRIG(0) AND STRIG(1) THEN 7
514
7516 REM MUSIC
7518 RESTORE 7520:FOR D=1 TO 8:READ
Z:FOR DEL=0 TO 15 STEP 3:SOUND
1,Z,10,DEL:NEXT DEL
7519 FOR DEL=15 TO 0 STEP -3:SOUND 1
,Z,10,DEL:NEXT DEL:FOR DEL=1 TO
10:NEXT DEL:NEXT D
7520 DATA 121,121,121,121,102,108,12
1,136
7522 RETURN
7550 TRAP 40000:FOR I=1 TO 37:POSITI
ON I,15:? CHR$(32):NEXT I:GOTO
7510

```

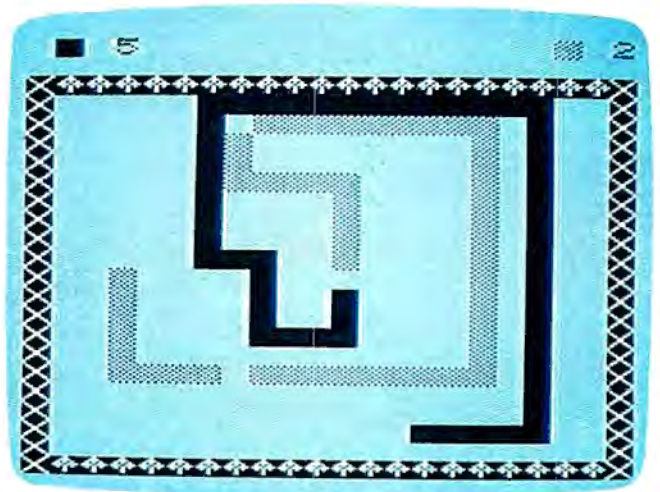
Program 2: VIC Barrier Battle

Translation by Jeff Hamdani, Editorial Programmer

```

93 REM INITIALIZATION
94 POKE36879,25:LV=5:GOSUB1000
98 DIM A$(18),B$(18),M(18)
100 X=11:Y=12:SR=7680+X+22*Y:SD=216:SS=10
2:C=30720
101 POKE198,0:WL=160:BR=214:BK=32:V1=5:V2
=5
105 LN=22:VE=LN:DR=-LN:
115 LC=SR:PS=LC
130 PRINT"[CLR]{RIGHT}{BLK}{RVS} {OFF}" v
1;
140 PRINT"[14 RIGHT]{BLU}{RVS}[+]{OFF}"
;V2

```



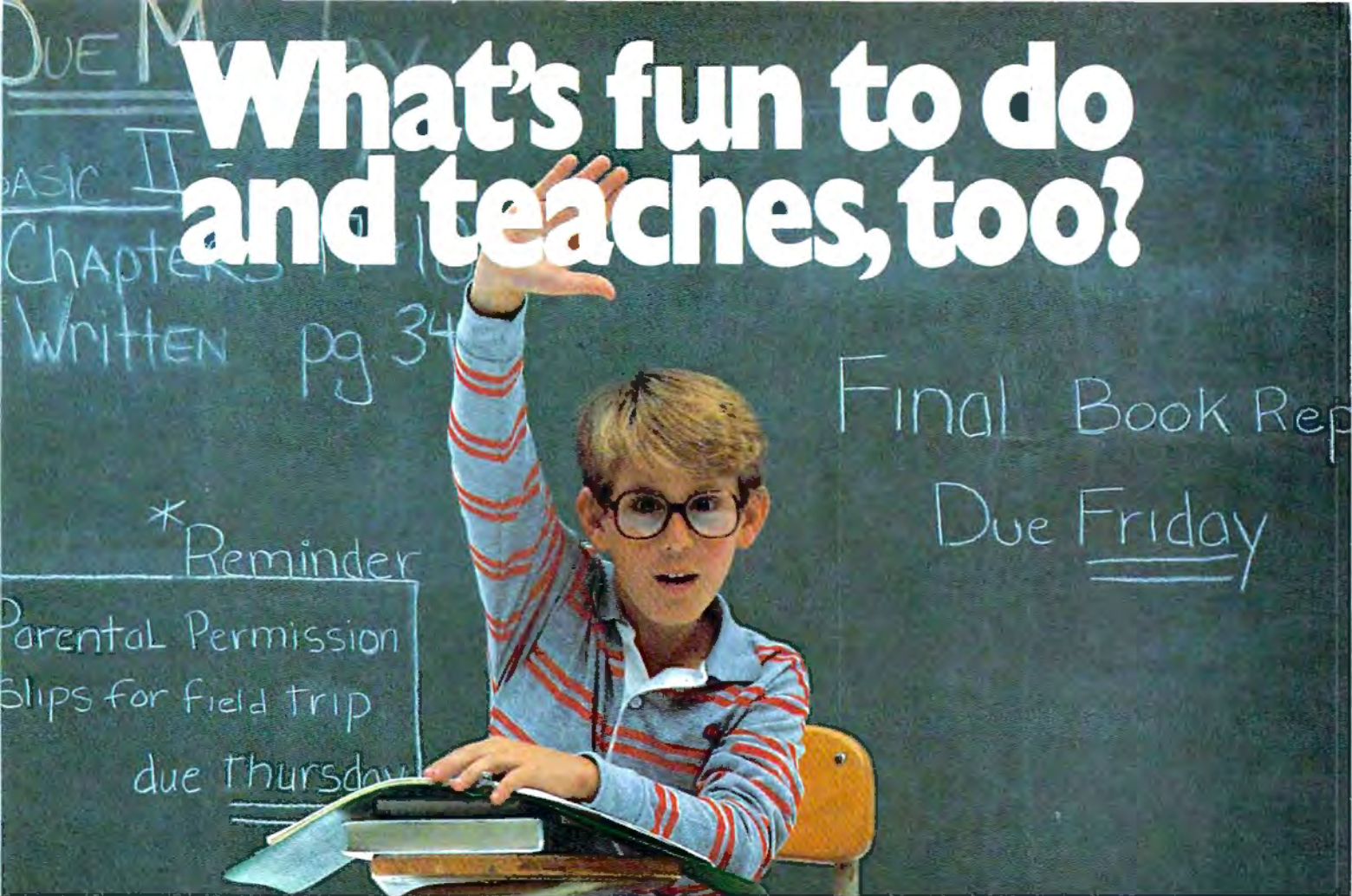
VIC version of "Barrier Battle."

```

145 GOSUB5000
199 REM CHECK JOYSTICKS
200 DD=37154:P1=37151:P2=37152:IF V2=2 TH
EN FOR I=1 TO 40000:NEXT
201 POKEDD,127:P=PEEK(P2)AND128:J0=-(P=0)
203 IFJ0=1THENVE=1:GOTO229
204 POKEDD,255:P=PEEK(P1)
205 FB=-((PAND32)=0)
221 J3=-((PAND4)=0):IFJ3=1THENVE=-LN:GOTO
229
223 J1=-((PAND8)=0):IFJ1=1THENVE=LN:GOTO2
29
227 J2=-((PAND16)=0):IFJ2=1THENVE=-1
229 GETZ$:IFZ$=""THENGOTO300
230 IFZ$="I"THENDR=-LN:GOTO300
233 IFZ$="M"THENDR=LN:GOTO300
236 IFZ$="K"THENDR=1:GOTO300
239 IFZ$="J"THENDR=-1
299 REM MOVE PLAYERS
300 FORSP=1TOLV:NEXTSP
301 LC=LC+VE:GOSUB7600
302 IFPEEK(LC)<>BKTHENP=1:GOTO6000
304 IFFB=0ORV1=0THEN307
305 POKELC,BK:V1=V1-1:POKE7683,V1+48:GOTO
308
307 POKELC,WL:POKELC+C,0
308 PS=PS+DR
309 IFPEEK(PS)<>32THENP=2:GOTO6000
310 IFZ$<>" "ORV2=0THEN314
312 POKEPS,BK:V2=V2-1:POKE7701,V2+48:GOTO
315
314 POKEPS,SS:POKEPS+C,6
315 GOTO200
999 REM REDEFINING
1000 GOSUB7502:PRINT"{2 DOWN}[2 RIGHT]TO
{SPACE}START, PRESS THE":PRINT"{RVS}
TRIGGER{OFF} OR {RVS}SPACEBAR{OFF}."
1010 GETX$:P=PEEK(37151):FB=-((PAND32)=0)
:IF(FB=0)AND(X$="")THEN1010
1018 GOSUB7510:RETURN
4999 REM DRAW BORDER
5000 FORI=7724TO7745:POKEI,SD:POKEI+C,2:N
EXT
5002 FORI=8164TO8185:POKEI,SD:POKEI+C,2:N
EXT
5004 FORI=7724TO8164STEP22:POKEI,BR:POKEI
+C,2:NEXT
5005 FORI=7745TO8185STEP22:POKEI,BR:POKEI
+C,2:NEXT

```


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```

5008 RETURN
5999 REM END OF GAME ROUTINE
6000 GOSUB6030:PRINT"{CLR}{13 DOWN}
{4 RIGHT}{BLU}PLAYER{RIGHT}";
6002 IFP=1THENPOKE7977,SS:POKE7977+C,6
6004 IFP=2THENPOKE7977,WL:POKE7977+C,0
6006 PRINT"{2 RIGHT}WINS":FORI=1TO700:NEX
TI:GOSUB 7000
6008 PRINT"{7 DOWN}{2 RIGHT}PRESS :":PRIN
T"{DOWN}{RIGHT}{RVS}TRIGGER{OFF} OR
{SPACE}{RVS}SPACEBAR{OFF}{3 SPACES}T
O{RIGHT}CONTINUE, {RVS}{BLK}Q-QUIT
{OFF}{BLU}"
6009 POKE198,0:P=PEEK(P1):FB=-((PAND32)=0
)
6010 IFPEEK(197)=48THENPOKE198,0:END
6012 IFFB<>1LANDPEEK(197)<>32THEN6009
6013 GOTO100
6029 REM EXPLOSION
6030 POKE36877,220:FORL=15TO0STEP-1:POKE3
6878,L
6035 FORM=1TO50:NEXTM:NEXTL:POKE36877,0
6040 POKE36878,0:RETURN
7000 PRINT"{CLR}{8 DOWN}{6 RIGHT}GAME OVE
R{OFF}"
7005 RESTORE
7006 FORT=1TO18:READM(T):NEXT
7007 FORT=1TO9:READL(T):NEXT
7010 FORI=1TO5
7020 FORJ=1TO9:POKEL(J),M(J):POKEL(J)+C,6
:NEXT
7030 FORK=1TO9:POKEL(K),M(K+9):POKEL(K)+C
,6:NEXT:NEXT
7050 DATA32,81,32,78,160,77,122,32,76,77,
81,78,32,160,32,122,32,76
7060 DATA7909,7910,7911,7931,7932,7933,79
53,7954,7955
7070 RETURN
7502 PRINT"{CLR}{4 RIGHT}{RVS}{BLU}BARRIE
R BATTLE{OFF}{3 DOWN}"
7503 PRINT"{2 RIGHT}ONE PLAYER MUST USE":
PRINT"JOYSTICK AND THE":PRINT"OTHER
{SPACE}KEYBOARD (I,J,"
7504 PRINT"K,M).{2 SPACES}WITH THESE,":PR
INT"CAUSE YOUR OPPONENT TO COLLIDE WI
TH A WALL."
7506 PRINT"{2 DOWN}{2 RIGHT}YOU HAVE 5 HO
LES TO USE.{2 SPACES}CREATE THEM BY"
7507 PRINT"PRESSING THE TRIGGER{2 SPACES}
OR SPACEBAR."
7508 RETURN
7510 PRINT"{CLR}{6 DOWN}SPEED LEVEL (1-4)
?"
7511 PRINT"{2 DOWN}(1 IS FASTEST)"
7512 GETS$:IFS$=""THEN7512
7513 SK=VAL(S$):IFSK<1ORSK>4THEN7512
7520 LV=(SK-1)*10:RETURN
7600 POKE36878,15
7610 FORL=1TO5:POKE36876,INT(RND(1)*128)+
128
7620 NEXTL
7630 POKE36876,0:POKE36878,0:RETURN

```

Program 3: 64 Barrier Battle

Translation by Jeff Hamdani, Editorial Programmer

```

10 FORL=54272TO54296:POKEL,0:NEXTL:POKE54
296,15:POKE54277,17
20 POKE54278,241
93 REM INITIALIZATION
94 POKE53280,1:POKE53281,1:LV=5:GOSUB1000
98 DIM A$(18),B$(18),M(18)
100 X=20:Y=11:SR=1024+X+40*Y:SD=171:SS=10
2
101 WL=160:BR=214:BK=32:V1=5:V2=5
105 LN=40:VE=LN:DR=-LN:C=54272
115 LC=SR:PS=LC
130 PRINT"{CLR}{23 DOWN}{RIGHT}[4]{RVS}
{OFF} HOLES LEFT"V1;
140 PRINT"{8 RIGHT}{BLU}{RVS}[+]{OFF} H
OLES LEFT";V2
145 GOSUB5000
199 REM CHECK JOYSTICKS
200 K1=PEEK(56321):K2=PEEK(56320)
201 J1=15-(K1AND15):J2=15-(K2AND15)
203 F1=K1AND16:F2=K2AND16
221 IFJ1=1THENVE=-LN:GOTO230
223 IFJ1=2THENVE=LN:GOTO230
225 IFJ1=8THENVE=1:GOTO230
227 IFJ1=4THENVE=-1
230 IFJ2=1THENDR=-LN:GOTO300
233 IFJ2=2THENDR=LN:GOTO300
236 IFJ2=8THENDR=1:GOTO300
239 IFJ2=4THENDR=-1
299 REM MOVE PLAYERS
300 FORSP=1TOLV:NEXTSP
301 LC=LC+VE:GOSUB7600
302 IFPEEK(LC)<>BKTHENP=1:GOTO6000
304 IFF1=16ORV1=0THEN307
306 POKELC,BK:V1=V1-1:POKE1958,V1+48:GOTO
308
307 POKELC+C,11:POKELC,WL
308 PS=PS+DR
309 IFPEEK(PS)<>32THENP=2:GOTO6000
310 IFF2=16ORV2=0THEN314
311 POKEPS,BK:V2=V2-1:POKE1981,V2+48
313 GOTO315
314 POKEPS+C,6:POKEPS,SS
315 GOTO200
1000 GOSUB7502:PRINT"{5 DOWN}{7 RIGHT} PR
ESS TRIGGER TO CONTINUE"
1010 F1=PEEK(56321)AND16:F2=PEEK(56320)AN
D16:IFF1=16 AND F2=16 THEN1010
1018 GOSUB7510:RETURN
4999 REM DRAW BORDER
5000 FORI=1024TO1063:POKEI+C,9:POKEI,SD:N
EXT
5002 FORI=1904TO1943:POKEI+C,9:POKEI,SD:N
EXT
5004 FORI=1024TO1904STEP40:POKEI+C,9:POKE
I,BR:NEXT
5005 FORI=1063TO1943STEP40:POKEI+C,9:POKE
I,BR:NEXT
5008 RETURN
5999 REM END OF GAME ROUTINE
6000 GOSUB6030:PRINT"{CLR}{10 DOWN}
{14 RIGHT}[2]PLAYER{RIGHT}";
6002 IFP=1THENPOKE1445,SS:POKE1445+54272,
6
6004 IFP=2THENPOKE1445,WL:POKE1445+54272,
11
6006 PRINT"{2 RIGHT}WINS":FORI=1TO700:NEX
TI
6008 GOSUB7000:PRINT"{8 DOWN}{7 RIGHT}TRI
GGER TO CONTINUE:{RVS}{BLK}Q-QUIT
{OFF}{RED}"
6009 POKE198,0:F1=PEEK(56321)AND16:F2=PEE
K(56320)AND16
6010 IFPEEK(197)=62THENPOKE198,0:END
6012 IFF1=16ANDF2=16THEN6009
6013 GOTO100
6029 REM EXPLOSION
6030 W=54276:A=54277:H=54273

```


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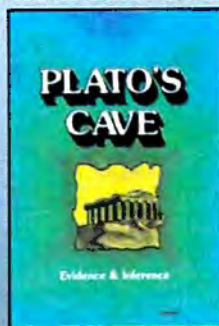
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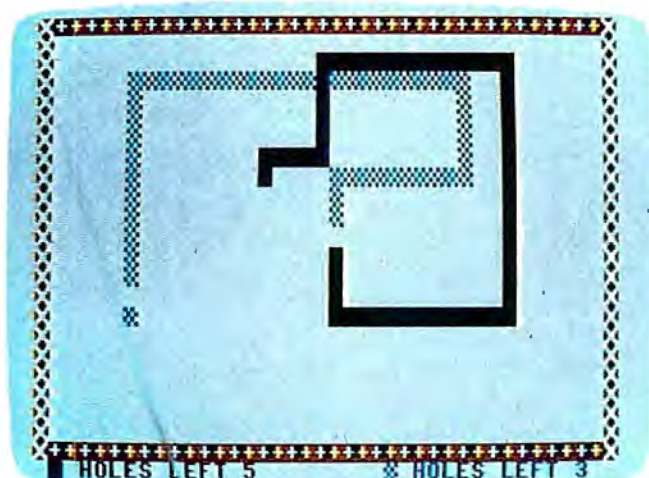
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64 Version of "Barrier Battle."

```

6035 POKEW,129:POKEA,15:POKEH,40:POKEC,20
    0:FORI=1TO500:NEXT
6040 POKEW,128:POKEA,0:RETURN
7000 PRINT"[CLR][8 DOWN][15 RIGHT]GAME OVE
    R[OFF]"
7005 RESTORE
7006 FORT=1TO18:READM(T):NEXT
7007 FORT=1TO9:READL(T):NEXT
7010 FORI=1TO5
7020 FORJ=1TO9:POKEL(J)+C,9:POKEL(J),M(J)
    :NEXT
7030 FORK=1TO9:POKEL(K)+C,9:POKEL(K),M(K+
    9):NEXT:NEXT
7050 DATA32,81,32,78,160,77,122,32,76,77,
    81,78,32,160,32,122,32,76
7060 DATA1482,1483,1484,1522,1523,1524,15
    62,1563,1564
7070 RETURN
7502 PRINT"[CLR][14 RIGHT][3 DOWN][RVS]
    [BLU]BARRIER BATTLE[OFF][4 DOWN]"
7504 PRINT"[4 RIGHT]USING YOUR JOYSTICK,
    [SPACE]CAUSE YOUR"
7505 PRINT"[4 RIGHT]OPPONENT TO COLLIDE W
    ITH A WALL."
7506 PRINT"[DOWN][4 RIGHT]YOU HAVE 5 HOLE
    S TO USE. CREATE"
7507 PRINT"[4 RIGHT]HOLES BY PRESSING THE
    TRIGGER."
7508 RETURN
7510 PRINT"[CLR][9 DOWN][10 RIGHT]SPEED L
    EVEL (1-4) ?"
7512 PRINT"[2 DOWN][11 RIGHT](1 IS THE FA
    STEST)"
7513 GETS$:IFSS$=""THEN7513
7515 SK=VAL(SS):IFSK<1ORSK>4THEN7513
7520 LV=(SK-1)*10:RETURN
7600 POKE54276,17:X1=PEEK(162):X2=PEEK(16
    2)
7610 POKE54273,X1:POKEC,X2
7620 POKE54276,16:RETURN

```

Program 4: TRS-80 Barrier Battle

Translation by Jeff Hamdani, Editorial Programmer

```

93 REM INITIALIZATION
94 CLS:LV=5:GOSUB1000
100 CLS:X=16:Y=8:SR=1024+X+32*Y:SD=
    249:BR=246
101 WL=175:SS=159:BK=96:V1=5:V2=5
105 U=1:LN=32:VE=LN:DR=-LN

```

```

115 LC=SR:PS=SR
126 CLS:PRINT01,CHR$(175);"HOLES";V
    1:PRINT022,CHR$(159);"HOLES";V2
127 GOSUB 5000:IFU=1 THEN 300
199 REM JOYSTICK ROUTINE
200 H0=JOYSTK(0):H1=JOYSTK(1):H2=JO
    YSTK(2):H3=JOYSTK(3)
210 H0=INT(H0/2):H1=INT(H1/4):H2=IN
    T(H2/2):H3=INT(H3/4):I=0
215 IF H1<=3 AND H1>=0 AND H0>2 THE
    N VE=-LN:GOTO 235
220 IF H1>=13 AND H1<=15 AND H0<29
    THEN VE=LN:GOTO 235
225 IF H0>22 THEN VE=1:GOTO 235
230 IF H0<9 THEN VE=-1
235 IF H3<=3 AND H3>=0 AND H2>2 THE
    N DR=-LN:GOTO 300
240 IF H3>=13 AND H3<=15 AND H2<29
    THEN DR=LN:GOTO 300
245 IF H2>22 THEN DR=1:GOTO 300
250 IF H2<9 THEN DR=-1
299 REM MOVE PLAYERS
300 FORSP=1TOLV:NEXTSP
301 LC=LC+VE:Q1=PEEK(LC):GOSUB7600
302 IF Q1 <> BK THEN 6000
304 B1=PEEK(65280):IF B1=126 OR B1=
    254 OR B1=124 OR B1=252 THEN 30
    6 ELSE 307
306 POKELC,BK:V1=V1-1:IF V1>=0 THEN
    POKE 1032,V1+112:GOTO 308
307 POKELC,WL
308 PS=PS+DR:Q2=PEEK(PS):SOUND X,1
309 IF Q2 <> BK THEN 6010
310 B2=PEEK(65280):IF B2=125 OR B2=
    253 OR B2=124 OR B2=252 THEN 31
    2 ELSE 313
312 POKEPS,BK:V2=V2-1:IF V2>=0 THEN
    POKE 1053,V2+112:GOTO 315
313 POKEPS,SS
315 U=U+1:GOTO200
1000 GOSUB7502:PRINT0452,"PRESS TRI
    GGER TO START"
1010 B1=PEEK(65280):IF B1=126 OR B1
    =254 OR B1=124 OR B1=252 THEN1
    018
1012 B2=PEEK(65280):IF B2=125 OR B2
    =253 OR B2=124 OR B2=252 THEN
    1018 ELSE 1010
1018 GOSUB7510:RETURN
4999 REM DRAW BORDERS
5000 FORI=1056TO1087:POKEI,SD:NEXTI
5002 FORI=1504TO1535:POKEI,SD:NEXTI
5004 FORI=1056TO1504STEP32:POKEI,BR
    :NEXTI
5005 FORI=1087TO1535STEP32:POKEI,BR
    :NEXTI
5008 RETURN
6000 GOSUB 6030:CLS:PRINT0233,"PLAY
    ER ";CHR$(159);" WINS":FORI=1
    TO700:NEXTI:GOTO6015
6010 GOSUB 6030:CLS:PRINT0233,"PLAY
    ER ";CHR$(175);" WINS":FORI=1
    TO700:NEXTI:GOTO6015
6015 PRINT0161,"<C> OR <FIREBUTTON>
    TO CONTINUE"
6016 PRINT0193,"<S> CHANGE SPEED &
    CONTINUE"
6017 PRINT0225,"<Q> QUIT"
6018 PRINT0326,"CHOOSE YOUR OPTION"
6020 A$=INKEY$:IF A$="" THEN 6021 E
    LSE 6023

```


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Notes For Commodore 64, VIC-20, TRS-80 Color Computer, And Apple Versions

Jeff Hamdani, Editorial Programmer

In "Barrier Battle," you must maneuver your barrier in an effort to contain your opponent. The fire button on the joystick (or the space bar for the versions using keyboard) allows you to leave spaces (holes) within your barrier. Clever use of this feature lets you corner your opponent and still leave yourself a means of escape. You can create a maximum of five holes in each game.

The VIC and 64 versions of Barrier Battle are similar to the Atari version. However, in the Commodore versions, the characters are not redefined. Instead, the existing graphic characters are used to draw the borders and the barriers. After you or your opponent crashes, the winner is picked, and you are asked if you want to continue or quit. To continue, press the trigger button on your joystick, or press the Q key to quit. Since only one joystick can be used on the VIC-20, the second player must use keys I, J, K, and M to move up, left, right, and down, respectively.

Like the Commodore versions, the TRS-80 Color Computer version draws the barrier with existing graphic characters. In this version, use the left and right joysticks and their fire buttons for movement and spacing, respectively.

Unlike the other versions, Barrier Battle on the Apple is over when you or your opponent wins four rounds. The barriers are drawn on the low-resolution graphics screen. Paddles were chosen to control each player's movement. Direction is based upon the change of the values in functions PDL(0) and PDL(1). A positive change of more than eight units will move you to the right. A negative change of more than eight units will turn you to the left. If you find that the paddles are too sensitive (or not sensitive enough), increase or decrease this number (8) in lines 340 and 400 to suit you.

```

00ELSE 6020
6023 IF A$="C" THEN 100
6024 IF A$="S" THEN GOSUB 1018:GOTO
100
6025 IF A$="Q" THEN END
6026 IF A$<>"C" OR A$<>"S" OR A$<>"
Q" THEN&015
6030 SOUND 178,5:SOUND 250,4:SOUND
252,3:SOUND 255,2:RETURN
7502 PRINTAB(7)"**BARRIER BATTLE**
":PRINT:PRINT
7504 PRINTAB(2)"BARRICADE YOUR OPP
ONENT INTO(4 SPACES)A COLLISIO
N WITH A WALL.":PRINT:PRINT
7505 PRINTAB(2)"YOU HAVE FIVE HOLE
S TO USE.(5 SPACES)THESE CAN B
E CREATED BY"
7506 PRINTAB(2)"PRESSING THE TRIGG
ER.":RETURN
7510 CLS:PRINT@230,"SPEED LEVEL (1-
4)":PRINT@295,"(1 IS FASTEST)"
7511 S$=INKEY$:IF S$="" THEN 7511
7512 SK=VAL(S$):IF SK<1 OR SK>4 THE
N 7511
7515 LV=(SK-1)*10:RETURN
7600 X=RND(50)
7610 SOUND X, 1:RETURN

```

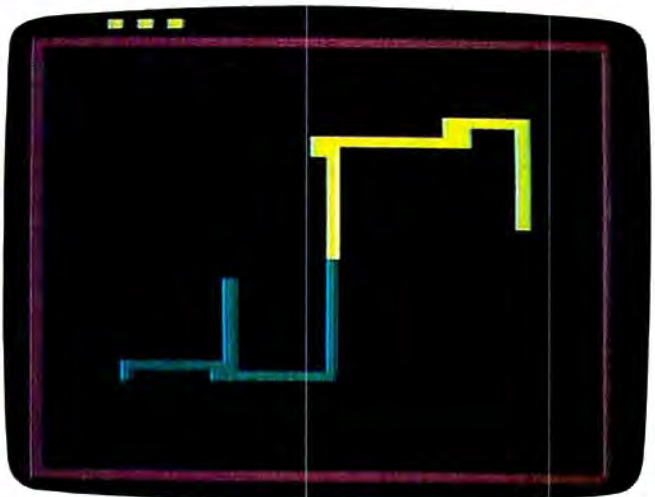
Program 5: Apple Barrier Battle

Version by Chris Poer, Editorial Programmer

```

10 TEXT : HOME :PI = 3.1415927 / 180
20 A = 0:B = 0
30 GOSUB 660
40 REM INITIALIZATION
50 FIR = 0:SEC = 0
60 XLOC = 20:YLOC = 26:ALOC = 20:BLAC =
25:AVAR = 0:BVAR = - 1
70 T1 = 0:T2 = 180:XVAR = 0:YVAR = 1
80 S = 0:T = 0
90 REM PADDLE SETTING
100 PRINT : PRINT "NOW SET YOUR PADDLE
ON THE CENTER VALUE OF 125": PRINT
: PRINT : PRINT
110 VTAB 22: PRINT , " "; HTAB 1: PRINT
B$;" IS AT": VTAB 22: PRINT , PDL
(1)
120 VTAB 23: PRINT , " "; HTAB 1: PRINT
A$;" IS AT": VTAB 23: PRINT , PDL
(0)

```



Players have gone opposite ways in the Apple version of "Barrier Battle."

```

6021 B1=PEEK(65280):IF B1=126 OR B1
=254 OR B1=124 OR B1=252 THEN
100
6022 B2=PEEK(65280):IF B2=125 OR B2
=253 OR B2=124 OR B2=252 THEN1

```



```

130 IF PDL (1) < 123 OR PDL (1) > 12
7 OR PDL (0) < 122 OR PDL (0) >
127 THEN 110
140 PRINT " HIT A PADDLE BUTTON TO CON
TINUE"
150 IF PEEK ( - 16287) < 128 AND PEEK
( - 16286) < 128 THEN 150
160 N1 = PDL (1):N2 = PDL (0)
170 HOME
180 REM SET SCREEN
190 GR : HOME : POKE - 16302,0: CALL
- 1998
200 COLOR= 1: HLIN 0,39 AT 4: HLIN 0,3
9 AT 47: VLIN 47,4 AT 0: VLIN 47,4
AT 39
210 COLOR= 13: FOR I = 1 TO 10 STEP 2:
PLOT I,2: NEXT
220 COLOR= 4: FOR I = 20 TO 29 STEP 2:
PLOT I,2: NEXT
230 COLOR= 13: PLOT ALOC,BLOC: COLOR=
4: PLOT XLOC,YLOC
240 FOR I = 1 TO 300: NEXT
250 GOTO 330
260 REM MOVE PLAYERS
270 COLOR= 13
280 IF S < 5 AND PEEK ( - 16286) > 12
7 THEN COLOR= 0:S = S + 1: PLOT S
* 2 - 1,2
290 PLOT ALOC,BLOC
300 COLOR= 4
310 IF T < 5 AND PEEK ( - 16287) > 12
7 THEN T = T + 1: COLOR= 0: PLOT 1
8 + (T * 2),2
320 PLOT XLOC,YLOC
330 O1 = N1:N1 = PDL (0):O2 = N2:N2 =
PDL (1)
340 IF ABS (O1 - N1) < 8 THEN 390
350 S1 = SGN (O1 - N1)
360 IF S1 = 1 THEN T1 = T1 + 90: GOTO
380
370 T1 = T1 - 90
380 XVAR = INT ( SIN (T1 * PI) + .1):Y
VAR = INT ( COS (T1 * PI) + .1)
390 XLOC = XLOC + XVAR:YLOC = YLOC + YV
AR
400 IF ABS (O2 - N2) < 8 THEN 450
410 S2 = SGN (O2 - N2)
420 IF S2 = 1 THEN T2 = T2 + 90: GOTO
440
430 T2 = T2 - 90
440 AVAR = INT ( SIN (T2 * PI) + .1):B
VAR = INT ( COS (T2 * PI) + .1)
450 ALOC = ALOC + AVAR:BLOC = BLOC + BV
AR
460 PNT = SCRNI (XLOC,YLOC):POT = SCRNI
(ALOC,BLOC)
470 IF PNT = 0 AND POT = 0 THEN FOR I
= 1 TO LEV: GOTO 270
480 IF PNT = 4 OR PNT = 1 OR PNT = 13 THEN
FIR = 1
490 IF POT = 4 OR POT = 13 OR POT = 1 THEN
SEC = 1
500 FOR I = 1 TO 1000: NEXT
510 REM DETERMINING WINNER
520 GOSUB 790: TEXT : HOME
530 IF FIR = 1 AND SEC = 1 THEN PRINT
"IT WAS A TIE": GOTO 560
540 IF FIR = 1 THEN B = B + 1: PRINT B
$: " WON THIS ROUND": GOTO 560
550 A = A + 1: PRINT A$: " WON THIS ROUN
D"
560 PRINT "THE SCORE IS ": PRINT B$: " V
ICTORIES FOR ";B$

