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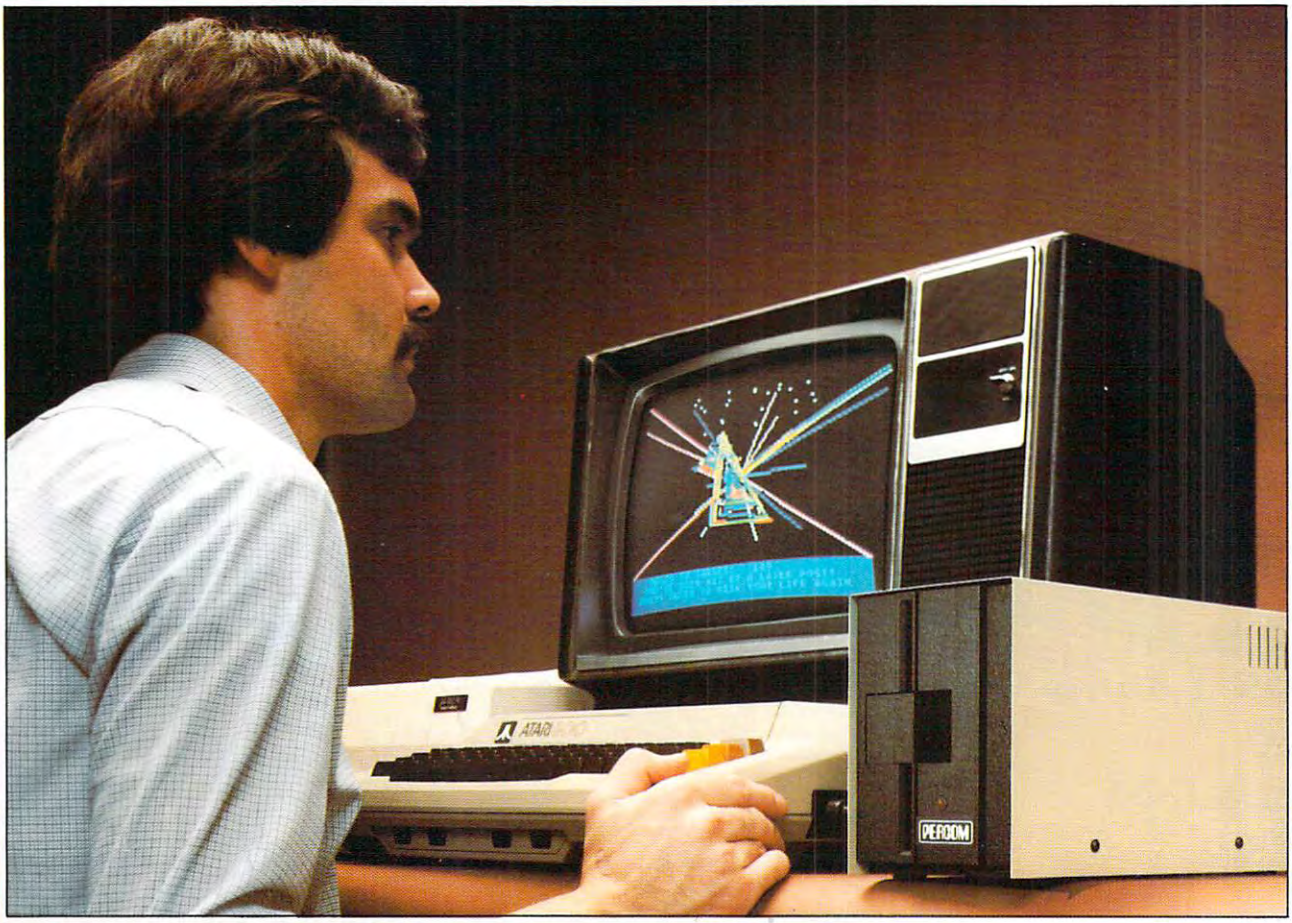

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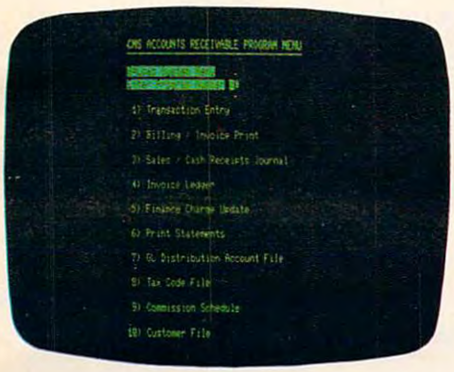

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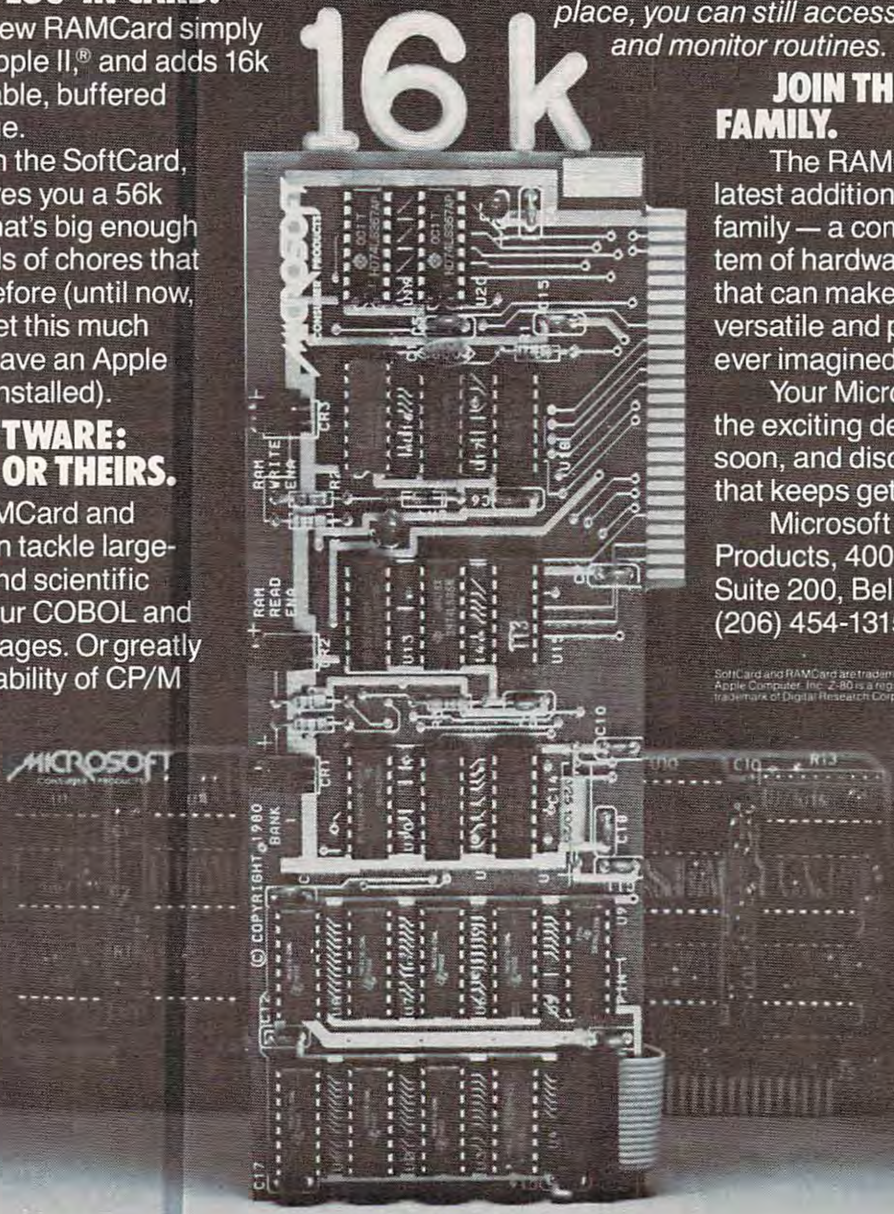

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The Editor's notes...

A Brief Overview Of The Chicago Consumer Electronics Show And National Computer Conference In Houston

Robert Lock, Publisher/Editor and Tom Halfhill, Features Editor

I don't know why they ended up holding these two significant shows on overlapping days, but it made for some extremely hectic traveling. Tom Halfhill, our new Features Editor, will describe the shows and new products in much more detail next issue (both shows are still in progress), but we thought you'd enjoy a tantalizing preview.

Commodore's Third Generation

In this partial list of features you'll be able to discern the impact of the Commodore introductions. Tom will fill in the blanks next month:

	BX256	B128	"P" Series	64	MAX
Integral Monitor	80X25	80X25	40X25	40X25	40X25
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Dual Disks optional cassette	yes	yes	optional	optional	
Standard RAM	256K	128K	128K	64K	unknown
Colors	N/A	N/A	16	16	unknown
Graphics Resolution	N/A	N/A	320X200	320X200	unknown
CP/M Compatible	yes	optional	optional	optional	N/A
Interfaces: IEEE-488	yes	yes	yes	accepts VIC peripherals CBM peripherals optional	N/A
RS-232	Yes	Yes	Yes	unknown	N/A
Standard Language	BASIC 4.0	BASIC 4.0	BASIC 4.0	A BASIC Version Described As Compatible In Most Ways With 4.0	BASIC Cartridge Available
Planned Retail:	$2995	$1695	$995	$595	$179.95
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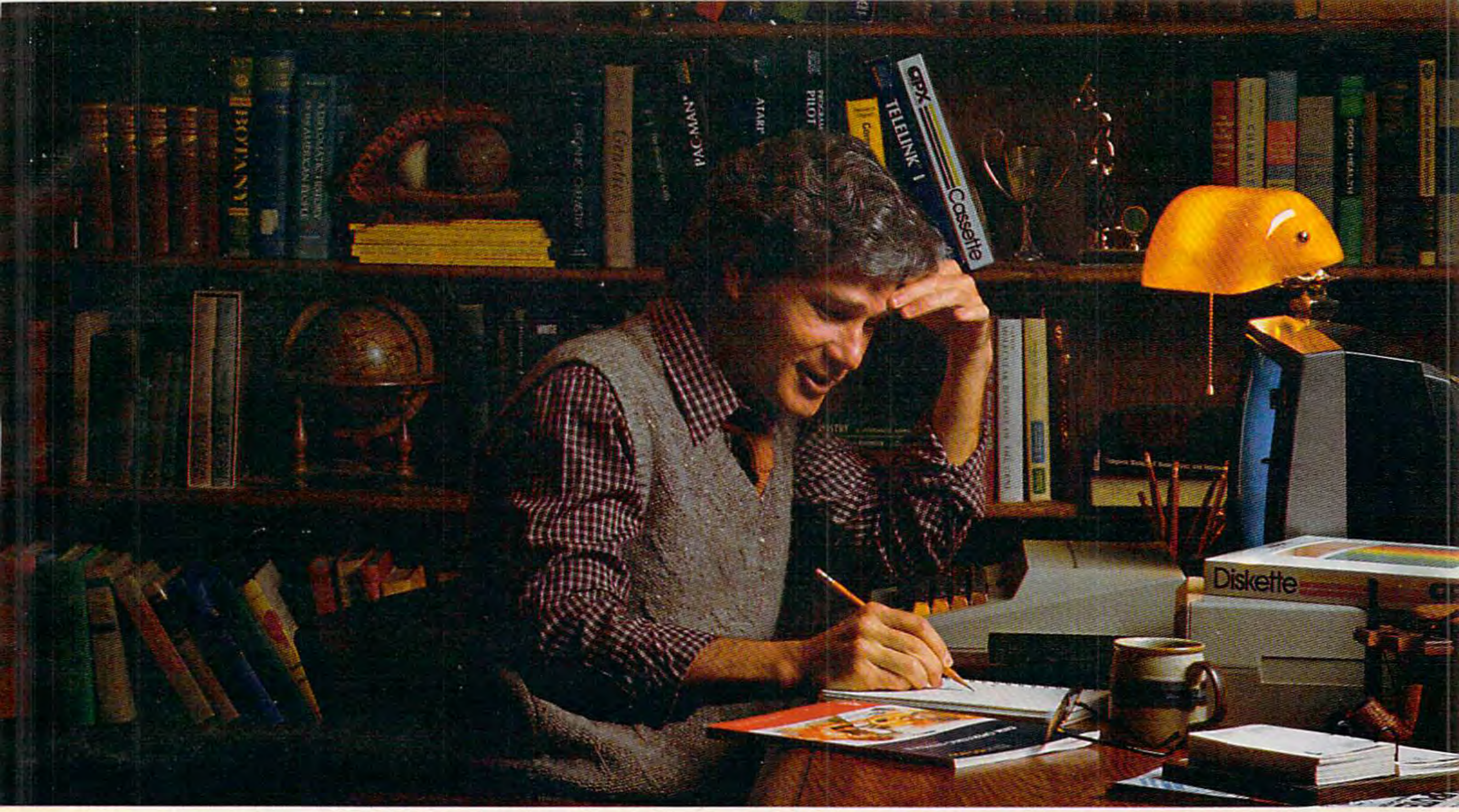

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ATARI Assembler Editor—An excellent tool to assist the assembler-programmer in creating, editing and debugging assembly programs.