```

```

570 PRINT A$: " VICTORIES FOR ";A$
580 IF B = 4 THEN C$ = B$: GOTO 630
590 IF A = 4 THEN C$ = A$: GOTO 630
600 PRINT "HIT YOUR PADDLE BUTTON TO C
ONTINUE"
610 IF PEEK ( - 16287) > 127 OR PEEK
( - 16286) > 127 THEN 40: GOTO 620
620 GOTO 610
630 PRINT : PRINT : PRINT C$: " IS THE
WINNER"
640 END
650 IF PEEK ( - 16287) > 127 OR PEEK
( - 16286) > 127 THEN 40: GOTO 650
660 INVERSE : HTAB 15: PRINT "BARRIER
BATTLE"
670 NORMAL : PRINT : PRINT : PRINT "TH
E OBJECT OF THE GAME IS TO FORCE Y
OUR OPPONENT INTO A WALL."
680 PRINT : PRINT "YOU CANNOT RUN INTO
YOUR OWN WALL OR THE";: PRINT "BO
UNDARY."
690 PRINT : PRINT "YOU CAN MAKE FIVE H
OLES IN THE WALL PER ROUND BY PRES
SING THE BUTTON ON YOUR": PRINT "P
ADDLE.": PRINT : PRINT "THE NUMBER
OF HOLES YOU HAVE LEFT IS": PRINT
"SHOWN AT THE TOP OF THE SCREEN."
700 PRINT : PRINT "THE FIRST MAN TO WI
N FOUR ROUNDS WINS": PRINT "THE GA
ME."
710 PRINT : PRINT "WHAT SPEED DO YOU W
ANT (1-4) ? <4 IS THE";: PRINT "FA
STEST>": INPUT LEV
720 LEV = (4 / LEV - 1) * 40
730 PRINT "WHO IS PLAYER ONE": INPUT B
$
740 PRINT "WHO IS PLAYER TWO": INPUT A
$
750 HOME
760 PRINT : PRINT B$: " IS ON TOP AND U
SES PADDLE 1": PRINT A$: " IS UNDER
NEATH AND USES PADDLE 0"
770 RETURN
780 REM NOISE
790 FOR I = 1 TO 40
800 F = PEEK ( - 16336)
810 NEXT
820 RETURN

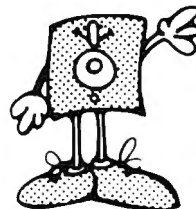
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The enemy missiles come in waves, increasing in number and speed with each new attack. You must meet this massive assault alone, matching the speed and power of your computer against an onslaught of simulated juggernauts. Your defensive missiles can hover in ambush or rocket through the atmosphere at twice the speed of anything the enemy can launch against you. But even with such weapons at your disposal, you know that lightning reflexes and all your skill will be required to repel the attack.

Inside The *Trident* Computer

"Trident" is an arcade-style game making extensive use of machine language. It will run in 24K RAM on the Atari. Three machine language routines are used, stored in a string. A\$ contains

"Textplot II" by Mark Grebe (COMPUTE!, December 1982); it is used to place numerical data in the various screen readouts. M\$ contains D. K. Titchenell's MOV\$ (COMPUTE!, March 1983). This routine speeds up initialization and clears the P/M graphics area. The third routine, stored in D\$, is the actual game routine. It reads the joystick, keeps track of the incoming missiles, homes them in on the target, handles their movement, and detects collision.

If all is well, D\$ returns a 17 PEEK(207), directing the program to reexecute the routine. A 16 indicates a missile has gotten through and the game is over. A value of 1-15 is returned when an incoming missile is destroyed. This number is used to indicate which missiles were destroyed and to compute the score.

Because this program does make extensive use of machine language, a five-line BASIC routine is included (beginning at line 1000) to aid in verifying each DATA line. After entering the program and before typing RUN, type GOTO 1000. If screen output matches the chart below, DATA statements have been entered correctly; you can delete lines 1000-1020 and RUN the program. If there is a discrepancy, the line with the incorrect DATA will be indicated by the number to the left.

Line No.	Check No.	Line No.	Check No.
515	4701	585	3829
520	4304	590	4282
525	4139	595	4278
530	4147	600	4378
535	4403	605	4480
540	4417	610	4003
545	4465	615	4648
550	4191	620	4718
555	4416	625	4685
560	4733	630	4365
565	4620	635	1094
570	4609	640	4931
575	4714	645	2326
580	2841		

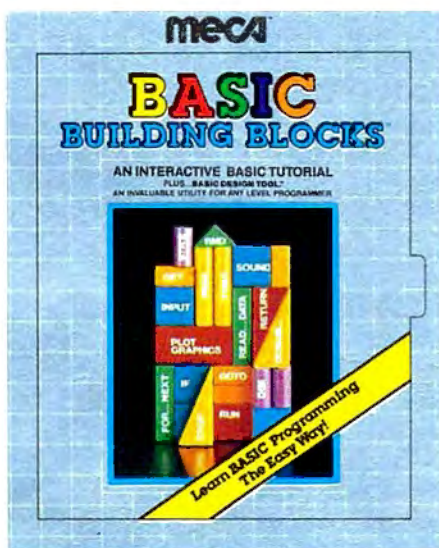
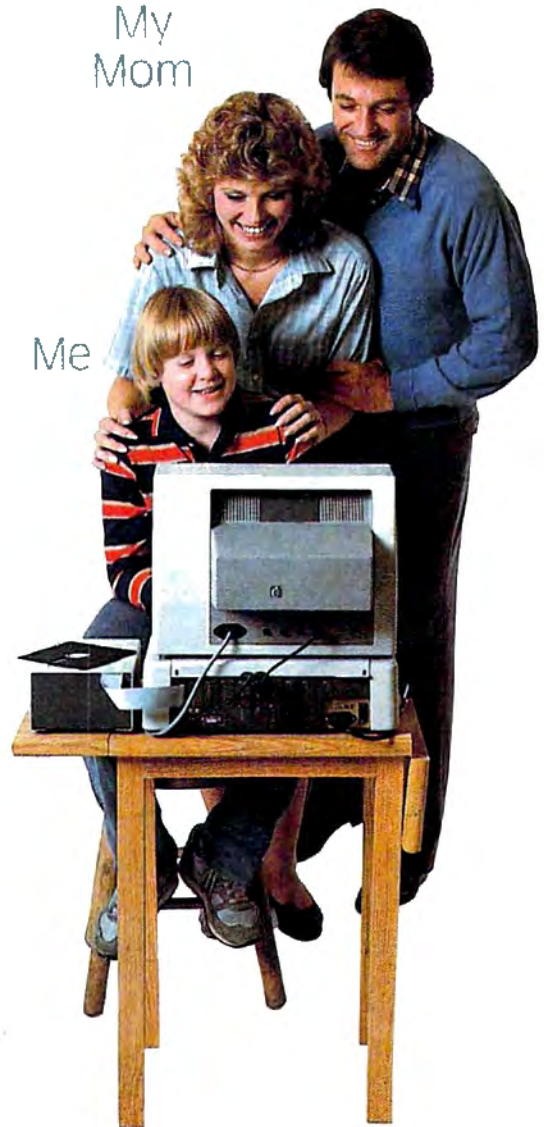
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Launching Your Missile

To stop the incoming wave of enemy missiles, release an antimissile from your base (centered in the radar grid) by pressing the fire button on joystick 1. Use the joystick to direct the antimissile toward the nearest incoming missile as shown on the radar screen. Once you have picked off the incoming missile, you are ready to release another antimissile from your base. Be sure to keep your antimissiles on the radar grid.

If you destroy all missiles in an incoming wave, you move to a higher difficulty level where the frequency and speed of the missiles are increased. If you lose, start over by hitting the fire button.

Console Indicators (from top to bottom)

Number of antimissiles launched

Score

Number of missiles in the wave and number of missiles destroyed

Incoming missile speed

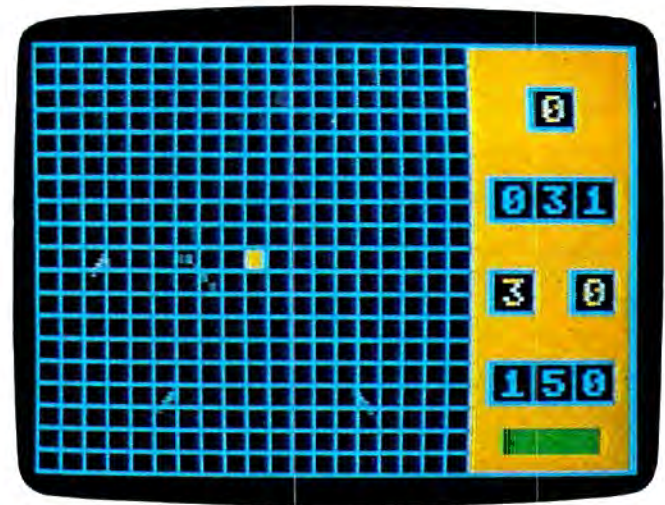
Scoring begins at two points for each incoming missile destroyed, increasing by one with each new speed level. A bonus is given for each antimissile not used during the wave. Thus, if each hit counts four points and you are able to destroy four incoming missiles using only three antimissiles, your score for that wave is 20 (4 points for each missile destroyed plus a bonus of 4 points for the antimissile you didn't use).

Program 1: Trident For Atari

```

BG 10 GRAPHICS 0:POKE 752,1:POSITION 1
    2,12:?"STANDBY PLEASE":Q=100:S=
    0:GOSUB 240:GOSUB 345:GOSUB 160:
    GOSUB 285
LI 15 REM MISSILE ALERT(17 SPACES)
NO 20 FOR I=1 TO 10:FOR D=30 TO 20 STE
    P -1:SOUND 0,D,10,8:NEXT D:NEXT
    I:Z=USR(ADR(A$),48+PEEK(1691),1,
    122,51)
BN 25 T=10-(0/10):Z=USR(ADR(A$),T+48,2
    ,122,71):Z=USR(ADR(A$),53,2,133,
    71)
IF 30 POKE 1690,0:POKE 1692,0:POKE 203
    ,128:POKE 204,PM+1:POKE 208,105:
    POKE 209,61:POKE 53278,0:POKE 77
    ,0:C=0
EM 35 FOR I=1 TO PEEK(1691):POKE 53247
    +I,PEEK(1663+I):Z=USR(ADR(M$),16
    74,ST+384+I*128+PEEK(1667+I),4):
    NEXT I
EK 40 FOR I=1 TO 4*PEEK(1691)
BN 45 IF PEEK(710)=198 THEN POKE 704,1
    4:POKE 705,14:POKE 706,14:POKE 7
    07,14:POKE 710,52:SOUND 0,60,12,
    8:GOTO 55
LL 50 POKE 704,10:POKE 705,44:POKE 706
    ,202:POKE 707,106:POKE 710,198:S
    OUND 0,0,0,0
LS 55 FOR D=1 TO 100:NEXT D:NEXT I
EL 60 REM MAIN LOOP ( LINES 55 & 60 )
    (3 SPACES)

```



Incoming missiles speed toward the base at center screen in the Atari version of "Trident."

```

LE 65 FOR D=0 TO Q:NEXT D
LJ 70 Z=USR(ADR(D$)):POKE 53278,0:IF P
    EEK(207)=17 THEN 65
HC 75 IF PEEK(207)=16 THEN 320
ME 80 REM HIT ON MISSILE(16 SPACES)
OD 85 T=PEEK(207):IF T>7 THEN T=T-8:C=
    C+1:POKE 1667,0:Z=USR(ADR(M$),16
    84,ST+896+PEEK(1671),4)
EJ 90 IF T>3 THEN T=T-4:C=C+1:POKE 166
    6,0:Z=USR(ADR(M$),1684,ST+768+PE
    EK(1670),4)
EG 95 IF T>1 THEN T=T-2:C=C+1:POKE 166
    5,0:Z=USR(ADR(M$),1684,ST+640+PE
    EK(1669),4)
OG 100 IF T=1 THEN C=C+1:POKE 1664,0:Z
    =USR(ADR(M$),1684,ST+512+PEEK(1
    668),4)
OJ 105 Z=USR(ADR(M$),M,M+1,128):FOR I=
    15 TO 0 STEP -.5:SOUND 0,10,10
    ,I:NEXT I:Z=USR(ADR(A$),48+C,1,
    144,51)
PP 110 Z=USR(ADR(A$),PEEK(1692)+48,1,1
    33,11):POKE 203,128:POKE 204,PM
    +1:POKE 208,105:POKE 209,61
NJ 115 Z=USR(ADR(M$),M,M+1,640):IF C=P
    EEK(1691) THEN 130
AB 120 POKE 53278,0:GOTO 70
GP 125 REM INCREASE NUMBER/SPEED
    (8 SPACES)
IK 130 Z=(C-PEEK(1692)+C)*((120-Q)/10)
    :S=S+Z:T1=INT(S/100):I=S-T1*100
    :T2=INT(I/10):T3=S-T1*100-T2*10
EI 135 Z=USR(ADR(A$),T1+48,2,122,31):Z
    =USR(ADR(A$),T2+48,2,133,31):Z=
    USR(ADR(A$),T3+48,2,144,31)
OL 140 FOR D=1 TO 500:NEXT D:POKE 1691
    ,PEEK(1691)+1:IF PEEK(1691)=5 T
    HEN POKE 1691,1:Q=Q-10:IF Q<0 T
    HEN 320
DA 145 Z=USR(ADR(A$),48,1,122,51):Z=US
    R(ADR(A$),48,1,144,51):Z=USR(AD
    R(A$),48,2,122,71):Z=USR(ADR(A$
    ),48,2,133,71)
HJ 150 Z=USR(ADR(A$),48,1,133,11):GOSU
    B 285:GOTO 20
GH 155 REM DRAW PLAYFIELD(15 SPACES)
EM 160 GRAPHICS 23:POKE 559,0:POKE 708
    ,42:POKE 709,152:POKE 710,198:P
    OKE 712,2

```




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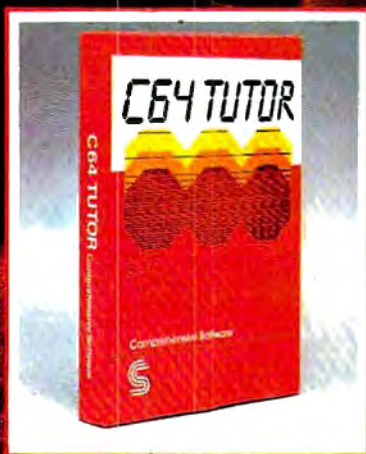
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```

IE 165 COLOR 2:PLOT 114,95:DRAWTO 159,
95:DRAWTO 159,0:DRAWTO 114,0:PO
SITION 114,95:POKE 765,1
BB 170 XIO 18,#6,0,0,"S":FOR I=0 TO 1
14 STEP 6:PLOT I,0:DRAWTO I,95:
NEXT I:FOR I=0 TO 95 STEP 5:PLO
T 0,I
DL 175 DRAWTO 114,I:NEYT I:PLOT 131,10
:DRAWTO 142,10:DRAWTO 142,19:DR
AWTO 131,19:DRAWTO 131,10:PLOT
120,30
NF 180 DRAWTO 153,30:DRAWTO 153,39:DR
AWTO 120,39:DRAWTO 120,30:PLOT 1
31,30:DRAWTO 131,39:PLOT 142,30
:DRAWTO 142,39
OP 185 PLOT 120,50:DRAWTO 131,50:DR
AWTO 131,59:DRAWTO 120,59:DRAWTO 1
20,50:PLOT 142,50:DRAWTO 153,50
:DRAWTO 153,59
PB 190 DRAWTO 142,59:DRAWTO 142,50:PL
OT 120,70:DRAWTO 153,70:DRAWTO 1
53,79:DRAWTO 120,79:DRAWTO 120,
70:PLOT 131,70
DF 195 DRAWTO 131,79:PLOT 142,70:DR
AWTO 142,78:X=132:Y=11:GOSUB 230:X
=121:Y=31:GOSUB 230:X=132:Y=31:
GOSUB 230
DM 200 X=143:Y=31:GOSUB 230:X=121:Y=51
:GOSUB 230:X=143:Y=51:GOSUB 230
:X=121:Y=71:GOSUB 230:X=132:Y=7
1:GOSUB 230
EK 205 X=143:Y=71:GOSUB 230:COLOR 1:FO
R I=46 TO 49:PLOT 55,I:DRAWTO 5
9,I:NEXT I:COLOR 3
NG 210 FOR I=85 TO 90:PLOT 124,I:DR
AWTO 149,I:NEXT I
DN 215 Z=USR(ADR(A$),48,1,133,11):Z=US
R(ADR(A$),48,2,122,31)
CG 220 Z=USR(ADR(A$),48,2,133,31):Z=US
R(ADR(A$),48,2,144,31):Z=USR(AD
R(A$),48,1,122,51):Z=USR(ADR(A$
),48,1,144,51)
PN 225 Z=USR(ADR(A$),48,2,122,71):Z=US
R(ADR(A$),48,2,133,71):Z=USR(AD
R(A$),48,2,144,71):POKE 559,46:
RETURN
AA 230 COLOR 0:FOR I=Y TO Y+7:PLOT X,I
:DRAWTO X+9,I:NEXT I:RETURN
BK 235 REM INITIALIZE...(16 SPACES)
BM 240 DIM A$(354),D$(241),M$(39),N$(1
6),T$(9)
LC 245 FOR I=1 TO 354:READ A:A$(I,I)=C
HR$(A):NEXT I:FOR I=1536 TO 155
7:READ A:POKE I,A:NEXT I
BD 250 FOR I=1 TO 241:READ A:D$(I,I)=C
HR$(A):NEXT I:FOR I=1 TO 39:REA
D A:M$(I,I)=CHR$(A):NEXT I
HG 255 T$="TRIDENT":N$="(16 SPACES)":
POKE 1664,0:Z=USR(ADR(M$),1664,
1665,44)
DM 260 PM=PEEK(106)-24:ST=PM*256:POKE
ST,0:Z=USR(ADR(M$),ST,ST+1,1024
):POKE 54279,PM:POKE 53277,3:M=
ST+384
DF 265 POKE 1675,24:POKE 1676,24:POKE
1680,255:POKE 1681,255:POKE 168
4,24:POKE 1685,60:POKE 1686,60:
POKE 1687,24
CE 270 POKE 1691,1:POKE 623,1:POKE 170
1,0:POKE 1702,128:POKE 1703,0:P
OKE 1704,128:POKE 1705,PM+2:POK
E 1706,PM+2
DN 275 POKE 1707,PM+3:POKE 1708,PM+3:R
ETURN
JH 280 REM SELECT RANDOM MISSILE POSI
TIONS
KH 285 FOR I=1 TO PEEK(1691):Z=INT(4*R
ND(0)+1):ON Z GOTO 290,295,300,
305
BL 290 POKE (1667+I),16:POKE (1663+I),
INT(112*RND(0)+46):GOTO 310
CK 295 POKE (1663+I),157:POKE (1667+I)
,INT(92*RND(0)+16):GOTO 310
EF 300 POKE (1667+I),108:POKE (1663+I)
,INT(112*RND(0)+46):GOTO 310
OI 305 POKE (1663+I),46:POKE (1667+I),
INT(92*RND(0)+16)
DG 310 NEXT I:RETURN
KD 315 REM END OF GAME(18 SPACES)
OP 320 Z=USR(ADR(M$),M,M+1,640):POKE 5
3761,143:FOR I=255 TO 0 STEP -1
:POKE 712,I:POKE 53760,I:NEXT I
:POKE 53761,0
KE 325 POKE 1691,1:Q=100:S=0:FOR I=0 T
O 7:POKE 53248+I,0:POKE 1664+I,
0:NEXT I:POKE 77,254
PH 330 IF PEEK(53279)<>6 AND STRIG(0)
THEN 330
BE 335 GOSUB 215:GOSUB 285:POKE 77,0:G
OTO 20
LH 340 REM GAME TITLE(19 SPACES)
AI 345 GRAPHICS 7:POKE 710,146:POKE 71
2,146:POKE 709,42:POKE 752,1:PO
KE 559,0:COLOR 2
CA 350 FOR I=1 TO 9:Z=USR(ADR(A$),ASC(
T$(I,I)),2,15+I*8,15):NEXT I:PL
OT 21,15:DRAWTO 23,15
KG 355 PLOT 17,16:DRAWTO 23,16:PLOT 13
,17:DRAWTO 23,17:PLOT 11,18:DR
AWTO 23,18:PLOT 11,19:DRAWTO 23,
19:PLOT 13,20
FC 360 DRAWTO 23,20:PLOT 17,21:DRAWTO
23,21:PLOT 21,22:DRAWTO 23,22:F
OR I=0 TO 5:PLOT 80-I,10+I:DR
AWTO 100-I,10+I
JD 365 NEXT I:FOR I=0 TO 5:PLOT 80-I,2
8-I:DRAWTO 100-I,28-I:NEXT I:CO
LOR 1:FOR I=0 TO 4:PLOT 110-2*I
,15+I
DL 370 DRAWTO 112+2*I,15+I:NEXT I:DR
AWTO 159,19:FOR I=4 TO 0 STEP -1:
PLOT 110-2*I,23-I:DRAWTO 112+2*
I,23-I:NEXT I
LD 375 FOR I=1 TO 16:Z=USR(ADR(A$),ASC
(N$(I,I)),2,7+I*8,45):NEXT I
NN 380 SOUND 0,60,4,4:?"(8 SPACES)PRE
SS START TO BEGIN":? :? "
(3 SPACES)PRESS OPTION FOR INST
RUCTIONS":POKE 559,34
FA 385 IF PEEK(53279)=6 OR STRIG(0)=0
THEN SOUND 0,0,0,0:RETURN
EL 390 T=T+1:POKE 708,T:IF T=255 THEN
T=0
CE 395 IF PEEK(53279)=3 THEN SOUND 0,0
,0,0:GOTO 410
GN 400 GOTO 385
FM 405 REM INSTRUCTIONS ( MESSAGE FOR
M)
JI 410 GRAPHICS 0:POKE 710,30:POKE 712
,30:POKE 752,1:?"(13 SPACES)-TR
IDENT-(14 SPACES)":? :? :?
HF 415 ? "STANDBY FOR HIGH PRECEDENCE
MESSAGE(13 SPACES)FROM PENTAGON"
:FOR I=1 TO 10:FOR D=1 TO 25:SO
UND 0,20,10,6
LG 420 NEXT D:FOR D=1 TO 25:SOUND 0,0,
0,0:NEXT D:NEXT I:?"(CLEAR)"

```


GC 425 ? "Z 152347Z JAN 87":? "FM CHIE
F OF NAVAL OPERATIONS":? "TO US
S TRIDENT (SSBN-12)":? "BT":?

NG 430 ? "{5 SPACES}R E D{3 SPACES}A L
E R T{3 SPACES}D R I L L":? :?

DH 435 ? "1. HEAVY MISSILE ATTACK ON U
SS TRIDENTIS IMMINENT. INTELLIG
ENCE SOURCES"

NH 440 ? "INDICATE THAT ATTACK WILL OC
CUR IN{4 SPACES}WAVES, INCREASI
NG MISSILE NUMBER AND"

KC 445 ? "SPEED WITH EACH ATTACK.":? "
2. YOU ARE DIRECTED TO PLACE YO
UR{5 SPACES}BEST MISSILE OFFICE
R AT THE DEFENSIVE"

DJ 450 ? "MISSILE CONSOLE. INSURE HE I
S AWARE{3 SPACES}THAT USS TRIDE
NT POSSESSES A LIMITED"

KK 455 ? "NUMBER OF ANTI-MISSILE MISSI
LES. EXTRACREDIT WILL BE GIVEN
FOR MULTIPLE{5 SPACES}KILLS ON
ENEMY TARGETS.":?

CC 460 ? "**Press TRIGGER to continue wi
th message**";

AG 465 IF STRIG(0) THEN 465

JC 470 ? "{CLEAR}":? :? :? :? "3. I
NFORM MISSILE OFFICER THAT UPPE
R INDICATOR OF CONSOLE WILL RE
PORT"

EO 475 ? "NUMBER OF ANTI-MISSILES FIRE
D, NEXT{3 SPACES}INDICATOR WILL
REPORT SCORE. THE TWO"

JO 480 ? "INDICATORS BELOW THAT WILL R
EPORT THE NUMBER OF ENEMY MISSI
LES IN THE WAVE"

AF 485 ? "AND THE NUMBER DESTROYED. TH
E FINAL{3 SPACES}INDICATOR WILL
REPORT INCOMING ENEMY MISSILE
SPEED."

HN 487 ? "4. RELEASE MISSILES WITH THE
FIRE{5 SPACES}BUTTON. IF YOU
SHOULD LOSE, HIT **FIRE BUTTON** FO
R ANOTHER DRILL."

DF 490 ? "5. GOOD LUCK!!! YOUR COUNTRY
DEPENDS ON YOU. ADMIRAL IMA C
OMPUTER SENDS.":? "BT":? :? :?

GO 495 ? "{7 SPACES}**press TRIGGER to c
ont**{7 SPACES}"

PC 500 IF STRIG(0) THEN 500

HD 505 RETURN

LL 510 **REM DATA STATEMENTS - warning
{3 SPACES}machine language - G
o up carefully{4 SPACES}**

BC 515 DATA 104,240,10,201,4,240,13,17
0,104,104,202,208,251,169,22,13
3,185,76,64,185,104,133,195,104
,201,128

IB 520 DATA 144,4,41,127,198,195,170,1
41,22,6,224,96,176,15,169,64,22
4,32,144,2,169,224,24,109,22,6

OB 525 DATA 141,22,6,104,104,141,23,6,
104,104,141,24,6,201,4,144,5,56
,233,4,176,247,133,214,201,0

OF 530 DATA 240,7,169,4,56,229,214,133
,214,78,24,6,78,24,6,6,214,24,1
04,104,141,25,6,133,186,166

OK 535 DATA 87,169,10,224,3,240,8,169,
20,224,5,240,2,169,40,133,207,1
33,187,165,88,133,203,165,89,13
3

PE 540 DATA 204,32,0,6,24,173,24,6,101
,203,133,203,144,2,230,204,24,1

65,203,101,212,133,203,165,204,
101

CJ 545 DATA 213,133,204,173,22,6,133,1
87,169,8,133,186,32,0,6,165,212
,133,205,173,244,2,101,213,133,
206

BD 550 DATA 160,0,162,8,169,0,133,209,
133,208,177,205,69,195,72,104,1
0,72,144,8,24,173,23,6,5,208

PJ 555 DATA 133,208,224,1,240,8,6,208,
38,209,6,208,38,209,202,208,228
,104,152,72,160,0,132,215,132,2
12

DC 560 DATA 166,214,240,88,56,38,215,2
02,208,250,177,203,5,215,69,215
,145,203,165,215,73,255,133,215
,200,200

MG 565 DATA 177,203,5,215,69,215,145,2
03,166,214,6,209,38,212,202,208
,249,160,0,24,177,203,101,212,1
45,203

LH 570 DATA 169,8,56,229,214,170,132,2
12,70,208,102,212,202,208,249,2
40,2,208,135,160,2,24,177,203,1
01,212

CF 575 DATA 145,203,24,165,208,101,209
,160,1,145,203,24,144,9,165,209
,145,203,200,165,208,145,203,10
4,168,24

NA 580 DATA 165,203,101,207,133,203,14
4,2,230,204,200,192,8,208,206,9
6

LB 585 DATA 169,0,133,212,162,8,70,186
,144,3,24,101,187,106,102,212,2
02,208,243,133,213,96

HC 590 DATA 104,169,17,133,207,162,0,1
89,128,6,201,0,240,83,56,233,10
2,48,5,222,128,6,208,3,254,128

HD 595 DATA 6,189,128,6,157,0,208,189,
165,6,133,205,189,169,6,133,206
,189,132,6,56,233,63,48,5,222

HH 600 DATA 132,6,208,3,254,132,6,188,
132,6,173,138,6,145,205,200,173
,139,6,145,205,200,173,140,6,14
5

DF 605 DATA 205,200,173,141,6,145,205,
189,4,208,201,1,208,5,169,16,13
3,207,96,232,224,4,208,161,173,
154

FE 610 DATA 6,201,1,240,11,169,1,205,1
32,2,208,1,96,238,156,6,141,154
,6,173,120,2,201,14,208,4

NO 615 DATA 198,209,198,209,201,13,208
,4,230,209,230,209,201,11,208,4
,198,208,198,208,201,10,208,8,1
98,208

CA 620 DATA 198,208,198,209,198,209,20
1,9,208,8,198,208,198,208,230,2
09,230,209,201,7,208,4,230,208,
230,208

AE 625 DATA 201,6,208,8,230,208,230,20
8,198,209,198,209,201,5,208,8,2
30,208,230,208,230,209,230,209,
165,208

MA 630 DATA 141,4,208,164,209,162,0,18
9,142,6,145,203,200,232,224,6,2
08,245,173,8,208,201,0,240,7,13
3

PD 635 DATA 207,169,0,141,154,6,96

PH 640 DATA 104,104,133,215,104,133,21
4,104,133,217,104,133,216,104,1
33,218,104,170,160,0,177,214,14
5,216,200,208

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MF 645 DATA 4,230,215,230,217,202,208,
242,198,218,16,238,96
KP 1000 REM THIS PORTION OF PROGRAM IS
(3 SPACES) USED TO VERIFY THAT
DATA LINES HAVE(3 SPACES) BEEN
READ CORRECTLY BEFORE RUNNING.
CE 1005 GRAPHICS 0:S=PEEK(136)+PEEK(13
7)*256
AG 1010 N=PEEK(S)+PEEK(S+1)*256:IF N>5
14 THEN ? N;" - " :A=0:FOR I=5
+5 TO S+PEEK(S+2)-2:A=A+PEEK(I
):NEXT I:? A
IG 1015 IF N=645 THEN END
CM 1020 S=S+PEEK(S+2):GOTO 1010

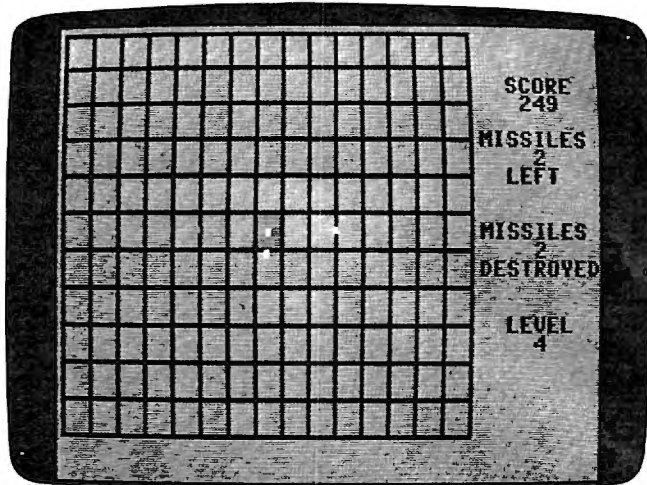
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Program 2: 64 Trident

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49152 :032,041,197,169,000,141,068
49158 :032,208,169,011,141,033,088
49164 :208,169,060,141,132,003,213
49170 :169,147,032,210,255,173,236
49176 :030,208,169,000,141,120,180
49182 :003,169,144,032,210,255,075
49188 :160,000,185,071,201,201,086
49194 :008,240,007,153,000,050,244
49200 :200,076,038,192,169,138,093
49206 :133,252,169,197,133,253,167
49212 :160,000,177,252,201,000,082
49218 :240,012,032,210,255,230,021
49224 :252,208,243,230,253,076,054
49230 :062,192,169,063,141,021,214
49236 :208,169,200,141,248,007,033
49242 :141,250,007,141,251,007,119
49248 :141,252,007,141,253,007,129
49254 :169,201,141,249,007,169,014
49260 :000,162,000,157,000,208,123
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"Trident," 64 version.

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49752 :127,105,044,141,134,197,068

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Notes On The Commodore 64 Version

Kevin Martin, Editorial Programmer

To stop the incoming missiles, you must direct your defensive missile to its target with a joystick plugged into port 2. Once you destroy one of the enemy missiles, preparations are made by the computer to launch another antimissile. If you destroy all the incoming missiles in one attack wave, you are moved on to a higher difficulty level where the speed of the incoming missiles is increased. If you lose, you can start over by pressing the fire button.

The 64 version of "Trident" is similar to the Atari version. It is written entirely in machine language and must be entered with MLX, the machine language editor program found elsewhere in this issue. Be sure you read the MLX article and understand how to use that program before you start typing the data for Program 2. MLX requires that you input the starting and ending addresses for your machine language. For Trident, the starting address is 49152 and the ending address is 51659. After typing in Trident, be sure to use the MLX Save option to store a copy of your work on tape or disk. After saving, you can load it back into the computer by typing:

LOAD "TRIDENT",8,1 for disk

OR

LOAD "TRIDENT",1,1 for tape.

To run Trident, type:

SYS 49152

The Commodore 64 version has one major enhancement. It allows you to choose a level of difficulty, which determines the speed of the incoming missiles. Each successive level has an increased speed. You have four choices, which can be selected by pressing the appropriate function key:

- f1: Beginner
- f3: Intermediate
- f5: Advanced
- f7: Expert

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 50202 :035,024,032,240,255,206,050
 50208 :063,003,238,064,003,173,064

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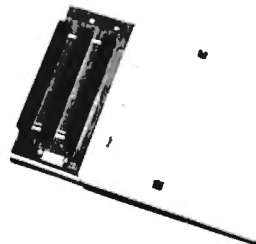
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51336 :032,221,032,221,032,221,127
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51390 :195,219,195,219,195,219,152
51396 :195,219,195,219,195,179,118
51402 :032,032,032,032,032,032,138
51408 :032,032,032,221,032,221,010
51414 :032,221,032,221,032,221,205
51420 :032,221,032,221,032,221,211
51426 :032,221,032,221,032,221,217
51432 :032,221,032,221,032,221,223
51438 :032,221,032,221,032,032,040
51444 :032,032,032,032,032,032,180
51450 :032,173,195,177,195,177,175

51456 :195,177,195,177,195,177,092
51462 :195,177,195,177,195,177,098
51468 :195,177,195,177,195,177,104
51474 :195,177,195,177,195,177,110
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51534 :000,000,000,000,000,000,078
51540 :000,000,000,000,000,000,084
51546 :000,000,000,000,000,000,090
51552 :000,000,000,000,000,000,096
51558 :000,000,000,000,000,000,102
51564 :000,000,000,000,000,000,108
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Dancing Feats For Commodore 64, Atari, And Coleco Adam

Tony Roberts, Assistant Managing Editor

Take a Commodore 64, Atari, or Coleco Adam, add a joystick and a program from Softsync, and you have created a musical instrument that can be played easily by nonmusicians.

The program, *Dancing Feats*, is subtitled *The One Man Joystick Band*. *Dancing Feats* provides the backup, and you use the joystick to make a melody. The music rings out instantly, because there's virtually nothing—in terms of music—to learn.

The kind of music *Dancing Feats* makes is dependent on the decisions you make from a series of menus. The main menu provides the following choices: Choose Bass, Choose Beat, Choose Style, Choose Tempo, and Choose Ending. For each of these choices, there is a submenu. For example, if you select Choose Beat, the submenu asks you to choose from Jazz, Rock, Blues, or Boogie Woogie.

Go through the process for each of the main menu headings, and then you're ready to play.

Making Music

Dancing Feats follows your instructions and begins performing in its role as a backup band. It goes through a chord progression, playing in the style and tempo you selected.

Your joystick provides the melody. As you push it in various directions, different notes are added to the composition. The program sees to it that the

note you're playing is compatible with the chord being played by the computer. Pressing the fire button on the joystick will change the octave of the note you're playing.

Once a song is under way, you play as long as you like. When you're ready to end your composition, press the space bar, and the program will begin to play the ending you selected before you began. The possible endings are The Duke, The Elvis, The Chance, and The Mozart.

As you play, the screen displays a visual accompaniment to your music. Colored bars dance on the screen for each note you play. The positioning of the bars is relative to the pitch of the note being played. Low notes are displayed on the left, high notes are displayed on the right.