PILOT—PILOT is an exceptional learning language, with built-in "turtle" graphics to let you create spectacular designs and pictures with very short programs. Simple one or two-letter commands can allow you to create a dialogue with the computer. And a single "match" command can perform complex text evaluation and pattern-matching instantly.

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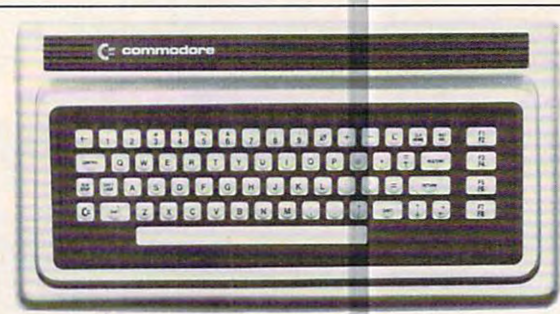

Commodore "MAX" Machine

Third Generation
Commodore P128 Series Microcomputer

Third Generation
Commodore "B" Series
Microcomputer

Commodore 64

Other New Computers: Sinclair Introduces A Color Computer

The Sinclair Spectrum was introduced in the US at the CES. It's roughly the same size as the ZX-81, but includes a partial stroke keyboard rather than the familiar membrane keyboard. The unit features extended Sinclair BASIC, 16 colors, 16K RAM standard, and a suggested retail in the $200 price range. More next issue.

Epson, the well-known printer manufacturer, introduced a 16K portable computer with a suggested retail of $795. The computer is truly portable, deriving power from four NiCad batteries. Built-in (standard) features include a LCD (Liquid Crystal Display) screen with 20 character by four line display, and a 24 column dot matrix printer. The entire unit measures roughly 11 inches by 8.5 inches by 2 inches, and weighs 3 pounds, 13 ounces. The unit also features a built-in RS-232C communications port with full/half duplex selection and 110 to 4800 baud rate. A standard microcassette unit is optional.

Epson HX-20

Other Random Bits In The "More Later" Category...

Atari, Apple and Commodore were showing off new software. Atari announced a price reduction on the 400's suggested list to $349.95. Microsoft reports increased and substantial support for MS-DOS. TIMEX was actively promoting the $99.00 TIMEX/Sinclair computer.

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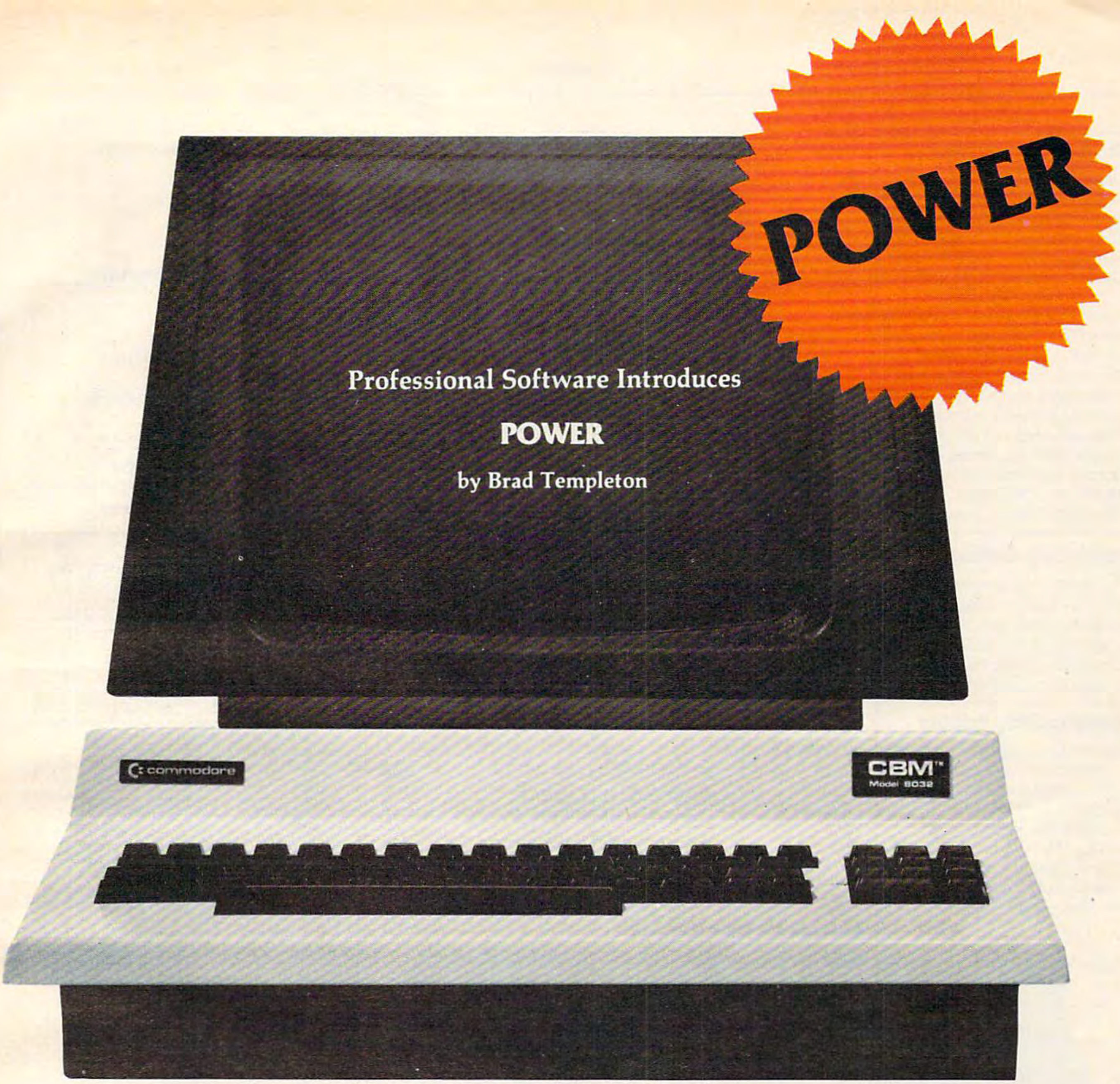

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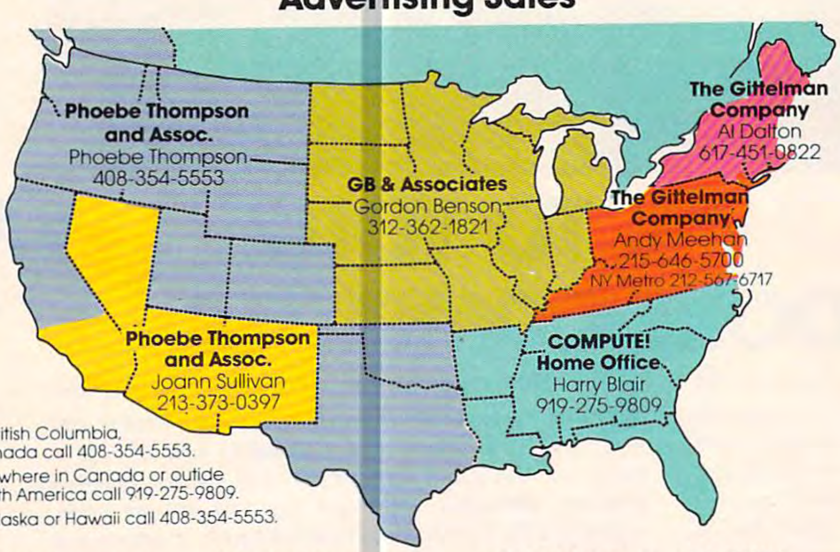

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Ask The Readers

Robert Lock, Richard Mansfield,
And Readers

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A Bigger Set Of Commands

I keep reading about this new POKE, and that new POKE, to do all sorts of wonderful things. But it seems cumbersome to me. As micros evolve, might not some scheme evolve so these memory addresses do not need to be memorized?

In other words, a much larger command set. The new commands are directly translated internally to the proper POKE, so it wouldn't require that much more memory. And it would be both easier to remember *and* more transportable.

What do your readers think? Perhaps some of them already have done such a program!

Kevin Sinclair

Language designers face a tough decision: they must balance convenience (many commands) versus the amount of ROM or RAM granted to them (such as 8K BASIC).

Fortunately, many languages can be extended, permitting you to add extra, custom commands. If your language is "soft-loaded," coming off disk or tape into RAM, you can usually "patch into" (modify) the language to force it to recognize your new commands. However, the new commands will generally have to be written in machine language and reside in RAM somewhere.

ROM-based languages are more difficult to alter. Most Microsoft BASICs (Apple, OSI, Commodore) put a fragment of the language into RAM during their start-up sequences when you turn power on. You can put a machine language "JMP" command (a "wedge") in the midst of this fragment which causes the computer to regularly "jump" to a machine language routine of your own which would check to see if you had typed "SPECIAL" or whatever instead of a normal BASIC word.

The "Universal Wedge" for disk commands, Basic Aid, and other BASIC enhancement programs use this method. Non-Microsoft BASICs, such as Atari 8K BASIC, can also be made to recognize new commands, but it is a tricky business. Watch upcoming issues of **COMPUTE!** *for an Atari Wedge routine.*

*For further information about adding "Wedges," see Bill Wilkinson's "Insight: Atari" column (***COMPUTE!***, May, 1982 #24), "Modifying Apple's Floating Point BASIC" (***COMPUTE!***, May, 1982, #24) and, for Microsoft BASIC in general, "The Wonderful Wedge" (***COMPUTE!***, April, 1981, #11).*

Atari Lockup Revisited

Several readers have responded to the issue raised by Greg Kopp in Ask the Readers, May, 1982, about the occasional "lockup" where the Atari will, mysteriously, "go away" and no longer respond to the keyboard.

Bill Wilkinson, **COMPUTE!** *columnist and one of the authors of Atari BASIC, responded that "all substantial software has bugs. If it's in ROM, the bug can't be repaired unless a new set of ROM chips are brought out. For whatever reason, Atari has never brought out a new ROM set. To be fair about it, there are bugs in the original TRS-80 which have never been fixed either."*

We might add that the new IBM computer has a bug in the division routine. Also, the several fixes which Commodore has made to its BASIC in ROM have cured the original bugs, but brought about new problems of software compatibility between versions.

BASIC To BASIC

I'm having trouble with the PET program on page 14 in Issue 23, April, 1982. I couldn't get it to work. Now that I have looked at lines 140 and 150, I'm confused. Isn't [the variable] "TI" always zero? If so...doesn't this cause line 150 just to loop? At least that's where my program gets stuck.

Guy Lillis

The program you refer to is a "fast-find" for cassettes, but is designed to work only on Commodore cassette drives (PET/CBM/VIC). Programs which use only the keyboard or screen can usually work (with some changes) on most computers using BASIC. However, techniques involving peripherals *like tape drives tend not to be very "portable" between computer brands.*

For example, the Commodore machines have a special variable called TI (for TIme*) which is an internal clock. This variable is always being updated by the computer and can, therefore, be used to time events. In your computer, TI is an ordinary variable, always zero unless you assign a value to it.*

The "fast-find" technique is so specific to the machinery involved that it even needs adaptations to work on the different models of the Commodore line. (See the following letter.)

VIC Fast-Find

I need your help with a small problem. I entered the BASIC code for the cassette tape to locate programs on fast-forward as shown on Page 14 of the April, 1982, **COMPUTE!**, and, although you claim that it "can be adapted to any Commodore

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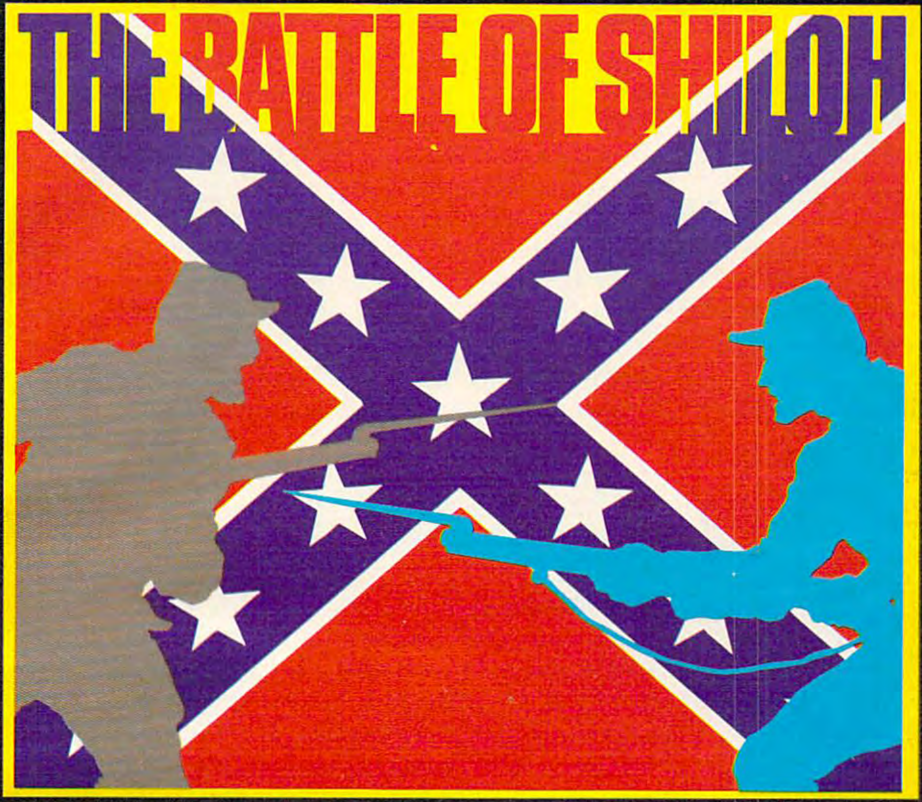

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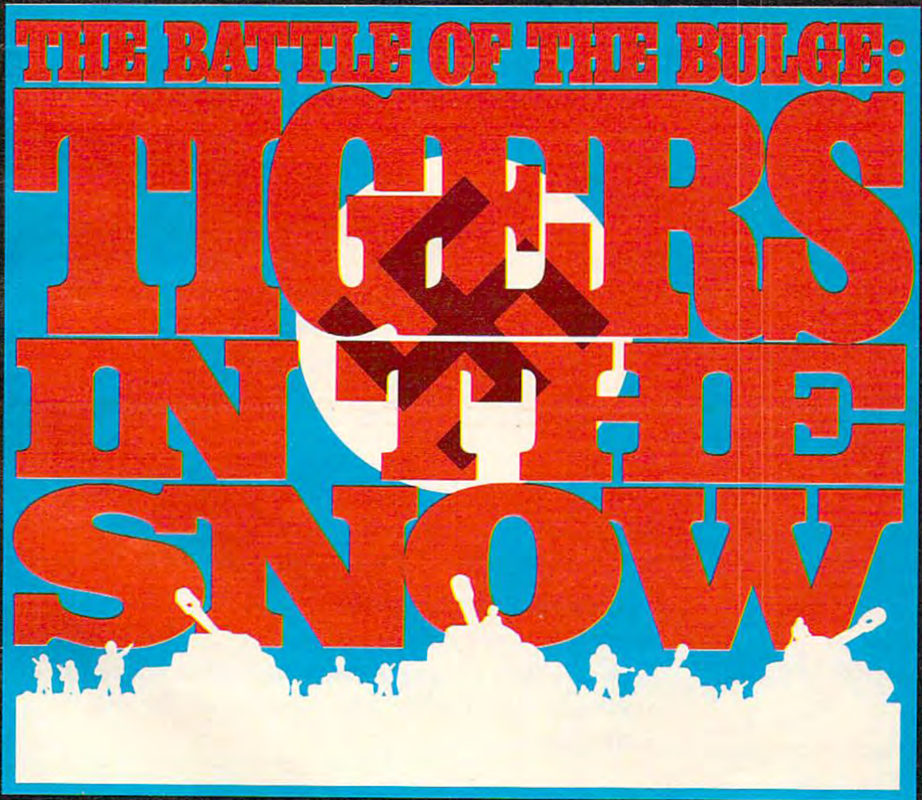

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machine," I can't get it to run on the VIC-20.

I suspect that the memory addresses in the PEEK and POKE statements for the Commodore PET are different than the VIC-20, but since I don't own the PET, I don't know how to convert these few memory addresses to the VIC-20.

Since there are only three BASIC statements that refer to memory addresses, could you inform me what the VIC-20 equivalent addresses would be.

I believe that **COMPUTE!** has a wide following among VIC-20 owners and that this data would be of interest to many readers.

William E. Bender

You're right, POKEs, PEEKs, and SYSs are the least "portable" aspect of BASIC. When you try to translate a program written for one computer model or brand, these words are sure to give you problems. The following version of tape Fast Find for VIC, by Associate Editor Harvey Herman, was originally published last fall. It makes for an efficient tape management system, but must be the first program on each tape.

```
100 REM VIC FAST FIND
110 REM
120 REM HARVEY B. HERMAN
130 REM
140 N=5:DIM A$(N):REM N IS # OF PROGRAMS ~
    ON TAPE
150 FOR I=1 TO N:READ A$(I):NEXT I
160 PRINT CHR$(147);CHR$(144);"  PROGRAM"
    ::PRINT:PRINT "NUMBER NAME":PRIN
    T
170 FOR I=1 TO N:PRINT I;"     ";A$(I):NEX
    T I:PRINT
180 INPUT "FIND NUMBER";J:PRINT
190 IF J<1 OR J>N THEN 160
200 IF J=1 THEN 330
210 REM START OF ROUTINE TO FAST FORWARD
220 REM WAIT FOR RELEASE IF NECESSARY
230 IF(PEEK(37151) AND 64)=0 THEN PRINT "
    PRESS STOP ON CASSETTE"
240 IF(PEEK(37151) AND 64)=0 THEN 240
250 PRINT "PRESS FAST FORWARD":PRINT
260 IF(PEEK(37151) AND 64)=64 THEN 260:RE
    M CHECK FOR PRESS
270 PRINT "OK":PRINT:A=TI
280 IF ABS(TI-A)<(J-1)*360 THEN 280:REM F
    AST FORWARD 6 SEC PER PROGRAM
290 POKE 37148,PEEK(37148) AND 247:REM ST
    OP MOTOR
300 PRINT "RELEASE FAST FORWARD"
310 IF(PEEK(37151) AND 64)=0 THEN 310:REM
     WAIT FOR RELEASE
320 REM DYNAMIC KEYBOARD LOAD
330 PRINT CHR$(147);CHR$(17);CHR$(17);CHR
    $(17);"LOAD ";CHR$(34);A$(J);CHR
    $(34);CHR$(19)
340 POKE 198,1:POKE 631,13:END
350 DATA PROGRAM 1,PROGRAM 2,PROGRAM 3,PR
    OGRAM 4,PROGRAM5
```

Hidden Adventure

Regarding Rudolph F. Lauer's query in the May issue: I am co-author of Fantasy Games Software's PET programs Swordquest and Escape From the Death Planet. We have both Original-ROM and Upgrade-ROM versions of these games.

Except for a few early orders, our cassettes include both versions. Users who have upgraded their PETs should try loading from the (unlabeled) flip-side of the cassette. If that side proves to be blank, they may send their cassettes to me with a stamped reply envelope, and I will record the Upgrade version for them at no charge.

J. L. Pietenpol

J. L. Pietenpol
5711 Trinity Rd.
Raleigh, NC 27607

GETting On Atari

I'm a new Atari owner and one thing bothers me much about Atari BASIC. In Apple BASIC and in PET/CBM BASIC, one keyword is GET, in terms of strings. Atari's keyword GET has a different meaning. How can I input characters without pressing return? It would be much easier to make advanced games without just using the joysticks.

Howie Fishman

To use Atari's GET command, you must first open a file to the keyboard, e.g. OPEN#1,4,0,"K:". You can then GET a keystroke with GET#1,A. A (or whatever variable you use) will contain the ASCII value of the key typed (A=69 for "E",97 FOR"a",etc.). GET will always wait for a keystroke.

You can use location 764 to see if a key has been pressed. It normally holds 255, but when a key is pressed, it will contain a "keyboard code" (not ASCII). POKEing 764 with a 255 will reset the register.

```
100 IF PEEK(764)=255 THEN 100  } Waits for
110 POKE 764,255               } a key
 10 OPEN #1,4,0,"K"
  .
  .
  .
100 GET#1,A            Gets a key
```

VIC Expansion Software

Why don't the manufacturers of software for the VIC-20 offer more sophisticated software requiring memory expansion? They do for all the other computers.

Scott Barber

The VIC is a new machine and memory expansion is even newer. Its library of software is building quickly, however, as the many ads in **COMPUTE!** *illustrate. For predictions and information about VIC software, see Jim Butterfield's "Whither VIC?" in this issue.*

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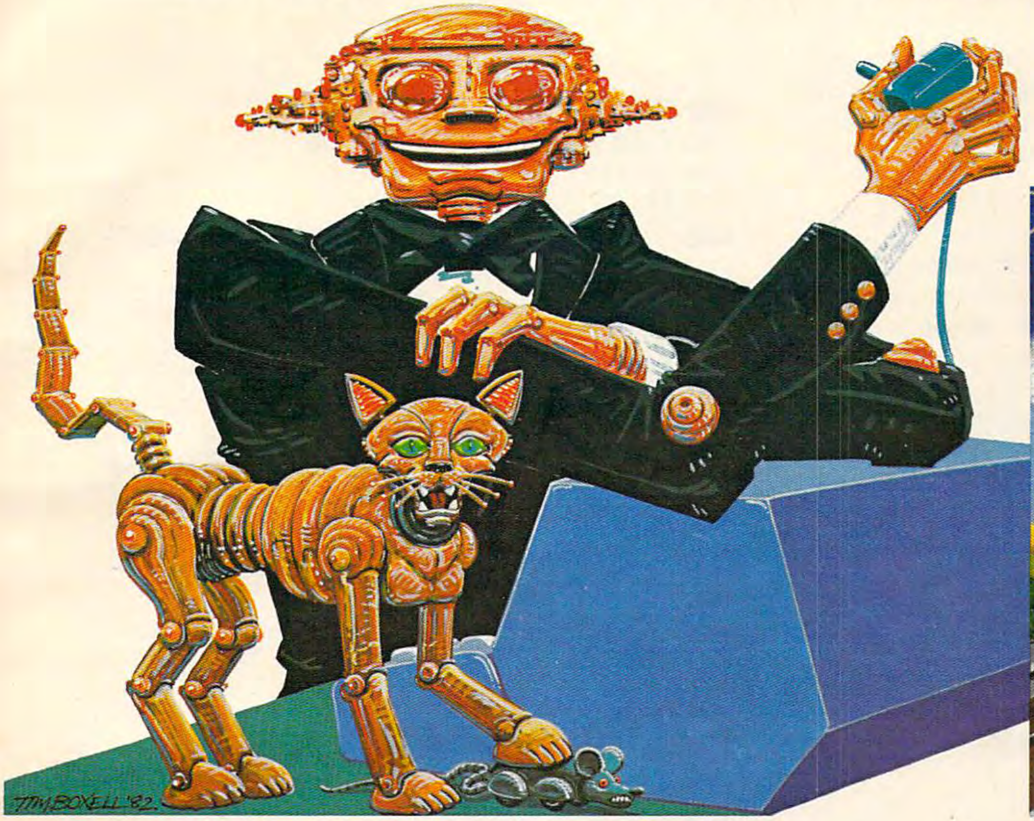

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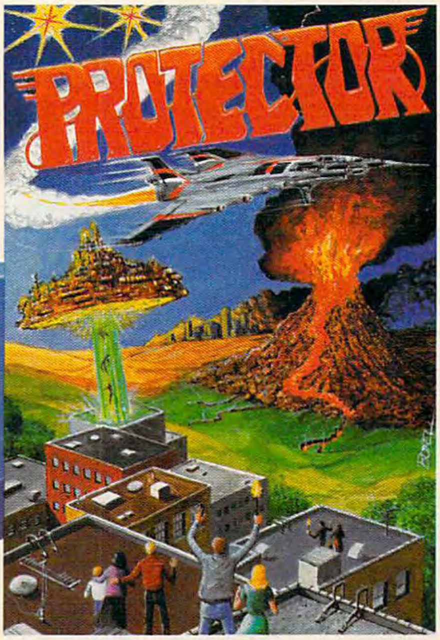

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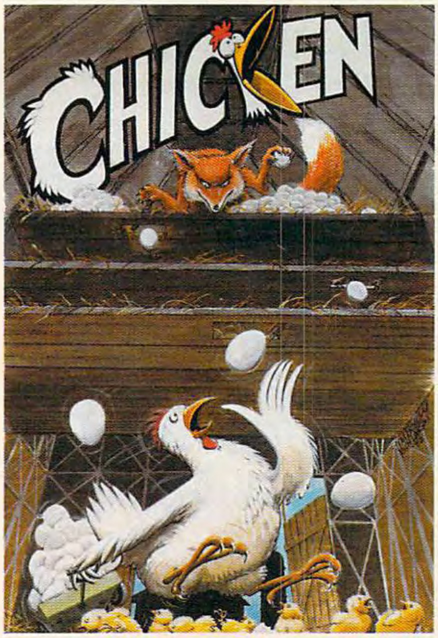
CHICKEN.



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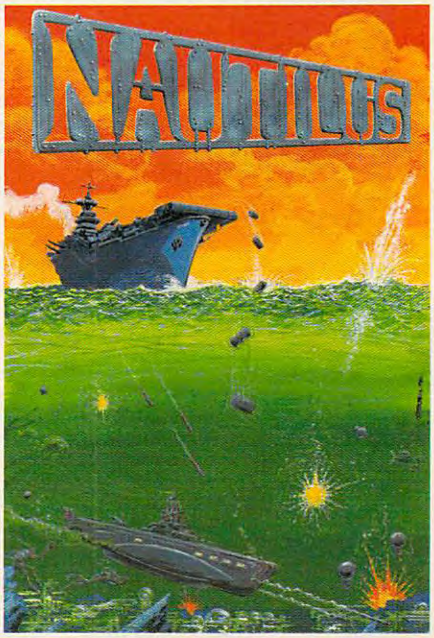

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An Attack Of Hearts

When I do a POKE 756,226, enabling lowercase and control characters to be printed on the screen in graphics mode 1 or 2, the computer fills the screen with a bunch of hearts. How do I get rid of them?