The screen also shows you what chord the computer is playing and what note you are playing.

The program includes an a cappella mode, in which you can play melody without accompaniment.

An Educational Tool

Dancing Feats does provide the user with a simple musical instrument, but there are some differences between it and a conventional instrument. With *Dancing Feats*, the musician is not in full control. You can't use your joystick to play *Mary Had a Little Lamb* or your favorite pop

tune. You can play only notes that are compatible with the chords the computer is playing.

If, for example, you keep the joystick in the same position while the computer plays a C chord, you'll get the same note. But when the computer switches to an F chord, that same position on the joystick will play a different note.

The music that results from *Dancing Feats*, while lively and enjoyable, cannot be composed note for note in the conventional sense. Nevertheless, *Dancing Feats* does provide nonmusicians or beginning musicians with the opportunity to learn something about music and music theory. For example, by experimenting with the options under Choose Tempo in the main menu, the user will learn the differences among adagio, allegretto, allegro, and vivace.

Dancing Feats cannot hope to duplicate what might result from solid training and years of practice on a conventional instrument, but it certainly allows those who haven't had such training to make a little music that sounds pretty good.

Children too young to tackle the intricacies of a violin or saxophone will enjoy the upbeat computer backup, and will be thrilled to make music many times more sophisticated than their dime-store xylophone can produce.

Dancing Feats
Softsync, Inc.
14 East 34th St.
New York, NY 10016
(212) 685-2081

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Coleco Adam, \$29.95



A Singing/ Talking Voice For VIC And 64

Arthur B. Hunkins

The Alien Group of New York City has come up with a significant advance in microcomputer voice synthesis with Voice Box, a peripheral for the VIC and 64 that can *sing* as well as speak. And with Voice Box you can program vocal *inflection* to create voices which are expressive and lifelike with virtually unlimited nuance.

Voice Box consists of the hardware peripheral, speech synthesis software on tape or disk, and *Music System* software, which drives both the singing voice and three-voice music from the Commodore SID chip (available only for the 64, on disk).

Plugs Into The User Port

The Voice Box itself is a sturdy, secure, 1.5 x 3 x 4-inch black box that plugs into the User Port. It consists of a 3 x 4-inch circuit board with seven chips and assorted components, an internal 2 x 3-inch speaker (.8 watt), and two external dials. One dial regulates the volume, the other the pitch range (the higher the faster for spoken material).

Voice Box produces only the vocal sound; sounds coming from the 64 SID chip require an external amplifier and speaker.

Volume is adequate for personal or small group use, but there is no provision for external amplification or headphones.

Voice Box software is different for VIC and 64, though the documentation—which is thorough and clear—differs only in detail. Software is offered on cassette for VIC and on disk for 64.

All Phonemes Are Used

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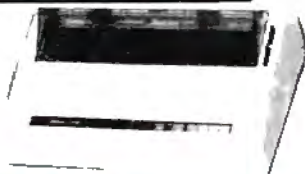
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producing all 64 phonemes used by the English language. The software permits programming either in English, in phonemes, or in BASIC, using number codes for phonemes.

You can incorporate the SPEAK subroutine into your BASIC programs (2K free memory required) to permit English or phoneme speech coding. If your program leaves only about 700 bytes free, you can use the

PSPEAK subroutine, that allows phoneme coding only.

The Talking Head

There are three other programs in the driving software. One is the SPEAK routine with an alien face added in character graphics with a moving mouth for vocal animation. A second program allows the user to type in words to be spoken by the face.

Most elaborate and perhaps

most fascinating is a SPELL program, in which an alien professor asks you to spell words, and either congratulates or chastises you, depending on your answers.

There also is a provision for adding your own words. All you need to do is to furnish the phonetic spellings in DATA statements.

Changing The Pronunciation

Many of the spoken words provided by Voice Box are difficult to understand, even though the professor will repeat them as often as you like. But you can experiment with inflection, vowel length, and timing to have Voice Box speak the way you want. The documentation provides a number of hints on improving pronunciation.

The software normally permits speech in four pitches, to give you vocal inflections through a simple system of notated slashes. But in combination with the *Music System*, Voice Box has the potential for continuous, infinite inflection.

The Music System

Unfortunately, the *Music System* software is available only for the 64, because it uses the SID chip. I recommend it even if you don't have Voice Box, since it provides an outstanding method for programming your own SID sound arrangements.

Music System is menu-driven. From a main menu, select SYNTHESIZER SETTINGS, and a densely packed screen displays SID sound options. You use the cursor controls, and the + and - keys, to select options. After you choose the new instrumentation, press the f7 key to hear the results.

By pressing other function keys, you can record a melody. Pitch is entered in a piano-like arrangement of the upper two rows on the keyboard. After you record your melody, you can go back and edit the pitch and rhythm.



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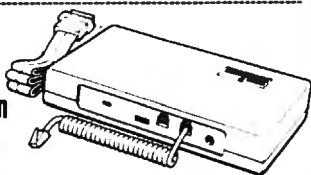
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What *Music System* gives you is a three-voice digital recorder with synchronizing click track (metronome), changeable tempo independent of pitch, and the ability to vary the sound of any line. You can try out and rerecord arrangements at will. And all this uses about 90 percent of the SID chip's potential. You have the ability to program pitch, waveform (including pulse width), filter type, filter resonance, filter routing select, filter cutoff point, overall amplitude, and all ADSR parameters.

You can get a single-speed phasing by internally cycling the pulse width, and you can set the rate of sweep of the filter cutoff point during a note.

This switchable effect requires specifying a beginning and ending cutoff point. (The sweep can be triggered by any selected oscillator, as it begins a new note.)

A third option, here exercised on playback (like the rhythmic editing mentioned earlier), provides for the addition of *accents* for selected notes per voice. The programming techniques behind these three effects bode well for the future of SID sound synthesis.

There are a few limitations, though. There is no pitch transposition, and no microtones. Only one type of filtering can be selected at a time, there is no ring modulation, only 15 pulse-width settings are available, and the modulating capabilities of both ADSR and Oscillator 3 are not implemented.

The Singing Voice

To work with the singing voice, select LYRIC EDITOR from the main menu. Text is entered in phonemes, with slashes between the sounds to be sung to different notes. A total of nine lines of text with 77 phonemes each is permitted. As a pronunciation aid, there is a "trial" line; a series

of phonemes entered here will be sung in monotone when you hit RETURN.

After text is entered, pitch is added in the same way as with the SID oscillators, using the top two keyboard rows—complete with vocal tone and text. As before, rhythm can be edited later. The voice has a fixed-rate amplitude vibrato that can be edited in later, and a programmable glissando on selected pitches. It is this variable-rate slide that can theoretically be applied to achieve subtlety of inflection in speech synthesis. You are not told how to do this, but it can be done. Perhaps Alien Group or an enterprising independent programmer will soon show us.

Disk Save Option

Several other choices are available from the main menu. One allows SAVEing to disk; both a text and a music file are stored. There is a MEDLEY option, where you can string together

several selections to be played in succession. And there is a program to redraw the face. During playback of any song, you can select video of a male singer with moving mouth and eyebrows, by choosing among mouth and eyebrow shapes.

Actually, the entire screen can be changed in high-resolution, multicolor graphics mode, and you can SAVE these new faces.

Voice Box represents a substantial step forward in speech synthesis. The cost, considering software and hardware flexibility, is reasonable. With all its power and options, it is remarkably easy to use, either alone or incorporated into other programs.

Voice Box

(for VIC-20 or Commodore 64; tape, disk for 64 only)
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AMDC 3-Inch Disk Drives For Atari

Richard DeVore

The AMDC-1 is a single-drive, single-sided, dual-density 3-inch disk drive with a parallel printer port. The AMDC-2 is the dual drive version. AMDC-2 lists for \$850. However, AMDEK has announced special introductory pricing. Through June 30, 1984, the AMDC-1 will sell for \$550, and the price of the AMDC-2 will be \$760. The AMDC-1 may be upgraded to the AMDC-2 for \$300. The Atari 810 single-density single drive lists for the same price as the AMDC-1 but has only half the storage capacity and cannot run a parallel printer.

The AMDISK AMDC-1 uses 3-inch disks which are designed to be used on both sides. A nice feature is that the drive has a LED which is keyed to whichever side of the disk is in use. When

the A side is in position, the LED is green. When the B side is in position, the LED is red. This eliminates confusion over which side of the disk is in use, and prevents problems such as formatting the wrong side. A simple slide switch on the disk write-protects it, eliminating the need for a supply of write-protect tabs.

A Disk In Your Pocket

These disks are available from Amdek and Maxell for a suggested retail price of \$6.99. Extra protection is offered by the disk enclosure, which seals the disk surfaces completely until the disk is inserted into the drive.

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area of the disk surface. This cover is automatically moved aside when the disk is inserted into the drive. This cover, and their small size, allows them to be carried in a shirt pocket with relative impunity. Their small size also makes it possible to mail them in a standard envelope.

The drive formats the 3-inch disks so that they are fully compatible with the 5¼-inch disks you're used to. This, in effect, makes them transparent to the computer, which accepts them as a 5¼-inch disk.

During my tests of the AMDC-2 I used it in both single- and double-density modes with no problems at all. I was able to fill all the disk sectors in both single- and double-density modes, and consistently read all the information. In transferring full disks of programs from one drive to the other, including from 3-inch to 5¼-inch and back, the units performed perfectly.

Four Drives And A Printer

The drives contain a controller which will take care of four drives and a Centronics-type parallel printer or plotter. It also allows the use of 5¼-inch and the 3-inch drives in any combination. DIP (dual in-line pin) switches mounted on the rear panel of the unit allow the 3-inch drives to be used as any drive, from drive 1 to drive 4. The factory setting is drive 1 for the AMDC-1 and drives 1 and 2 for the AMDC-2.

Being able to add noncontroller disk drives to the AMDC is a bonus. Low-cost units are available and may be single- or double-sided. You may also use 40- or 80-track drives. These capabilities allow for a massive amount of storage at reasonable cost. The use of double-sided or 80-track drives requires the DOS/XL operating system to access the additional storage potential.

Connecting the external drives requires setting the drive to respond to the proper signal, connecting them to the cable,

and plugging the power cord in. External drives must have their own power supplies and cabinets.

Switches Select Options

There are eight DIP switches located on the upper right-rear panel of the AMDC. These allow the following configurations:

Switches 1 through 4 are density selection switches that allow you to configure the drives for either single or double density on boot-up. The density of the boot drive is determined by the disk installed at boot-up. These switches have no effect if the controller is set for DOS 3.0.

Switches 5 and 6 determine which drive will be the boot drive. The factory setting is for drive 1, but any drive up to and including 4 may be selected for this function.

Switch 7 is used when more than three drives are connected to the controller, and is particularly useful when there is a 5¼-inch drive attached. When this switch is on, the external drive will be recognized as drive 1. When it is off, the 3-inch drives are 1 and 2, and the external drive is drive 3.

Switch 8 sets drives that have been selected as dual density to 256 bytes per sector when off. When switch 8 is on, it sets all drives to be Atari 1050 compatible for use with DOS 3.0. When switch 1 is on, disks with 256 bytes per sector will not be recognized.

The 3-inch drives are also available as a dual drive without a controller. This version is called the AMDISK IIIB and is fully compatible with the AMDC-1 or 2. The AMDISK IIIB in conjunction with an AMDC-2 lets you have a total of four double-density drives that take up about the same desk space as one Atari disk drive.

If you have 5¼-inch dual-density disk drives with controllers that use the industry standard 34-pin ribbon cable for

drive connection, you can use the AMDISK IIIB as add-on drives.

Parallel Printer Port

The printer port on the AMDC is software-compatible with the Atari 850 interface. This enables the use of data base programs, word processors, and LPRINT statements from BASIC. The printer port also uses the same 15 pin D connector as the 850. This port is located on the upper rear panel of the AMDC. Since the pinout is the same as the 850 interface, any Atari-compatible printer cable will work with your printer or plotter.

Should you already own an Atari 850 interface, one printer/plotter may be attached to it, and another to the AMDC. Since they both respond to the same signals from the computer, it is possible to have the equivalent of a printer switch by simply turning on the unit you wish to use and turning off the other.

Drives Supplied With DOS/XL

The AMDC drives will be supplied with the DOS/XL operating system by Optimized Systems Software, Inc., of Cupertino, CA. This is a menu-driven version of OSA + Version 2.0 and OSA + Version 4.1. This allows compatibility with the Atari operating system as well as the use of double-sided or 80-track drives. DOS/XL was not ready at the time of this review, but both OSA + versions performed as advertised.

Amdek also will provide a group of utility programs and a patch to Atari DOS which will permit it to function under double density. Most of these utilities are quite complex and are intended for programmers who wish to take full advantage of all the drives' capabilities.

Two of these utilities, however, will be of value to anyone: Config and Version. Config configures the drives as to type and density, and Version tells you

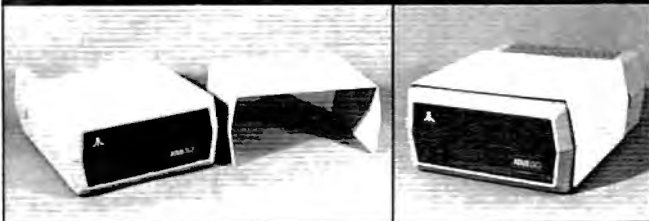
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the version number and date of the AMDC operating software which may help should you have a problem.

The more complex utilities are:

FREFORM – This allows you to specify the sector order on the disk. This would be a way to protect programs from being copied.

TIME EXTEND – This may be used to change the printer port time-out value from the normal 20 seconds to any value from 1 to 255 seconds. This may be useful when setting up a plotter or if you want to make it 5 seconds to match the normal 850 interface timing.

CONTD – Use this program to set the controller and drives to match the diskettes in the drives.

IDTABLE – Use this program to change the drive numbers as far as the computer is concerned. You may make drive 2 your boot drive, for instance.

IDENT – A program to check how many drives are presently attached and operating in the system.

The AMDC-1 and 2 have a formatted capacity of 92K per side in 40-track single-density, and 184K per side in 40-track double-density. In DOS 3 mode they have 127K in double-density. Each of the figures above is doubled since you can use both sides of the disk. If you connect an 80-track, double-density, double-sided drive to the system using DOS/XL, you can get 736K.

Software Compatibility

At the time this review was written the following software vendors had agreed to make all of their software available on the 3-inch format: LJK, Synapse, Brøderbund, Sirius, and Penguin, with more expected, including some educational vendors. This may make it unnecessary to have any other drive to get full use of your computer.

The AMDC-2 takes up less space than the 5¼-inch dual drive I have been using, not to mention the fact that the Atari 850 interface was not needed. This space saving also eliminated the additional expense, cables, and power supplies that would have been required with another configuration.

This, and the fact that software will be available in the 3-inch disk format, makes the AMDC disk drives an impressive alternative to the standard 5¼-inch drives. The extra protection of the media and ease of use make them especially good in teaching environments. In short, if you are in the market for a disk drive, the AMDC suits your needs perfectly and deserves serious consideration.

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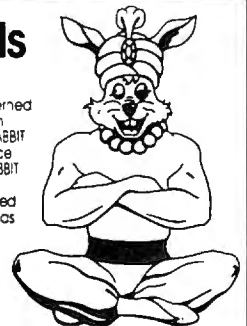
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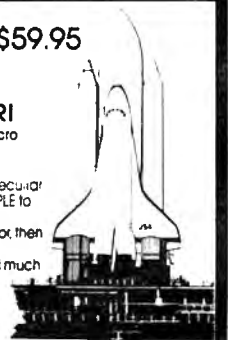
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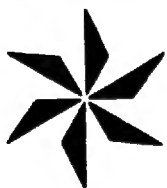
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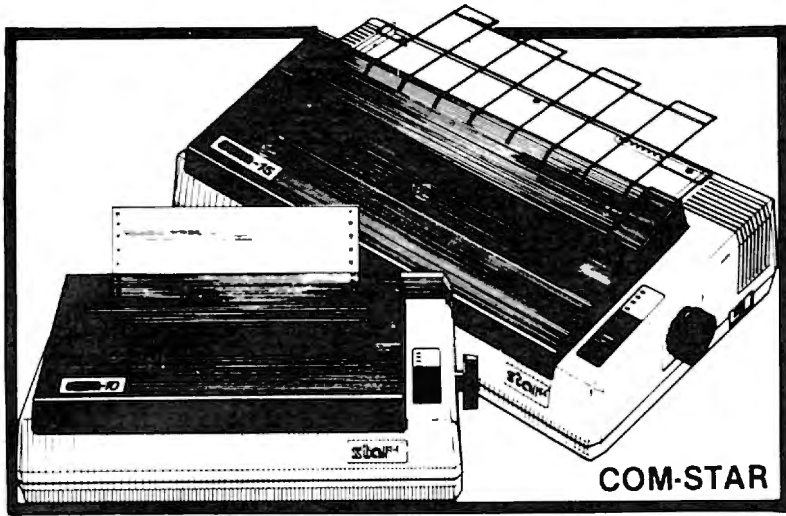
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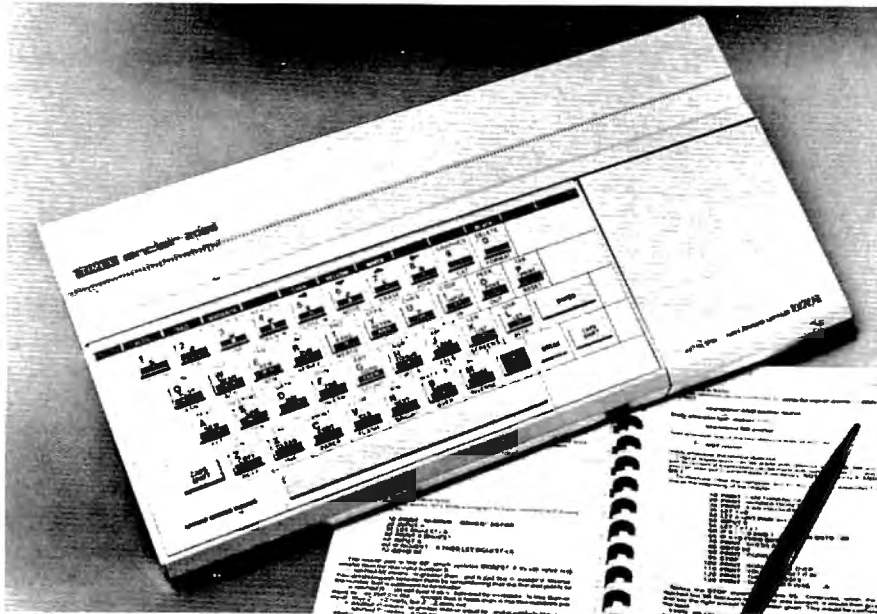
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The Timex/Sinclair 2068

John Krause, Assistant Technical Editor



The Timex/Sinclair 2068 offers 72K of internal memory, eight colors, and sound.

The Timex/Sinclair 2068 is the latest addition to the Timex line of home computers. Retailing for \$199.95, the 2068 features 72K of internal memory, eight colors, and sound, making it the most powerful Timex computer yet. The 72K is achieved through the use of bank switching and consists of 24K of ROM and 48K of RAM, of which about 38K is available for BASIC programs. The 2068 comes with three programs on cassette tape so you can put the computer to good use immediately if you have a suitable tape recorder.

The keyboard is full size and has 42 keys arranged in the familiar QWERTY layout. Timex describes the keys as being "full-travel," but they feel more like those on a calculator. They click into position when pressed and snap back when released. Each time a key is pressed, a faint sound can be heard from the internal speaker. This enables you to type without having to look up at the screen to verify that each keystroke was entered. All keys repeat when held down. And small raised dots on the F

and J keys make it easier for touch-typists to find the home keys.

To the right of the keyboard is a cartridge port. Timex sells ready-to-run programs on cartridge which you use by simply opening the cartridge door and inserting the cartridge in the slot. Two joystick ports are available—one on the right side of the computer and one on the left. Both are standard Atari-style ports, compatible with a wide variety of joysticks. Located in the back of the computer are ports for connecting a tape recorder and a television or monitor, as well as a port for peripherals such as a printer or modem.

Using The Keyboard

As Timex admits in the manual, the keyboard may seem hopelessly complicated at first. Most of the keys have five or more different functions. The reason for so many functions is that the 2068, like all Timex computers, uses one-key BASIC commands. On most other computers, if you want the PRINT command, for example, you would type the

letters P-R-I-N-T. But on the 2068, all you do is hit the P key. (It's not always that simple, as we'll see in a moment.) Since there are more BASIC commands than keys, each key must serve more than one function. Which function the computer uses depends on which shift key is pressed, if any, and which mode the computer is in at the time.

Five modes are available: keyword, letter, extended, capital, and graphic. The current mode is indicated on the screen by the cursor, which displays the initial of the mode—either K, L, E, C, or G. The extended, capital, and graphic modes can be switched in and out using keyboard commands. The keyword and letter modes are chosen automatically by the computer depending on which would be correct for the particular situation.

Let's examine all the different functions available via the P key. To get a lowercase P, you press the P key when in letter mode. To get a capital P, press P when in capital mode, or press CAPS SHIFT-P while in letter mode. To get the PRINT command, press P while in keyword mode. The quotation mark is chosen by pressing SYMBOL SHIFT-P while in either keyword, letter, or capital mode. To get TAB, you press P when in extended mode. To choose RESET, press SYMBOL SHIFT-P while in extended mode. The same general procedure applies to the other letter keys. This keyboard might be difficult to learn, but it's not difficult to use once you get used to it.

Two-Part Screen

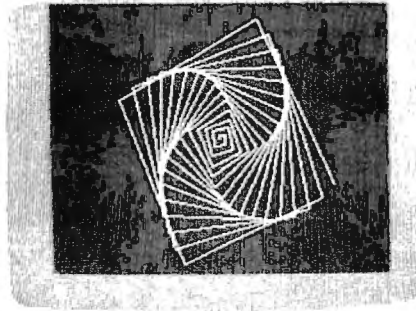
The screen can display 24 lines with 32 characters each and is divided into two parts. The top part, normally 22 lines, is used for program output and listings. The bottom two lines are for entering commands and program lines, and also for displaying error messages by the computer. When you type in a

program, each step is entered in the bottom part and is added to the listing above when ENTER is pressed. You can change any program step by moving an arrow to the step, using the up-arrow and down-arrow keys, and pressing EDIT. The step will appear in the bottom part, allowing you to insert or delete characters and then replace the step by pressing ENTER.

Several Graphics Modes

Characters can appear on the screen in many forms. Each character position has six parameters: PAPER, INK, FLASH, BRIGHT, INVERSE, and OVER. INK sets the character color and PAPER sets the background color. The available colors are blue, red, magenta, green, cyan, yellow, white, and black. The border color can also be changed using the BORDER command. INVERSE reverses the colors of INK and PAPER to print inverse characters. FLASH causes characters to flash by rapidly switching INVERSE on and off. BRIGHT makes characters appear brighter for emphasis. OVER allows you to create special characters by overstriking one character with another, as on a typewriter. For example, you could underline a letter by printing over it with the underline character.

Eight graphics characters are available from graphic mode. Eight more can be obtained by using the inverse of these characters. You can also create your own graphics characters and store them "under" the letter keys A-U. Most computers give you the ability to define your own characters, but the procedure is not easy and usually requires sacrificing other characters. On the 2068, however, it's a breeze. Each character consists of an 8-by-8 matrix of pixels. Each pixel can show either the INK color or the PAPER color. Think of the INK color as a 1 and the PAPER color as a 0. Each row of eight pixels is defined



High-resolution graphics is available on the 2068.

separately. To define the top row of pixels for a character stored "under" the E key, for example, you would type

```
POKE USR "e", BIN 01001100
```

The other seven rows are similarly defined. Then if you press the E key while in graphic mode, you'll get your character. It's that easy. Moreover, you don't have to sacrifice any of the normal characters.

One of the best features of the 2068 is its high-resolution graphics capability. The screen is 256 pixels wide and 192 pixels high. Three commands are available for drawing in high resolution. The PLOT command puts a dot at a specified place on the screen. DRAW draws a line and CIRCLE draws a circle or arc.

Simple Or Complex

The 2068 has both simple and complex ways of creating sounds. If all you need is a simple beep, you can use the BEEP command followed by two numbers representing the pitch, which has a range of ten octaves, and the duration of the note. For more complex sounds, you use the SOUND command. It allows you to play up to three notes at once and produce special effects. Consequently, it is also more difficult to use.

The SOUND command is followed by up to 15 pairs of numbers. Each pair specifies a number to be stored in one of 15 registers within the sound synthesizer chip. These registers control the pitch (eight octaves), duration, and volume of up to

three voices or channels. Each channel can play either a tone or a noise waveform. The envelope of the sound can be changed by specifying the rate of attack (increasing volume), and decay (decreasing volume). You can play the envelope once or make it repeat automatically.

With all these features, you can create a wide variety of sounds. But it's a shame that these sounds must be heard through the small internal speaker. It would have been better to have an audio output to give you the option of using your monitor's speaker or an audio system. This would give higher quality sound and better volume control.

Included Software

Like all Timex computers, the 2068 has the ability to use a conventional tape recorder for loading and storing programs. Using an ordinary tape recorder has its drawbacks, however. The volume level must be set just right or the program will not load properly. Fortunately, the same volume level works for all programs, so you should have to adjust the volume only once. If you do not already own a cassette recorder, you can purchase the Timex/Sinclair 2020 Computer Program Recorder. It is designed especially for use with Timex/Sinclair computers and can also be used as a conventional tape recorder for speech or music.

The first program is Keyboard Tutorial. It summarizes the material covered in the manual to familiarize you with the keyboard. It also demonstrates the sound and graphics capabilities of the 2068. As each key is introduced, a picture of the keyboard is drawn, using high-resolution graphics accompanied by sound effects. The appropriate key flashes, allowing the user to find its exact location on the keyboard. At the end of the tutorial is a practice session to test your ability to use the keyboard.

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The second program is Turtle Graphics. It lets you draw high-resolution pictures by guiding a "turtle" around on the screen. By typing commands from the keyboard you can tell the turtle to move forward so many pixels and turn left or right so many degrees. As the turtle moves, it leaves behind a trail. The power of Turtle Graphics is its ability to repeat a sequence of commands many times to create interesting patterns on the screen.

The third program is Home Accounting, which helps you keep track of your household budget or business records. You enter your budget and actual amount spent for each month, and the computer calculates the difference. You can display a bar graph of each month's budget versus your actual expenses.

Timex seems to realize the importance of software. They promise to have a "plentiful" supply of programs ranging in price from \$9.95 to \$19.95 on cassette, \$12.95 to \$29.95 on cartridge. Cassette programs developed for the ZX Spectrum can also be used on the 2068.

Documentation

The 290-page *User Manual* explains all the features of the 2068 well. Part I introduces the major features and assumes the user has no computer experience. It also explains how to load programs on tape cassettes so the included software can be used right away. For those who want to write their own programs, Part II provides an introduction to programming in T/S 2068 BASIC. It covers the use of variables, arrays, arithmetic functions, subroutines, and the concepts of looping and branching. Part III describes more advanced features to allow the experienced computer user to get the most from the computer. Such features include user-defined graphics, input and output, and music and sound effects.

The appendices go into de-

tail about the memory configuration and briefly mention several "enhanced display modes," including a 64-character wide screen, a dual screen mode, and an extended color mode. Exactly how these modes are used is not clear, but they are discussed in more detail in the *T/S 2068 Advanced Programming Concepts Manual*.

Throughout the manual there are illustrations showing exactly which keys to press and roughly what should appear on the screen. Beginners will enjoy the cartoons, featuring an old woman and her cat, which have nothing to do with the computer, but help make the computer less intimidating.

Besides a tape recorder, you can add two more peripherals. The 2068 is compatible with the Timex/Sinclair 2040 Thermal Printer used by the TS1500 and TS1000 computers. It prints graphics and text and retails for \$99.95. A modem is also available

to provide access to data banks and telecommunications services. Special programs for use with the modem provide home shopping and banking capabilities. Other peripherals will be announced, including bulk storage devices. Peripherals are connected to the expansion port, which can accept only two at a time.

In terms of memory, graphics, and sound, the Timex/Sinclair 2068 is an impressive entry into the under \$200 market. And, where some other computers require that you spend an additional \$60 to \$70 for a cassette recorder, you can use any player with the 2068. Furthermore, the included software enables you to use the computer immediately, without spending another cent.

Timex/Sinclair 2068 Personal Color Computer

Timex Computer Corporation
Waterbury, CT 06720
(203) 573-5000
\$199.95

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Snake Byte For VIC, 64, Apple, And Atari

Tony Roberts, Assistant Managing Editor

Since the advent of microcomputers, snake games have been a mainstay of the menu of available entertainment software. Generally, snake games are simple, yet they have the power to charm and challenge.

One of my favorite games in this genre is *Cleanup*, which was programmed years ago for the TRS-80 Model I. Despite its lack of color, sound, or sophisticated graphics, *Cleanup* remains one of the most frequently played programs in my game collection.

A more modern program of the same ilk is *Snake Byte* from Sirius Software. This program takes the same captivating idea, mixes in color and sound, a number of screens, and a time factor, and the result is a game I'll play again and again.

Gobbling Up Apples

The object of *Snake Byte* is to guide your snake to the apples that appear on the screen. Gobble up an apple, and another appears. Your snake also grows longer. Gobble up ten apples without hitting a wall or any part of your own ever-growing body, and a door to the next level opens. Thread your way through the door and you start over again, this time on a more complicated screen. As you move from level to level, the obstacles become more difficult.

As you play, bars on each side of the display inch toward the top of the screen. Should they complete their journey before you've eaten an apple, you are penalized: Three more apples are added to the total you must

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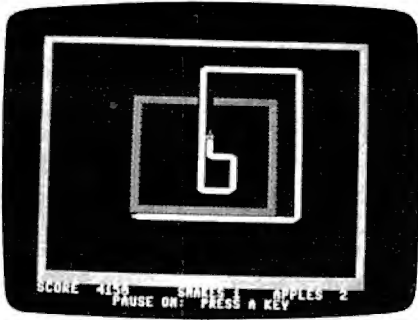
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In Snake Byte, the snake gobbles up apples and grows longer as it threads its way to more complicated screens.

eat before completing the level.

Your snake is controlled from the keyboard; there is no provision for joysticks. The keyboard, however, offers several options. You can control up-down movement with your left hand and right-left movement with your right. Or you can play with one hand using the I, J, K, and M keys. A third option allows you to use the > and < keys to achieve clockwise and counterclockwise movement. Despite its simplicity, I was unable to master this variation.

Perilous Purple Plums

Another aspect of *Snake Byte* that adds to the challenge is the option for playing with one or two purple plums in the arena. The plums offer the potential for higher scores, but at the same time they add to your headaches.

The plums bounce around the screen, deflecting off walls, obstacles, and your snake. Unless a plum hits your snake on the head, no harm is done. Sometimes it is possible to use the snake's body to corral the plums, temporarily keeping them out of your way.

The Commodore 64 version is a little easier to control. Guiding the snake into the door that leads to the next level is more difficult on the VIC than it is on the Commodore 64. The more highly defined screen on the 64 provides additional room to maneuver through tight spots, and that's the part of the game

you'll probably enjoy most. Even people who aren't normally exhibitionistic seem to love to play this type of game with an audience and have them ooh and aah as the player escapes impossible predicaments.

This game is more akin to a ballet than to a battlefield. It generates neither the hyperactivity associated with hyperspace flight nor the heart-pounding excitement of protecting a planet.

Snake Byte can even be a relaxing game. The snake,

winding its way around the screen, has a hypnotic quality—a tonic that calms the nerves. It's enjoyable both when played for a few minutes as a counterpoint to more serious pursuits and when played seriously for the challenge.

Snake Byte
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 Sacramento, CA 95827
 (916) 366-1195
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 Commodore 64 disk, \$34.95
 VIC-20 cartridge, \$39.95



WordPro 3 Plus/64

Larry Bihlmeyer

As word processing programs compete in the Commodore 64 market, better programs are available at lower costs. *WordPro 3 Plus/64*, by Professional Software Inc., is part of this trend.

WordPro, in its other versions, has long been the standard for comparison in office and small business word processing applications.

WordPro 3 Plus/64 comes on disk with a complete instruction manual of 160 pages. The manual is well organized into these categories: introduction, getting started, functions, editing text, advanced functions, file handling, disk drive commands, summaries, programmer's notes, example letter, care of diskettes, glossary, warranty and disclaimer, printer information, index and addenda.

There are far too many commands to adequately cover, so this review will only highlight some of the more interesting features.

Set-up Options

To start *WordPro*, you load a short boot program and then load the main word processing program. This process takes about 90 seconds. Then the screen clears and a message appears with the title "Word Proc-

essor Three Plus" and you are asked what kind of printer you have. Six printers can be selected—Spinwriter, Diablo, Qume, Tec, 8027, and Other.

Next, the number of lines available for main text is shown, and you can choose up to about 329 lines. A second storage area, called "Extra Text" (it's like a buffer), can also be allocated.

Finally, the main screen appears with a status line at the top. First, you see a sequence of characters like X:I:S:C:N. Here, X indicates the extra text mode, I insert mode, S shift lock mode, C control mode, and N numeric mode. When you select one of these modes, the corresponding indicator letter will be highlighted (background color changes) so you can tell quickly what mode you are in.

Advanced Features

Editing is done with the normal 64 cursor controls. Special functions, selected with the "control" key, then get you into more advanced features. For example, Control-D will delete words and sentences. And Control-F will search for a given string of characters. Other more unique control functions allow you to append lines from the extra text area, put a variable block on

screen, duplicate a range of lines, go to numeric mode, set up tabs, transfer a range of lines, underline, access bold type or disk utilities or subscript and superscript, add and subtract columns of numbers, sound a beeper, and perform global functions.

There are 23 format commands and 47 control functions. For instance, cn turns on centering and pt sets the pitch.