Larry L.

The alternate character set for Graphics modes one and two is the bottom half of the full character set, i.e., lowercase, graphics, and control symbols. Unfortunately, the heart (CHR$(0)), maps into the place where SPACE is encoded, resulting in a screen full of hearts. The usual cure is to perform a SETCOLOR 0,0,0, since the SPACE (or heart) defaults to color register zero. This will make the hearts black, the default background color. Naturally, you'll have to change this if the background is not black.

Unfortunately, this prevents you from printing any text in the blacked-out color, reducing your available colors from five to four. A superior, if more complicated, procedure would be to modify the character set by zeroing out the heart character. This requires additional RAM to hold the new character set and POKEing 756 with the pointer to the custom character set. Here is an example program:

```
100 CHBAS=756:CHORG=57344
110 CHSET=(PEEK(106)-8)*256
120 GRAPHICS 1
130 POKE 756,226
140 ? #6:? #6;" now |changing|":? #6;"
 |CHARACTER| SET"
150 FOR I=0 TO 511:REM ONLY HALF NEEDS T
O BE TRANSFERRED
160 POKE CHSET+I,PEEK(CHORG+512+I)
170 NEXT I
180 POKE 756,CHSET/256
190 REM 'FOR W=1 TO 50:NEXT W' IS A PAUS
E USED ONLY FOR EMPHASIS
195 REM NOT NEEDED FOR WORKING PROGRAM
200 FOR I=0 TO 7:POKE CHSET+I,0:FOR W=1
TO 50:NEXT W:NEXT I:REM ERASE HEART
210 ? #6:? #6;"|dO|nE"
220 END
```

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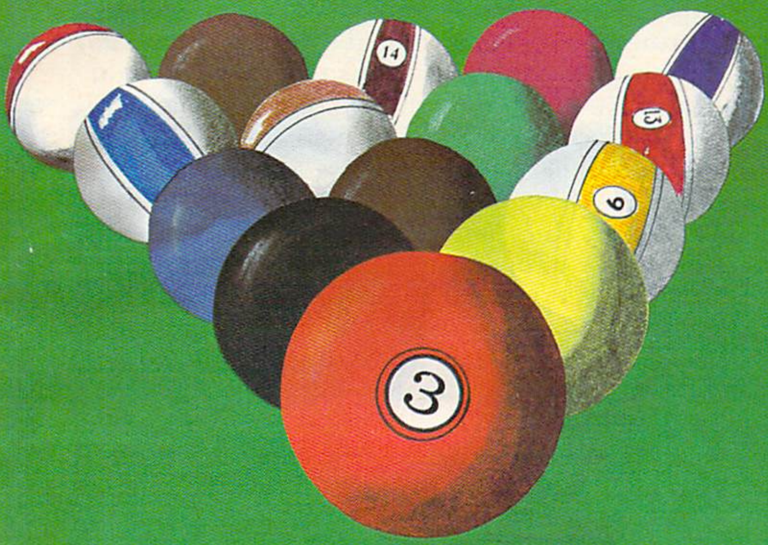

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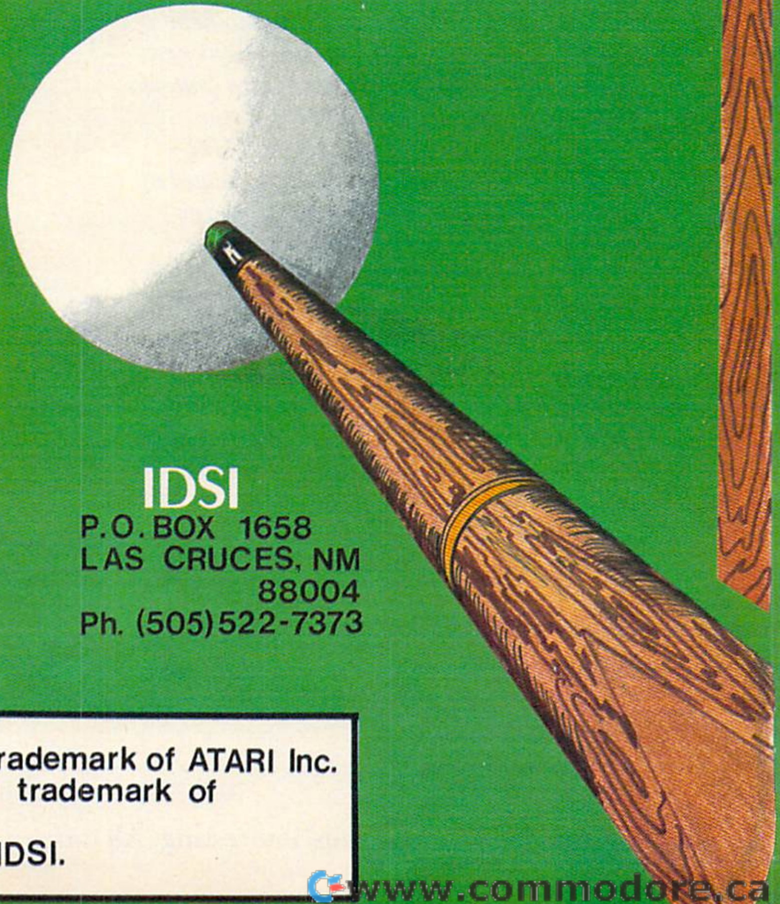

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A Monthly Column

Computers And Society

David D. Thornburg
Associate Editor

Odds And Ends...

You folks sure love to write letters! My mail load from this column and Friends of the Turtle is large enough that I don't always get answers out right away. If you have written and haven't heard from me, don't despair – I will write as soon as I can.

I received several letters in response to the "computers and the arts" columns. Reader Ted Nemeth of New York wrote in part:

Dear Dr. Thornburg:

In "Computers and Society" in the March issue of **COMPUTE!** *you wrote "... Whitney saw a new medium."*

Mary Ellen Bute (my grandmother) was the *first (absolutely) to use a light pen on an oscilloscope to create animated patterns with music. She worked with Professor Theraman creating this technique. Her work received major acclaim and showed at Radio City Music Hall in New York for years.*

I have shown her Mr. Whitney's book and while she enjoyed many of the graphics, she felt his technique of visual-sound interpretation is not all that well developed. She worked with many composers from George Gershwin to Edgard Varese in developing her theories. Since her methods did not include the use of the digital computer, her work (about 25 short films) has been all but ignored. ...

As for myself, I am a student at NYIT. I own an Atari 800 and am working on programs similar to my Grandmother's, except with Rock and Roll music. ...

Sincerely,

Ted Nemeth

I found Ted's letter quite interesting. All too often we forget to look at the progress made with technologies that preceded the ones which currently hold our interest.

Several other readers shared their favorite graphics programs with me. Among the finest graphics packages I have seen for the Atari computers is the program Graphics Master written by Courtney Goodin (distributed by Datasoft, $49.95). This program allows the user to create pictures in either of two high resolution (320 x 192 pixel) screens. I use one screen for small graphic elements that I can then "pick up" and stand anywhere I wish on the second screen. The user can intermix text and graphics, and has several choices of text size. Symmetry operations, such as rotations and mirror reflections, can be performed as well. Since text is treated as part of the graphics screen, you can split a word in the middle of a letter if you wish. This fine program provides many features for its modest price. It is a tribute to its author that one can create superb drawings using only the Atari joystick as the input device.

I have just begun to explore a professional graphics package for the Apple – more on that in a later column.

The columns on computer games in the classroom also generated a lot of mail. Most of you who wrote agree with the idea that there is something to be learned from the arcade games. In the area of educational software, I have several new programs I am reviewing, including a beautiful set of programs from The Learning Company (formerly ALT) in Portola Valley, California. As with the graphics program for the Apple, these software reviews will have to wait for another column.

Computer Literacy – Who Needs It?

Those of you who read this column regularly know that I am a proponent of the use of computers in the classroom. There seem to be two extremes to the use of the classroom computer – as a tool for programming the child through rote drill and practice, or as an object of study and exploration. My own bias lies toward the use of intrinsically motivating learning games to reinforce basic skills that were taught using conventional (human teacher) methods. In addition, I am a strong proponent of the idea that children should gain mastery over the computer through the use of user friendly languages such as PILOT and LOGO.

Historically, my argument has been with those who see the computer used only as a replacement for or simple adjunct to a teacher – who see the computer as a data processing tool to probe the student's skills and report all failings and progress to a human for analysis and further action. I guess that the thought of row upon row of school children

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sitting in front of sterile terminals performing the same tasks that could be performed better under human guidance and supervision is just not comfortable to me.

But now, it seems, there is even another issue to deal with. There appears to be growing concern that computer literacy is not an appropriate topic for our schools to teach. According to Eric Burtis, a member of the Palo Alto, California-based Ad Hoc Committee on Basic Skills Education, the education of children in basic skills is suffering from the use of computers in the classroom. The committee states that "The suggestion that every American citizen must become computer literate is fallacious and untrue, just as it would be untrue to state that every citizen must become an airline pilot if mass air transportation is to remain available to all mankind."

If the committee is of the opinion that our children are being taught computer skills at a level commensurate with an airline pilot's training, they certainly have not been paying attention to what is happening in the classroom. It is erroneous in the extreme to suggest that those of us who are computer literate are an isolated breed that provide services to the masses (as do airline pilots). The reality is that we can either control technology ourselves, or let others control it for us.

The digital computer promises to be the most significant technological development of the twentieth century (Ada, forgive me for leaving Babbage's machine out of the discussion). Today – just a few short years into the era of the personal computer, there is almost no one who fails to come in contact with computers, if only indirectly.

If computer literacy is not appropriate subject matter for our children, then what is? Is our educational system so sound and complete that it is impervious to further improvement? The function of schools is partly to prepare our children for survival in the real world. This requires the acquisition of skills in math, reading and writing, and a sense of historical perspective, etc. It includes the development of the whole child – the creative as well as the analytical mind – in order that each child is prepared to take an active participatory role in society.

Increasingly, ours is a society governed by the flow of information. And, increasingly, this information flow is mediated by computers. By not having "computer literacy" courses in the classroom, groups such as the Ad Hoc Commitee on Basic Skills Education are insuring that only children from certain economic and cultural backgrounds will have a chance to learn about this technology. To suggest that computer literacy be denied to all our children is elitism in the extreme. In the information age, those of us who are computer literate will be at a tremendous advantage over those of us who are not. If we believe the principle of equality of opportunity so central to our national identity, then we must have the foresight to realize that this equality can only occur when we provide equivalent educational opportunities to all of our children – regardless of their economic background. The schools are the most appropriate place to do this.

A Few Words About Innovision...

I own a company called Innovision. In the past, Innovision has made forays into the commercial marketplace with products such as the Presto-Digitizer tablet. It has also served as the umbrella company for my consulting practice, and as the haven from which I write books and articles.

The fact is that I enjoy writing a great deal, and, as an Associate Editor of **COMPUTE!** I felt a bit awkward also appearing as an occasional advertiser. While I have never done or said anything that, in my opinion, constituted a conflict of interest, it is essential that my readers know that no conflict could ever arise.

Accordingly, I have disbanded the commercial product lines of Innovision. I write, I occasionally consult, and I am involved with some new ventures run by other people. Innovision no longer has any products of its own.

While this was not an easy decision to make, it was aided by the increased time needed to answer your letters to Friends of the Turtle (I received 15 today alone). I have never failed to speak my mind from these pages, and I'm not planning on stopping now! Thank you all for your tremendous support.

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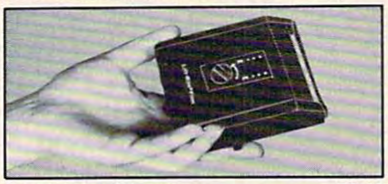

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The Beginner's Page

Making Files Work

Richard Mansfield
Assistant Editor

Last month we examined *files,* often the most difficult aspect of programming for the new computerist. Here we'll conclude this overview by looking at some specific details about file handling.

In general, a file is a list or a collection of information which has been saved on a tape or a disk. A list of all the people you send Christmas cards to could be "memorized" on tape/disk by the computer and would then be a file.

How is this list of names and addresses "memorized" and how, at Christmas, is it used to print the addresses on envelopes? A file by itself is incapable of *doing* anything: it is not a program, it's just a list. A separate program is needed to create, update, and make use of files.

"Mailing Address," "File Manager," and others of this type are called data base management programs. Their primary function is to build, add to, modify, or print something out from files. They manage a collection (a *base*) of data.

You can, of course, write your own custom data base manager. This would amount to writing a program (or a set of programs) which would let you manipulate the list on tape or disk.

Writing a large data base management program is not an easy task – it can involve sorting, searching, and other complex programming techniques. Nonetheless, handling Christmas card lists is something the novice can accomplish and it's well worth learning. Files do, though, represent something of a challenge. Your computer's manual will contain information on the necessary punctuation and syntax for BASIC's commands which manipulate files. However, the following brief overview might be of help.

OPEN, PRINT#, INPUT#, And CLOSE

Where a program would be stored by the simple SAVE instruction, a file is stored by a combination of OPEN, PRINT#, and CLOSE. (On the Apple, PRINT is used in a special way instead of PRINT#. We'll get to that in a minute.) Likewise, a program is just LOADed, but a file is "loaded" into the computer with OPEN, INPUT#, and CLOSE.

It is a bit more complicated with files, but the bonus is that you can do more manipulating with files, easier *appending* (adding to them), easier *merging* (making two files into one), and so on.

The command OPEN is generally used to communicate with a disk or tape drive. It's like pulling open a file cabinet drawer – once a file is OPENed, you can then get at the records inside. Here's what you would do to OPEN a file named "inventory" on a disk drive attached to a Commodore, Atari, or Apple:

Commodore

```
10 OPEN 1,8,8,"0:INVENTORY,S,R"
```

The first number (1) means that this file will hereafter be called #1. When you pull something out of it, you would use INPUT#1 (you can have up to ten files OPEN at one time). The second number (8) means "disk drive" (a 1 in this position would mean: open a file on the cassette drive). The second eight is a "secondary address" which allows you to give additional instructions. With disk drives, just use eight.

The "0:" specifies drive zero and the "S" means *sequential* file. The Commodore disks can create other kinds of files: random, relative, and program files, but sequential is the simplest. Finally, the "R" means *read*. You will be using INPUT# to get things out of this file. (A "W" here would mean *write* and you would PRINT# to the file.) To make this "reading or writing" distinction for tape files, the secondary address is used: a one means write and a zero means read. (10 OPEN 1,1,0,"INVENTORY" would be the same as the example above, except it makes a cassette file.) No drive number is specified and the "S" is not necessary since cassette files can only be sequential files.)

Atari

The equivalent of the disk example above is similar in Atari BASIC:

```
10 OPEN#1,4,0,"D1:INVENTORY"
```

Here, the second number (4) stands for *read* (use 8 for write), the next number (0) is not used by the disk drive (but is necessary to satisfy the syntax of OPEN), and the "D1" specifies the first drive (there can be up to four drives attached, D1 through D4; D: means D1:).

Apple

To OPEN an Apple disk file, you first define a special character, D$, which holds the "control-D" character (you cannot see it). You would type:

```
10 D$="(hold down both CTRL and D keys)"
   (or you could use 10 D$=CHR$(4) instead)
15 PRINT D$;"OPEN INVENTORY"
```

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In our simple example, it isn't necessary to include drive and slot numbers with the OPEN command. Line 15, however, could indicate drive one, slot six if we add "OPEN INVENTORY, S6,D1" to the quoted information. The Apple uses the format in line 15 for its disk commands; first control-D is printed and then the desired action is described within the quotes.

Putting Something In And Taking Something Out

On the Commodore and Atari, you can put information into an OPENed file by using PRINT#. For Commodore files you could put the word "PENCILS" into the file by:

```
20 PRINT#1,"PENCILS"
```

and Atari would be:

```
20 PRINT#1;"PENCILS"
```

The Apple uses two lines:

```
20 PRINT D$;"WRITE INVENTORY"
21 PRINT "PENCILS"
```

(After line 20, the following PRINT command will be considered a print to the file, not to the screen).

Going the other way, you get something out of an OPENed file by using INPUT# in combination with a string variable to "hold" whatever comes from the file (they come back to the computer in the order they were PRINT#ed). To get the word "PENCILS" back from a Commodore file:

```
20 INPUT#1,A$
```

(Then later you could print A$ to see "PENCILS") and Atari is:

```
20 INPUT#1,A$
```

(You must have previously DIMed A$).

Again, the Apple uses two lines:

```
20 PRINT D$;"READ INVENTORY"
21 INPUT A$
```

After you are finished INPUT#ing or PRINT#ing from a file which had been OPENed as file #1, you would CLOSE1 (PET/CBM) or CLOSE#1 (Atari) or PRINT D$;"CLOSE INVENTORY" (Apple). When you've finally CLOSEd, you are free to use that file number (#1 in these examples) for some other file, with a different name. CLOSE is essential, however. Without it you could permanently lose part or all of a file, or even damage other files.

INPUT# And PRINT# Hints

INPUT# or PRINT# work very similarly to the way INPUT and PRINT work from the keyboard and to the screen. The only catch is that PRINT# needs some special handling. It's best to give it a line all to itself:

```
20 PRINT#1,A$ (Commodore)
30 PRINT#1,B$
20 PRINT#1;A$ (Atari)
20 PRINT D$; "WRITE NAMEOFFILE" (Apple)
21 PRINT A$
```

The reason for putting PRINT# on its own line is that this is an easy way to separate items in a file: with "carriage returns." Just as 10 PRINT A$ / 20 PRINT B$ will cause B$ to be on the line below A$ on the screen (since using a new line "forces" a carriage return to take place) – a separate program line puts a carriage return symbol onto the tape or disk.

Manipulating Files

Files are usually created within loops. Here's a simple program to "write" a file to tape:

```
10 DATA BILL, SANDY, KATIE, LARRY
20 OPEN 1,1,1,"NAMES": REM (A PET/CBM TAPE
   FILE)
30 FOR I=1 TO 4
40 READ A$
50 PRINT#1,A$
60 NEXT I
70 CLOSE1
```

Since there are four names in this file, the loop counts up to four, READing a new A$ from the DATA line each time through. Since PRINT#1 is by itself on line 50, it will send carriage returns to the tape each time it PRINT#s, separating the names on tape. This way, there will be no question that a name should be BILLSANDY.

When this file is later read into the computer, it would be very useful to know when it ends, how big it is. There are two easy ways to do this. You could add the word "END" to the DATA line and then change line 30 to read: FOR I = 1 TO 5. Or, you could put the "count" (the number of records for this file) on the tape or disk itself, as part of the file. To do this, you would add a line: 25 PRINT#1,4.

Here's a "reader" program which brings the records from this second type of file back into the computer, finding out first what the count is:

```
10 OPEN1,1,0,"NAMES": REM (A PET/CBM TAPE
   FILE)
20 INPUT#1,COUNT:REM THIS WAS THE FIRST
   ITEM ON THE FILE
30 FOR I=1 TO COUNT
40 INPUT#1,A$
50 PRINT A$ (TO THE SCREEN)
60 NEXT I
70 CLOSE1
```

If you use the "END" technique, the reader program would not use line 20 and would add line: 45 IF A$="END" THEN GOTO 70. Notice also that you can PRINT# and INPUT# both numeric and string (alphabetical) variables.

One final note about something which might not be immediately obvious: if you update a file on

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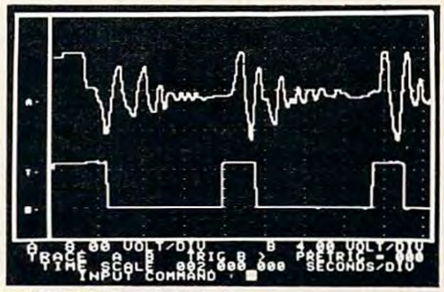

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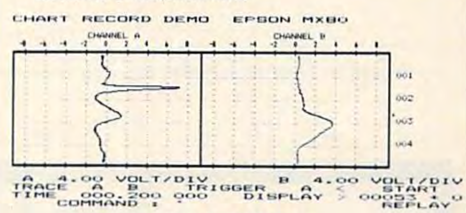

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a PET/CBM computer, you cannot put it back on a disk with the same name. You might have read it off the disk and into memory to make some changes. But before you OPEN-PRINT#-CLOSE it back onto the disk, you must first "scratch" (remove) the *original* version in order to replace it with the updated one. Again, each computer has different formats for this and your manual will describe them. Some systems, the Atari for example, automatically replace files when one "comes into" the disk with the same name as one already on the disk. This *scratching* of unwanted files is unnecessary for tape files, they will write over the old file (if you rewind the tape).

There are numerous ways to manipulate files – this is precisely why it is a challenging programming task. The programmer has more control over what is happening, but more responsibility, too. As always, start out small by perhaps just creating a file with your name on it, reading it back into memory, and printing it on the screen. Then try ten names, a mailing list, updating records, and so on. Eventually you'll become adept at file manipulation and will find many uses for these valuable programming techniques. ©

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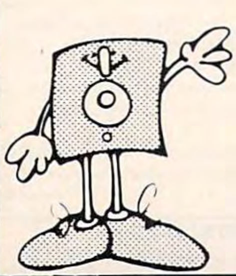

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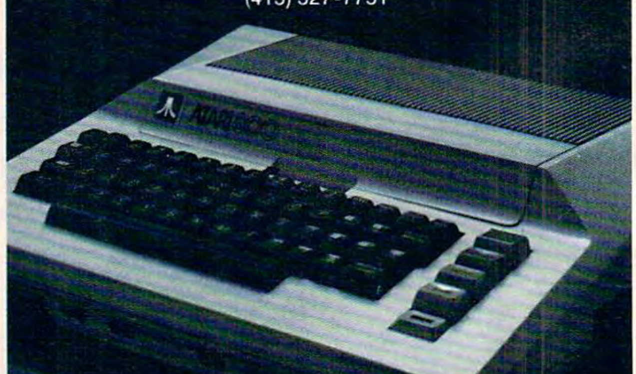

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This exciting action game is for the Atari and the VIC. Blast out new caverns, dig the gold, and return to the surface for your reward. If you run out of dynamite, get to the surface fast or you'll wander the mine forever. And watch out for cave-ins – they can block your exit, or worse!

Gold Rush!

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Rapid City, SD

After reading the fascinating article "Using The VIC Joystick," by David Malmberg (*Home and Educational Computing!*, Fall, 1981), I couldn't wait to try out what I had learned. It wasn't long after I got to the VIC keyboard that the Gold Rush game started to emerge.

After a few false starts, here it is.

The game gives you one more chance to use your joystick. In this game you have five miners to dig as much gold as you can from the Lost Goldmine. Each miner has ten sticks of dynamite (charges) to blast his way into the mine. The miner gathers them by moving to the same space as the dot (poke X,81).

The number of pieces of gold is counted and displayed at the bottom of the screen. The number of charges left is also displayed at the bottom of the screen. After gathering all the gold you can, you must move out of the mine to the Assay Office (the heart) to exchange the gold for money. When you touch the heart, the gold is exchanged for money at the rate of Gold times Remaining Charges.

Cave-ins Can ... Put You Out Of The Game

That all sounds easy enough, but there are several things that can happen to slow up your progress. First, there are the cave-ins. Since the Lost Goldmine is very old, cave-ins occur every time you blast. These cave-ins can block your way out or (how can I put this nicely) ah... put you out of the game. When you are caved-in upon, your gold is lost and the miner is replaced with an asterisk. If you can reach the asterisk, you regain all of the gold the "dead" miner had.

Another danger can beset you if you should use up all of your charges. When this happens, you have only a short time to get back to the surface. If you cannot exit the mine, either due to a cave-in or a slow miner, then all is lost and you end up wandering the mine forever.

Let's plug in our joysticks and strike it rich. There's gold in them there hills!

Program 1. Atari Version

Atari Version Notes

This game simulates the appearance of the VIC version by using a custom character set in Graphics mode 1. Notice that only half of the character set in ROM needs to be transferred to RAM, since Graphics modes 1 and 2 can only access 64 characters (to allow multicolor text), so we loop from 0 to 511.

This game makes extensive use of the LOCATE command to "look at" the computer's screen, such as checking for various objects the miner finds. Also, unlike the VIC version, if you clear the mine of all gold, you can start over with a new mine when you "cash in" your gold. You get three "lives."

```
100 REM ATARI GOLDRUSH
110 REM
120 REM Custom characters:
130 DATA 56,56,16,56,84,16,40,68
140 DATA 170,85,170,85,170,85,170,85
150 DATA 0,28,60,110,126,62,28,0
160 DATA 129,66,36,24,24,36,66,129
170 DATA 128,64,32,16,8,4,2,1
180 DATA 1,2,4,8,16,32,64,128
190 DATA 16,16,124,16,16,16,56,124
200 DIM CHAR$(8),WHICH(3,2)
210 CHAR$="*+-=<>%":MINER=3
220 GRAPHICS 1+16:SETCOLOR 4,6,4:SETCOLO
R 0,1,10:SETCOLOR 3,4,10
230 ? #6;"GOLDRUSH!":SETCOLOR 2,3,0
240 POSITION 9,0:? #6;"please wait"
250 CHSET=(PEEK(106)-8)*256:CHORG=57344
260 IF PEEK(CHSET+9)<>0 THEN 340
270 FOR I=0 TO 511:POKE CHSET+I,PEEK(CHO
RG+I):NEXT I
280 FOR I=1 TO 7
290 CHPOS=CHSET+(ASC(CHAR$(I))-32)*8
300 FOR J=0 TO 7
310 READ A:POKE CHPOS+J,A
320 NEXT J:NEXT I
330 FOR I=32 TO 39:POKE CHSET+I,255-PEEK
(CHORG+I):NEXT I
340 POKE 756,CHSET/256
350 POSITION 9,0:? #6;"     {D}        "
360 NUGGETS=0
370 FOR I=1 TO 22:FOR J=0 TO 19
380 IF RND(0)>0.4 THEN COLOR ASC(CHAR$(2
))+128:PLOT J,I:GOTO 400
390 IF I>3 THEN COLOR ASC(CHAR$(3)):PLOT
 J,I:NUGGETS=NUGGETS+1
400 NEXT J:NEXT I
410 CHARGES=10:POSITION 9,23:? #6;"!CHAR
```