The Extra Text area is like a buffer where you can store text, for reference or for eventual addition to the main text. You can write and store standard or "boilerplate" paragraphs to use repeatedly in letters. Extra text can be used either manually or automatically, with the variable blocks feature.

Although there are a lot of commands to learn, the instruction manual includes many examples which you can copy, and in no time you'll be using the commands on your own. You

can also copy the feature summary sheets and have them nearby for quick reference.

Finally, there is a section called "Programmer's Notes" which will help if you run into complications, or want to do more with the input/output features. This will be useful for readers with various types of printers.

Printer Connections

And speaking of printers, this is the only area where I find any shortcomings with *WordPro 3 Plus/64*. The program supports only printing to device #4 on the serial port, so if you use the RS-232 port with a printer interface, you will not be able to print using *WordPro 3 Plus/64*.

If you are unsure of your printer/interface requirements, you should either contact your *WordPro* dealer for an actual try-out on your equipment or find out what interface you need.

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THE BEGINNER'S PAGE

Richard Mansfield, Senior Editor

Computer Amnesia

Here's a nasty little problem that can completely baffle you if you don't know what's causing it. We'll provide a short utility program that will cure this deadly error—but first, let's explore the symptoms. It appears in several disguises.

As you begin to write longer and more complicated programs, sooner or later your computer will halt execution and announce that you're OUT OF MEMORY. You know you're not. When you ask for a report of free memory (?FRE, or whatever command your BASIC uses), there's a lot of room left. But the computer is claiming that it has no more memory left. What's going on?

Something's Gone Awry

Try Program 1. After you type RUN, the computer will obediently follow your instructions and then grind to a halt. Your machine won't smolder, but something's gone awry. Clearly, these three lines cannot be using up all the memory in even the smallest computer.

Notice that there is no RETURN instruction to match the GOSUB. We are continuously GOSUBing, but always jumping back without a proper RETURN. That's variation one of this problem. Whenever the computer comes upon a GOSUB, it makes a mental note of where it is currently located so it can RETURN there. In Program 1, the computer would make a note that "line 150" was the correct place to RETURN. These mental notes are put on a *stack*, a zone in memory from addresses 256–511 (in 6502-based computers). As each note gets put on the stack, it takes up more room in the stack.

When the computer comes upon a RETURN instruction, it pulls off the most recent note and knows where to jump back to. Program 1, however, has no RETURN and so those notes keep piling up in the stack. Pretty soon, the computer is out of stack memory because each GOSUB puts a two-byte-sized note on the stack. To make things worse, some versions of BASIC use part of stack memory for their own purposes, making the stack smaller still.

A Common Stack Stuffer

In a cleanly written program, you'll always RETURN from every GOSUB. When you're writing large programs, however, that's easier said than done. It's hard to keep track of everything. Added to that, there's an even more subtle way to run out of stack space: early exit loops.

Look at Program 3. It's a very common technique to set up a loop and then test something, exiting the loop if the test succeeds. In such cases, you keep bouncing between FOR and NEXT until the IF part is satisfied. (For the moment, don't pay any attention to lines 10–20 and the SYS statement.) When, in line 110, A = 1, we jump out of that FOR/NEXT loop and into another one. And we start searching for B. *The first loop was never completed.* That is, we left an unsatisfied NEXT A because it didn't get to count up to 5 as it wanted to. It wouldn't make much difference if these NEXTs were unsatisfied except that this condition, too, leaves something on the stack. This isn't quite the stack stuffer that unRETURNed GOSUBs are, but it does eventually cause an overflow and an OUT OF MEMORY.

Solving The Problem

So, if you run into this mysterious memory loss, check through your program first for early exits from GOSUBs (that's the most likely cause). Then, if that's not it, look at your FOR/NEXT loops. The cure for GOSUBs is to create a RETURN to satisfy each one. The cure for the loops is to *use the same variable name again*. In Program 3, if we write IF A, IF A, IF A, instead of IF A, IF B, IF C, there would be no problem. Reusing an IF variable will clean the stack for you.

Experienced programmers make it a habit to use I for almost every FOR/NEXT loop, J if they need a loop within the I loop, and T for timing loops. That way, they keep the stack clean without having to think about it.

Lines 10–20 in Programs 2 and 3 are a short utility that can be attached to any program and give a report of the memory left within the stack.



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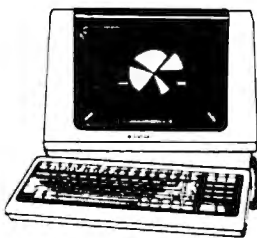
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As written, the DATA line contains the information for the Commodore 64 version of this utility, "Stackwatch." Replacements for this line to make it work on other computers are given below.

If you've been working on a long, complicated program and are getting an odd out-of-memory error, add lines 10-20 to the long program. They'll stick a machine language program down in a safe place. Then, put SYS 864 into various places in your program. You can then quickly locate which loop or GOSUB is unclosed. When the number printed on screen by Stackwatch takes a big dip, hit the STOP key and see where you are.

To make Stackwatch work on other Commodore computers and the Apple, you must change

the last three items in the DATA line, line 10, as follows:

for Original ROM PET:	159,220,96
Upgrade ROM PET:	217,220,96
4.0 BASIC PET:	131,207,96
VIC-20:	205,221,96
64:	(as printed)
For Apple:	10 DATA 186,169,0,32,36,207,96

There is no comparable number printing routine within the Atari operating system, but Charles Brannon has provided the following replica for those who know machine language and want to implement Stackwatch on the Atari.

For TI, you can run these BASIC tests, but the TI's brain chip will not run Stackwatch.

```

0000      0100      *= $600
0600      0110      .OPT OBJ
          0120 ;Test routine
0600 A900      0130      LDA #0
0602 A264      0140      LDX #100
0604 200806    0150      JSR PRNUM
0607 60        0160      RTS
          0170 ;
          0180 ;MSB in A, LSB in X
          0190 ;Prints number to screen
          0200 ;
0608 86D4      0210 PRNUM STX $D4
060A 85D5      0220      STA $D5
060C 20AAD9    0230      JSR $D9AA
060F 20E6D8    0240      JSR $D8E6
          0250 ;
          0260 ;Print ASCII number pointed to
          0270 ;by $F3 and $F4
          0280 ;The last digit of the number will be signalled by bit 7
          0285 ;If it is set, then we have the last digit
0612 A000      0290      LDY #0
0614 84CB      0300 LOOP STY $CB ;Save Y index
0616 B1F3      0310      LDA ($F3),Y ;Get char
0618 48        0320      PHA ;save it on stack
0619 297F      0330      AND #$7F ;mask off high bit (or it would be invers
e)
061B 202706    0340      JSR PRCHAR ;print character
061E 68        0350      PLA ;restore character
061F 3005      0360      BMI EXIT ;test for high bit set
0621 A4CB      0370      LDY $CB ;restore Y index
0623 C8        0380      INY
0624 D0EE      0390      BNE LOOP
0626 60        0400 EXIT RTS
          0410 ;
          0411 ;This routine pushes the high,low bytes of the address
          0412 ;of the CIO print character routine onto the stack,
          0413 ;creating an artificial return address
          0414 ;In effect, we have an indirect jump
0627 AA        0415 PRCHAR TAX
0628 AD4703    0420      LDA $0347
062B 48        0430      PHA
062C AD4603    0440      LDA $0346
062F 48        0450      PHA
0630 BA        0460      TXA
0631 A092      0470      LDY #$92
0633 60        0480      RTS
          0490 ;
0634          0500      .END

```


Program 1: Memory Collapse

```
100 GOSUB 150
150 X = X + 1:PRINT X
160 GOTO 100
```

Program 2:

Stackwatch Attached To Program 1

```
10 DATA 186, 169, 0, 32, 205, 189, 96
20 FOR A=864TO870:READ D:POKE A,D:NEXT A
100 GOSUB 150
150 X=X+1:PRINTX
160 SYS864:GOTO100
```

Program 3: Too Many Loops

```
10 DATA 186,169,0,32,205,189,96
20 FORA=864TO870:READD:POKEA,D:NEXTA
100 FORA=1TO5
110 IFA=1THEN130
120 NEXTA
130 SYS864:FORB=1TO5
140 IFB=1THEN160
150 NEXTB
160 SYS864:FORC=1TO5
170 IFC=1THEN190
180 NEXTC
190 SYS864:FORD=1TO5
200 IFD=1THEN220
210 NEXTD
220 SYS864:FORE=1TO5
230 IFE=1THEN250
240 NEXTE
250 SYS864:FORF=1TO5
260 IFF=1THEN280
270 NEXTF
280 SYS864:FORG=1TO5
290 IFG=1THEN310
300 NEXTG
310 SYS864:FORH=1TO5
320 IFH=1THEN340
330 NEXTH
340 SYS864:FORI=1TO5
350 IFI=1THEN370
360 NEXTI
370 SYS864:FORJ=1TO5
380 IFJ=1THEN400
390 NEXTJ
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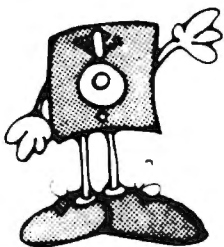
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THE WORLD INSIDE THE COMPUTER

New Directions For Computer Camps

Fred D'Ignazio, Associate Editor



I thought that this camp would be about programming. I didn't know that it would be so much fun!

Ashley Bell, age 8

Ashley was one of the youngest campers at the Computer FUN-

damentals camp at Hollins College, in Roanoke, Virginia, last summer. Her comments reflect the kind of computer activities she participated in at the camp. However, if she had gone to another camp, she might have learned about computers in a completely different way.

The Changing Face Of Computer Camps

Most educators agree that the first computer camp was organized by Dr. Michael Zabinski in Connecticut, in 1978. Now, six years later, Zabinski's organization offers five camps annually, in locations from Simsbury, Connecticut, to Portland, Oregon. In addition to Zabinski's camps there are hundreds of other computer camps throughout the U.S.

The first camps were mostly attended by boys. The boys studied "hard-core" computer subjects like BASIC programming, computer hardware, and hooking up different devices to computers. Compared to today's models, the

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

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

computers at the first camps were primitive. They consisted of early Apple computers, TRS-80 (Model I's), Commodore PETs, and other computers whose names we have all but forgotten.

Today's campers enter a new world filled with the latest personal computers and peripheral devices such as speech synthesizers, graphics pads, light pens, and robots. They study a variety of subjects, including the impact of computers on society, computers for handicapped people, and computers in the arts and humanities.

Today, girls represent a much larger proportion of the campers. In some camps, they number as many as a third.

At most camps you will also see a few campers who have some sort of mental or physical disability. Campers in wheelchairs are a common sight at many camps.

So are adults. The newest computer camps cater to both youngsters and oldsters. In fact, it's predicted that many of the most avid campers in 1984 will be men and women in their 60s and 70s.

How To Choose A Computer Camp

There are hundreds of computer camps to choose from, each with its own philosophy and personality. And you can find the right one for you, if you look hard enough.

The first thing you should look at is the type of camp. Is it sponsored locally or nationally? Is it for children, adults, or both? Do the counselors concentrate on programming or on computer literacy and applications? Is the camp residential or a day camp?

There are benefits and drawbacks associated with each type of camp. For example, if a camp is locally sponsored, it may be more suited to the needs of the people in your community. But local sponsorship doesn't necessarily mean high-quality sponsorship. Generally speaking, the best local computer camps are affiliated with a community college or university.

Residential computer camps are nice because they take the children away from home for a week

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Authors: COMPUTE! Magazine Contributors

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First Book of VIC Games contains fast-action arcade games that require quick reflexes, as well as strategy games that test logical skills. For \$12.95 you get two dozen games, including:

Time Bomb — You hear the time bomb ticking, and you have to find your way through the maze to defuse it. But the maze is larger than the screen, and you can't always see where the dead ends are.

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Cryptic Numbers — A good logic game. The computer picks a pattern of numbers that you have to guess. After each turn you learn how close you were.

Air Defense — Missiles are falling out of the sky onto your city. Aim carefully; you get only one shot at each missile.

Thunderbird — Your goal is to break out of the playing field by using the thunderbird that controls the satellite.

Sky Diver — Put on your parachute, jump out of the plane, and try to land on one of the targets. Watch out for wind currents that may blow you off course.

Deflector — A ball is bouncing around the screen. You can aim it toward targets by strategically placing deflectors that change its direction.

Hidden Maze — Lost in a maze, you're trying to get out. But it is dark, and you can see only a few spaces in front of you.

Outpost — Your small fortress is under siege. You have two types of lasers and some torpedoes. Unfortunately, the energy supply is dwindling and the computer is on the blink. The supply ship may (or may not) show up in time to make repairs.

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or two of fun, physical exercise, and computer instruction. But some educators feel that residential camps are a fad. Their outdoor activities are often an afterthought, and the camps cannot compare, in terms of staff, program, or facilities, to the regular summer camps, which, on their own, are beginning to offer computer activities. Also, residential camps are expensive and relatively inefficient if your main goal is to introduce your child to computers.



Campers draw on each other's skills and interests to program a computer. Courtesy of Computer FUNdamentals Camp. (Photo by Walker Healy, Jr.)

In the past, most computer camps were for kids. Now adult camps are springing up all over the country.

Many families send their kids to computer camp so they can come back and tell the family which computer to buy. But why let your kids have all the fun? Why not attend computer camp at the same time as your son or daughter? Then you and your kids can decide together which computer is right for the family.

New "mixed-age" camp classes are springing up that include people of all ages. Being in a class with several bright youngsters can be unnerving, but it can also add a new dimension to your computing. Kids approach computers as *explorers*. By imitating them you can begin computing fearlessly and playfully.

The Need For Continuing Support

The best computer camps offer a balanced approach—some computer programming and some computer activities. But beware. If you get your child started in either side of computing, his or her appetite for more computing is liable to increase. When you look for a computer camp you should try to find one that will be around to satisfy your and your child's computing interests no matter how sophisticated they become.

Dr. Zabinski, for example, believes that com-

puter camps "breed kids who are sophisticated with computers, so they can't just drop them." His camps emphasize programming as opposed to computer activities. "We train the youngsters in computers, so it is our responsibility to be around when they become more sophisticated and need more advanced training."

Zabinski's philosophy is "to motivate kids and excite them with examples they can relate to and identify with." His camps have been so popular and successful that he and his staff have to revamp their curriculum each year just to keep up with the kids they trained the previous year.

According to Zabinski, "We used to be content teaching kids to program in BASIC and Pascal. Now I feel that teaching new programming languages is just moving sideways. We can't afford to move sideways. Kids can master new languages in just a couple of weeks. Our objective in 1984 is to teach kids how to interface computers with each other and how to interface computers with other machines. We'll teach kids how to create their own computer languages, and how to use modems and bulletin boards and get computers communicating over the telephone."

Zabinski emphasizes that his highly technical curriculum is not aimed at just teenagers and older children. "Take nine-year-olds," he says. "Nine and ten-year-olds are not what they used to be. We have one nine-year-old who learned Assembler and won a national Assembler Language contest on the TRS-80 computer.

"There are plenty of sophisticated kids at all ages," contends Zabinski. "Computer camps are often these kids' only outlet. We've helped to create these kids, so we have to be ready when they come back to us each year. We can't abandon them."

Computer FUNdamentals

Nancy Healy and Dr. Barbara Kurshan run the Computer FUNdamentals Camp at Hollins College, in Roanoke, Virginia. Kurshan and Healy agree with Zabinski that computer camps need to keep upgrading their curriculum to keep up with the newest computers and the increasing sophistication of the average camper. But Kurshan and Healy stress computer applications as opposed to computer programming. And, above all, they want their campers to have fun.

According to Healy, "What makes our camp different is that it is oriented toward fun, and, at the same time, the kids become good computer users. Also, we don't mix physical activities and computer instruction. This lets our handicapped campers do everything that all the other kids do.

"Another reason our camp is different," Healy continues, "is that our camp isn't just for math and science freaks. Kids who love music

and the arts are equally interested and involved.

"After the first few days at camp, it is easy to see who knows what. The 'knowers' are those who attract people around them. But the great thing is that each child brings a different skill with him, like typing, music, art, programming, or math. The kids work together and draw on each other's skills and interests. That way everybody gets a chance to shine."

The Computer That Ate Manhattan

Like their counterparts at other camps, computer campers at Hollins spent most of their time last summer using real computers as electronic notebooks, typewriters, telephones, libraries, and mailboxes. But camp counselors also encouraged the children to spend time inventing totally new fantasy computers. Children described these computers and what things they could do. One boy, for example, made up a story about a computer that ate Manhattan.

One of the big projects during the camp was for the children to build their own *junk computers*. The children designed and built the junk computers out of all kinds of things, including buttons, wires, beads, tupperware, TV sets, and aluminum foil. One boy built a computer out of a nonworking TV set and a working walkie-talkie. The boy hid the walkie-talkie inside the TV set. Another boy built a junk computer that played beach music. The cardboard computer had a tape recorder hidden inside.

A local elementary school PTA in Roanoke sent two children to the camp on scholarships. The children were to learn as much as possible about computers during camp so they could help their teachers use the school's two new computers the following fall. The children, one 10 and the other 11, were chosen on the basis of an essay on why they wanted to go to computer camp. They wrote down everything they learned at camp in a spiral notebook, and were among the camp's most conscientious students.

Training A Future Sally Ride

While the camp was in progress at Hollins, America was glued to the TV set watching its first female astronaut, Sally Ride, blast off the earth in the Space Shuttle. This inspired the kids to create a computer-controlled rocket launching at camp.

The rocket was finally launched on the same day that Sally and her teammates brought the real Shuttle back to the earth. It even featured a computer-screen simulation of the rocket taking off and a speech synthesizer, in robot nasal monotone, doing the countdown: 5 ... 4 ... 3 ... 2 ... 1 ... IGNITION!

In honor of Sally Ride, the girl campers got to operate the computer to control the rocket launch.



Computer mania at the National Computer Camps. Courtesy of National Computer Camps. (Photo by Walker Healy, Jr.)

And the local TV station in Roanoke was so excited by this project that they filmed the rocket launch and, on the evening news, mixed the tape with a film of the real Space Shuttle take-off.

Computer Camp Resources

If you're interested in learning more about computer camps, you might want to send for *The Computer Camp Book*. It's a complete guide to computer camps and features a national directory of computer camps. The book is available for \$12.95 from

The Computer Camp Book
P.O. Box 292
Yellow Springs, OH 45387

For an additional \$4, you can get a copy of an updated directory of computer camps.

Two of the leading computer camps in the U.S. are the Atari Computer Camps and the National Computer Camps. You can learn more about them by writing:

Dr. Linda Gordon
Atari Computer Camps
Dept. AL
40 E. 34th Street
New York, NY 10012

Dr. Michael Zabinski,
Director
National Computer Camps
P.O. Box 585
Orange, CT 06477

You can learn more about the Hollins College Computer FUNdamentals Camp by writing:

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Computer FUNdamentals Camp
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To find out more about the Hollins camp's robot mascot, you can write:

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TI Aquarium

Michael A. Covington

Turn your TI into an aquarium. And the best part is, you never have to change the water. For TI-99/4A with Extended BASIC. The program also demonstrates some basic sprite techniques.

Recent studies have shown that the relaxing experience of watching fish glide around in an aquarium can lower your blood pressure and have other beneficial effects. This program (which we present somewhat with tongue in cheek) enables you to avoid the expense and bother of a real aquarium by using your TI-99/4A to simulate one.

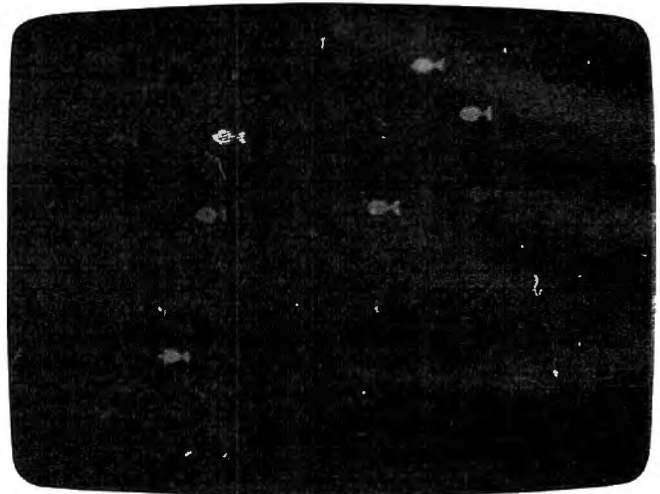
Lines 310 to 330 establish the characteristics of a double-sized, fish-shaped sprite. Lines 400 to 430 read a number from the DATA statement (340) and, treating it both as a sprite number and as a color number, create a fish accordingly. When the sprite is created, it has the same color as the background (color 1, "transparent").

It is made visible by a separate COLOR statement because newly created sprites tend to appear momentarily in the wrong place before jumping to the specified location. If this phenomenon were visible, it would detract from the atmosphere of tranquility.

The subroutine at line 610, which is called several times while the fish are being created and repeatedly after they are on the screen, makes random changes in sprite motion so that the fish move in realistic bobbing movements rather than in straight lines at constant speed.

TI Aquarium

```
140 ! REQUIRES EXTENDED BASIC.
150 CALL SCREEN(2)
160 CALL CLEAR
170 FOR I=1 TO 14 :: CALL COLOR(I,1
    5,1):: NEXT I
180 PRINT "TI AQUARIUM": : : :
```



Relax and watch the fish glide by in "TI Aquarium."

```
190 PRINT "This program allows you
    to"
200 PRINT "use your TI-99 to enjoy
    the"
210 PRINT "relaxing sight of fish"
220 PRINT "swimming by, without the
    "
230 PRINT "expense and bother of a"
240 PRINT "real aquarium."
250 PRINT : : "To end the program, p
    ress"
260 PRINT "any key while the fish a
    re"
270 PRINT "being displayed."
280 FOR D=1 TO 1500 :: NEXT D
290 CALL CLEAR
300 RANDOMIZE
310 A$="0000000081C3E7FFFFE7C381000
    00000000000000F0F8FCFEFEFCF8F000
    000000"
320 CALL CHAR(120,A$)
330 CALL MAGNIFY(3)
340 DATA 9,6,4,7,8,10,11,12,14,0
350 CALL SCREEN(2)
360 !
```



```

370 ! Put fish on the screen, with
    sprite numbers and
380 ! colors based on the DATA stat
    ement
390 !
400 READ Q
410 IF Q=0 THEN 540
420 CALL SPRITE(#Q,120,1,90+30*(RND
    -0.5),1,4*RND-3,5*RND+1)
430 CALL COLOR(#Q,0)
440 GOSUB 610
450 GOSUB 610
460 GOSUB 610
470 FOR D=1 TO 300 :: NEXT D
480 GO TO 400
490 !
500 ! Now that all the fish are on
    the screen, make
510 ! random changes in their motio
    n and check for
520 ! a key being pressed.
530 !
540 GOSUB 610
550 CALL KEY(5,CODE,STATUS)
560 IF STATUS<>0 THEN CALL CLEAR ::
    STOP
570 GO TO 540
580 !
590 ! Subroutine: Change the motion
    of a
600 ! randomly chosen sprite
605 !
610 CALL MOTION(#INT(11*RND)+3,4*RN
    D-2,5*RND+2)
620 RETURN

```

©

RELATIONAL OPERATORS

Eric Brandon

Relational operators can make your BASIC programs more efficient. Here are some techniques which use relational operators on the Commodore, Atari, TI, Apple, IBM PC and PCjr, Color Computer, and Timex/Sinclair machines.

BASIC has a very useful, but little-known feature. A relational expression such as $2+3>4$ is interpreted by BASIC as a value of -1 (or 1, depending on the computer) if the expression is true, and a value of 0 if the expression is false. On all Commodore machines, the TI-99/4A, the Color Computer, the IBM PC and the PCjr, a relational expression which is true gives a value of -1. A relational expression which is true on the Atari, Apple, and Timex/Sinclair computers produces a value of 1. A value of 0 results for a relational expression which is false on each computer.

As an example, enter `PRINT 2=2`. You should get a result of -1 (or 1) since the expression is true. Now type in: `PRINT 2=3`. This time, the result is 0 because the expression is false.

Related to this is the fact that the statement

```
IF Q THEN 100
```

will be interpreted identically to the statement

```
IF Q<>0 THEN 100
```

Can you see why? Both expressions evaluate as true, if Q is nonzero.

Cycling A Variable

Suppose you wanted to continually cycle a variable, say J, from 1 to 10. One way to do this would be:

```

10 J=0
20 J=J+1
25 PRINT J
30 IF J<10 THEN 20
40 GOTO 10

```

However, by using a relational expression, we can do this:

```

5 N=-1:REM N=-1 FOR TRUE (MAY BE 1 DEPEND
    ING ON YOUR MACHINE)
10 J=0
20 J=J*(J<10)*N+1
25 PRINT J
40 GOTO 20

```

In this routine, N must be defined as +1 or -1, depending on your machine. Of course, there's really no need for a separate statement to define N. You could easily incorporate the value of N into the expression in line 20. If a true statement produces a -1 on your computer, line 20 becomes $J = -J*(J<10) + 1$. In this case, as long as J is less than 10, BASIC returns a value of -1 for $(J<10)$. So, -J

times -1 plus 1 increases the value of J by one. When J reaches a value of 10, (J<10) gives a value of zero. Adding one to zero starts the cycle over again.

Note that the relational operators are the last items to be resolved. Recall that numeric arguments are resolved in this order: *, /, +, -. This can be easily demonstrated by these two examples: PRINT 2*3=3. This gives a result of 0 since it is equivalent to PRINT 6=3.

Now try PRINT 2*(3=3). This gives -2 (or 2) since it is equivalent to 2*(-1) [or 2*(1)].

More Efficient Tabulation

For another example, suppose you wish to tabulate a score in a math drill program within a subroutine beginning at line 100. A scoring scheme is devised so that the player is awarded a greater number of points the more problems he has solved. You would like the player to get 100 points for each of the first five correct answers, and 1000 points for any correct answers thereafter. If we let X be the total number of correct answers, a common way of doing this would be:

```
99 REM SCORING SUB
100 IF X>5 THEN 130
110 TALLY=TALLY+100
120 GOTO 140
130 TALLY=TALLY+1000
140 RETURN
```

Using relational operators, however, we can

shorten this to (defining N as +1 or -1 as before):

```
99 REM SCORING SUB
100 N=-1
110 TALLY=TALLY+(X<6)*100*N+(X>5)*1000*N
120 RETURN
```

Fewer IF-THEN Statements

Still another example: If you want to transfer program execution to line 1000 if the value of variable I is 100, and to line 2000, if I is 500, several IF-THEN statements would usually be required:

```
100 IF I=100 THEN 1000
110 IF I=500 THEN 2000
```

On most machines, this can be easily done with relational operators as:

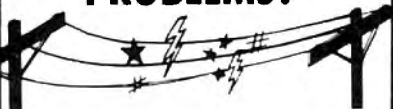
```
90 N=-1
100 ON N*(I=100)+N*2*(I=500) GOTO 1000,2000
```

On the Timex/Sinclair, since the ON-GOTO statement is not supported in BASIC, you would use GOTO with a conditional expression in the following manner (N=1, so it's not included here):

```
100 GOTO (I=100)*1000+(I=500)*2000+(I<>100 AND I<>500)*200
200 REM RETURN TO MAIN LOOP OF PROGRAM
```

If you use this powerful technique with imagination, you will find that your programs can be shorter, faster, and easier to write. ©

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Learning With Computers

Glenn M. Kleiman

GETTING STARTED

Let's consider some of the steps involved in the introduction of computers in schools, and some of the difficult issues teachers, parents, and school administrations must face.

Computers are tools. They are different from most other tools in that they operate on information and can be programmed to serve a wide variety of purposes. But they are the same as other tools in that they can be used well or poorly. A hammer can be used to build furniture or to destroy it. A computer can be used to create original stories, music, and art; to explore complex scientific relationships; or to play the most mindless of games.

How computers affect students depends upon how the students use them, the quality and appropriateness of computer activities and software, and the manner in which computers are integrated with other educational activities.

In many schools, individual teachers, parents, or students have brought computers into classrooms. Since those who do so are typically knowledgeable and excited about computers, they are usually successful in integrating computers with classroom activities, and in teaching students about them. However, implementing computers on a school-wide or district-wide basis is a more complex task, one that requires a great deal of thought, careful planning, and an ongoing effort.

Computer Comfort

The first step towards using computers as educational tools is for teachers, administrators, parents, and students to become aware of the possibilities, to develop an interest in trying some of them. Understanding the possible uses of computers and having a general understanding of their nature is often called *computer awareness*.

The next step is *computer comfort*. This means that everyone involved should actually use a computer and become comfortable with the mechanics of loading and running programs, entering information, using printers and so on. There is no substitute for hands-on experience in coming to appreciate the potential of computers. At this stage, it is best to try a variety of programs to experience the different possibilities. The aim is to develop more concrete knowledge about what computers can do, and to gain critical skills in evaluating software.

Once past the awareness and comfort levels, the real work begins. Decisions have to be made about how computers will be used and whether some students or classes will have priority over others. How will computers be integrated into the curriculum at each grade level? Will they be used primarily for lessons and drills or to teach computer programming?

If programming is to be taught, which language (Logo, BASIC, Pascal) will be selected? Should the computers be used primarily in math and science classes or mainly for word processing? Will educational computer games be used? What about computer art and music? Will all students get equal access to the computers? Should gifted children or those in need of remedial assistance be given priority?

There are no "right" answers to these difficult questions. Each group of decision makers must decide how to best allocate the available computer resources to meet the needs of their school or district.

Selecting Products

Other important questions focus on the setting in which the computers will be used. Will they be

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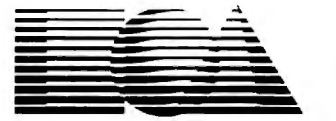
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placed in classrooms, in the library, or in a special computer laboratory room? How will their use be supervised, and by whom? Who will take care of maintenance and demonstrations of how to properly use the computers?

After decisions are made about how the computers will be used, by whom, and in what settings, it's time to start selecting hardware and software. Again, there are many questions. Should one brand of computers be purchased, or are different ones best for different purposes? For which brands of computers is the best software available? For which computers are good versions of the BASIC, Logo, and Pascal languages available? How much memory is needed, and are disk drives and printers needed for each computer? Are color video monitors essential, or will black-and-white do? Are modems needed? Which word processing program is best for students? What about lesson and drill programs? Where can good science simulations be obtained? These are just some of the questions that need to be addressed.

The relative importance of such questions, and the appropriate answers to each, depends on the prior decisions about how computers will be

used, as well as the constraints imposed by the available budget, space, and personnel.

Hardware Is Not The Only Budget Item

At this stage, careful budget planning is critical so that sufficient money will be available for software, peripherals such as printers, staff training, maintenance, and supplies (such as disks and paper). This point cannot be overemphasized. Many schools have invested all their available funds in hardware, only to discover that it is useless without appropriate software and staff training.

Once the computers are installed, there is another set of concerns. How will requests to use computers be handled? What about keeping up with new developments and the ongoing acquisition of new hardware and software? What should be done to encourage students and teachers who are uncomfortable using computers? What should be done about students who are so interested in computers they neglect other areas of study? How are computers changing the social structure of classes? Has a group of interested students evolved into a computer elite which tries to monopolize the computers? If so, how can this clique be led to serve as peer tutors to help and encourage the other students? Will teachers be uncomfortable because some students will know more than they do about the computers? What about students interested in more advanced programming or in forming a computer club?

The Challenge Of Computers In Education

As with any educational innovation, many new questions arise. This presents an exciting new challenge to educators: to adapt new technology to improve children's education.

Current claims about computers can be compared to prior claims about the educational potential of television, and this comparison raises serious concerns. Computers in education are now at a stage similar to that of television a few decades ago.

The enormous educational potential of television is well established; most children have learned a great deal from television. Unfortunately, much of what they have learned consists of advertising jingles and other trivia. With a few notable exceptions, television has not fulfilled its potential as an educational tool. The same could happen with computers; they could end up being used primarily as mindless electronic toys. Since computers are just beginning to be widely used, the directions we set in the next few years will be critical in determining whether their potential as educational tools will be fulfilled. ©

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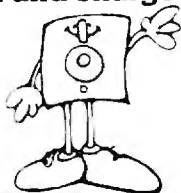
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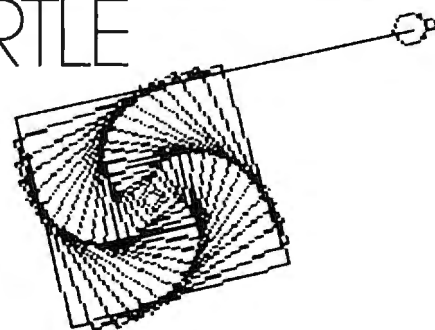


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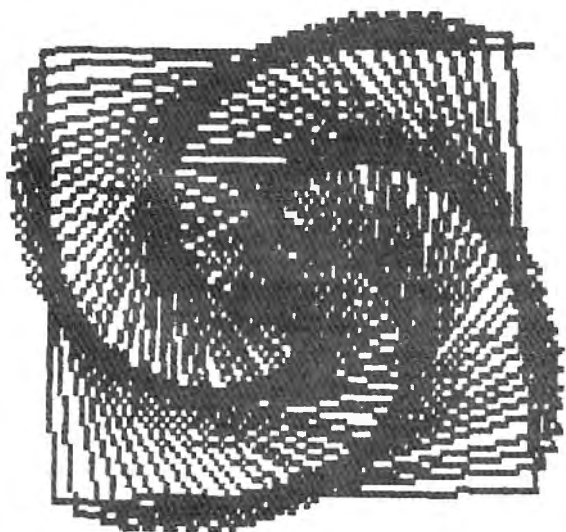


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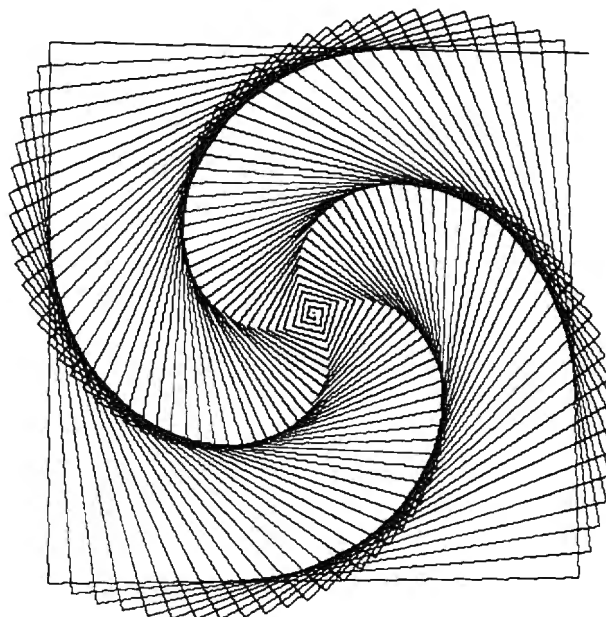
Atari Logo— The Plot Thickens

Perhaps it is because I am in the somewhat enviable position of working with four versions of Logo on a daily basis, but I sometimes get concerned about issues that might not bother most people. In the case of Atari Logo, I find myself wishing that I could draw lines with a higher resolution than that available from graphics mode 7. Unfortunately, even though the computer supports many other graphic modes, Atari Logo does not.

For example, if I draw a closely spaced squiral pattern on the screen, I get a dense and somewhat fuzzy picture like this:



Instead, I would like to get a nice crisp picture like this:



Obviously, since I *did* get a nice crisp picture, I was able to solve the problem. The trick is to have your turtle graphics pictures drawn with the Atari 1020 color graphics printer. This device is a four-color pen plotter that draws pictures on plain white paper with black, blue, green, or red ball-point pens. As you can see from the picture above, the resolution of this plotter is quite high and the lines are crisp and thin.

Plotter Commands

The key to plotting Logo procedures is to generate the plotter commands as the picture is being drawn. This task was first tackled by Peter Cann at the Atari Cambridge Research Laboratory and then modified by Jason Gervich in Atari Customer Relations before being given to me. Naturally, I tinkered with the procedures some, so the results should not be blamed on anyone at Atari.

My goal was to build a set of plotting procedures that would work in the following way: If a procedure to draw a picture was typed by itself, it would appear only on the display screen. If, instead, the user typed