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```
GES! ";CHARGES
420 XPOS=11:YPOS=0:EMF=0:GOTO 590
430 REM MAIN LOOP
440 ST=STICK(0):TR=STRIG(0)
450 IF PEEK(20)>15 THEN POKE 709,(INT(16
*RND(0))*16+10):POKE 20,0
460 IF EMF THEN SOUND 1,T,10,8:T=T*(T<8)
+2:TI=TI+1:IF TI>200 THEN SOUND 1,0,0,0:
GOTO 1120
470 IF 1-TR THEN IF EMF=0 THEN 820
480 IF ST=15 THEN 440
490 V=-(ST=14)*(YPOS>0)+(ST=13)*(YPOS<22
)
500 H=-(ST=11)*(XPOS>0)+(ST=7)*(XPOS<19)
510 COLOR 32:PLOT XPOS,YPOS
520 XPOS=XPOS+H:YPOS=YPOS+V
530 LOCATE XPOS,YPOS,WHAT
540 IF WHAT=32 THEN 590
550 IF WHAT=ASC(CHAR$(3)) THEN GOSUB 640
:GOTO 590
560 IF WHAT=ASC(CHAR$(7)) THEN GOSUB 760
:GOTO 590
570 IF WHAT=4 THEN GOSUB 670:REM CASH IN
!
580 SOUND 0,100,12,8:FOR W=1 TO 20:NEXT
W:SOUND 0,0,0,0:XPOS=XPOS-H:YPOS=YPOS-V:
COLOR 138:PLOT XPOS,YPOS:GOTO 440
590 COLOR 138:PLOT XPOS,YPOS
600 IF EMF AND YPOS=0 THEN EMF=0:COLOR 3
2:PLOT XPOS,YPOS:SOUND 1,0,0,0:GOTO 410
610 FOR W=8 TO 0 STEP -1:SOUND 0,W*5,12,
W:NEXT W
620 GOTO 440
630 GOTO 630
640 FOR W=15 TO 0 STEP -1:SOUND 0,20,10,
W:NEXT W:GOLD=GOLD+1:NUGGETS=NUGGETS-1:I
F NUGGETS<0 THEN NUGGETS=0
650 POSITION 0,23:? #6;"gold ";GOLD;"  "
;
660 RETURN
670 REM CASH IN!
680 SOUND 2,4,10,4
690 FOR W=10 TO 5 STEP -1:FOR I=15 TO 0
STEP -1:SOUND 0,W,10,I:NEXT I:NEXT W
700 SOUND 2,0,0,0
710 CASH=CASH+GOLD*CHARGES:GOLD=0
720 GOSUB 650
730 POSITION 14,0:? #6;CASH
740 IF NUGGETS=0 THEN POP :GOTO 360
750 RETURN
760 REM GET THE GOLD FROM DEAD MINER
770 FOR I=3 TO 1 STEP -1
780 IF WHICH(I,0)=XPOS AND WHICH(I,1)=YP
OS THEN 800
790 NEXT I:RETURN
800 GOLD=GOLD+WHICH(I,2):GOSUB 650
810 RETURN
820 REM EXPLOSION
830 XP=XPOS+H:YP=YPOS+V:IF YP=0 THEN 440
840 RESTORE 3007
850 DATA 0,0,-1,-1,1,1,-1,1,1,-1
860 FOR I=1 TO 5:READ A,B
870 IF XP+A>=0 AND XP+A<=19 AND YP+B>=1
AND YP+B<=22 THEN LOCATE XP+A,YP+B,ZZ:IF
 ZZ=45 THEN NUGGETS=NUGGETS-1
880 NEXT I: COLOR ASC(CHAR$(4))
890 IF XP>0 AND XP<20 THEN PLOT XP,YP
900 COLOR ASC(CHAR$(5)):IF YP>2 AND XP>0
 THEN PLOT XP-1,YP-1
910 IF YP<22 AND XP<19 THEN PLOT XP+1,YP
+1
920 COLOR ASC(CHAR$(6)):IF YP>2 AND XP<1
9 THEN PLOT XP+1,YP-1
930 IF YP<22 AND XP>0 THEN PLOT XP-1,YP+
1
940 DL=PEEK(560)+256*PEEK(561):SV=PEEK(7
12)
950 FOR W=15 TO 0 STEP -0.5:SOUND 0,50,0
,W:SW=1-SW:POKE 712,SW*(4*16+6):POKE DL,
112*SW:NEXT W
960 POKE DL,112:POKE 712,SV
970 REM
980 COLOR 32:PLOT XP,YP:IF YP>2 AND XP>0
 THEN PLOT XP-1,YP-1
990 IF YP<22 AND XP<19 THEN PLOT XP+1,YP
+1
1000 IF YP>2 AND XP<19 THEN PLOT XP+1,YP
-1
1010 IF YP<22 AND XP>0 THEN PLOT XP-1,YP
+1
1020 COLOR 138:PLOT XPOS,YPOS
1030 FOR I=1 TO 20
1040 RX=INT(20*RND(0)):RY=INT(22*RND(0)+
1)
1050 LOCATE RX,RY-1,Z2
1060 LOCATE RX,RY,Z:IF Z=32 AND Z2=171 T
HEN COLOR 171:PLOT RX,RY
1070 IF Z=138 THEN 1130
1080 NEXT I
1090 CHARGES=CHARGES-1:POSITION 17,23:?
#6;CHARGES;" ";
1100 IF CHARGES>0 THEN 440
1110 TI=0:EMF=1:POSITION 9,23:? #6;"get
out(A)    ";:GOTO 440
1120 REM DEAD MINER
1130 FOR I=14 TO 0 STEP -0.5:SETCOLOR 3,
4,I:SOUND 0,I,10,I:NEXT I:RESTORE 3400
1140 READ A,W:IF A>0 THEN SOUND 0,A,10,8
:FOR I=1 TO W*2:NEXT I
1150 IF A>0 THEN SOUND 0,0,0,0:FOR W=1 T
O 5:NEXT W:GOTO 1140
1160 COLOR ASC(CHAR$(7)):PLOT XPOS,YPOS:
WHICH(MINER,2)=GOLD:GOLD=0:GOSUB 650
1170 WHICH(MINER,0)=XPOS:WHICH(MINER,1)=
YPOS:MINER=MINER-1:IF MINER=0 THEN 1210:
REM GAME OVER
1180 SETCOLOR 3,4,10:GOTO 410
1190 DATA 100,30,100,20,100,5,100,30,85,
```

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```
40,90,30,100,20,105,10,100,30
1200 DATA -1,0
1210 POSITION 0,0:? #6;"game over"
1220 POKE 709,PEEK(53770)
1230 IF PEEK(53279)<>6 THEN 1220
1240 RUN
```

Program 2. VIC Version

```
100 CLR:S=0:C=10:M=4:L=0:W=0
110 PRINT"{CLEAR}"
112 GOSUB300
120 POKE36879,9
130 GOSUB800
132 Z=7712:FB=0:Y=250
140 POKEZ,32
150 IFJ1THENZ=Z+22:IFPEEK(Z)=102THENZ=Z-22
160 IFPEEK(Z)=35THENZ=Z-22
170 IFJ2THENZ=Z-1:IFPEEK(Z)=102THENZ=Z+1
180 IFPEEK(Z)=35THENZ=Z+1
190 IFJ3THENZ=Z-22:IFPEEK(Z)=102ORZ<7680THE
    NZ=Z+22
200 IFPEEK(Z)=35THENZ=Z+22
210 IFJ0THENZ=Z+1:IFPEEK(Z)=102THENZ=Z-1
212 IFPEEK(Z)=35THENZ=Z-1
220 IFPEEK(Z)=81THENS=S+1:GOSUB6000
222 IFPEEK(Z)=83THENGOSUB4000
224 IFPEEK(Z)=42THENGOSUB3000
230 IFFBTHENGOSUB5000:GOSUB8000
240 PRINT"{HOME}{20 DOWN}{REV}GOLD{OFF}";S;
    TAB(10)"{REV}CHARGES{OFF}";C
250 POKEZ,90
260 IFC=<0THENGOSUB9000
270 DD=37154:P1=37151:P2=37152
280 GOSUB500
290 GOTO140
300 REM INSTRUCTIONS
310 PRINT"{DOWN}{04 RIGHT}{REV}VIC GOLDRUSH
    {OFF}"
320 PRINT:PRINT:PRINT"{04 RIGHT}{REV}Z{OFF}
     = MINER"
330 PRINT:PRINT"{04 RIGHT}{REV}Q{OFF} = GOL
    D"
340 PRINT:PRINT"{04 RIGHT}{REV}*{OFF} = DEA
    D MINER"
350 PRINT:PRINT"{04 RIGHT}{REV}&{OFF} = DIR
    T"
360 PRINT:PRINT"{04 RIGHT}{REV}S{OFF} = ASS
    AY OFFICE"
362 PRINT:PRINT:PRINT"{02 RIGHT}USE {REV}FI
    RE BUTTON{OFF} TO"
364 PRINT"{02 RIGHT}BLAST"
370 PRINT"{HOME}{20 DOWN}{REV}PRESS ANY KEY
     TO PLAY"
380 A$="":GETA$:IFA$=""THEN380
390 PRINT"{CLEAR}"
400 RETURN
500 POKEDD,127:P=PEEK(P2)AND128
510 J0=-(P=0)
520 POKEDD,255:P=PEEK(P1)
530 J1=-((PAND8)=0)
540 J2=-((PAND16)=0)
550 J3=-((PAND4)=0)
560 FB=-((PAND32)=0)
570 RETURN
800 REM DRAW BOARD
810 X=7702
820 FORI=1TO22
830 POKEX,35
840 X=X+1
850 NEXTI
860 POKE7712,32
870 X=7724
880 FORI=1TO18
890 FORJ=1TO2
900 POKEX,35
910 X=X-1
920 NEXTJ
930 X=X+24
940 NEXTI
950 X=8098
960 FORI=1TO22
970 POKEX,35
980 X=X+1
990 NEXTI
1000 FORI=1TO180
1010 X=INT(RND(1)*374)+7724
1012 IFPEEK(X)=35THEN1010
1014 IFPEEK(X)=102THEN1010
1020 POKEX,102
1030 NEXTI
1040 FORI=7724TO8097
1050 IFPEEK(I)=102THEN1070
1052 IFPEEK(I)=35THEN1070
1060 POKEI,81
1070 NEXTI
1080 POKE7689,35:POKE7692,35:POKE7691,83
1090 GOSUB2000
1200 RETURN
2000 REM PLACE MINERS
2002 IFM<0THEN9500
2010 X=7680
2020 FORI=0TO4
2030 POKEX,32
2040 X=X+1
2050 NEXTI
2060 X=7680
2070 FORI=1TOM
2080 POKEX,90
2090 X=X+1
2100 NEXTI
2110 C=10:S=0
2120 Z=7712
2130 PRINT"{HOME}{20 DOWN}                "
2140 FORI=8142TO8164:POKEI,32:NEXT
2150 IF M=0THENPOKE7680,32
2200 RETURN
3000 REM DIG UP MINER
3010 S=S+S1
3200 RETURN
4000 REM TALLY GOLD

4002 FORI=7694TO7701:POKEI,32:NEXT
4010 FORJ=1TO5
4020 FORI=15TO0STEP-1
4030 POKE36878,I
4040 POKE36876,230
4050 FORT=1TO10:NEXT
4060 NEXTI
4070 POKE36876,0
4080 NEXTJ
4090 C1=C:IFC1=0THENC1=1
4100 W=S*C1+W
4110 PRINT"{HOME}{REV}{WHT}{13 RIGHT}$";STR$
     (W);".00{RED}"
4120 POKE7691,83
4130 M=M-1
4140 GOSUB2000
4150 RETURN
```