```
DRAW [procedurename]
```

the procedure would be drawn *both* on the screen and on the plotter. Having two ways to examine a procedure lets you save the plotter for the final debugged version. This saves on pen wear and on time, since the plotter is not nearly as fast as the screen turtle.

The key procedure is shown below:

```
TO DRAW :LIST
SETWRITE "P:
( TYPE CHAR 27 CHAR 27 CHAR 7 )
( PR "M240,0\*I\M INT 2 * YCOR ", INT (-2) *
  XCOR )
RUN :LIST
SETWRITE [ ]
END
```

Basically, all this does is set the plotter up in the graphics mode and zero the pen position prior to running the procedure. Once the procedure is finished, the plotter is turned off (with the SETWRITE [] command). Note that the line that looks cryptic includes some backslashes (\). These are used to let Logo know that the following asterisks are to be taken literally, and do not indicate multiplication.

Movement And Color

Well, if we just run our procedure, we might ask by what magic the plotter is supposed to know how to draw the lines. The answer is that anytime we move the location of the turtle, we must send this information to the plotter as well. Since the turtle graphics commands for turtle movement are FD and BK, we must create new ones that also send messages to the plotter. Because I am intrinsically lazy, it was appealing to define new motion commands called F and B as follows:

```
TO F :X
FD :X
PLOT
END
```

```
TO B :X
BK :X
PLOT
END
```

Clearly, from these procedures, you can see that our PLOT is very thin. To thicken the PLOT, we add:

```
TO PLOT
( PR IF PEN="PD ["D] ["M] INT 2 * YCOR ", INT
  (-2) * XCOR )
END
```

This procedure examines the pen position of the turtle along with the turtle location, and sends the plotter pen scurrying to its corresponding position. In order to take maximum advantage of the plotter paper width, I rotated the plot by 90 degrees so that as the screen image moves from left to right, the plotted image moves from top to bottom. This gives a very nice-sized image, even though the plotter paper is only 4.5 inches wide.

Of course, there is always the possibility that you might want to clear the screen. Since this should also move the plotter pen to the origin, we add the command:

```
TO C
CS
PR "M0,0
END
```

Changing the pen color is also easy—especially with these procedures:

```
TO PENBLACK
( TYPE CHAR 67 CHAR 48 )
END
```

```
TO PENBLUE
( TYPE CHAR 67 CHAR 49 )
END
```

```
TO PENGREEN
( TYPE CHAR 67 CHAR 50 )
END
```

```
TO PENRED
( TYPE CHAR 67 CHAR 51 )
END
```

The crafty among you will no doubt find that you can modify these four procedures to change the screen pen and pen colors as well.

Printing Procedures

The remaining plotter procedure that I find useful lets you get a "plotted" printout of your procedure listings:

```
TO P.PROCS
SETWRITE "P:
( TYPE CHAR 27 CHAR 27 CHAR 14 )
POPS
SETWRITE [ ]
END
```

I suggest that you enter these procedures into an otherwise empty workspace and save them in a file called PLOTTER. Then, whenever you want to plot the results of your handiwork later on, you can read these into your workspace by typing:

```
LOAD "D:PLOTTER
```


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The squirrel pattern at the beginning of this article was obtained by entering:

```
DRAW [SQUIRAL 91]
```

in which SQUIRAL had the following definition:

```
TO SQUIRAL :ANGLE
MAKE "SIDE 0
REPEAT 180 [F:SIDE RT:ANGLE MAKE "SIDE
:SIDE +1]
END
```

To see an even more spectacular picture (one that I call a snowflake sunset), enter:

```
DRAW [SETUP SN 300 9]
```

in which SETUP and SN have the following definitions:

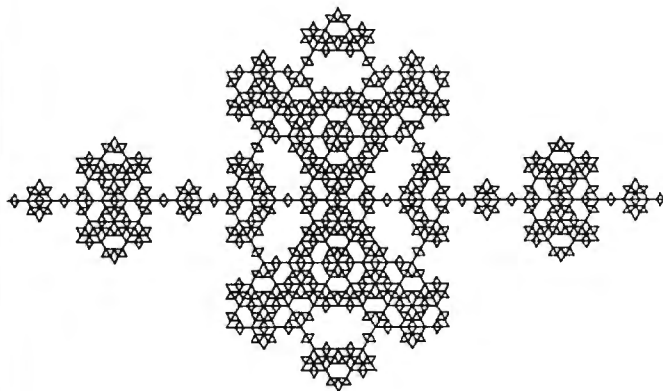
```
TO SETUP
PU SETPOS [-150 0] PLOT SETH 90 PD
HT
END
```

```
TO SN :S :L
IF :S < :L [F:S STOP]
SN :S / 3 :L
LT 60
SN :S / 3 :L
RT 120
SN :S / 3 :L
RT 120
SN :S / 3 :L
LT 120
SN :S / 3 :L
LT 120
SN :S / 3 :L
RT 60
SN :S / 3 :L
END
```

On the screen you get this:



And, on the plotter, you get this:



The snowflake sunset is one level of a fractal curve. You can experiment with different generations of this curve by changing the second number when you use SN (for example, SN 300 30). For the purposes of this month's column, this curve nicely demonstrates the value of connecting a pen plotter to your Atari Logo system! ©

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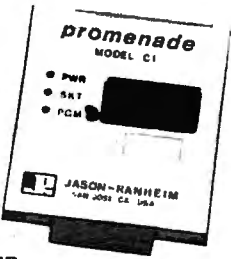

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

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SOUND SHAPER

Steven Kaye

"Sound Shaper" manipulates volume and frequency to give the VIC a smoother, more musical sound. We've also included versions for the 64, Atari, and TI. See the "Automatic Proofreader" article on page 60 before typing in the 64 and Atari versions.

One of the main differences between the sound the Commodore 64 can produce and sound produced by the VIC is the shape of the sound's waveform. The VIC produces only square waves. One microsecond the sound is off, the next it's on. This abrupt onset of sound produces somewhat nonmusical music. The tones sound electronic and unlike any acoustic instrument.

The Commodore 64, on the other hand, can simulate musical instruments by controlling the waveshape of the sound produced. Instead of turning the sound on and off abruptly, it can increase and decrease the amplitude (volume) more gradually under control of the programmer. It is important to bear in mind that the onset-offset or rise-fall time is still on the order of fractions of milliseconds, but it is not instantaneous as is the case with the VIC. It is this programmable rise-fall time that allows the Commodore 64 to sound more like a traditional acoustic instrument. We cannot control the actual waveshape of sounds on the VIC, but we can simulate wave-shaping by modulating the volume.

The first part of Program 1 demonstrates a simple application of this technique. It plays the entire frequency range for one of the VIC's four voices. First, the program asks for two inputs, the rise time and the fall time. Values between .5 and 10 seem to work best. Then the frequency value is POKed into the appropriate register (line 140). Two separate FOR-NEXT loops (lines 150 and 180) control the rise and fall times. As the volume varies between 0 and 15, the input variables con-

trol the rate of volume change. Experiment with different rise-fall time values.

Frequency manipulation can also be used to produce unique effects. The second part of Program 1 shows how to produce an echo effect by rapidly alternating a frequency with its complementary frequency. Again we move through the frequency scale. In line 270 we use the amplitude modulation technique described above. Lines 280 and 300 POKE the frequency and then the frequency subtracted from 383 into the appropriate voice register.

On the first time through the loop, voice 2 (36875) is POKed with 128 and then rapidly alternated with 255 ($255 = 383 - 128$) while the sound fades as variable DB decreases. The timing loops in 290 and 310 as well as the step value in line 270 can be manipulated to increase or decrease the reverberation effect. Voice 2 was chosen for the example, but any of the four voices will produce interesting sounds.

Program 1: VIC Sound Shaper

```
40 PRINT "{CLR}{9 DOWN}"TAB(2) "{RVS}SHAPIN
   G{OFF} {RVS}VIC{OFF} {RVS}SOUNDS{OFF}"
                                          :rem 179
45 FOR T=1 TO 1500:NEXT                    :rem 244
50 PRINT "{CLR}{7 DOWN}{6 RIGHT}SHAPED (1)
   "                                       :rem 37
55 PRINTTAB(9); "{DOWN}OR":PRINTTAB(7) "
   {DOWN}ECHO (2)"                               :rem 166
60 PRINT "{4 DOWN}{9 RIGHT}";:INPUT I$:IFV
   AL(I$)<1OR VAL(I$)>2THEN50                :rem 15
70 ONVAL(I$)GOTO100,240                      :rem 49
100 REM*** THIS PART PRODUCES "SHAPED" MU
   SICAL NOTES***                               :rem 213
110 PRINT "{3 DOWN}{2 RIGHT}RISE AND FALL
   TIME"                                         :rem 36
115 PRINT"VALUES MUST EXCEED 0"              :rem 95
116 INPUT R,D:IF (R=0)OR(D=0) THEN 116
                                          :rem 45
120 V=36878:S=36875                           :rem 13
130 FOR F=128 TO 255 STEP3                   :rem 71
```

Notes For 64, Atari, And TI Versions

Since the Commodore 64 has a programmable sound envelope, we added Program 2 to make the SID chip more accessible. By changing values entered for attack, decay, sustain and release, you can control the shape of the sounds produced by the program. The second part of the program produces an echo effect very similar to the effect produced in the VIC version. The parameters set in the first part are also used for the sounds produced in the second part.

The Atari and TI versions of "Sound Shaper" are designed to alter the shape of sounds in the same fashion as the VIC version. Since sound generation in these computers is similar to the VIC's, the logic in these versions is essentially the same as in the VIC version. In the Atari version (Program 3), you may also change the distortion quality of the sound. Since the execution speed differs considerably between TI console and Extended BASIC, users with console BASIC will not hear a smooth shaping of the sounds in the first part of the TI version (Program 4). Extended BASIC provides much better results.

```

140 POKE S,F :rem 137
150 FOR DB=0 TO 15 STEP 5/R :rem 107
160 POKE V,DB :rem 206
170 NEXT :rem 215
180 FOR DB=15 TO 0 STEP -5/D :rem 141
190 POKE V,DB :rem 209
200 NEXT :rem 209
210 FOR T=1 TO 50:NEXT :rem 189
220 NEXT :rem 211
230 POKE V,0:END :rem 135
240 REM*** THIS PART CREATES AN ECHO EFFECT*** :rem 71
250 V=36878:S=36875 :rem 17
260 FOR P=128 TO 255 STEP 3 :rem 85
270 FOR DB=15 TO 1 STEP -.5 :rem 73
280 POKE V,DB:POKE S,P :rem 9
290 FOR T=1 TO 10:NEXT :rem 193
300 POKE S,383-P :rem 92
310 FOR J=1 TO 10:NEXT :rem 176
320 NEXT:NEXT :rem 77
330 POKE V,0 :rem 119

```

Program 2: 64 Sound Shaper

```

15 PRINT"{CLR}SET PARAMETERS FOR SOUND AND ECHO" :rem 12
20 CHIP = 54272 :rem 199
22 FOR T=CHIP TO CHIP + 24 : POKET,0:NEXT :rem 234
30 INPUT "ATTACK RATE (0-15)";AT$:AT=VAL(AT$):IF AT<0 OR AT>15 THEN 30 :rem 82

```

```

40 INPUT "DECAY RATE (0-15)";DE$:DE=VAL(DE$):IF DE<0 OR DE>15THEN 40 :rem 198
50 INPUT "SUSTAIN VOLUME (0-15)";SU$:SU=VAL(SU$):IF SUS<0OR SU>15THEN50 :rem 35
60 INPUT "RELEASE RATE(0-15)";RE$:RE=VAL(RE$):IF RE<0ORRE>15THEN60 :rem 171
80 POKECHIP+24,15:POKECHIP+5,16*AT+DE :rem 209
90 POKECHIP+6,16*SU+RE :rem 68
100 FOR T= 20{2 SPACES}TO 80 STEP 5:POKECHIP+4,17 :rem 103
110 POKECHIP,50:POKECHIP+1,T :rem 223
115 FORJ= 1 TO 500+1.7↑AT+1.7↑DE:NEXTJ :rem 141
120 POKECHIP+4,16:FORH=1TO2↑RE:NEXT:NEXT :rem 107
200 FOR T= 20 TO 80 STEP 5 :rem 232
210 FOR DB = 15 TO 1STEP -.5 :rem 67
215 PRINT"{HOME}{5 DOWN}*ECHO*{6 LEFT}{7 SPACES}" :rem 242
220 POKECHIP+4,17:POKECHIP+24,DB:POKECHIP+1,T:FORP=1TO10:NEXT :rem 111
230 POKECHIP+1,100-T:FORJ=1TO10:NEXT:NEXT :rem 202
240 POKECHIP+4,16 :rem 219

```

Program 3: Atari Sound Shaper

```

NN 3 ? "(CLEAR)":POSITION 12,12:? "SOUND SHAPER"
FO 4 POKE 752,1
OK 5 DIM I$(5),VO$(5),DS$(5)
OC 6 FOR T=1 TO 300:NEXT T
ND 10 PRINT "Shape (1) or Echo (2)";
FP 20 INPUT I$
EC 21 IF VAL(I$)<1 OR VAL(I$)>2 THEN 10
EF 40 REM *** THIS PROGRAM PRODUCES SHAPED MUSICAL NOTES ***
NL 50 PRINT "Voice (0-3)";:INPUT VO$
AF 55 IF VAL(VO$)>3 OR VAL(VO$)<0 THEN 50
EL 57 VO=VAL(VO$)
DJ 60 PRINT "Distortion(0-14)";:INPUT DS$
BN 65 IF VAL(DS$)<0 OR VAL(DS$)>14 THEN 60
DA 67 DS=VAL(DS$)
BH 68 ON VAL(I$) GOTO 70,195
FC 70 ? "Rise Fall Time";:INPUT R,D
KC 75 IF R<1 OR D<1 THEN 70
LJ 95 ? "(CLEAR)";:POSITION 12,12:? " * Shaped Notes*"
JE 100 FOR F=121 TO 60 STEP -4.1
EF 120 FOR DB=0 TO 15 STEP (1/R)*15
KJ 130 SOUND VO,F,DS,DB
FK 140 NEXT DB
GH 150 FOR DB=15 TO 0 STEP -(1/D)*15
KN 160 SOUND VO,F,DS,DB
GB 165 NEXT DB
BG 170 FOR T=1 TO 50:NEXT T
BO 180 NEXT F
NE 190 POKE 752,0:END
AA 195 ? "{CLEAR}";:POSITION 12,12:? " ***ECHO EFFECT***"
JP 200 FOR P=121 TO 60 STEP -4.1
HD 210 FOR DB=15 TO 1 STEP -0.5
LD 220 SOUND VO,P,DS,DB
AP 230 FOR T=1 TO 10:NEXT T
HM 240 SOUND VO,181-P,DS,DB
PN 250 FOR J=1 TO 10:NEXT J
CG 260 NEXT DB:NEXT P
ND 270 POKE 752,0:END

```


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Program 4: TI Sound Shaper

```

100 CALL CLEAR
110 CALL SCREEN(15)
120 PRINT TAB(7);"SHAPING TI SOUNDS
"
130 FOR T=1 TO 6
140 PRINT
150 NEXT T
160 PRINT "CHOOSE:"
170 PRINT
180 PRINT
190 PRINT TAB(4);"1) SHAPED MUSICAL
NOTES"
200 PRINT
210 PRINT TAB(4);"2) ECHO"
220 PRINT
230 PRINT TAB(4);"3) QUIT"
240 PRINT
250 INPUT A$
260 IF (VAL(A$)<1)+(VAL(A$)>3) THEN
250
270 ON VAL(A$)GOTO 290,520,690
280 REM THIS PART PRODUCES "SHAPED
" MUSICAL NOTES
290 CALL CLEAR
300 CALL SCREEN(13)
310 PRINT TAB(3);"* SHAPED MUSICAL
NOTES *"
320 FOR T=1 TO 10
330 PRINT
340 NEXT T
350 PRINT "ENTER RISE AND FALL TIME
S -"
360 PRINT "USE VALUES GREATER THAN

```

```

ZERO";
370 PRINT
380 INPUT R,D
390 IF (R=0)+(D=0) THEN 380
400 FOR F=110 TO 880 STEP 30
410 FOR DB=30 TO 0 STEP -5/R
420 CALL SOUND(-10,F,DB)
430 NEXT DB
440 FOR DB=0 TO 30 STEP 5/D
450 CALL SOUND(-10,F,DB)
460 NEXT DB
470 FOR T=1 TO 50
480 NEXT T
490 NEXT F
500 GOTO 100
510 REM THIS PART CREATES AN ECHO
EFFECT
520 CALL CLEAR
530 CALL SCREEN(14)
540 PRINT TAB(8);"* ECHO EFFECT *"
550 FOR T=1 TO 12
560 PRINT
570 NEXT T
580 FOR F=110 TO 880 STEP 30
590 FOR DB=1 TO 30
600 CALL SOUND(-10,F,DB)
610 FOR T=1 TO 10
620 NEXT T
630 CALL SOUND(-10,990-F,DB)
640 FOR J=1 TO 10
650 NEXT J
660 NEXT DB
670 NEXT F
680 GOTO 100
690 END

```

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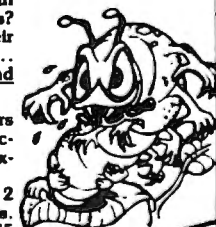
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INSIGHT: Atari

Bill Wilkinson

In this column, we continue the discussion of formatted screen techniques.

PUT And GET And The Text Screen

This is another one of those "Did you know?" tidbits. Did you know that when you use GRAPHICS 0 from Atari BASIC you have automatically opened the screen for GETting and PUTting via file number 6? It's true, and it is because Atari BASIC does not check the mode number for the GRAPHICS statement.

GRAPHICS 0 is thus exactly equivalent to:

```
OPEN #6, 12+16,0, "S:"
```

So if you need to GET or PUT from or to the screen, you can do it directly to file #6 without any further ado.

Unfortunately, there are a few gotchas involved in using GET and PUT to the Atari Screen graphics driver ("S:"), some of which you may have seen before, so let's discuss them, as well as ways around them.

The first problem is that if you use PUT #6 combined with POSITION statements or PRINT statements, you will probably end up leaving some inverse video spaces (white boxes) around on the screen, as Program 1 illustrates. This is because the screen graphics driver works almost (but not quite) like the screen editor driver ("E:", the normal channel #0 device which PRINT and INPUT use). Unfortunately, "S:" can't seem to handle its cursor properly, so it may be best to avoid using PUT #6.

Program 1: Problems With PUT #6

```
10 GRAPHICS 0
20 POSITION 30*RND(0), 20*RND(0)
30 PUT #6, 65+20*RND(0)
40 GOTO 20
```

How can we avoid PUT #6 if we have something we need on the screen? Simple. Use PUT#0 (if you have BASIC XL or any other product which allows PUT to file #0) or PRINT. If you use PRINT, of course, you will have to use

```
PRINT CHR$(X);
```

in place of PUT #0,X. And why does outputting to file #0 work where using #6 does not? Because #0 is opened to "E:", and there are several subtle differences between "E:" and "S:" where cursor

positioning and character I/O are concerned.

Unfortunately, while the problems with PUT #6 are fairly easy to get around, the problems with GET #6 must be dealt with directly. And why can't we simply use GET #0 in place of #6 here, as we did with PUT? Because, when you ask "E:" (channel #0) for a character, it waits until the user actually types in an entire line—terminated by a RETURN character—before returning anything at all to its caller (you are the caller via BASIC in this case).

The whole reason for using GET #6 is to allow ourselves to read individual characters from the screen. We simply can't use GET #0 or anything else which accesses "E:".

But this is putting the cart before the horse a little. Before "fixing" the problem, let's illustrate it with Program 2.

Program 2: Problems With GET #6

```
10 GRAPHICS 0
20 PRINT "ABCDEFGHJKLMNOP"
30 FOR I=2 TO 12 : POSITION I,0
40 GET #6, CHAR
50 POSITION 20,20 : PRINT CHAR
60 FOR J=1 TO 200 : NEXT J : REM just a delay loop
70 NEXT I
```

I hope you actually stopped while reading to try out that listing. Bizarre, isn't it? It seems that you can't GET data from the screen without destroying it. Now, most of the articles which I have seen which note this problem suggest that the only safe fix is the following:

1. POSITION yourself on the character you want.
2. GET the character to a variable.
3. POSITION yourself again to the same location.
4. PRINT the character back onto the screen.

That fix will indeed work, but I would propose that an alternate solution is to simply print a "left arrow" (backspace) and then the character, thus avoiding the extra POSITION statement. In Program 2, we could simply add this line to fix things up:

```
45 PRINT CHR$(30);CHR$(CHAR);
```

Now that you know how to properly PUT and GET to the screen, you probably have a fair idea of how I built my onscreen editor. It isn't too hard to do anything you want to the GRAPHICS

0 screen, once you get past the quirks in the Atari OS.

Fettering Your NEXT

Probably every BASIC book you have ever seen tells you to properly nest FOR/NEXT loops. Aside from the neatness of it, there are some good and practical reasons. Consider Program 3.

Program 3: Obviously Invalid Nesting

```
10 FOR I=1 TO 6
20   FOR J=1 TO 3
30   NEXT I
40   NEXT J
```

Very few of you would deliberately write a BASIC program which looked like that. Even with the indentation I have given it, it should be obvious that something is wrong.

And, yet, it is fairly easy to write a program which will look proper and yet have the effect of that listing! Don't believe it? Try Program 4.

Program 4: A Subtle Problem

```
100 REM Program task: Print all numbers from 1 to 9, in a nested loop fashion. When the first sum of 15 or
101 REM greater is found, cease the operation. When the sum is 10 or more, don't print the result.
102 REM Repeat for the products of the same numbers in the same fashion.
110 print "I", "J", "SUM"
120 FOR I=1 TO 9
130   FOR J=1 TO 9
140     SUM = I+J
150     IF SUM > 14 THEN 200
160     IF SUM > 10 THEN 190
170     PRINT I, J, SUM
180   NEXT J
190 NEXT I
200 PRINT "I", "J", "PRODUCT"
210 FOR J=1 TO 9
220   FOR I=1 TO 9
230     PROD = I*J
240     IF PROD > 14 THEN 290
250     IF PROD > 10 THEN 280
260     PRINT J, I, PROD
270   NEXT I
280 NEXT J
290 END
```

Now this looks perfectly harmless, if somewhat pointless, right? It looks like it should work fine. Yet, if you will type it in and RUN it, you will find that line 280 will give you a NEXT WITHOUT MATCHING FOR error the first time it is reached. How? Surely line 210 is the FOR which matches the NEXT of line 280.

The Interpreter's Dilemma

If Atari BASIC were a compiler language, it would probably execute that program correctly. However, since it is an interpreter, it must work within the strictures of that mode. Interpreters, by their

very nature, cannot easily keep a history of all NEXT usages. It is enough that they remember where the FOR statements are, so that when a NEXT is encountered they can go back to the FOR to execute the loop another time.

Consider, then, the dilemma of the poor interpreter in the above program. In line 160, we are asking it to bypass the end of the inner FOR loop (since we know we are done with the previous usage of it) and start the next iteration of the outer loop (NEXT I). But wait. There is still a FOR J on the runtime stack, yet we are executing a NEXT I. What can we do?

Atari BASIC does what most modern "smart" BASICs do. If it finds a loop variable NEXT which does not match the last FOR on the stack, it presumes that the user has jumped out of the inner loop (as indeed we have here) since that is a common occurrence. So BASIC looks backward in the stack for a matching FOR. Eureka! It finds the FOR I only one level down in the stack, without any intervening GOSUBs, so its supposition seems confirmed. All works well.

However, look at line 150, wherein we jump out of all the loops. What have we left on the runtime stack now? Obviously, both a FOR I and a FOR J. Well, no real problem. After all, we know we jumped all the way out of the loop, don't we? We don't. Why not? Because a BASIC interpreter must presume that the BASIC programmer knows what he or she is doing. It is, unfortunately, perfectly legal to jump in and out of a loop in Atari BASIC. It is, in fact, even legal to have more than one NEXT for any given FOR.

So what can BASIC think when it gets to line 210 but that it is starting the inner FOR loop over again? It leaves the FOR I in place (for all it knows, the next statement it encounters might be a NEXT I) and adds a new FOR J.

Disaster really strikes in line 220. Poor BASIC is trying its best. Knowing that it is not uncommon for BASIC programmers to jump out of loops or to jump to the beginning of a loop to start it again, BASIC almost *has* to presume that the FOR I of line 220 is the beginning of a new outer loop. Besides, it already has a FOR I on its runtime stack. How can it allow another?

Well, if this is the beginning of a new outer loop, better throw away the old outer loop and any of its inner loops. Say good-bye to the old FOR I and FOR J; we're ready for another outer loop with a new FOR I. Right?

Wrong. But BASIC doesn't know about it while it stays in the FOR I loop, since it encounters no other FORs or NEXTs. In fact, the entire loop executes nicely with no problems, and the FOR is properly removed from the stack when the last value of I is reached. Did you notice that the stack is now empty?

Where did this NEXT J come from? FOR J was an inner loop and was thrown away when the outer loop was restarted.

The Fix In Atari BASIC

Actually, Atari BASIC is not a culprit here. Virtually every BASIC will have this same problem unless it makes a pre-pass through the user's program to detect possible inconsistencies (such as jumping out of nested loops). In point of fact, Atari BASIC is almost a good guy here. Recognizing that even with the best interpretation we could do, we could not prevent users from writing (or needing to write) structures such as I have shown you, we designed a "fix" into Atari BASIC.

The fix takes the form of the POP statement. POP simply removes the last level of the runtime stack. In Program 4, the easiest fix is

```
150 IF SUM > 9 THEN POP : POP : GOTO 200
```

(and a similar fix is needed in line 240, of course).

Notice I said that was the easiest fix. POP is usually not the best fix. Generally, you can write good and properly structured programs, with properly terminating FOR loops, without ever resorting to such extreme measures as the POP statement. Still, it is comforting to know that POP is around. Personally, I tend to use it whenever an error condition occurs and I want to get all the way back out to (for example) the menu level without leaving nasty GOSUBs or FORs on the runtime stack.

A curiosity: Did you notice that if the nesting in lines 200 through 290 is reversed (that is, if the FOR I occurs before the FOR J), the program will work correctly? Do you see why? Fundamentally, because you are now doing what BASIC expected you to do. Go try this example both ways on a Commodore or Radio Shack or whatever computer. Does either method work? I'd be interested in knowing.

If you ever get a NEXT WITHOUT MATCHING FOR error, look for this kind of structure in your program. If you find it, you can fix it with POP, but wouldn't it be nicer to write the program correctly?

A footnote to all of that: Can you begin to get an appreciation of what language designers must contend with? It is not enough that a language do what it is expected to do. A good language will come halfway toward helping its users over the rough spots.

Reading Object Code Files

Here's a loader for binary object files which will place them in memory at the location they were assembled for. The routine is written entirely in Atari BASIC, so it is slow. Next month, we'll present the same routine written in machine language, perhaps even in a version callable from a

BASIC program (just to speed things up).

Atari object files have a fixed and reasonable format. The first two bytes of the file are always \$FF and \$FF (255 and 255, in decimal). They serve as a check that the file is indeed an object file. The next two bytes are the starting address in memory of the first (and perhaps only) "segment," while the following two bytes are the ending address of the segment. These header bytes are followed by enough object bytes to fill up the memory from the starting address through and including the ending address.

If a file has multiple segments, each segment may or may not (programmer's option) be preceded by the same \$FF and \$FF bytes. Each segment must always be headed by both a start and an end address. Without further ado, then, the loader program, Program 5.

Program 5: Load A Binary Object File

```
100 REM binary object file loader
110 DIM NAME$(30)
120 PRINT "WHAT FILE TO LOAD ";
130 INPUT NAME$
140 OPEN #1,4,0,NAME$
200 REM get and check header
210 TRAP 400
220 GET #1,LOW : GET #1,HIGH
230 TRAP 40000
240 IF LOW=255 AND HIGH=255 THEN GET
    #1,LOW : GET #1,HIGH
250 START = LOW + 256*HIGH
260 GET #1,LOW : GET #1,HIGH
270 QUIT = LOW + 256*HIGH
300 REM read in a segment
310 FOR ADDR = START TO QUIT
320 GET #1,BYTE
330 POKE ADDR,BYTE
340 NEXT ADDR
350 GOTO 200 : REM try for another s
    egment
400 REM trapped to here, assume end-
    of-file
410 CLOSE #1
```

Since I'm running out of time and space this month, I will let the explanation of object file format, above, serve for now as an explanation of this program. I will warn you, however, that I cheated a bit in line 240 to make the multiple segment loading easier. The routine will try to load *anything* into memory, whether or not it is truly a binary object file. If your memory dies a violent death (fixable only by turning power off and back on), you tried to load something other than an object file with this. Naughty.

Next month some notes on destination strings in Atari BASIC. And maybe—just maybe—we'll play around with Atari screen I/O a little more. ©

COMPUTE!
The Resource

File Processing

I've received quite a few letters wondering about files on the TI-99/4A. Files on a computer can be compared to those ordinary big, gray file drawers. Each *file* is a drawer, and you can label your drawers. Each *record* is one of the file folders inside a drawer. On the computer your file cabinet can be either a cassette or a diskette.

You can read about file processing in the *User's Reference Guide* that comes with the computer (pages II-118 to II-136 for the TI-99/4A and pages 144 to 162 for the TI-99/4), so I won't repeat that information here. For some example programs, you can refer to "Color Computer General-Purpose Data Base" in *COMPUTE!* (May 1983).

If you prefer not to do your own programming, there are several business programs available for the TI, as well as some command modules which utilize file processing. Home Budget Management keeps personal finance records. Personal Record Keeping is a versatile module that helps you set up your own files and records for a small business.

A Spelling Drill

Let's get to an example. This "Spelling Quiz" program presents a drill for spelling words. In many schools, students are sent home with a list of words each Monday with instructions to practice, then a test is given on Friday. TI to the rescue! Enter the spelling words and save them on cassette. Let the computer conduct the drill.

Line 100 DIMensions or reserves space for 30 spelling words on the list. If you have more words, you can change this statement and lines 460-470 to handle more words. Lines 110-150 define graphics characters, and line 1630 draws a smiling face for a correct answer. Please feel free to add your own graphics. Lines 160-310 print the main menu screen of options. When you RUN the program, you have your choice of entering a new word list, editing the existing list, loading a list of previously saved words, saving the present list, reviewing the complete word list, actually performing the quiz, or ending the program.

The first time you RUN the program, you would press 1 to enter a word list, edit the list if necessary, then save the list on cassette for future use. Lines 320-370 contain the procedure that tells you when you try to access an empty list.

Enter The Number Of Words

When you enter a new word list, you are first asked how many words it will contain. This number, N, is unchanged throughout the program and is necessary for saving N items and for performing the quiz for N words. Lines 490-530 ask for the new words, and you type the words in one at a time, pressing ENTER after each word. When you have entered the right number of words, the program returns to the main menu screen.

The edit option is contained in lines 550-960. The complete word list is printed, then you can enter the word you want changed. Lines 640-660 compare the word you entered to the word list so the word can be replaced. If you prefer to delete the word, you can just press the ENTER key. Lines 730-770 adjust N and the positions of the other words if you delete a word.

Lines 1070-1150 save the list of words. The first time you use the program you would enter the words, then save the list for future use.

The OPEN statement is the crux of a file processing program. Line 1090 is OPEN #1:"CS1",INTERNAL,OUTPUT,FIXED which readies device number 1 (you can choose any number or even a variable name that corresponds to a number) labeled Cassette 1. The data file we create is for OUTPUT—we will be filing information on the tape. The format for this output is INTERNAL (versus DISPLAY) and FIXED (versus VARIABLE). This means that the computer will save the output in internal machine format rather than printable ASCII format, and that each record is FIXED at a certain length. Since I didn't specify a length, the computer will assume FIXED 64, or a record length of 64 characters.

COMPUTE!'s Programmer's Reference Guide to the TI-99/4A

Author: C. Regena
Price: \$14.95
On Sale: Now

Just about the best way to learn how to program a computer is to sit down with a patient friend who already knows how, and ask questions while you experiment with the computer. Owners of the popular Texas Instruments home computer will find that C. Regena is that kind of friend, and *Programmer's Reference Guide to the TI-99/4A* is that kind of book.

Regena carefully explains every BASIC command and function, and all the techniques needed to program TI graphics, sound, and speech. It's hard to think of a question that she doesn't answer simply and clearly, with hints about ways to write programs that do exactly what you want.

The book also provides dozens and dozens of programs, ranging from very short examples to full-length commercial-quality software. In effect, readers can look over Regena's shoulder as she goes through the programming process step by step, explaining what she's doing as she goes along. Not to mention the fact that the finished programs are valuable in their own right.

Even readers who are familiar with the computer will find this book valuable as a reference, where they can look up information they need and find the answers to particular questions.

Above all, *Programmer's Reference Guide to the TI-99/4A* is a book that lets readers use it however they like. You don't have to start at page one and read through, following someone else's plan for what you should learn first and what can wait until later. Instead, you can explore this book from any point of view, to solve almost any programming problem, and find the answer quickly and easily.

C. Regena is **COMPUTE!** Magazine's regular columnist on the TI-99/4A. She's an experienced and resourceful programmer. Like most of her readers, she taught herself how to program, and she hasn't forgotten what it's like to be a beginner, just starting out with the computer. And with *Programmer's Reference Guide*, TI users now have Regena to help them learn how to make their computer do exactly what they want it to do.

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Store The Program And Data Separately

To try this program, use one tape to store the actual program, then place a blank tape in the recorder to save this word list. This tape will be called the data tape. If you have diskettes you could call it a data diskette.

On the screen you will see cassette operating instructions. The PRINT #1 statement is used to put information on the tape, so line 1100 PRINT #1:N writes the number of words N on the tape. Lines 1110-1130 use PRINT #1 to record the words on the tape. When the data is being recorded you will hear a longer header tone, then a sort of dot-dot-dot sound, a little different sound than a regular program recording. CLOSE #1 closes the file and gives you instructions to turn off the recorder.

There are more efficient ways to save data (by combining strings, for example), but I used this method so it would be easier to understand. As you program, you will probably want to economize to save both memory and time.

The next time you run this program and want to use a previously saved list of words, press option 3, Load Previous List. Lines 970-1050 retrieve the data. The OPEN statement tells the computer what kind of information to expect. Line 990 OPEN #2:"CS1",INTERNAL,INPUT,FIXED opens device number 2—again, you can use any number here. For clarity I used #1 to save the data and #2 for retrieving the data, but you could use the same number for both processes. This statement matches line 1090 in the format of the data saved. Lines 1000-1030 are similar to the output lines. First N is read as input (INPUT #2, or input from device #2), then the words are read in. Line 1040 CLOSE #2 closes the file.

The Quiz Routine

Option 6 is to perform the spelling quiz. Lines 1250-1810 contain this procedure. The word list is in the W\$ array, but an identical array T\$ is defined for the quiz. A word is chosen in random order, and is printed on the screen. The student reads the word, then presses the ENTER key to erase it. The student then must type the word and press ENTER. If you prefer to have the word flash on the screen for a certain length of time, you can replace lines 1470-1480 with a delay loop or sound delay such as

```
1470 FOR D=1 TO 800
1480 NEXT D
```

OR

```
1470 CALL SOUND(1000,9999,30)
1480 CALL SOUND(1,9999,30)
```

If the student spells the word correctly, a smiling face is printed on the screen and TI plays an arpeggio. Correctly spelled words will not be

chosen again, but a word that is missed will reappear later in the quiz.

F and FL are variables to keep track of words that are spelled incorrectly. SC is the score and is incremented only if the word is spelled correctly the first try.

Next month I'll have programs that show an easy way to set up a data file and print reports from the file.

Spelling Quiz

```
100 DIM W$(30),T$(30),FL(30)
110 CALL CHAR(97,"071820404C8C808")
120 CALL CHAR(98,"E018040232310101")
130 CALL CHAR(99,"80988C4740201807")
140 CALL CHAR(100,"011931E2020418E")
150 CALL COLOR(9,12,1)
160 CALL CLEAR
170 PRINT TAB(5):"** SPELLING QUIZ
**": : : :
180 PRINT "CHOOSE:"
190 PRINT : "1 ENTER NEW WORD LIST"
200 PRINT : "2 EDIT LIST"
210 PRINT : "3 LOAD PREVIOUS LIST"
220 PRINT : "4 SAVE PRESENT LIST"
230 PRINT : "5 SEE WORD LIST"
240 PRINT : "6 PERFORM QUIZ"
250 PRINT : "7 END PROGRAM": :
260 CALL SOUND(150,1497,4)
270 CALL KEY(0,K,S)
280 IF (K<49)+(K=55)THEN 270
290 CALL CLEAR
300 ON K-48 GOSUB 380,550,970,1050,
1160,1250,1820
310 GOTO 160
320 PRINT : "SORRY, NO WORDS IN LIST
."
330 CALL SOUND(100,330,4)
340 CALL SOUND(100,262,4)
350 CALL SOUND(1000,9999,30)
360 CALL SOUND(1,9999,30)
370 GOTO 160
380 PRINT "** ENTER NEW WORD LIST *
*"
390 PRINT : : "HOW MANY WORDS?"
400 CALL SOUND(150,1497,4)
410 INPUT N
420 IF N=0 THEN 160
430 IF N>0 THEN 460
440 PRINT : "PLEASE ENTER A NUMBER":
"GREATER THAN ZERO."
450 GOTO 390
460 IF N<31 THEN 490
470 PRINT : "SORRY, THIS PROGRAM CAN
ONLYHANDLE UP TO 30 WORDS."
480 GOTO 390
490 PRINT : : "ENTER WORDS ONE AT A
TIME.": : :
500 FOR I=1 TO N
510 CALL SOUND(150,1497,4)
520 INPUT W$(I)
530 NEXT I
540 RETURN
550 CALL CLEAR
560 PRINT "** EDIT LIST **": :
570 IF N=0 THEN 320
```



```

580 FOR I=1 TO N
590 PRINT W$(I),
600 NEXT I
610 PRINT : : "CHANGE WHICH WORD?"
620 CALL SOUND(150,1497,4)
630 INPUT E$
640 FOR I=1 TO N
650 IF E$=W$(I) THEN 710
660 NEXT I
670 PRINT : "THAT WORD IS NOT IN LIST."
680 CALL SOUND(100,330,4)
690 CALL SOUND(100,262,4)
700 GOTO 780
710 PRINT : "ENTER NEW WORD OR": "PRESS
ENTER TO DELETE": :
720 INPUT W$(I)
730 IF W$(I)<>" " THEN 780
740 FOR J=I TO N-1
750 W$(J)=W$(J+1)
760 NEXT J
770 N=N-1
780 PRINT : : "PRESS:"
790 PRINT "1 EDIT MORE WORDS"
800 PRINT "2 SEE CURRENT WORD LIST"
810 PRINT "3 RETURN TO MENU SCREEN"
820 CALL KEY(0,K,S)
830 IF K=49 THEN 550
840 IF K=51 THEN 160
850 IF K<>50 THEN 820
860 CALL CLEAR
870 IF N=0 THEN 320
880 FOR I=1 TO N
890 PRINT W$(I),
900 NEXT I
910 PRINT : : "PRESS:"
920 PRINT "1 EDIT A WORD"
930 PRINT "2 RETURN TO MENU SCREEN"
940 CALL KEY(0,K,S)
950 IF K=49 THEN 610
960 IF K=50 THEN 160 ELSE 940
970 PRINT "** LOADING PREVIOUS LIST
**"
980 PRINT : : "INSERT DATA CASSETTE.
": : :
990 OPEN #2:"CS1",INTERNAL,INPUT,FIXED
1000 INPUT #2:N
1010 FOR I=1 TO N
1020 INPUT #2:W$(I)
1030 NEXT I
1040 CLOSE #2
1050 RETURN
1060 CALL CLEAR
1070 PRINT "** SAVING LIST **"
1080 IF N=0 THEN 320
1090 OPEN #1:"CS1",INTERNAL,OUTPUT,
FIXED
1100 PRINT #1:N
1110 FOR I=1 TO N
1120 PRINT #1:W$(I)
1130 NEXT I
1140 CLOSE #1
1150 RETURN
1160 PRINT "** WORD LIST **": :
1170 IF N=0 THEN 320
1180 FOR I=1 TO N
1190 PRINT W$(I),
1200 NEXT I
1210 PRINT : : "PRESS <ENTER> TO CON
TINUE.":
1220 CALL KEY(0,K,S)
1230 IF K<>13 THEN 1220
1240 RETURN
1250 CALL CLEAR
1260 IF N=0 THEN 320
1270 FOR I=1 TO N
1280 T$(I)=W$(I)
1290 FL(I)=0
1300 NEXT I
1310 PRINT "YOU WILL SEE A WORD."
1320 PRINT : "PRESS <ENTER>."
1330 PRINT : "WHEN THE WORD CLEARS,"
1340 PRINT : "SPELL THE WORD THEN"
1350 PRINT : "PRESS <ENTER>."
1360 PRINT : : "PRESS ANY KEY TO S
TART."
1370 CALL KEY(0,K,S)
1380 IF S<1 THEN 1370
1390 SC=0
1400 FOR I=1 TO N
1410 CALL CLEAR
1420 F=0
1430 RANDOMIZE
1440 R=INT(N*RND+1)
1450 IF T$(R)=" " THEN 1440
1460 PRINT T$(R): :
1470 CALL KEY(0,K,S)
1480 IF K<>13 THEN 1470
1490 CALL CLEAR
1500 INPUT X$
1510 IF X$=T$(R) THEN 1630
1520 CALL SOUND(100,330,2)
1530 CALL SOUND(100,262,2)
1540 FL(R)=1
1550 F=F+1
1560 IF F=2 THEN 1590
1570 PRINT : : "TRY AGAIN."
1580 GOTO 1490
1590 PRINT : : "THE CORRECT SPELLING
IS":T$(R)
1600 PRINT : : "PRESS <ENTER> TO CON
TINUE."
1610 CALL KEY(0,K,S)
1620 IF K=13 THEN 1410 ELSE 1610
1630 PRINT TAB(10); "ab":TAB(10); "cd
": :
1640 CALL SOUND(100,262,2)
1650 CALL SOUND(100,330,2)
1660 CALL SOUND(100,392,2)
1670 CALL SOUND(150,524,2)
1680 IF F>0 THEN 1410
1690 T$(R)=" "
1700 IF FL(R)>0 THEN 1720
1710 SC=SC+1
1720 NEXT I
1730 CALL CLEAR
1740 PRINT "OUT OF":N;"WORDS,"
1750 PRINT : "YOU SPELLED";SC;"CORRE
CTLY"
1760 PRINT : "ON THE FIRST TRY."
1770 PRINT : : "TRY AGAIN? (Y/N)"
1780 CALL KEY(0,K,S)
1790 IF K=89 THEN 1250
1800 IF K<>78 THEN 1780
1810 RETURN
1820 PRINT "PRESS:"
1830 PRINT : "1 SAVE WORD LIST"
1840 PRINT : "2 END PROGRAM"
1850 CALL KEY(0,K,S)
1860 IF K=49 THEN 1060
1870 IF K<>50 THEN 1850
1880 CALL CLEAR
1890 END

```

COMMODORE Floating Subroutines

Louis F. Sander

Here is a subroutine that lets you automatically combine BASIC and machine language. It's easy, flexible, and inventive. For all VIC, 64, and all PETs except Original ROM models.

It's often desirable to include one or more machine language (ML) subroutines in your Commodore BASIC program, especially when the program must be optimized for speed. There are several ways of combining the BASIC and ML, each having its own advantages and disadvantages. The method described here puts your ML in a protected area at the end of the BASIC program, where it will automatically SAVE and LOAD along with the BASIC. Other ways of doing the same thing have one huge disadvantage—after the ML is in place, the BASIC program cannot be changed in any way, ever. *This* method overcomes that drawback, letting you make any number of subsequent changes to the BASIC program.

Our new technique requires your ML to be completely relocatable. That is, it requires that your ML will work properly at any place in memory, so long as the proper entry point is used. In some cases this restriction will keep you from using the new technique, but this may not happen often. Many, if not most, useful ML subroutines are completely relocatable, or can be made so.

Reserving Space

As a BASIC program runs, the operating system keeps track of certain important addresses by storing them in zero page locations called *pointers*. One of these is the Start Of Variables (SOV) pointer, which normally holds an address one byte higher than the end of whatever BASIC program is in memory. If that program changes size, the SOV pointer keeps track of its end + 1, so the computer knows where to store its variables without writing over the program. By altering the SOV pointer to make it point artificially high in memory, we can reserve space for ML between the end of BASIC and the newly redefined Start Of Variables.

When we put our ML program into the reserved space, it is effectively made a part of our BASIC program, and there are several accompanying benefits. Since it's part of the BASIC program, the computer will never overwrite it unless told to. Since it lies above the end of program marker (three zeros at the very end of a BASIC program), the computer won't try to relink it when BASIC lines are changed. And when the BASIC program is SAVED, the ML will go right along with it, because the computer automatically saves everything from the Start Of BASIC to the Start Of Variables.

The trouble comes when we change the BASIC program—as the *real* BASIC program's end moves up or down in memory, our ML moves with it. If our ML program is completely relocatable, it runs the same in any part of memory, so moving it doesn't matter, as far as proper execution goes. What *does* matter is that our ML's entry point is then no longer known, so we can't tell what number to put in our SYS statement.

If we could find the first byte of the relocated ML, we could adjust our SYS statement accordingly, and everything would be fine. Fortunately, BASIC has a pointer which makes the ML easy to find; the pointer in question always holds the address of the first byte in whatever BASIC line is currently being executed. If our BASIC program's final line adds its own length to the address in that pointer, and stores the result in a variable, the variable holds the address of the first byte of our ML. Once we execute this line, say as a subroutine, the BASIC program knows where the ML is, and can easily make the proper SYS calls.

Setting It Up

To use the new technique, you add the ML finder line as the last line in your main BASIC program, then change the SOV pointer so it points above the highest byte you want to reserve for ML. Finally, you execute a CLR (not CLEAR SCREEN, the other one), which corrects some other pointers.

A short BASIC subroutine can make these things automatic and foolproof. You append it to

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your main BASIC program, RUN it, then delete most of its lines. If your library includes an APPEND program, the automation is easy; if you lack APPENDING capability, doing things manually may be easier. The accompanying programs are the subroutine I use, in versions for all Commodore machines except Original ROM PETs. The comments below apply to all versions:

Line 63991 checks the accuracy of the all-important line 63999, which is the line that finds our machine language.

Lines 63992, 63995, and 63996 move the SOV pointer, which requires the temporary use of two memory locations. The ones used here are the USR vector locations, but you can use others if you'd like.

Line 63997 is a decimal-to-hex converter.

Line 63999 sets variable ML equal to the address of the first byte of the reserved ML area. The line must be entered *exactly* as listed, with no embedded spaces, and must be the last line in

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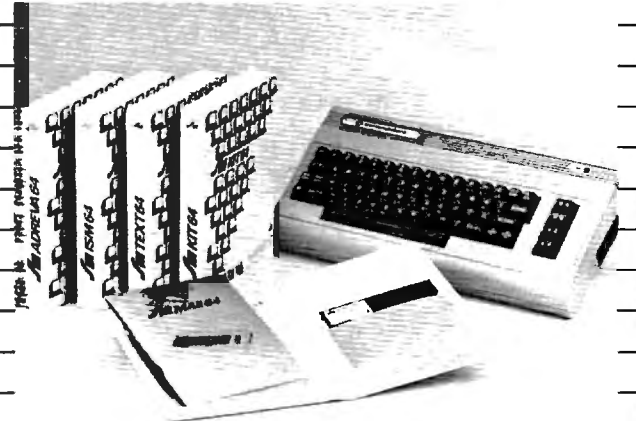
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your BASIC program. (That's why it has the highest line number allowed in BASIC.)

Here are step-by-step instructions for entering your automation subroutine and checking its accuracy:

1. Type the appropriate subroutine into your computer.
2. SAVE the subroutine onto tape or disk.
3. RUN it and observe the screen. If you get an error message, you've made a mistake in typing line 63999. Reload what you SAVED, correct your error, then go to step 2.
4. If there is no error message, enter a 6 in response to the # BYTES prompt. You'll get some screen messages and a READY prompt.
5. At this point, there should be six bytes reserved for ML, just above the end of your BASIC program. Your screen should show the addresses of the lowest and highest bytes in the reserved area. Immediately below the ML area should be the three zeros which mark the end of BASIC; immediately above it should be four bytes of 218 decimal, which were put there as a marker by the ZZ% business in line 63996.

If you know how to examine memory, you should check that the zeros and 218's are where they would be, for proof that your subroutine is working correctly. (If you use a monitor to examine memory, the hex version of the 218's will announce

the good news in dramatic fashion. Try it.) If the zeros and 218's aren't in the right places, something is wrong; check your work, find the errors, and start again from step 2.

6. Now put something into those six bytes and SAVE the subroutine. Turn your computer off to destroy what is in memory, then LOAD what you just saved. Check to make sure your six bytes of ML traveled along with the BASIC. If they did, you're finished.

Using It

The subroutine you SAVED in step 2 has now been proven to work perfectly. The one you saved in step 6 is OK too, but it has some ML appended to it. When you want to add some machine language to the end of a BASIC program, just put the step 2 subroutine at the end of the BASIC program, in one of these ways:

1. LOAD the BASIC program, then use an APPEND routine to add the subroutine, or
2. LOAD the subroutine, then type in the BASIC program, or
3. LOAD and LIST the subroutine, then LOAD the BASIC; add the subroutine to it by putting your cursor on each of the previously LISTed subroutine lines and hitting RETURN. The VIC's screen is too small for this; all others are fine, but you *must* be careful with your cursor, or important subroutine lines will scroll off the

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screen as the BASIC loads. When LOADING the main program from the Datassette, put your cursor on the first letter of the READY prompt, type LOAD [space] [space], press PLAY, then hit RETURN. Doing otherwise may cause too much scrolling. When using a disk, put your cursor on the first letter of the READY prompt, then enter your LOAD command in the normal way.

Once the subroutine is in place, do a RUN 63991 and follow the instructions on the screen. You can reserve any number of bytes for ML, up to the limit of your memory. The subroutine shows the current boundaries of the ML area, and you should put your ML there immediately, since the boundaries will move if you change the BASIC program. *Caution:* When you delete lines, you *must* do it line by line from the keyboard; Toolkit or other programming aids' deletes will detach your ML from the end of BASIC.

You can now make all sorts of changes to the BASIC program, and your ML subroutine will follow its end up and down like a shadow. You can even delete every line of BASIC; in that case, a SAVE will save your ML as though it were a BASIC program itself. And if you ever want to expand an ML area already in use, you can just reappend the subroutine and run it again; it will tack more reserved area onto that you already have!

To use the ML from the BASIC program, have an early line do a GOSUB 63999, which will put the address of the first ML byte into variable ML. Use this information to find the machine language entry point, then call the ML program at will. If the entry point is the first byte of the ML, SYS ML will do the job; otherwise, use SYS ML + X, where X is the offset of the entry point from the first byte.

So there's the ideal technique for combining BASIC and relocatable ML—it's easy to set up, easy to use, and has no undesirable restrictions. Once you SAVE a fully tested subroutine to automate the setup process, it becomes a fine-tuned tool that you can use with ease for many years.

Program 1:

Combining BASIC And ML On The 64

```
63990 REM COMMODORE 64 VERSION
63991 GOSUB63999:IFPEEK(ML-1)+PEEK(ML-2)+
PEEK(ML-3)THENPRINT"63999 IS BAD":E
ND
63992 INPUT"{CLR}# BYTES TO RESERVE FOR M
L";A:J=256:B=PEEK(45)+J*PEEK(46):C=
A+B
63993 PRINT"{DOWN}NOW PUT THE ML INTO:":P
RINT"{DOWN}DECIMAL"B"- "C-1:PRINT"
{DOWN}{4 SPACES}HEX ";
63994 K=4096:H=B:GOSUB63997:PRINT" - ";H
=C:GOSUB63997:PRINT
63995 PRINT"{DOWN}THEN DELETE LINES 63991
-63997.{DOWN}":D=INT(C/J):POKE786,D
63996 POKE785,C-J*D:POKE45,PEEK(785):POKE
46,PEEK(786):CLR:ZZ%=-9510:END
63997 H=H/K:FORI=1TO4:H%=H:H$=CHR$(48+H%-
(H%>9)*7):PRINTH$;:H=16*(H-H%):NEXT
63998 REM * 63999 FINDS ML START ADDR
63999 ML=PEEK(61)+256*PEEK(62)+31:RETURN
```

Program 2:

Combining BASIC And ML On The VIC

```
63990 REM VIC-20 VERSION
```

```
63991 GOSUB63999:IFPEEK(ML-1)+PEEK(ML-2)+
PEEK(ML-3)THENPRINT"63999 IS BAD":E
ND
63992 INPUT"{CLR}# BYTES FOR ML";A:J=256:
B=PEEK(45)+J*PEEK(46):C=A+B
63993 PRINT"{DOWN}NOW PUT THE ML INTO:":P
RINT"{DOWN}DECIMAL"B"- "C-1:PRINT"
{DOWN}{4 SPACES}HEX ";
63994 K=4096:H=B:GOSUB63997:PRINT" - ";H
=C:GOSUB63997:PRINT
63995 PRINT"{DOWN}THEN DELETE LINES 63991
-63997.{DOWN}":D=INT(C/J)
63996 POKE2,D:POKE1,C-J*D:POKE45,PEEK(1):
POKE46,PEEK(2):CLR:ZZ%=-9510:END
63997 H=H/K:FORI=1TO4:H%=H:H$=CHR$(48+H%-
(H%>9)*7):PRINTH$;:H=16*(H-H%):NEXT
63998 REM * 63999 FINDS ML START ADDR
63999 ML=PEEK(61)+256*PEEK(62)+31:RETURN
```

Program 3:

Combining BASIC And ML On PET/CBM

```
63990 REM UPGR/4.0 ROM PET/CBM VERSION
63991 GOSUB63999:IFPEEK(ML-1)+PEEK(ML-2)+
PEEK(ML-3)THENPRINT"63999 IS BAD":E
ND
63992 INPUT"{CLR}# BYTES TO RESERVE FOR M
L";A:J=256:B=PEEK(42)+J*PEEK(43):C=
A+B
63993 PRINT"{DOWN}NOW PUT THE ML INTO:":P
RINT"{DOWN}DECIMAL"B"- "C-1:PRINT"
{DOWN}{4 SPACES}HEX ";
63994 K=4096:H=B:GOSUB63997:PRINT" - ";H
=C:GOSUB63997:PRINT
63995 PRINT"{DOWN}THEN DELETE LINES 63991
-63997.{DOWN}":D=INT(C/J)
63996 POKE2,D:POKE1,C-J*D:POKE42,PEEK(1):
POKE43,PEEK(2):CLR:ZZ%=-9510:END
63997 H=H/K:FORI=1TO4:H%=H:H$=CHR$(48+H%-
(H%>9)*7):PRINTH$;:H=16*(H-H%):NEXT
63998 REM * 63999 FINDS ML START ADDR
63999 ML=PEEK(58)+256*PEEK(59)+31:RETURN ©
```

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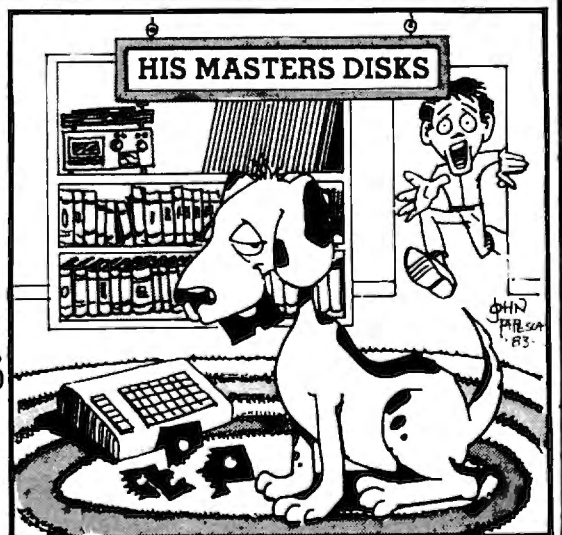
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Big Buffer For Atari

Jeff Brenner

Add a keyboard buffer to your Atari so you can type in characters while a program is running or listing, and even during a SAVE. See the "Automatic Proofreader" article on page 60 before typing these programs.

This article will show you how to add an extremely powerful feature to your Atari computer—a keyboard buffer. A keyboard buffer is a reserved area of computer memory used to temporarily store keypresses while the keyboard is inactive. When the keyboard is ready for input, any stored keypresses will be printed out onto the screen.

Look at this simple program:

```
10 GOTO 10
```

When you run this program, the computer will be put into an infinite loop. If you type in characters while this program is running, the computer will ignore your input.

With a keyboard buffer, you still see nothing when you run the program and type characters. But as soon as you stop the program by pressing the BREAK key, all of the characters that you typed in previously will be printed out.

Most higher-priced computers, such as the IBM Personal Computer, have intricate keyboard buffers controlled by a separate microprocessor. Some lower-priced computers, such as the Commodore 64 and VIC-20, have simple ten-character buffers built into the operating system.

A 100-Character Buffer

Atari computers do not have a buffer, but "Keyboard Buffer" will give your Atari a 100-character buffer.

Here's how Keyboard Buffer works. Each time a key is pressed, the program will check whether the computer is busy or not. If the computer is not prepared for an input, the number representing that keypress will be stored in the buffer (on Page 6, so it won't interfere with

BASIC). As soon as the computer is ready to accept input, the characters stored in the buffer will be displayed.

Program 1 is a BASIC program which loads a machine language program into memory. The program is designed to be a subroutine for any BASIC program requiring keyboard input. After you enter this program, LIST it to tape or disk so you can ENTER it later and merge it with your program.

If you press SYSTEM RESET while using the buffer program, it will be necessary to restart the program by typing:

```
A =USR(1536)
```

Program 1: Keyboard Buffer

```
0C 30000 REM KEYBOARD BUFFER
0D 30010 DATA 104,173,8,2,141,96,6,173
,9,2,141,97,6,169,0,141,14,21
2,120,169,52,141,8,2
0N 30020 DATA 169,6,141,9,2,169,98,141
,36,2,169,6,141,37,2,169,192,
141,14,212,169,0,133,204
0J 30030 DATA 133,205,88,96,173,9,210,
201,159,240,36,152,72,173,252
,2,201,255,240,19,164,204,192
,100
0M 30040 DATA 240,9,230,204,200,173,9,
210,153,143,6,104,168,104,64,
165,204,197,205,208,231,104,1
68,76
0B 30050 DATA 95,6,173,252,2,201,255,2
08,35,165,204,197,205,240,23,
230,205,164,204,192,120,176,1
5,164
0E 30060 DATA 205,192,120,176,9,185,14
3,6,141,252,2,76,98,228,169,0
,133,204,133,205,76,98,228
0L 30070 T=0
0G 30080 IF PEEK(521)=6 THEN GOTO 3015
0
0F 30090 FOR I=1 TO 143
0P 30100 READ N:T=T+N
0A 30110 POKE 1535+I,N
0H 30120 NEXT I
0J 30130 IF T<>18309 THEN PRINT "CHECK
DATA STATEMENTS":STOP
```

```
JA 30140 A=USR(1536)
NJ 30150 RETURN
```

After you type in Program 1, LIST it to cassette or disk. If you wish to test your work, do not type NEW. Add the lines from Program 2 and RUN.

Program 2: Buffer Test

```
JA 10 REM KEYBOARD BUFFER TEST
NF 20 GOSUB 30000
DG 30 DIM NAME$(30)
OP 40 PRINT "WHAT IS YOUR NAME?";
DL 50 FOR I=1 TO 500
AP 60 A=RND(0)*255
HP 70 SOUND 1,A,10,B
PA 80 NEXT I
DB 90 INPUT NAME$
DD 100 PRINT "YOUR NAME IS ";NAME$
GJ 110 END
```

A Test With Background Music

If you get an error or a CHECK DATA STATEMENTS message, you have made an error in typing Program 1. Check all the DATA statements carefully.

When everything is correct, the computer will print WHAT IS YOUR NAME? and start playing tones. Even though the music is busy playing, type in your name and press RETURN. After the music is over, your name will be printed out and entered automatically.

This is only one example of an application for Keyboard Buffer. If you would like to use Keyboard Buffer while doing your own programming in BASIC, change line 30150 to:

```
30150 END
```

Then RUN the program. When the READY prompt appears, type NEW. Keyboard Buffer will be operational and you can begin programming.

A keyboard buffer can surely improve the quality of any program requiring user input. Since you can enter characters even while the computer is in a lengthy loop, you save time. After using Keyboard Buffer, you will begin to see the advantage of having a constantly monitored keyboard. ©

Commodore Filetracker

Richard C Wilson

"Filetracker" for VIC or Commodore 64 solves those irritating problems that arise so often, when you can't remember if the file you want is on the disk you're working with, or you can't remember how you spelled the filename. By using Filetracker as a subroutine, you can look up any filename and read or write it while your main program is running.

Other possible uses for Filetracker include cross-checking filenames, generating filenames, compiling a disk library cross-reference index, computing disk space remaining, reformatting directory output to screen or printer, and autorun of programs. See the "Automatic Proofreader" article on page 60 before typing in this program.

Sequential files are very useful tools for storage and retrieval of long data lists on disk. One problem arises occasionally, however: How do you read a sequential file when you don't know its name? The simple answer, of course, is to stop the program, read the disk directory, memorize or write down the filename, then run the program again and enter the correct filename.

This method is less painful if you are using a DOS wedge that allows you to read the disk directory without erasing the program in memory. But it's not very helpful if you are trying to merge data from several related files into a new file, and you must stop repeatedly to look up filenames.

Let The Computer Do It

You can save yourself time and aggravation if you have your computer look up the names on the disk and read the appropriate files. This can be especially useful with a business program which stores each order and account in a separate sequential file. If the account filename is the last four digits of the client's phone number, when an order is written, the account file is read, the account number is added to the order number, and the combined (hyphenated) number becomes the name of the new file. For example, order number 1666 from client 1212 becomes file 1666-1212.

Once the disk starts to fill up (it will hold over 100 such files), sorting out just those order files assigned to account number 1212 can be quite tiresome. "Filetracker" solves such problems.

Selecting The Files You Want

Lines 20-120 read the disk directory. Line 120 prints the number of blocks, name, and file type for each file. (You can delete this line if you don't want to display the entire disk directory.)

The name (only) of each file is stored in the I\$ array. Line 150 selects out names of all sequential files and discards the rest. By changing SEQ in this line to PRG, REL, or USR, you can have the line look exclusively for any type of file.

For example, instead of having line 150 return to get another filename when the condition is not met, it could go to one or more secondary routines to create separate arrays for other file types.

Lines 60 and 130 check the Status word to make certain the disk channel is closed. The program ends when there is no more data to be read.

Making It A Subroutine

To use Filetracker in other programs, change the END statement in line 140 to a RETURN, and the program becomes a subroutine.

If you use Filetracker as a subroutine, then the main program should ask for a key word (1212) which would be assigned to a variable (KY\$).

Since all the filenames are structured the same way, we can change line 150 to compare KY\$ with the account number portion of each sequential filename.

```
150 IF RIGHT$(I$(P),4)<>KY$ THEN I$(P)=""
      :GOTO30
```

If line 120 is left in the routine, all the files listed in the disk directory will be printed on the screen, and the I\$ array will contain the names of all (and only) the order files assigned to account number 1212.

You also can write a subroutine to read each of the files into a two- or three-dimensional array, for further processing.

An Array For Each File Type

By adding these lines to Filetracker, you can enter the names of each type of file into a separate array.

```
150 IFLEFT$(N$,3)<>"SEQ"THEN152
151 P=P+1:GOTO30
152 IFLEFT$(N$,3)<>"PRG"THEN154
153 P$(K)=I$(P):I$(P)="" :K=K+1:GOTO30
154 IFLEFT$(N$,3)<>"REL"THEN156
155 R$(L)=I$(P):I$(P)="" :L=L+1:GOTO30
156 IFLEFT$(N$,3)<>"USR"THENI$(P)="" :GOTO
    30
157 U$(M)=I$(P):I$(P)="" :M=M+1:GOTO30
```

Notice that line 150 is modified to branch to line 152, and you will have to DIMension any arrays you introduce into the program.

Filetracker

```
5 DIMI$(151) :rem 100
10 PRINT"READING SEQUENTIAL FILES..." :rem 36
20 P=0:OPEN3,8,0,"$0":GET#3,D1$,D2$ :rem 61
30 GET#3,D1$,D2$:GET#3,D1$,D2$:N=0:rem 20
40 IFD1$<>" "THENN=ASC(D1$) :rem 197
50 IFD2$<>" "THENN=N+ASC(D2$)*256 :rem 8
60 GET#3,D2$:IFST<>0THEN140 :rem 64
70 IFD2$<>CHR$(34)THEN60 :rem 88
80 GET#3,D2$:IFD2$<>CHR$(34)THENI$(P)=I$(
    P)+D2$:GOTO80 :rem 34
90 GET#3,D2$:IFD2$=CHR$(32)THEN90 :rem 84
100 N$="" :rem 132
110 N$=N$+D2$:GET#3,D2$:IFD2$<>" "THEN110 :rem 144
120 PRINTN;" ";I$(P),N$ :rem 212
130 IFST=0THEN150 :rem 252
140 CLOSE3:END :rem 79
150 IFLEFT$(N$,3)<>"SEQ"THENI$(P)="" :GOTO
    30 :rem 209
160 P=P+1:GOTO30 :rem 166
```

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MACHINE LANGUAGE

Jim Butterfield, Associate Editor

FACTORS: A Machine Language Factoring Program Part 3

This month we conclude the commented listing of our machine language program to find prime factors.

Last month in Part 2, we examined the routines that handle keyboard input and prepare our number for factoring.

Now, here's the division routine. It rolls the dividend left through the joint remainder/quotient area. When we're finished, what's left of the dividend is in the remainder area; the quotient has miraculously appeared on the right.