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```
5ØØØ REM EXPLOSION
5ØØ2 IFC<=ØTHEN9ØØØ
5ØØ4 IFPEEK(Z-1)=35THEN5Ø12
5Ø1Ø POKEZ-1,86
5Ø12 IFPEEK(Z+1)=35THEN5Ø22
5Ø2Ø POKEZ+1,86
5Ø22 IFPEEK(Z+22)=35THEN5Ø32
5Ø3Ø POKEZ+22,86
5Ø32 IFPEEK(Z-22)=35THEN51ØØ
5Ø4Ø POKEZ-22,86
51ØØ POKE36877,22Ø
511Ø FORL=15TOØSTEP-1
512Ø POKE36878,L
513Ø FORT=1TO75:NEXT
514Ø NEXTL
515Ø POKE36877,Ø:POKE36878,Ø
5152 IFPEEK(Z-1)=35THEN5156
5154 POKEZ-1,32
5156 IFPEEK(Z+1)=35THEN516Ø
5158 POKEZ+1,32
516Ø IFPEEK(Z+22)=35THEN5164
5162 POKEZ+22,32
5164 IFPEEK(Z-22)=35THEN517Ø
5166 POKEZ-22,32
517Ø C=C-1:POKE8138,32:POKE8139,32:POKEZ,9Ø
53ØØ RETURN
6ØØØ REM DOT PICKUP
6Ø1Ø POKE36878,15
6Ø2Ø FORL=1ØTO1STEP-1
6Ø3Ø POKE36876,L*25
6Ø4Ø NEXTL
6Ø5Ø FORL=1TO1Ø
6Ø6Ø POKE36876,L*25
6Ø7Ø NEXTL
6Ø8Ø POKE36876,Ø:POKE36878,Ø
61ØØ RETURN
8ØØØ REM CAVE IN
8Ø1Ø X=INT(RND(1)*1)+1Ø
8Ø2Ø FORI=1TOX
8Ø3Ø V=INT(RND(1)*418)+77Ø2
8Ø32 IFPEEK(V)=35THEN8Ø3Ø
8Ø34 IFPEEK(V)=9ØTHENGOSUB86ØØ:GOTO132
8Ø36 IFPEEK(V)=81THEN8Ø3Ø
8Ø4Ø POKEV,1Ø2
8Ø5Ø NEXTI
81ØØ RETURN
86ØØ REM SQUASH MINER
861Ø POKE36878,15
862Ø FORI=255TO128STEP-4
863Ø POKE36874,I
864Ø FORT=1TO3Ø:NEXT
865Ø NEXTI
866Ø POKE36878,Ø:POKE36874,Ø
867Ø M=M-1
868Ø POKEZ,42
8682 S1=S
869Ø GOSUB2ØØØ
88ØØ RETURN
9ØØØ REM GET OUT COUNTER
9ØØ4 IFY<128THENPOKEZ,32:GOSUB2ØØØ:GOTO132
9Ø1Ø PRINT"{HOME}{21 DOWN}{Ø2 RIGHT}{REV}TIM
    E TO GET OUT{OFF}"
9Ø2Ø POKE36878,15:POKE36876,Y
9Ø3Ø FORT=1TO3Ø:NEXT
9Ø4Ø Y=Y-4
9Ø5Ø POKE 36878,Ø:POKE36876,Ø
91ØØ RETURN
95ØØ REM PLAY AGAIN
952Ø PRINT"{HOME}{21 DOWN}{WHT}{REV}PLAY AGA
    IN?Y=YES N=NO{OFF}{RED}"
953Ø IFA$="Y"THEN1ØØ
954Ø A$="":GETA$:IFA$=""THEN954Ø
956Ø IFA$="Y"THEN1ØØ
9999 END
```

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You've seen the bank ads: "Retire a Millionaire." Type in this short program (it will run on Atari, Radio Shack Color Computer, PET/CBM, VIC, and Apple) and see for yourself how IRA accounts compute. The program uses very little memory. The "^" symbol means "to the power of."

IRA Planner

Richard and Betty Givan
Richmond, KY

Most get-rich schemes of the past have proven to be of questionable legality and dubious worth. The latest promotion, however, is endorsed by the US Government and seems foolproof. This device is the Individual Retirement Account (IRA), expanded in 1982 to allow up to a $2000 ($2250 in a joint plan with a nonworking spouse) yearly deposit to be put into a private retirement account.

This amount is deductible from the person's gross income during the year deposited, decreasing the income tax accordingly. The retirement fund is then free to grow at the prevailing competitive interest rate – compounded daily and tax free – until it is withdrawn during retirement. Although taxes are then due, presumably the taxpayer will be in a lower tax bracket and so pay a lesser tax.

The Relationship Between Inflation And Interest

The allure of the plan is in the rapid growth of the principal through compound interest at the currently high rates. Hence the ads in which banks all but guarantee that you can be a millionaire upon retirement via a $2000 yearly deposit for 35 years at a 12% return. Actually, your account *would* be worth an astounding $1,161,059. Such a modest sacrifice in order to retire a millionaire!

As with all get-rich plans, however, there is a catch – not a legal or even an ethical one, but a matter of economics. The IRA promotion campaigns conveniently overlook the devastating effects of inflation on your million. At the same time that compound interest is building your fortune, inflation is eroding it. Historically, the interest rate is fairly well dictated by the rate of inflation. Although temporary imbalances occur, economists generally agree that, in the long run, the interest rate will seek out a level approximately three to four percent higher than the inflation rate.

Assuming that the prevailing inflation rate (say nine percent) holds steady, your retirement fortune of $1,161,059 from the above example will really be worth only $56,875 in the purchasing power of 1982 dollars. You may have a carload of dollars in the year 2017, but the Cadillac you buy to haul it home would cost $306,000 and the gasoline to power it would be $25 a gallon!

This is not to say that an IRA is a bad way to save. It does offer immediate tax relief, and that in itself might provide you with the incentive to put aside some funds for your golden years. But it would be well to put the numbers in perspective when planning for your future.

The program asks you several questions: the amount of money you wish to set aside each year; the tax bracket you are currently in (which can be found by reference to the IRS booklet accompanying your tax forms, but is not really essential to the rest of the program); your age when you begin and end the plan; and the average interest and inflation rates you expect to experience (here's where a crystal ball program would be nice).

The program then displays the tax savings you would receive the first year in the plan. (Income and tax rate would probably fluctuate too much to benefit from attempting to compute these over the life of your IRA.) The sum of your deposits is displayed, followed by the principal of the account increased by accumulated interest. Then the *real spending power* of your final nest egg is shown by reducing the principal to reflect the inflation rate. You can see its worth in terms of the 1982 dollar. Bear in mind that this money is taxable when withdrawn, also. You can then easily experiment with different interest and inflation rates at this point without having to answer the other questions again.

One note: the two questions about inflation and interest ask for the figures *expressed as decimals*. In other words, if you want to answer 12% inflation, you should type .12 and 6% interest would be entered as .06.

```
10 REM IRA PLANNER
30 DIM A$(1):REM THIS LINE ONLY NECESSARY ~
    FOR ATARI
40 PRINT"AT WHAT AGE DO YOU PLAN"
50 PRINT"TO OPEN AN IRA ACCOUNT";:INPUT A
60 PRINT:PRINT"AT WHAT AGE DO YOU PLAN TO ~
    RETIRE";:INPUT A1
70 Y=A1-A
80 PRINT:PRINT "HOW MUCH DO YOU PLAN TO"
90 PRINT"DEPOSIT PER YEAR";:INPUT D:C=D
100 PRINT:PRINT"WHAT IS YOUR TAX BRACKET?"
110 PRINT"(ENTER PERCENTAGE EXPRESSED":PRIN
    T"AS A DECIMAL)":INPUT P
120 PRINT:PRINT"WHAT IS THE AVERAGE INTERES
    T RATE YOU
130 PRINT"EXPECT FOR THE ACCOUNT OVER THE
140 PRINT"YEARS IT EXISTS? (ENTER PERCENTAG
    E
150 PRINT"EXPRESSED AS A DECIMAL)":INPUT R
160 PRINT:PRINT"WHAT IS THE AVERAGE INFLATI
```

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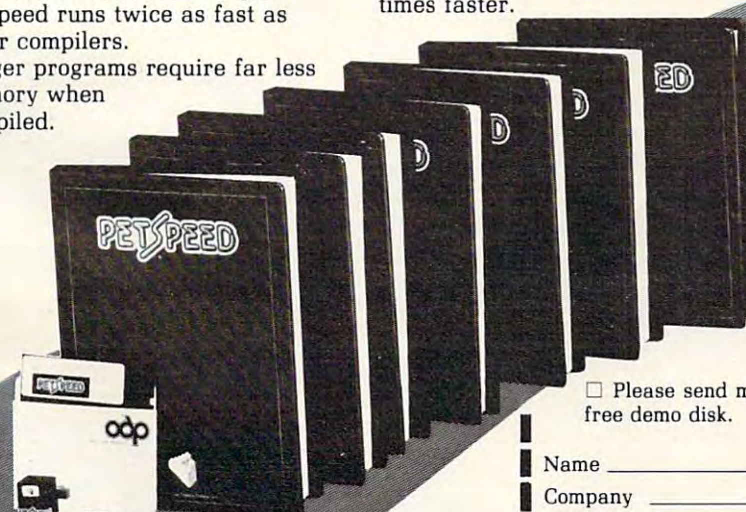

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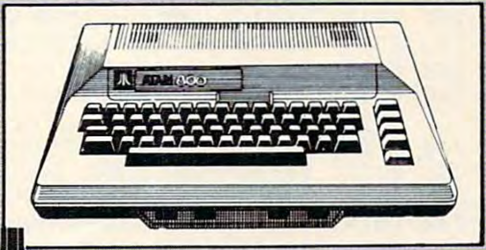

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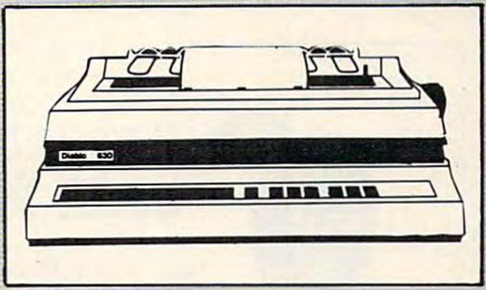

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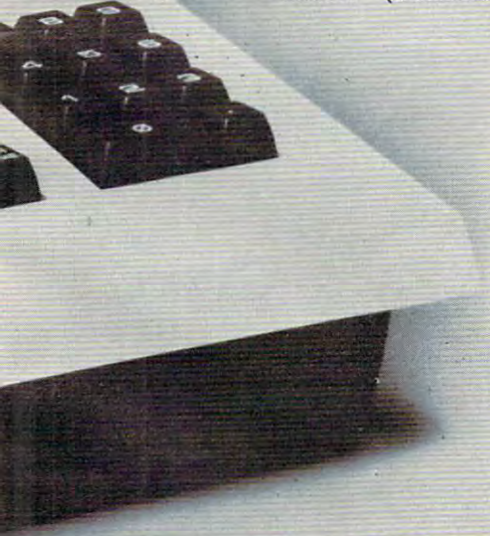

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```
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170 PRINT"YOU EXPECT DURING THE YEARS"
180 PRINT"BETWEEN OPENING THE ACCOUNT AND
190 PRINT"RETIREMENT? (ENTER PERCENTAGE
195 PRINT"EXPRESSED AS A DECIMAL)":INPUT I
200 S=D*P
210 PRINT:PRINT"YOU WILL SAVE $";INT(S);" O
    N TAXES THIS YEAR."
220 T=D*Y
230 PRINT:PRINT"THE TOTAL AMOUNT DEPOSITED ~
    INTO YOUR
240 PRINT"IRA ACCOUNT OVER THE ";Y;" YEARS ~
    IS":PRINT"$";INT(T);"."
250 FOR J=1 TO Y
260 X=D*(1+R/365)^365
270 D=X+C
280 NEXT J
290 PRINT:PRINT"WHEN YOU RETIRE, THE AMOUNT
     IN YOUR"
300 PRINT"ACCOUNT WILL BE $";INT(X);"."
310 Z=(1+I)^Y
320 W=X/Z
330 PRINT:PRINT"...WHICH IS WORTH $";INT(W)
    ;" IN 1982"
340 PRINT"DOLLARS."
350 PRINT:PRINT"WOULD YOU LIKE TO TRY THIS ~
    AGAIN WITH
360 PRINT"DIFFERENT INTEREST AND INFLATION ~
    RATES"
370 PRINT"(Y OR N)";:INPUT A$
380 IF A$="N" THEN END
390 D=C:GOTO 120
```

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Maze Race

Mike Peterson
Cheyenne, WY

I was impressed by the Maze algorithm that appeared in **COMPUTE!**, December, 1981, #19. After watching the maze form several times, I had an idea for a program that incorporated the maze algorithm.

First, I modified the routine so that two symmetrical mazes would be formed. One starts in the upper left corner of the screen while the other starts in the lower right. By POKEing a 32 ($20) in the center of the screen, identical (but opposite) mazes are formed. As one goes left, the other goes right. And as one goes down, the other goes up. This continues until the screen is full and the algorithm completed. The mazes are then linked together in the screen's middle and a "target" character is POKEd in the center.

Now, depending upon your choice of options during initialization, you race against a human opponent (or the computer) to the center of the maze. If you select the two-player option, I strongly recommend the use of joysticks. The program will process both player's joystick input during each cycle. On the keyboard, one player can prevent the other's input by holding a key pressed.

With the one-player version, you will always be on the right and use the right joystick or the number pad to control your movement. The computer will not begin until after your first input. Since the computer doesn't know the best path to follow, and strays down dead-end paths, it is easy to beat. My daughter loses just often enough to keep her interested and make each game a new challenge.

Through experimentation with the joysticks, I found that the left joystick sets the high four bits and the right joystick sets the low four bits of the byte at address 59471 ($E84F). The byte, A, can be separated into a left value and a right value with : A= PEEK(59471) : L= (A/16) AND 15 : R= A AND 15. If both joysticks are in the same position, L=R. An array with 15 elements can be used to determine the new position of each player, move there if not off the screen, and then erase the previous position. The following table shows all possible joystick values, positions, and screen movement offsets:

L or R	POSITION	OFFSET
0	not used	0
1	left/button	–1
2	right/button	+1
3	button	0
4	not used	0
5	left/up	–41
6	right/up	–39
7	up	–40
8	not used	0
9	left/down	+39
10	right/down	+41
11	down	+40
12	not used	0
13	left	–1
14	right	+1
15	center	0

Note: with the button pressed only the row can be determined.