```
0615 A9 00    DIVIDE LDA #0          ;CLEAN HOUSE
0617 A2 0B    LDX #11          ;12 BYTES
0619 9D 6C 03 DLP1  STA REMDR,X
061C CA      DEX
061D 10 FA    BPL DLP1
061F A2 00    LDX #0          ;"FROM" POINTER
0621 A0 00    LDY #0          ;"TO" POINTER
0623 8E 48 03 STX BCOUNT
0626 BD 50 03 DLP2  LDA NUMBER,X
0629 D0 06    BNE DLP4
062B E8      INX          ;DROP HIGH
                        BYTES
062C D0 F8    BNE DLP2
062E BD 50 03 DLP3  LDA NUMBER,X
0631 99 70 03 DLP4  STA QUOT,Y
0634 E8      INX
0635 C8      INY
0636 EE 48 03 INC BCOUNT
0639 E0 08    CPX #8
063B 90 F1    BCC DLP3
063D 0E 48 03 ASL BCOUNT ;TIMES 8
0640 0E 48 03 ASL BCOUNT ;CHANGES BYTES
0643 0E 48 03 ASL BCOUNT ;TO BITS
0646 18      CLC
0647 A2 0B    DLP5  LDX #11        ;ROLLENTIRE
0649 3E 6C 03 DLP6  ROL REMDR,X   ;..WORK AREA
064C CA      DEX          ;..LEFT
064D 10 FA    BPL DLP6
064F A2 03    LDX #3
0651 38      SEC
0652 BD 6C 03 DLP7  LDA REMDR,X   ;COMPARE
0655 FD 68 03 SBC DVSR,X   ;..DIVIDEND TO
                        ;..DIVISOR
```

```
0658 CA      DEX          ;FOUR BYTES
0659 10 F7    BPL DLP7
065B 90 0F    BCC NDIV    ;TOO SMALL
065D A2 03    LDX #3      ;NOT TOO SMALL,
065F 38      SEC          ;SUBTRACT..
0660 BD 6C 03 DLP8  LDA REMDR,X   ;DIVISOR
0663 FD 68 03 SBC DVSR,X
0666 9D 6C 03 STA REMDR,X
0669 CA      DEX
066A 10 F4    BPL DLP8
066C CE 48 03 NDIV  DEC BCOUNT   ;COUNT BITS
066F D0 D6    BNE DLP5    ;LOOP (CARRY?)
0671 A2 07    LDX #7      ;FINISHED:
0673 3E 70 03 DLP9  ROL REMDR+4,X ;TRIM
                        REMAINDER
0676 CA      DEX
0677 10 FA    BPL DLP9
0679 60      RTS
```

This is where we try dividing our number into selected divisors and see if we get an even division (remainder zero)

```
067A 8D 6B 03 FLOOK STA DVSR+3 ;PLANT DIVISOR
067D A9 00    FLOOP  LDA #0
067F 8D 49 03 STA EXP   ;ZERO TO START
0682 20 15 06 FPOWR JSR DIVIDE
0685 A9 00    LDA #0    ;CHECK
                        REMAINDER
0687 A2 03    LDX #3
0689 1D 6C 03 FLP1  ORA REMDR,X ;FOR ZERO
068C CA      DEX
068D 10 FA    BPL FLP1
068F AA      TAX
0690 D0 10    BNE FEXIT ;NOT ZERO?
```

Factor Found

We've found a factor. The quotient now becomes our new number; then we can increment the exponent counter and try again.

```
                                ;MOVE QUOTIENT
0692 EE 49 03 INC EXP   ;ADD ONE
0695 A2 07    LDX #7
0697 BD 70 03 FLP2  LDA QUOT,X   ;QUOTIENT TO
069A 9D 50 03 STA NUMBER,X ;..ORIG NUMBER
069D CA      DEX
```


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```
069E 10 F7      BPL FLP2
06A0 30 E0      BMI FPOWR      ;TRYFOR
                                   ANOTHER
```

We compare the number to the divisor by subtracting. That way, we'll find out whether or not it's time to wrap it up.

```
                                   ;CHECK LIMITS
06A2 A2 07      FEXIT LDX #7          ;EIGHT BYTES
06A4 38          SEC
06A5 BD 70 03   FCHEK LDA QUOT,X
06A8 FD 64 03   SBC DVSR-4,X
06AB CA          DEX
06AC 10 F7      BPL FCHEK
```

If the exponent is nonzero, we've found a divisor and it's time to report it.

```
06AE 08          PHP          ;FREEZE STATUS
06AF AE 49 03   LDX EXP
06B2 F0 03      BEQ FPASS
06B4 20 D0 06   JSR SHOW
06B7 28          FPASS PLP          ;UNFREEZE STAT
06B8 60          RTS
```

Here come the routines for printing numbers SRAP prints the remaining value when we wrap up the line. It's different from printing the other factors, in that the final value might be a very large number.

```
06B9 AD 4A 03   SRAP  LDA CHAR      ;EQUALS OR PLUS
06BC 20 D2 FF   JSR $FFD2      ;..PRINT IT
06BF 20 04 07   JSR SWIPE     ;CLEAR WORK
                                   AREA
06C2 A2 07      LDX #7          ;EIGHT BYTES!
06C4 BD 50 03   SRAL  LDA NUMBER,X
06C7 9D 70 03   STA REMDR+4,X
06CA CA          DEX
06CB 10 F7      BPL SRAL
06CD 4C 0F 07   JMP CPR
```

Our main number printing routine coming up. First, the leading character (equals sign or plus sign). Then we place the binary number into a work area, and call the binary-to-decimal output routine, CPR. We may also need to do this for the exponent if it's greater than one.

```
06D0 AD 4A 03   SHOW  LDA CHAR      ;EQUALS OR PLUS
06D3 20 D2 FF   JSR $FFD2      ;..PRINT IT
06D6 A9 2A      LDA #$2A      ;NEXT IS PLUS
06D8 8D 4A 03   STA CHAR
06DB 20 04 07   JSR SWIPE     ;CLEAR WORK
                                   AREA
06DE A2 03      LDX #3          ;FOUR BYTES
06E0 BD 68 03   SLP1  LDA DVSR,X   ;..TO WORK AREA
06E3 9D 74 03   STA REMDR+8,X
06E6 CA          DEX
06E7 10 F7      BPL SLP1
06E9 20 0F 07   JSR CPR
```

```
                                   ;PRINT EXPONENT IF APPR
06EC AE 49 03   LDX EXP
06EF CA          DEX
06F0 F0 11      BEQ SOUT      ;ONE, DON'T
                                   PRINT
06F2 20 04 07   JSR SWIPE
06F5 AE 49 03   LDX EXP
06F8 8F 77 03   STX REMDR+11
06FB A9 5E      LDA #$5E      ;UP ARROW
06FD 20 D2 FF   JSR $FFD2      ;..PRINT IT
0700 20 0F 07   JSR CPR
0703 60          SOUT  RTS
0704 A2 07      SWIPE LDX #7      ;EIGHT BYTE
```

```
0706 A9 00      LDA #0          ;CLEAR TO ZERO
0708 9D 70 03   SW1  STA QUOT,X
070B CA          DEX
070C 10 FA      BPL SW1
070E 60          RTS
```

Simple, But Curious

CPR, or Character Print, first changes binary into binary coded decimal. To do this, it uses the Decimal mode of the 6502. The method is simple but curious: It shifts the binary bits out of the work area, and shifts them (decimally!) into area DECIML.

```
070F A2 09      CPR  LDX #9          ;TEN BYTES..
0711 A9 00      LDA #0          ;..20 DIGITS
0713 9D 78 03   CLP1 STA DECIML,X ;..CLEAR
0716 CA          DEX
0717 10 FA      BPL CLP1
0719 A0 3F      LDY #63       ;64 BITS
071B A2 07      CLP2 LDX #7          ;8 BYTES
071D 18          CLC
071E 3E 70 03   CLP3 ROL REMDR+4,X ;POP OUT A BIT
0721 CA          DEX          ;..INTO CARRY
0722 10 FA      BPL CLP3
0724 A2 09      LDX #9          ;TEN BYTES
0726 78          SEI          ;LOCKOUT IRQ
0727 F8          SED          ;DECIMAL MODE
0728 BD 78 03   CLP4 LDA DECIML,X ;SHIFT BIT IN
072B 7D 78 03   ADC DECIML,X
072E 9D 78 03   STA DECIML,X
0731 CA          DEX
0732 10 F4      BPL CLP4
0734 D8          CLD          ;BACK TO BINARY
0735 58          CLI          ;RELEASE IRQ
0736 88          DEY
0737 10 E2      BPL CLP2
```

Now we print out the decimal digits. They are packed two to a byte, so we must unpack them first. Of course, we remove leading zeros.

```
0739 A2 00      LDX #0          ;Z SUPPRESSION
073B 8E 4B 03   STX ZSUP
073E BD 78 03   CLP5 LDA DECIML,X ;HIGH END
0741 48          PHA          ;SAVE IT
0742 4A          LSR A          ;GET HIGH
0743 4A          LSR A          ;..4 BITS
0744 4A          LSR A
0745 4A          LSR A
0746 20 55 07   JSR COUT      ;SEND 'EM
0749 68          PLA          ;RECALL IT
074A 29 0F      AND #$0F      ;LOW 4 BITS
074C 20 55 07   JSR COUT      ;SEND 'EM
074F E8          INX          ;NEXT BYTE
0750 E0 0A      CPX #10      ;STOP AT 10
0752 90 EA      BCC CLP5
0754 60          RTS
```

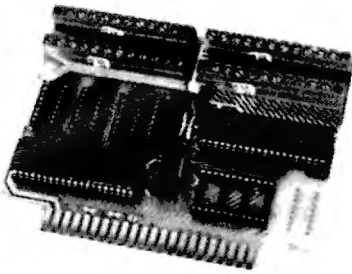
COUT outputs the individual characters, and implements zero suppression.

```
0755 D0 06      COUT  BNE CFL      ;NOT ZERO,
                                   PRINT
0757 CD 4B 03   CMP ZSUP      ;ZSUP FLAG ON?
075A D0 01      BNE CFL      ;NO, PRINT
075C 60          RTS          ;ELSE DON'T
075D EE 4B 03   CFL  INC ZSUP      ;KILL ZSUP FLAG
0760 09 30      ORA #$30      ;CHANGE TO
                                   ASCII
0762 4C D2 FF   JMP $FFD2      ;PRINT & RETURN.
```

Finally, here's our table of offset values. They are a great timesaver.

```
0765 01 07 0B 0D TABLE .BYTE 1,7,11,13
0769 11 13 17 1D        .BYTE 17,19,23,29
```


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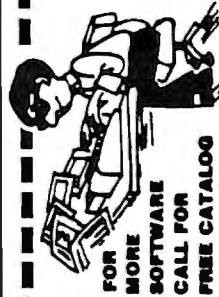
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64 EXPLORER

Larry Isaacs

This month we'll cover two topics. First, we'll add a RESET switch so you can easily recover from a program "crash," and then we'll discuss file access for the 1541 disk drive.

When you're using some of the special hardware features of the 64, and especially when you're experimenting with machine language, a simple mistake can cause the 64 to crash. The display just sits there, if there is a display; nothing happens when keys are pressed; and even pressing RUN/STOP—RESTORE doesn't help.

In such cases, it takes a *reset* to bring the 64 back. Naturally, turning the machine off and back on is one way to recover from a crash. Unfortunately, this means that the contents of RAM will be lost, including the program you were working on.

There is another way to reset the computer, without turning it off. You can connect a switch to the User Port to trigger the reset sequence.

A Clean Start Out Of The Gate

As you would expect, the 6510 microprocessor contains some complex circuitry. If the microprocessor is to operate properly, all the various parts of this circuitry must work together in an exactly defined set of steps. A RESET signal gets everything synchronized. When this signal is grounded, the 6510 is forced through a sequence, like horses going into the starting gate to get ready for a race. When the RESET signal is released from ground, all the processor's components start off together.

At this point, the 6510 is ready to start executing machine language instructions. But where will these instructions first come from? The reset process also deals with this question. The first thing the 6510 will do after the RESET signal is released is fetch two bytes from the top two memory locations in the 64. These bytes are the starting address for executing machine instructions. Two such bytes, used to form an address, are called a *vector*; the two bytes mentioned above are called the RESET vector.

RESET Without Losing The Program

You have access to the RESET signal through two

pins in the User Port (the rightmost connector as you face the back of your 64). Triggering a RESET through the User Port will cause a RESET without turning the power off (and memory contents will not be lost). There is a good chance that the program you were working on will still be intact. You can save a fair amount of time while experimenting and debugging by not having to reload the program every time.

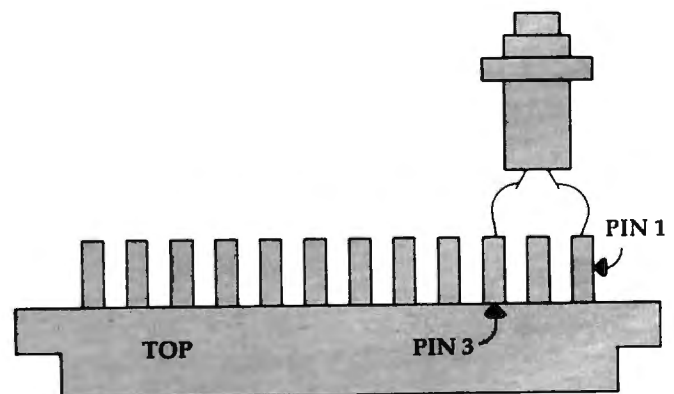
To construct a RESET switch, you will need the following items:

Hardware:

- 1 Momentary contact switch (SPST)
- 1 24-pin card edge connector (contacts on .156 inch centers)

You will also need a small amount of wire (preferably stiff wire) as well as a soldering iron and a little solder. If you aren't good at soldering, perhaps you can find a friend who can do the construction for you.

The construction involves connecting one terminal of the switch to pin 1 on the card edge connector, and the other terminal on the switch to pin 3 on the connector:



When construction is finished, plug the connector onto the 64 User Port (with the computer's power off), making sure that the terminals with connected wires are on top. With your switch in place, if your program crashes you just press the switch, and your 64 is RESET.

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If you are working strictly with machine language, you may be able to continue working with your program immediately after using the RESET switch. If you are working with BASIC or are using the DOS Wedge, you must do a little more work to get things back to normal. To restart the DOS Wedge, execute the following command:

```
POKE 186,8:SYS 52224
```

The first POKE is necessary to put the 1541's device number where the Wedge expects to find it. Normally it would be put there automatically when the Wedge is loaded from disk. The SYS command links the Wedge into BASIC again.

Recovering A BASIC Program

When you are working with BASIC programs, using the RESET switch will effectively perform a NEW on your program. To recover the BASIC program, a small machine language routine will be necessary. The following program will POKE the required routine into memory.

```
10 AD=49152:FOR I=0 TO 21
20 READ D:POKE AD+I,D:NEXT
30 DATA 169,8,141,2,8,32,51,165,24
40 DATA 165,34,105,2,133,45,165,35
50 DATA 105,0,133,46,96
60 PRINT"TO EXECUTE, USE SYS";AD;"CLR"
```

As written, the routine should be located at 49152 (\$C000). The routine will run correctly no matter where it is placed, provided it is some place out of the way. You could put the routine in the cassette buffer by simply setting AD to 828 in line 10. You should execute this program before beginning your experiments with the program under development. Should you be forced to use the RESET switch, you can recover the BASIC program by executing the command:

```
SYS 49152:CLR
```

As you might guess, this will also recover a program which has been inadvertently NEWed. The CLR command is necessary to clean up some pointers that BASIC uses to locate where variables and arrays are to be stored.

Finding The Variables Again

Unfortunately, there isn't an automatic way to recover the old values of the variables or arrays. Recovering arrays is too complicated to be practical. However, some of the variables can be recovered, provided you have an idea of how many there were. To recover a given number of variables, substitute that number for n in the following command:

```
?PEEK(45)+PEEK(46)*256+7*n
```

Substitute the value printed into the N in this additional command:

```
POKE48,INT(N/256):POKE47,N-PEEK(48)*256
```

At this point you should be able to print the values of the first N variables created by the BASIC program, assuming there were that many.

When you're working with machine language programs, the RESET switch can be especially handy. In addition to not having to reload your programs all the time, the variable storage used by the machine language program should still be intact. This can be very helpful in determining where in the program the crash occurred.

A Corrupted Program Must Be Reloaded

As mentioned before, the great majority of memory will be left unchanged after the reset. However, there is a possibility that the program *was* accidentally corrupted by the crash. Therefore, if you must be sure that there is a good copy in memory, you should reload the program. This obviously implies that you saved a copy before you tried it out.

But for simple experimentation, you can assume that the program in memory is still good and simply execute it again. If it crashes right away, or in a different manner, it may be time to reload the program.

If you've managed to live without a reset switch this long, you may wonder whether you should bother building one. When you are debugging a program which crashes the machine, anything which can help minimize the frustration is desirable.

File Access And The 1541

Now to look some more at the 1541 disk drive. Fortunately, we have a nice thick reference manual for the 64 to provide lots of detailed information. Unfortunately, the *Commodore 64 Programmer's Reference Guide* doesn't cover the 1541 disk drive. Instead, we are left with the *1541 User's Manual*, which isn't totally accurate or clean. To help fill this gap, I will pass on any interesting bits of information I can discover concerning operation of the disk drive.

How many disk files can be open at one time? The only hard facts I could find in the *1541 User's Manual* were under DOS Error Message 70: NO CHANNEL. Here it states that six "direct" access (which I assume to mean random access) or five sequential files may be open at one time. From previous experience, I knew these numbers were not correct.

Since my experiments gave inconsistent results, I am unable to give you a simple answer to the question. Instead, I'll just tell you what I observed, and not try to explain it.

Maximum Of Three Sequential Files

First of all, I was able to open only four random

access channels before getting the NO CHANNEL error message. This implies that only three sequential channels may be opened at one time. This I found to be true, provided only one of the three files was opened for writing. Opening three sequential files for writing resulted in an error. It's interesting that opening three sequential files did not result in a NO CHANNEL error, rather there was a DRIVE NOT READY error (74).

Opening two sequential files for writing and one for reading was accepted by the disk drive, provided that the one for reading was opened last. If the file for reading was opened first or second, a DRIVE NOT READY message was returned by the disk drive. Because of this inconsistent operation, I would open no more than two sequential files for writing.

As for relative files, it appears that only one relative file may be opened on the 1541 at one time. Opening a relative file in conjunction with a random access file or sequence file resulted in the same inconsistency as opening two sequential write files. If the relative file was opened first, another file, random or sequential, could be opened afterward without complaints from the disk drive. However, when a random or sequential file was opened first, opening a relative afterward caused the NO CHANNEL error.

Mixing File Types

From these observations, I would say it's safe to use up to four random access files at one time, three sequential files (with only one opened for writing), or one relative file. It should also be possible to mix some random access files with sequential channels, if desired. My experiments did not involve reading or writing data to any great extent. To be thorough, this should be done as well. I may be able to report on further experiments in my next column.

I will also try to verify if the 1541 drives currently being sold show the same symptoms as my drive. It is possible that the software inside has been upgraded since I obtained my drive, though I haven't heard any reports of this. ©

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Random Music

Roger Hagerty

Looking for some great sound effects for your game programs? "Random Music" plays random combinations of pitch, duration, and volume to produce a wide variety of sounds. And for even more variety, you can use the game paddles to control one of these parameters while the computer selects the others at random.

Displayed on the screen are the digital values of the game paddles (0-255) and paddle buttons (0 or 1). The program plays a random combination of pitch, duration, and volume.

Pressing the right paddle button enables you to control the duration by rotating the right paddle. When the left paddle button is pressed, the pitch is controlled by the value of the left paddle. When both buttons are pressed, the last note is pulsed. By using the noise voice in this mode, you can generate some exciting machine-gun effects. Releasing both buttons returns to the random music mode.

The Atari version uses one voice. The VIC version uses four voices which can be selected by the function keys. In the 64 version, the function keys are used to select the triangle, sawtooth, pulse, and noise waveforms. See the "Automatic Proofreader" article on page 60 before typing in these programs.

Program 1: Random Music—VIC Version

```
5 GOTO9040 :rem 59
6 POKE36879,76:PRINT"{CLR}" :rem 173
10 POKE37139,0:DD=37154:PA=37137:PB=37152 :rem 14
20 PX=36872:PY=36873:K1=4 :rem 163
100 FORI=1TO4 :rem 6
110 S(I)=36873+I:NEXTI :rem 253
130 V=36878 :rem 55
131 PRINT"{HOME}{4 DOWN}{RIGHT}{DOWN}
{BLU}{RVS}LEFT{OFF}{2 SPACES}{RVS}FB"
,{GRN}RIGHT{OFF}{2 SPACES}{RVS}FB
{OFF}" :rem 61
132 PRINT"{DOWN}{19 SPACES}" :rem 120
133 GOSUB9000:PRINT"{UP}" PEEK(PX)TAB(6)X
;TAB(10)PEEK(PY)TAB(17)Y :rem 28
134 D1=PEEK(PX):D=PEEK(PY) :rem 66
140 Q=INT(RND(1)*4)+1:L=INT(RND(1)*16) :rem 117
142 R=INT(RND(1)*128)+128 :rem 83
143 Q1=INT(RND(1)*4)+1 :rem 179
145 Z=S(Q):Z1=S(Q1) :rem 78
```

```
150 POKEZ,R:FORC=1TOD :NEXTC :rem 18
155 POKEV,L :rem 152
160 IFXTHEN200 :rem 63
165 POKEZ1,0 :rem 178
170 ONQGOTO134,140,131,134 :rem 157
200 FORI=1TO4:POKES(I),0:NEXT :rem 50
201 D2=PEEK(PX)+128:IFD2>255THEND2=255 :rem 193
202 PRINT"{UP}"D2TAB(17)Y :rem 85
203 KY=PEEK(197):IFKY=39THENK1=1 :rem 188
204 IFKY=47THENK1=2 :rem 139
205 IFKY=55THENK1=3 :rem 140
206 IFKY=63THENK1=4 :rem 141
208 IFKY<>39OR47OR55OR63THENKY=YY:rem 150
209 YY=KY :rem 46
210 POKES(K1),D2:POKEV,10 :rem 208
215 GOSUB9000 :rem 225
218 Z=X+Y :rem 14
220 ONZGOTO201,200 :rem 21
230 GOTO170 :rem 102
9000 POKEDD,127:Y=-((PEEK(PB)AND128)=0):P
OKEDD,255 :rem 129
9010 X=-((PEEK(PA)AND16)=0):RETURN :rem 246
9040 PRINT"{CLR}{RVS}{PUR}{7 SPACES}CONTR
OLS{7 SPACES}{OFF}" :rem 229
9050 PRINT"{RED}RIGHT PADDLE-CONTROLS DE
LAY OF RANDOM MUSIC" :rem 155
9060 PRINT"LEFT PADDLE-CONTROLS
{2 SPACES}PITCH WHEN LEFT FIRE- BUTT
ON IS{2 SPACES}DEPRESSED" :rem 38
9070 PRINT"{DOWN}FUNCTION KEYS DETER-
{2 SPACES}MINE VOICE WHEN LEFT
{2 SPACES}FIREBUTTON IS" :rem 96
9080 PRINT"{RIGHT}DEPRESSED :rem 60
9090 PRINT"{DOWN}WHEN BOTH FIREBUTTONS A
RE DEPRESSED THE{5 SPACES}LAST VOICE
USED IS{4 SPACES}PULSED"; :rem 16
10000 PRINT" AND REPEATED :rem 189
10010 PRINT"{2 DOWN}{RVS}{YEL}PRESS ANY K
EY TO START :rem 2
10020 GETA$:IFA$=""THEN10020 :rem 9
10030 GOTO6 :rem 99
```

Program 2: Random Music—64 Version

```
100 GOSUB 440 :rem 169
110 PRINT"{CLR}{9 DOWN}{13 RIGHT}RANDOM M
USIC" :rem 74
120 REM CLEAR CHIP :rem 2
130 SID =54272:PA=SID+25:FB = 56321:AD=17
:SR=243:FU=17:D1= 30:WA$="TRIANGLE" :rem 222
140 FOR T= SID TO SID +24:POKET,0:NEXT :rem 147
```


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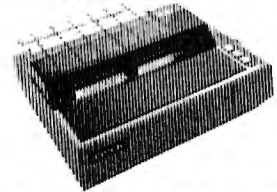
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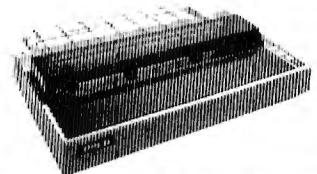
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```

150 POKESID+24,15 :rem 200
160 POKE SID+5,AD:POKESID+6,SR :rem 50
170 IF PEEK(197)>6ORPEEK(197)<3THEN190 :rem 162
180 ON PEEK(197)-2GOSUB320,330,340,350 :rem 10
190 F1=PEEK(FB)AND8:F2=PEEK(FB)AND4 :rem 75
200 IFF1<>0ANDF2<>0THENFB$="{12 SPACES}" :rem 63
:GOSUB410:GOSUB370:GOTO240
210 IF F1=0AND F2=0{2 SPACES}THEN FB$="BO :rem 63
TH BUTTONS":GOSUB400:GOSUB360:GOTO250
220 IF F1=0THEN FB$="LEFT{2 SPACES}BUTTON :rem 194
":GOSUB400:GOTO250
230 IF F2 =0THEN FB$="RIGHT BUTTON":GOSUB :rem 28
360:GOTO250
240 D1=INT(RND(0)*255):D2=INT(RND(0)*255) :rem 166
:GOSUB410:GOSUB370
250 POKE SID+1,D1:POKESID,50:POKE214,12:P :rem 198
RINT:POKE211,8:PRINT"PITCH";D1$;
260 POKESID+4,FU :rem 205
270 FORT=1 TO D2:NEXT:POKESID+4,FUAND254 :rem 177
280 PRINT"{4 RIGHT}DELAY";D2$; :rem 94
290 PRINT"{DOWN}{20 LEFT}WAVEFORM {RVS}"; :rem 108
WA$;
300 POKE214,14:PRINT:POKE211,13:PRINTFB$ :rem 177
310 GOTO170 :rem 101
320 FU=129:WA$=" NOISE{2 SPACES}":RETURN :rem 24
330 FU =17:WA$="TRIANGLE":RETURN :rem 189
340 FU= 33 :WA$="SAWTOOTH":RETURN:rem 223
350 FU = 65:WA$=" PULSE{2 SPACES}":POKESI :rem 108
D+2,245:POKESID+3,7:RETURN
360 D2=PEEK(PA) :rem 83
370 D2$=STR$(D2):IF LEN(D2$)=3THEND2$=" " :rem 103
+D2$
380 IF LEN(D2$)=2 THEND2$="{2 SPACES}"+D2 :rem 114
$
390 RETURN :rem 124
400 D1 = PEEK(PA+1) :rem 169
410 D1$=STR$(D1):IF LEN(D1$)=3THEND1$=" " :rem 93
+D1$
420 IF LEN(D1$)=2 THEND1$="{2 SPACES}"+D1 :rem 106
$
430 RETURN :rem 119
440 PRINT "{CLR}{16 RIGHT}{BLK}CONTROLS": :rem 153
POKE53281,1
450 PRINT"{BLK}{DOWN}{RIGHT}WHEN THE RIGH :rem 153
T FIRE BUTTON IS PRESSED,"
460 PRINT"{DOWN}{8 RIGHT}THE RIGHT PADDLE :rem 225
CONTROLS"
470 PRINT"{DOWN}{4 RIGHT}THE DELAY OF THE :rem 23
SOUNDS PRODUCED."
480 PRINT"{DOWN}{RIGHT}WHEN THE LEFT FIRE :rem 185
BUTTON IS PRESSED,"
490 PRINT"{DOWN}{8 RIGHT}THE LEFT PADDLE :rem 145
{SPACE}CONTROLS"
500 PRINT"{DOWN}{4 RIGHT}THE PITCH OF THE :rem 26
SOUNDS PRODUCED."
510 PRINT"{DOWN}{2 RIGHT}IF BOTH BUTTONS :rem 199
{SPACE}ARE PRESSED, THEN THE"
520 PRINT"{DOWN}{2 RIGHT}LAST SOUND PRODU :rem 212
CED IS PULSED AND CAN "
530 PRINT"{4 RIGHT}BE CONTROLLED BY EITHE :rem 142
R PADDLE."

```

```

540 PRINT"{DOWN}THE FUNCTION KEYS ARE USE :rem 75
D TO SELECT THE"
550 PRINT"{8 RIGHT}WAVEFORM FOR THE SOUND :rem 57
."
560 PRINT"{9 RIGHT}HIT ANY KEY TO BEGIN" :rem 47
570 FOR T=1 TO100:NEXT :rem 242
580 IF PEEK(197)=64 THEN 580 :rem 182
590 RETURN :rem 126

```

Program 3: Random Music—Atari Version

```

FD 4 POKE 752,1
ON 5 DIM FB$(12),D2$(3),D1$(3),DT$(3), :rem 75
DR$(3),A$(2)
MA 6 ? "(CLEAR)":GOSUB 600:? "(CLEAR)" :rem 57
JD 8 POSITION 14,10:? "RANDOM MUSIC" :rem 47
BD 10 F1=PTRIG(0):F2=PTRIG(1) :rem 242
DK 20 IF F1<>0 AND F2<>0 THEN FB$=" :rem 182
(12 SPACES)":GOTO 60
NA 30 IF F1+F2=0 THEN FB$="Both Button :rem 126
s":GOSUB 350:GOSUB 450:GOTO 70
SH 40 IF F1=0 THEN FB$="Left Button " :rem 47
:GOSUB 450:GOTO 70
NL 50 IF F2=0 THEN FB$="Right Button " :rem 242
:GOSUB 350:GOTO 70
HK 60 D1=INT(RND(0)*255):D2=INT(RND(0) :rem 182
*255):GOSUB 360:GOSUB 460
MP 70 SOUND 0,D1,14,10 :rem 57
FG 80 POSITION 10,12:? "Pitch ";D1$ :rem 47
FA 90 POSITION 20,12:? "Delay ";D2$ :rem 242
BF 100 POSITION 13,13:? FB$ :rem 126
KB 105 FOR T=1 TO D2:NEXT T:SOUND 0,D1 :rem 57
,14,0
CN 110 GOTO 10 :rem 182
HH 350 D2=PADDLE(1) :rem 182
OJ 360 D2$="":DT$=STR$(D2):A=LEN(DT$): :rem 182
ON A GOTO 370,380,390
AA 370 D2$(1,2)=" ":D2$(3)=DT$:RETURN :rem 182
FO 380 D2$(1,1)=" ":D2$(2,3)=DT$:RETUR :rem 182
N
CP 390 D2$=DT$ :rem 182
HE 400 RETURN :rem 182
HG 450 D1=PADDLE(0) :rem 182
OH 460 D1$="":DR$=STR$(D1):A=LEN(DR$): :rem 182
ON A GOTO 470,480,490
PN 470 D1$(1,2)=" ":D1$(3)=DR$:RETURN :rem 182
FL 480 D1$(1,1)=" ":D1$(2,3)=DR$:RETUR :rem 182
N
CN 490 D1$=DR$ :rem 182
HF 500 RETURN :rem 182
IN 600 SETCOLOR 4,13,10:SETCOLOR 1,8,0 :rem 182
:SETCOLOR 2,8,10:? "{CLEAR}":PO :rem 182
SITION 15,1:? "CONTROLS"
HR 610 POSITION 7,3:? "The right paddl :rem 182
e controls "
LG 620 POSITION 3,5:? "the delay of th :rem 182
e sounds produced"
AP 630 POSITION 7,7:? "The left paddle :rem 182
controls "
MF 640 POSITION 3,9:? "the pitch of th :rem 182
e sounds produced "
DH 650 POSITION 4,11:? "When both butt :rem 182
ons are pressed,"
CE 660 POSITION 3,13:? "the last note :rem 182
played is pulsed "
SF 665 POSITION 9,15:? "Hit any key to :rem 182
start"
FC 670 FOR T=1 TO 255:NEXT T :rem 182
LF 680 A=PEEK(764):POKE 764,255:IF A=2 :rem 182
55 THEN 680
HP 690 RETURN :rem 182

```


Questions Beginners Ask

Tom R. Halfhill, Features Editor

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

Q One of the big reasons I bought my computer was for word processing. I have word processing software and a dot-matrix printer. The printer has many print modes for printing expanded characters, condensed characters, double-strike, etc. But my word processor software was not made for this printer and doesn't have commands to switch the printer into these different modes. Is there any way I can use these modes?

A Yes, there is. Review the word processor manual carefully to see if there is a command for sending *escape codes* or *control codes* to the printer. Almost all word processors have some sort of feature like this. Usually they let you embed a nonprinting character in your text—that is, a character that appears on the screen but not in the printout. The escape code (CHR\$(27)) followed by a number, or a control code by itself, switches the printer to whatever mode you choose. You'll have to consult your printer manual to learn the code numbers for your particular printer. Look for an appendix.

If you still have no luck, there's yet another solution. Remember that printers can be computers, too. They often contain a microprocessor, RAM, and ROM, though their computing capability is not nearly as powerful as your main computer. Still, printers can often be programmed. Sending codes from your word processor is only one way of doing this. If your word processor does not have this capability, then you'll have to program the printer before you run the word processor.

First, switch on the printer and computer. Second, before loading the word processor, use BASIC to send the proper codes to the printer. Refer to your BASIC manual to find the right command. (Atari and TRS-80 computers use LPRINT; Commodores require you to open a file to the printer and use PRINT#. For example, from a

VIC or 64, you could type:

```
OPEN 4,4 : PRINT#4, CHR$(27) + CHR$(7)
```

and this would ring the printer's bell, if it has one.) Next, without turning off the printer, load the word processor. As long as the printer stays on, it should remain in the mode to which you set it. The only drawback of this method is that you cannot switch print modes within a document.

Q I use a cassette tape recorder to store programs on my computer. How safe is it to reuse tapes which have old programs on them? Can I just record over the old programs, or should I erase the tape first?

A We've re-recorded cassette tapes many times with no problems at all. Once with an Atari we even carried this practice to the extreme. It was a charting program that called for weekly updates to keep track of money market interest rates. Each Friday, at the end of the business week, the program was loaded from tape, the figures updated, and the new chart recorded over the old. By year's end, the program had been recorded over itself 52 times before the tape was retired and a new one started for the next year. Not once were there any saving or loading problems. What's more, the tape was the least expensive C-30 cassette sold by Radio Shack. However, this might be stretching things. Maybe we were just lucky.

Nevertheless, this shows that it's quite possible to re-record tapes several times without much risk. Of course, you should always keep a backup in case one recording proves faulty.

If you want to be extra careful, you can erase the tape first. The best way is to use a magnetic bulk tape eraser, available at Radio Shack and other electronic stores. Bulk erasers are electromagnetic devices which wipe a whole tape (or diskette) clean in a matter of seconds. Good erasers clean the tape more thoroughly than the recorder itself can because they generate a much stronger magnetic field, reducing background noise to a minimum. But if you use a bulk eraser, keep it far, far away from your good tapes or disks—you could carelessly destroy an entire software or music library in less time than it would take to hurl the eraser out the window. ©

How To Type COMPUTE!'s Programs

Many of the programs which are listed in COMPUTE! contain special control characters (cursor control, color keys, inverse video, etc.). To make it easy to tell exactly what to type when entering one of these programs into your computer, we have established the following listing conventions. There is a separate key for each computer. Refer to the appropriate tables when you come across an unusual symbol in a program listing. If you are unsure how to actually enter a control character, consult your computer's manuals.

Atari 400/800

Characters in inverse video will appear like: **██████████████**. Enter these characters with the Atari logo key, (▲).

When you see	Type	See
{CLEAR}	ESC SHIFT <	⌘ Clear Screen
{UP}	ESC CTRL -	↑ Cursor Up
{DOWN}	ESC CTRL =	↓ Cursor Down
{LEFT}	ESC CTRL +	← Cursor Left
{RIGHT}	ESC CTRL #	→ Cursor Right
{BACK S}	ESC DELETE	⌫ Backspace
{DELETE}	ESC CTRL DELETE	⌘ Delete character
{INSERT}	ESC CTRL INSERT	⌘ Insert character
{DEL LINE}	ESC SHIFT DELETE	⌘ Delete line
{INS LINE}	ESC SHIFT INSERT	⌘ Insert line
{TAB}	ESC TAB	⌘ TAB key
{CLR TAB}	ESC CTRL TAB	⌘ Clear tab
{SET TAB}	ESC SHIFT TAB	⌘ Set tab stop
{BELL}	ESC CTRL 2	⌘ Ring buzzer
{ESC}	ESC ESC	⌘ ESCape key

Graphics characters, such as CTRL-T, the ball character ● will appear as the "normal" letter enclosed in braces, e.g. {T}.

A series of identical control characters, such as 10 spaces, three cursor-lefts, or 20 CTRL-R's, will appear as {10 SPACES}, {3 LEFT}, {20 R}, etc. If the character in braces is in inverse video, that character or characters should be entered with the Atari logo key. For example {▲} means to enter a reverse-field heart with CTRL-comma, {5▲} means to enter five inverse-video CTRL-U's.

Commodore PET/CBM/VIC/64

Generally, any PET/CBM/VIC/64 program listings will contain words within braces which spell out any special characters: {DOWN} would mean to press the cursor down key. {5 SPACES} would mean to press the space bar five times.

To indicate that a key should be *shifted* (hold down the SHIFT key while pressing the other key), the key would be underlined in our listings. For example, S would mean to type the S key while holding the shift key. If you find an underlined key enclosed in braces (e.g., {10 N}), you should type the key as many times as indicated (in our example, you would enter ten shifted N's). Some graphics characters are inaccessible from the keyboard on CBM Business models (32N, 8032).

For the VIC and 64, if a key is enclosed in special brackets, [>], you should hold down the *Commodore key* while pressing the key inside the special brackets. (The Commodore key is the key in the lower left corner of the keyboard.) Again, if the key is preceded by a number, you should press the key as many times as indicated.

Rarely, you'll see in a Commodore 64 program a solitary letter of the alphabet enclosed in braces. These characters can be entered by holding down the CTRL key while typing the letter in the braces. For example, {A} would indicate that you should press CTRL-A.

About the *quote mode*: you know that you can move the cursor around the screen with the CRSR keys. Sometimes a programmer will want to move the cursor under program control. That's why you see all the {LEFT}'s, {HOME}'s, and {BLU}'s in our programs. The only way the computer

can tell the difference between direct and programmed cursor control is the quote mode.

Once you press the quote (the double quote, SHIFT-2), you are in the quote mode. If you type something and then try to change it by moving the cursor left, you'll only get a bunch of reverse-video lines. These are the symbols for cursor left. The only editing key that isn't programmable is the DEL key; you can still use DEL to back up and edit the line. Once you type another quote, you are out of quote mode.

You also go into quote mode when you INSerT spaces into a line. In any case, the easiest way to get out of quote mode is to just press RETURN. You'll then be out of quote mode and you can cursor up to the mistyped line and fix it.

Use the following tables when entering special characters:

VIC And 64

When You Read:	Press:	See:	When You Read:	Press:	See:
{CLR}	SHIFT CLR/HOME		{GRN}	CTRL 6	
{HOME}	CLR/HOME		{BLU}	CTRL 7	
{UP}	SHIFT ↑ CRSR		{YEL}	CTRL 8	
{DOWN}	↓ CRSR		{F1}	F1	
{LEFT}	SHIFT ← CRSR		{F2}	F2	
{RIGHT}	→ CRSR		{F3}	F3	
{RVS}	CTRL 9		{F4}	F4	
{OFF}	CTRL 0		{F5}	F5	
{BLK}	CTRL 1		{F6}	F6	
{WHT}	CTRL 2		{F7}	F7	
{RED}	CTRL 3		{F8}	F8	
{CYN}	CTRL 4				
{PUR}	CTRL 5				

All Commodore Machines

Clear Screen {CLR}	Cursor Left {LEFT}
Home Cursor {HOME}	Insert Character {INST}
Cursor Up {UP}	Delete Character {DEL}
Cursor Down {DOWN}	Reverse Field On {RVS}
Cursor Right {RIGHT}	Reverse Field Off {OFF}

Apple II / Apple II Plus

All programs are in Applesoft BASIC, unless otherwise stated. Control characters are printed as the "normal" character enclosed in braces, such as {D} for CTRL-D. Hold down CTRL while pressing the control key. You will not see the special character on the screen.

Texas Instruments 99/4

The only special characters used are in PRINT statements to indicate where two or more spaces should be left between words. For example, ENERGY {10 SPACES} MANAGEMENT means that ten spaces should be left between the words ENERGY and MANAGEMENT. Do not type in the braces or the words 10 SPACES. Enter all programs with the ALPHA LOCK on (in the down position). Release the ALPHA LOCK to enter lowercase text.

A Beginner's Guide To Typing In Programs

What Is A Program?

A computer cannot perform any task by itself. Like a car without gas, a computer has *potential*, but without a program, it isn't going anywhere. Most of the programs published in COMPUTE! are written in a computer language called BASIC. BASIC is easy to learn and is built into most computers (on some computers, you have to purchase an optional BASIC cartridge).

BASIC Programs

Each month, COMPUTE! publishes programs for many machines. To start out, type in only programs written for your machine, e.g., "TI Version" if you have a TI-99/4. Later, when you gain experience with your computer's BASIC, you can try typing in and converting certain programs from one computer to yours.

Computers can be picky. Unlike the English language, which is full of ambiguities, BASIC usually has only one "right way" of stating something. Every letter, character, or number is significant. A common mistake is substituting a letter such as O for the numeral 0, a lowercase l for the numeral 1, or an uppercase B for the numeral 8. Also, you must enter all punctuation such as colons and commas just as they appear in the magazine. Spacing can be important. To be safe, type in the listings *exactly* as they appear.

Braces And Special Characters

The exception to this typing rule is when you see the braces, such as DOWN}. Anything within a set of braces is a special character or characters that cannot easily be listed in a printer. When you come across such a special statement, refer to the appropriate key for your computer. For example, if you have an Atari, refer to the "Atari" section in "How To Type COMPUTE!'s Programs."

About DATA Statements

Some programs contain a section or sections of DATA statements. These lines provide information needed by the program. Some DATA statements contain actual programs (called machine language); others contain graphics codes. These lines are especially sensitive to errors.

If a single number in any one DATA statement is mistyped, your machine could "lock up," or "crash." The keyboard, break key, and RESET (or STOP) keys may all seem "dead," and the screen

may go blank. Don't panic – no damage is done. To regain control, you have to turn off your computer, then turn it back on. This will erase whatever program was in memory, so always SAVE a copy of your program before you RUN it. If your computer crashes, you can LOAD the program and look for your mistake.

Sometimes a mistyped DATA statement will cause an error message when the program is RUN. The error message may refer to the program line that READs the data. *The error is still in the DATA statements, though.*

Get To Know Your Machine

You should familiarize yourself with your computer before attempting to type in a program. Learn the statements you use to store and retrieve programs from tape or disk. You'll want to save a copy of your program, so that you won't have to type it in every time you want to use it. Learn to use your machine's editing functions. How do you change a line if you made a mistake? You can always retype the line, but you at least need to know how to backspace. Do you know how to enter inverse video, lowercase, and control characters? It's all explained in your computer's manuals.

A Quick Review

1. Type in the program a line at a time, in order. Press RETURN or ENTER at the end of each line. Use backspace or the back arrow to correct mistakes.
2. Check the line you've typed against the line in the magazine. You can check the entire program again if you get an error when you RUN the program.
3. Make sure you've entered statements in braces as the appropriate control key (see "How To Type COMPUTE!'s Programs" elsewhere in the magazine).

We regret that we are no longer able to respond to individual inquiries about programs, products, or services appearing in COMPUTE! due to increasing publication activity. On those infrequent occasions when a published program contains a typo, the correction will appear on the CAPUTE! page, usually within eight weeks. If you have specific questions about items or programs which you've seen in COMPUTE!, please send them to Readers' Feedback, P.O. Box 5406, Greensboro, NC 27403.

C

MLX Machine Language Entry Program For Commodore 64

Charles Brannon, Program Editor

MLX is a labor-saving utility that allows almost fail-safe entry of machine language programs published in COMPUTE!. You need to know nothing about machine language to use MLX—it was designed for everyone. MLX was conceived and written by Program Editor Charles Brannon. Important: MLX is required to type in the 64 version of "Trident" in this issue.

MLX is a new way to enter long machine language (ML) programs with a minimum of fuss. MLX lets you enter the numbers from a special list that looks similar to BASIC DATA statements. It checks your typing on a line-by-line basis. It won't let you enter illegal characters when you should be typing numbers. It won't let you enter numbers greater than 255 (forbidden in ML). It won't let you enter the wrong numbers on the wrong line. In addition, MLX creates a ready-to-use tape or disk file. You can then use the LOAD command to read the program into the computer, as with any program:

```
LOAD "filename",1,1 (for tape)
LOAD "filename",8,1 (for disk)
```

To start the program, you enter a SYS command that transfers control from BASIC to machine language. The starting SYS number appears in the article.

Using MLX

Type in and save MLX for your 64 (you'll want to use it in the future). When you're ready to type in an ML program, run MLX. MLX asks you for two numbers: the starting address and the ending address. These numbers are given in the article accompanying the ML program.

You'll see a prompt corresponding to the starting address. The prompt is the current line you are entering from the listing. It increases by six each time you enter a line. That's because each line has seven numbers—six actual data numbers plus a *checksum number*. The checksum verifies that you typed the previous six numbers correctly. If you enter any of the six numbers wrong, or enter the checksum wrong, the computer rings a buzzer and prompts you to reenter the line. If you enter it correctly, a bell tone sounds and you continue to the next line.

MLX accepts only numbers as input. If you make a typing error, press the INST/DEL key; the entire number is deleted. You can press it as many times as necessary back to the start of the line. If you enter three-digit numbers as listed, the computer automatically prints the comma and goes on to accept the next number. If you enter less than three digits, you can press either the comma, SPACE bar, or RETURN key

to advance to the next number. The checksum automatically appears in inverse video for emphasis.

MLX Commands

When you finish typing an ML listing (assuming you type it all in one session), you can then save the completed program on tape or disk. Follow the screen instructions. If you get any errors while saving, you probably have a bad disk, or the disk is full, or you've made a typo when entering the MLX program itself.

You don't have to enter the whole ML program in one sitting. MLX lets you enter as much as you want, save it, and then reload the file from tape or disk later. MLX recognizes these commands:

```
SHIFT-S: Save
SHIFT-L: Load
SHIFT-N: New Address
SHIFT-D: Display
```

When you enter a command, MLX jumps out of the line you've been typing, so we recommend you do it at a new prompt. Use the Save command to save what you've been working on. It will save on tape or disk as if you've finished, but the tape or disk won't work, of course, until you finish the typing. Remember what address you stop at. The next time you run MLX, answer all the prompts as you did before, then insert the disk or tape. When you get to the entry prompt, press SHIFT-L to reload the partly completed file into memory. Then use the New Address command to resume typing.

To use the New Address command, press SHIFT-N and enter the address where you previously stopped. The prompt will change, and you can then continue typing. Always enter a New Address that matches up with one of the line numbers in the special listing, or else the checksum won't work. The Display command lets you display a section of your typing. After you press SHIFT-D, enter two addresses within the line number range of the listing. You can abort the listing by pressing any key.

The special MLX commands may seem a bit confusing, but as you work with MLX, they will become valuable. For example, what if you forgot where you stopped typing? Use the Display command to scan memory from the beginning to the end of the program. When you reach the end of your typing, the lines will contain a random pattern of numbers. When you see the end of your typing, press any key to stop the listing. Use the New Address command to continue typing from the proper location.

You can use the Save and Load commands to make copies of the completed program. Use Load to reload the tape or disk, then insert a new tape or disk and use Save to make a new copy.

Be sure to save MLX; it will be used for future ML programs in COMPUTE!.

MLX: Machine Language Entry

```

100 PRINT"{CLR}{63}";CHR$(142);CHR$(8);:
    POKE53281,1:POKE53280,1 :rem 67
101 POKE 788,52:REM DISABLE RUN/STOP :rem 119
110 PRINT"{RVS}{39 SPACES}"; :rem 176
120 PRINT"{RVS}{14 SPACES}{RIGHT}{OFF}
    [*]{RVS}{RIGHT} {RIGHT}{2 SPACES}
    [*]{OFF}{*}{RVS}{RVS}
    {14 SPACES}"; :rem 250
130 PRINT"{RVS}{14 SPACES}{RIGHT} [G]
    [RIGHT] {2 RIGHT} {OFF}{RVS}{[*]
    [OFF]{*}{RVS}{14 SPACES}"; :rem 35
140 PRINT"{RVS}{41 SPACES}" :rem 120
200 PRINT"[2 DOWN]{PUR}{BLK} MACHINE LANG
    UAGE EDITOR VERSION 2.00{5 DOWN}"
    :rem 236
210 PRINT"[5]{2 UP}STARTING ADDRESS?
    {8 SPACES}{9 LEFT}"; :rem 143
215 INPUTS:F=1-F:C$=CHR$(31+119*F)
    :rem 166
220 IFS<256OR(S>40960ANDS<49152)ORS>53247
    THENGOSUB3000:GOTO210 :rem 235
225 PRINT:PRINT:PRINT :rem 180
230 PRINT"[5]{2 UP}ENDING ADDRESS?
    {8 SPACES}{9 LEFT}";:INPUTE:F=1-F:C$=
    CHR$(31+119*F) :rem 20
240 IFE<256OR(E>40960ANDE<49152)ORE>53247
    THENGOSUB3000:GOTO230 :rem 183
250 IFE<STHENPRINTCS;"{RVS}ENDING < START
    {2 SPACES}":GOSUB1000:GOTO 230
    :rem 176
260 PRINT:PRINT:PRINT :rem 179
300 PRINT"{CLR}";CHR$(14):AD=S:POKEV+21,0
    :rem 225
310 A=1:PRINTRIGHT$("0000"+MID$(STR$(AD),
    2),5);":": :rem 33
315 FORJ=ATO6 :rem 33
320 GOSUB570:IFN=-1THENJ=J+N:GOTO320
    :rem 228
390 IFN=-211THEN 710 :rem 62
400 IFN=-204THEN 790 :rem 64
410 IFN=-206THENPRINT:INPUT"{DOWN}ENTER N
    EW ADDRESS";ZZ :rem 44
415 IFN=-206THENIFZZ<SORZZ>ETHENPRINT"
    {RVS}OUT OF RANGE":GOSUB1000:GOTO410
    :rem 225
417 IFN=-206THENAD=ZZ:PRINT:GOTO310
    :rem 238
420 IF N<>~196 THEN 480 :rem 133
430 PRINT:INPUT"DISPLAY:FROM";F:PRINT,"TO
    ";:INPUTT :rem 234
440 IFF<SORF>EORT<SORT>ETHENPRINT"AT LEAS
    T";S;"{LEFT}, NOT MORE THAN";E:GOTO43
    0 :rem 159
450 FORI=FTOTSTEP6:PRINT:PRINTRIGHT$("000
    0"+MID$(STR$(I),2),5);":": :rem 30
451 FORK=0TO5:N=PEEK(I+K):PRINTRIGHT$("00
    "+MID$(STR$(N),2),3);":": :rem 66
460 GETA$:IFA$>"THENPRINT:PRINT:GOTO310
    :rem 25
470 NEXTK:PRINTCHR$(20);:NEXTI:PRINT:PRIN
    T:GOTO310 :rem 50
480 IFN<0 THEN PRINT:GOTO310 :rem 168
490 A(J)=N:NEXTJ :rem 199
500 CKSUM=AD-INT(AD/256)*256:FORI=1TO6:CK
    SUM=(CKSUM+A(I))AND255:NEXT :rem 200
510 PRINTCHR$(18);:GOSUB570:PRINTCHR$(146
    ); :rem 94
511 IFN=-1THENA=6:GOTO315 :rem 254
515 PRINTCHR$(20):IFN=CKSUMTHEN530
    :rem 122

```

```

520 PRINT:PRINT"LINE ENTERED WRONG : RE-E
    NTER":PRINT:GOSUB1000:GOTO310:rem 176
530 GOSUB2000 :rem 218
540 FORI=1TO6:POKEAD+I-1,A(I):NEXT:POKE54
    272,0:POKE54273,0 :rem 227
550 AD=AD+6:IF AD<E THEN 310 :rem 212
560 GOTO 710 :rem 108
570 N=0:Z=0 :rem 88
580 PRINT"[*]"; :rem 81
581 GETA$:IFA$="THEN581 :rem 95
582 AV=- (A$="M")-2*(A$="")-3*(A$=".")-4*
    (A$="J")-5*(A$="K")-6*(A$="L"):rem 41
583 AV=AV-7*(A$="U")-8*(A$="I")-9*(A$="O"
    ):IFA$="H"THENA$="0" :rem 134
584 IFAV=0THENA$=CHR$(48+AV) :rem 134
585 PRINTCHR$(20);:A=ASC(A$):IFA=13ORA=44
    ORA=32THEN670 :rem 229
590 IFA>128THENN=-A:RETURN :rem 137
600 IFA<20 THEN 630 :rem 10
610 GOSUB690:IFI=1ANDT=44THENN=-1:PRINT"
    {OFF}{LEFT} {LEFT}";:GOTO690 :rem 62
620 GOTO570 :rem 109
630 IFA<48ORA>57THEN580 :rem 105
640 PRINTA$;:N=N*10+A-48 :rem 106
650 IFN>255 THEN A=20:GOSUB1000:GOTO600
    :rem 229
660 Z=Z+1:IFZ<3THEN580 :rem 71
670 IFZ=0THENGOSUB1000:GOTO570 :rem 114
680 PRINT",":RETURN :rem 240
690 S$=PEEK(209)+256*PEEK(210)+PEEK(211)
    :rem 149
691 FORI=1TO3:T=PEEK(S%-I) :rem 67
695 IFT<>44ANDT<>58THENPOKES%-I,32:NEXT
    :rem 205
700 PRINTLEFT$("{3 LEFT}",I-1);:RETURN
    :rem 7
710 PRINT"{CLR}{RVS}*** SAVE ***{3 DOWN}"
    :rem 236
715 PRINT"{2 DOWN}(PRESS {RVS}RETURN{OFF}
    ALONE TO CANCEL SAVE){DOWN}";:rem 106
720 F$="":INPUT"{DOWN} FILENAME";F$:IFF$=
    ""THENPRINT:PRINT:GOTO310 :rem 71
730 PRINT:PRINT"{2 DOWN}{RVS}T{OFF}APE OR
    {RVS}D{OFF}ISK: (T/D)" :rem 228
740 GETA$:IFA$<"T"ANDA$<"D"THEN740
    :rem 36
750 DV=1-7*(A$="D"):IFDV=8THENF$="@0:"+F$
    :rem 222
760 T$=F$:ZK=PEEK(53)+256*PEEK(54)-LEN(T$
    ):POKE782,ZK/256 :rem 3
762 POKE781,ZK-PEEK(782)*256:POKE780,LEN(
    T$):SYS65469 :rem 109
763 POKE780,1:POKE781,DV:POKE782,1:SYS654
    66 :rem 69
765 K=S+1:POKE254,K/256:POKE253,K-PEEK(25
    4)*256:POKE780,253 :rem 109
766 K=E+1:POKE782,K/256:POKE781,K-PEEK(78
    2)*256:SYS65496 :rem 235
770 IF(PEEK(783)AND1)OR(ST AND191)THEN780
    :rem 111
775 PRINT"{DOWN}DONE.{DOWN}":GOTO310
    :rem 113
780 PRINT"{DOWN}ERROR ON SAVE.{2 SPACES}T
    RY AGAIN.":IFDV=1THEN720 :rem 171
781 OPEN15,8,15:INPUT#15,E1$,E2$:PRINTE1$
    ;E2$:CLOSE15:GOTO720 :rem 103
790 PRINT"{CLR}{RVS}*** LOAD ***{2 DOWN}"
    :rem 212
795 PRINT"{2 DOWN}(PRESS {RVS}RETURN{OFF}
    ALONE TO CANCEL LOAD)" :rem 82
800 F$="":INPUT"{2 DOWN} FILENAME";F$:IFF
    $=""THENPRINT:GOTO310 :rem 144

```

```

810 PRINT:PRINT"{2 DOWN}{RVS}T{OFF}APE OR
      {RVS}D{OFF}ISK: (T/D)" :rem 227
820 GETA$:IFA$<>"T"ANDAS$<>"D"THEN820
      :rem 34
830 DV=1-7*(A$="D"):IFDV=8THENF$="0":"+F$
      :rem 157
840 T$=F$:ZK=PEEK(53)+256*PEEK(54)-LEN(T$
      ):POKE782,ZK/256 :rem 2
841 POKE781,ZK-PEEK(782)*256:POKE780,LEN(
      T$):SYS65469 :rem 107
845 POKE780,1:POKE781,DV:POKE782,1:SYS654
      66 :rem 70
850 POKE780,0:SYS65493 :rem 11
860 IF(PEEK(783)AND1)OR(ST AND191)THEN870
      :rem 111
865 PRINT"{DOWN}DONE.":GOTO310 :rem 96
870 PRINT"{DOWN}ERROR ON LOAD.{2 SPACES}T
      RY AGAIN.{DOWN}":IFDV=1THEN800
      :rem 172

```

```

880 OPEN15,8,15:INPUT#15,E1$,E2$:PRINTE1$
      ;E2$:CLOSE15:GOTO800 :rem 102
1000 REM BUZZER :rem 135
1001 POKE54296,15:POKE54277,45:POKE54278,
      165 :rem 207
1002 POKE54276,33:POKE 54273,6:POKE54272,
      5 :rem 42
1003 FORT=1TO200:NEXT:POKE54276,32:POKE54
      273,0:POKE54272;0:RETURN :rem 202
2000 REM BELL SOUND :rem 78
2001 POKE54296,15:POKE54277,0:POKE54278,2
      47 :rem 152
2002 POKE 54276,17:POKE54273,40:POKE54272
      ,0 :rem 86
2003 FORT=1TO100:NEXT:POKE54276,16:RETURN
      :rem 57
3000 PRINTC$;"{RVS}NOT ZERO PAGE OR ROM":
      GOTO1000 :rem 89

```

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CAPUTE!

Modifications Or Corrections To Previous Articles

Machine Language: Factors

The commands to prepare the computer to enter Program 2, the VIC and 64 version of the machine language factoring routine from the January "Machine Language" column (p. 178), should read:

```
POKE 4608,0:POKE 44,18:NEW
```

Commodore Files For Beginners, Part 3

On page 193 of the January issue, lines 340, 350, and 360 should have a semicolon (;) following the CHR\$(13).

Disk Explorer For Commodore

This program from the December 1983 issue (p. 298) requires the following corrections, supplied by reader Duane Martin:

```
160 INPUT A$: IF LEFT$(A$,1)="$" THEN 190
1100 GETC$:IFC$=""THEN1040
```

Atari MLX

Line 190 of this machine language editor from the December issue (p. 216) creates a count of data blocks for use in the boot process. However, the line as written may cause problems due to rounding of the block count value when partial blocks are involved. Don Klich suggests the following change to avoid this problem:

```
190 BEG=BEG-24:BUFFER$=CHR$(0):BUFFER$(2)
      =CHR$(INT((FIN-BEG+127)/128))
```

This should not be a factor in getting the "Chopperoids" program to operate correctly.

See the February issue for the corrections to Chopperoids.

Comparing Commodore Machine Language Programs

Readers attempting to run this utility from the December 1983 issue (p. 340) on the Commodore 64 should note that lines 240 and 350 contain PET 4.0 BASIC disk status variables which are not supported by the 64's BASIC. In addition to the changes noted in the article, the following are also required:

```
225 OPEN 15,8,15
240 INPUT#15,DS,DS$,D1,D2:IF DS<>0 THEN
      PRINT DS$:STOP
350 INPUT#15,DS,DS$,D1,D2:IF DS<>0 THEN
      PRINT DS$:STOP
```

64 Clock

Overseas readers may be interested to learn that the built-in time-of-day clock in the 64's CIA chip can be adjusted for their 50 Hz household current with a simple POKE. C. J. Ayers of Guildford, Surrey, England, notes that adding the line:

```
75 POKE 56334,129
```

to the program from the December issue (p. 344) will cause it to keep proper time on European 64s.

Termulator For The 64

Line 170 of Program 2 of this article from the November 1983 issue (p. 222) should read:

```
170 DATA 133, 106, 32, 189, 255, 169, 192
```

The value 3515 in line 120 will need to be changed to 3485 to reflect the change to the DATA. With this correction, Program 2 will create a tape copy of the data loaded by Program 1 without a filename. To reload "Termulator" from the tape created by Program 2, type:

```
LOAD "",1,1
```

Thanks to Stan Lefkowitz for pointing out this correction.

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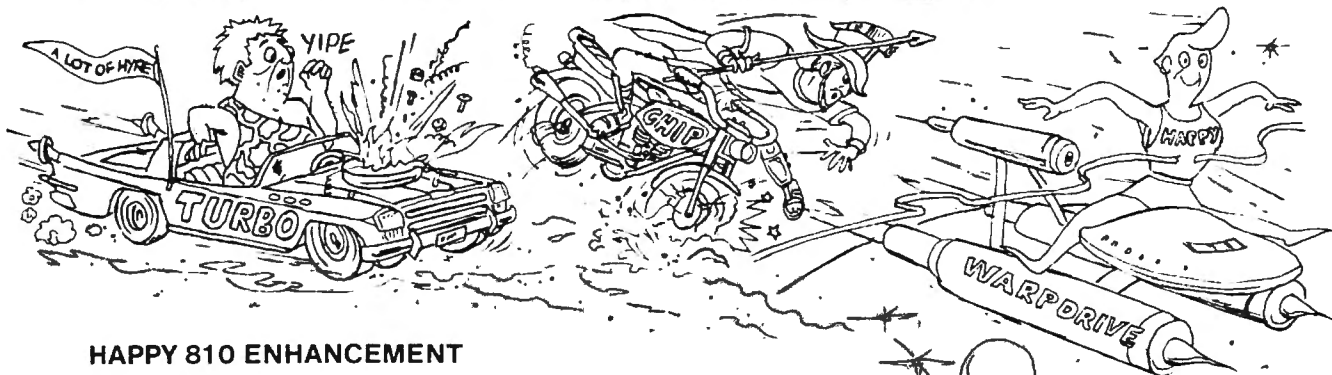
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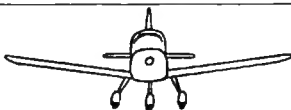
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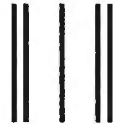
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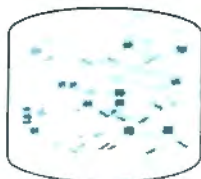
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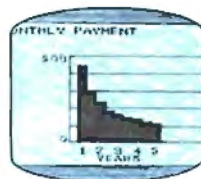
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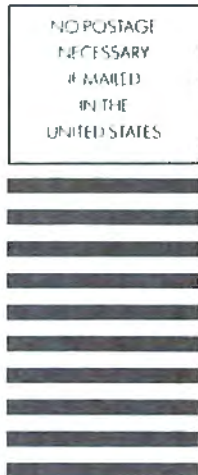
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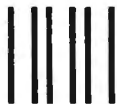
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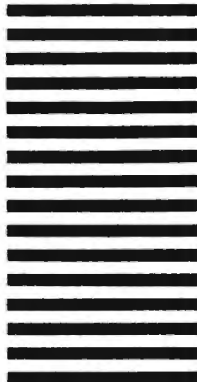
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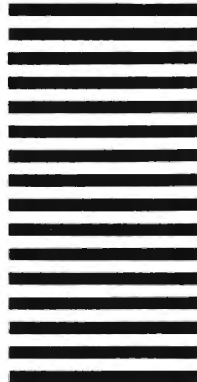
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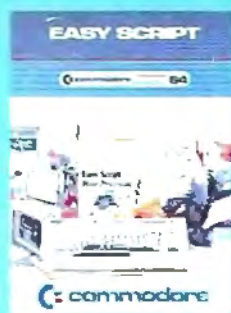
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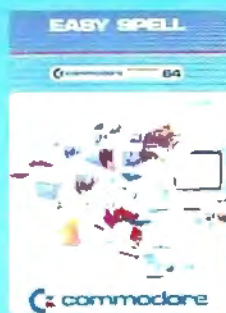
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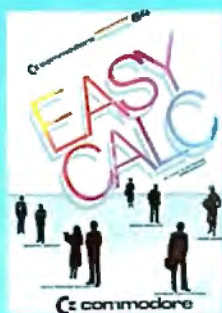
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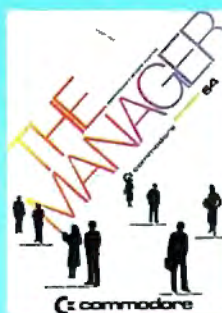
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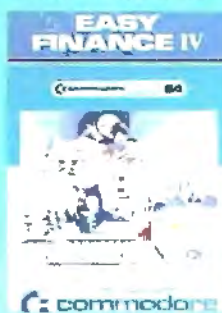
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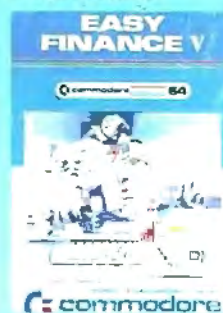
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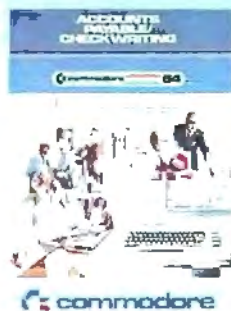
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16 capital investment functions. Bar graphs.



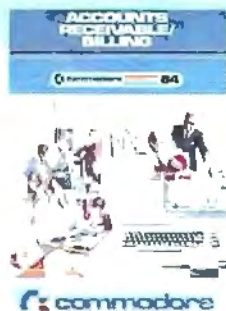
**Easy Finance IV—
Business Management**
21 business management features. Bar graphs.



**Easy Finance V—
Statistics and Forecasting**
Assess present/future sales trends with 9 statistics and forecasting functions.



**Accounts Payable/
Checkwriting**
11 functions. Automatic billing. 50 vendors/disk.



**Accounts Receivable/
Billing**
11 billing functions. Printed statements.



General Ledger
8 general ledger options. Custom income statement. Trial balances, reports.



Inventory Management
1000 inventory items. Full reports.



Payroll
24 different payroll functions. Integrated with G/L system.

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