Another feature of this program is the "flipping" of the marker that arrives in the center of the screen's maze first. This is performed by XORing the byte in the center screen address with 128 ($80). The result of an XOR with 128 is that RVS characters become normal characters and vice versa.

Since BASIC doesn't provide us with an XOR function, I consulted a Boolean Algebra text and found the AND, OR, and NOT gates used to produce the XOR truth table. In BASIC, XOR would be this : Y= ((X AND (NOT 128)) OR ((NOT X) AND 128)).

Program 1. Atari Version

Atari Notes

After the dual maze has been generated, select the number of players (player vs. computer or player vs. player) by pressing SELECT. When ready to play, press START. To re-start the game, press START. Use joysticks plugged into jacks one and two to play.

```
100 REM ***   MAZE RACE   ***
110 REM *** ATARI VERSION ***
120 DIM A(3):REM SET UP DIRECTION TABLE
130 A(0)=2:A(1)=-80:A(2)=-2:A(3)=80
140 WL=128:HL=0:SC=PEEK(88)+256*PEEK(89)
:A=SC+43:C=SC+877
150 GRAPHICS 0:POKE 752,1:SETCOLOR 2,INT
(16*RND(0)),4:POKE 712,PEEK(710)
160 FOR I=1 TO 23
```

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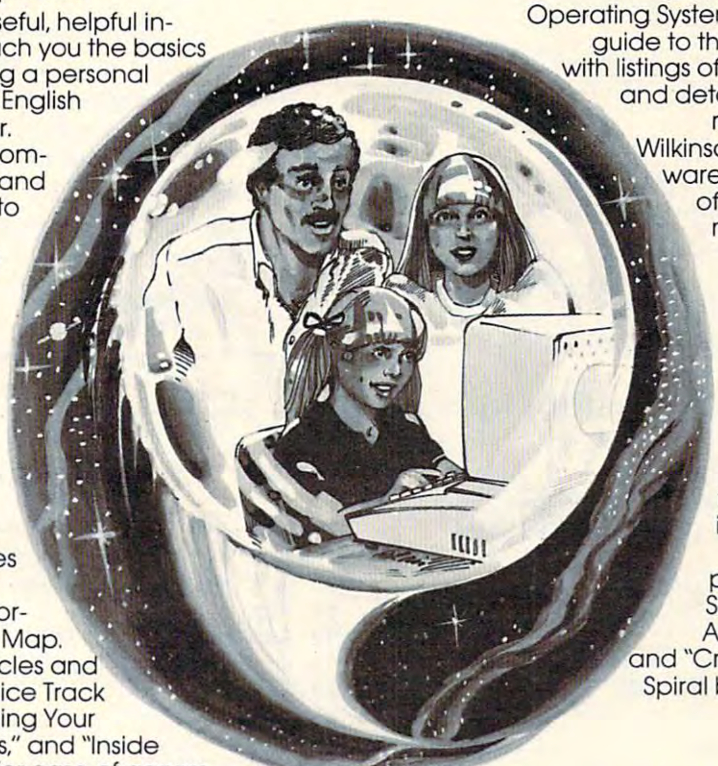

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```
170 PRINT "|
         |"
180 NEXT I
190 REM GENERATE THE MAZE!
200 POKE A,5:POKE C,2:POKE SC+499,HL
210 J=INT(RND(0)*4):X=J
220 B=A+A(J):D=C-A(J):IF PEEK(B)<>WL THE
N 240
230 POKE B,J+1:POKE D,J+1:POKE A+INT(A(J
)/2),HL:POKE C-INT(A(J)/2),HL:A=B:C=D:GO
TO 210
240 J=(J+1)*(J<3):IF J<>X THEN 220
250 J=PEEK(A):POKE A,HL:POKE C,HL:IF J<5
 THEN A=A-A(J-1):C=C+A(J-1):GOTO 210
260 A=SC+43:C=SC+877:J=2
270 POKE A,84:POKE C,111:POKE SC+459,10:
POKE SC+460,HL:POKE SC+458,HL
280 DIM M(15):FOR I=0 TO 15:M(I)=0:NEXT
I:NP=0
290 M(14)=-40:M(13)=40:M(11)=-1:M(7)=1:M
(10)=-41:M(6)=-39
300 M(9)=39:M(5)=41:PLR=1
310 DIM MS$(20):MS$="Maze Race":FOR I=1
TO LEN(MS$):POSITION 0,I+5:? MS$(I,I):NE
XT I
320 POSITION 9,23:? "One Player Vs. Comp
uter";
330 K=PEEK(53279):IF K=7 THEN 330
340 IF K=PEEK(53279) THEN 340
350 IF K=6 THEN 400
360 IF K=3 THEN 330
370 NP=1-NP:IF NP=0 THEN 320
380 POSITION 9,23:? "  Player Vs. Player
   ";
390 GOTO 330
400 PLR=1-PLR
410 IF PLR=0 OR NP THEN 440
420 B=A+INT(A(J)/2):Y=PEEK(B):IF Y=HL OR
 Y=10 THEN POKE B,84:POKE A,HL:A=B:J=(J+
2)-4*(J>1)
430 J=(J-1)+4*(J=0):GOTO 480
440 IF PLR THEN 470
450 D=C+M(STICK(PLR)):IF PEEK(D)=HL OR P
EEK(D)=10 THEN POKE D,111:POKE C,HL:C=D
460 GOTO 480
470 B=A+M(STICK(PLR)):IF PEEK(B)=HL OR P
EEK(B)=10 THEN POKE B,84:POKE A,HL:A=B
480 REM SOMEONE WON
490 IF A<>SC+459 AND C<>SC+459 THEN 400
500 P=PEEK(SC+459):PF=0
510 FOR I=1 TO 50:POKE SC+459,P+128*PF:P
F=1-PF:NEXT I
520 REM
530 IF C=SC+459 THEN 560
540 IF NP THEN POSITION 9,23:? "    Play
er 2 Won!    ";:GOTO 580
550 POSITION 9,23:? "        I WIN!
    ";:GOTO 580
560 IF NP THEN POSITION 9,23:? "    Playe
r 1 Won!    ";:GOTO 580
570 POSITION 9,23:? "       You win!
   ";
580 IF PEEK(53279)<>6 THEN 580
590 RUN
```

If you want to make Maze Race (for Atari) more challenging, add the following lines. They cause the screen to blank out during the maze generation, preventing a "sneak preview." A side effect is that this decreases the time necessary to generate the maze:

```
155 POKE 559,0
325 POKE 559,34
```

Program 2. Microsoft Version

```
10 REM *** MAZE RACE ***
20 REM * MIKE PETERSON *
30 REM ** CHEYENNE,WY **
40 REM
50 REM MAZE GENERATOR BY CHARLES BOND
60 REM COMPUTE! : DECEMBER, 1981
70 REM
80 GOTO120
90 POKE167,0
100 GETZ$:IFZ$=""THEN100
110 PRINTZ$:Z=VAL(Z$):POKE167,1:RETURN
120 PRINT"{CLEAR}{05 DOWN}":PRINTTAB(15)"MA
    ZE RACE{02 DOWN}"
130 PRINTTAB(5)"HOW MANY PEOPLE ARE PLAYING
     ?{LEFT}";:GOSUB90:NP=Z-1:PRINT
140 IFZ>2THENPRINTTAB(5)"SORRY, ONLY 2 CAN
    PLAY.{DOWN}":GOTO130
150 IFZ=0THENPRINTTAB(5)"PLEASE ENTER 1 OR
    2.{DOWN}":GOTO130
160 PRINTTAB(7)"ARE YOU USING JOYSTICKS ?{L
    LEFT}";:GOSUB90:PRINT
170 IFZ$="Y"THENJJ=1:GOTO190
180 IFZ$<>"N"THENPRINTTAB(7)"PLEASE ENTER Y
     OR N.{DOWN}":GOTO160
190 IFNPTHENPRINT"{DOWN}LEFT PLAYER = Q :RI
    GHT PLAYER = W":GOTO210
200 PRINT"{DOWN}I AM THE Q :YOU ARE THE W"
210 IFJJTHENPRINT"{DOWN}USE THE JOYSTICK TO
     MOVE AROUND":GOTO250
220 IFNPTHENPRINT"{DOWN}Q USES W FOR UP,A F
    OR LEFT,D FOR RIGHT,"
230 IFNPTHENPRINT"AND X FOR DOWN."
240 PRINT"{DOWN}W USES 8 FOR UP,4 FOR LEFT,
    6 FOR RIGHT, AND 2 FOR DOWN."
250 PRINT"{DOWN}PRESS ANY KEY TO BEGIN *{LE
    LEFT}";:GOSUB90
260 DIMM(255):JS=151:IFJJTHENJS=59471:GOTO2
    90
270 M(18)=40:M(42)=-1:M(41)=1:M(50)=-40
280 M(24)=40:M(48)=-1:M(47)=1:M(56)=-40:GOT
    O300
290 M(7)=-40:M(11)=40:M(13)=-1:M(14)=1
```

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```
300 DIMA(3):A(0)=2:A(1)=-80:A(2)=-2:A(3)=80
    :WL=160:HL=32:SC=32768
310 BL$="{REV}
              {OFF}"
320 A=SC+81:C=SC+917
330 PRINT"{CLEAR}":FORI=1TO23:PRINTBL$:NEXT

340 POKEA,4:POKEC,1:POKESC+499,HL
350 J=INT(RND(TI)*4):X=J
360 B=A+A(J):D=C-A(J):IFPEEK(B)<>WLTHEN380
370 POKEB,J:POKED,J:POKEA+A(J)/2,HL:POKEC-A
    (J)/2,HL:A=B:C=D:GOTO350
380 J=(J+1)*-(J<3):IFJ<>XTHEN360
390 J=PEEK(A):POKEA,HL:POKEC,HL:IFJ<4THENA=
    A-A(J):C=C+A(J):GOTO350
400 POKESC+498,HL:POKESC+499,42:POKESC+500,
    HL:A=SC+81:C=SC+917
410 POKEA,81:POKEC,87:J=2:K=2
420 PP=PEEK(JS):IFPP=255THEN420
430 PP=PEEK(JS)
440 IFNPTHEN470
450 B=A+A(J)/2:Y=PEEK(B):IFY=HLORY=42THENPO
    KEB,81:POKEA,HL:A=B:J=(J+2)+4*(J>1
    )
460 J=(J-1)-4*(J=0):GOTO510
470 IFJJTHEN500
480 IFPP<>24ANDPP<>48ANDPP<>47ANDPP<>56THEN
    520
490 B=A+M(PP):IFPEEK(B)=HLORPEEK(B)=42THENP
    OKEB,81:POKEA,HL:A=B:GOTO510
500 Q=(PP/16)AND15:B=A+M(Q):IFPEEK(B)=HLORP
    EEK(B)=42THENPOKEB,81:POKEA,HL:A=B

510 IFJJTHEN540
520 IFPP<>18ANDPP<>42ANDPP<>41ANDPP<>50THEN
    550
530 D=C+M(PP):IFPEEK(D)=HLORPEEK(D)=42THENP
    OKED,87:POKEC,HL:C=D:GOTO550
540 Q=(PPAND15):D=C+M(Q):IFPEEK(D)=HLORPEEK
    (D)=42THENPOKED,87:POKEC,HL:C=D
550 IFA<>SC+499ANDC<>SC+499THEN430
560 FORI=0TO99:W=PEEK(SC+499):X=(WAND(NOT12
    8))OR((NOTW)AND128):POKESC+499,X
570 NEXT
580 PRINT"ANOTHER GAME ?{LEFT}";:GOSUB90
590 IFZ$="Y"THEN320
600 IFZ$<>"N"THENPRINT"{02 UP}":GOTO580
```

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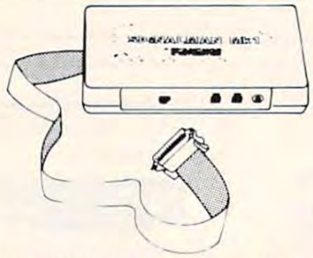

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Test RAM For Bad Bits, Nondestructively

Leo J. Scanlon
Inverness, FL

In a recent article in this magazine (**COMPUTE!**, April, 1981 #23) I presented a 6502 assembly language program that tests the integrity of a selected portion of RAM. That program was designed to detect "dead" bits or bytes, pattern sensitivity, crosstalk, and a variety of other error conditions. It could also be used to detect soft errors, in which the memory accepts the test data, but reverts back to its previous state after some period of time.

As useful as it is, that program has one possible shortcoming: it clobbers the contents of the portion of memory being tested. Clearly, that doesn't matter if you are just verifying a newly installed memory board, but is unacceptable if a program or some data is sitting within the test area. In this article, I present another kind of program, one that performs a *nondestructive* test on RAM memory. That is, a program that alters memory, but subsequently restores all locations to their previous (pre-test) values.

The Test Algorithm

Essentially, the test program described here validates RAM by comparing the actual contents of memory to the known data that should be contained within it. To make this comparison, the program uses a method that is often employed for testing punched paper tape and read only memories (ROMs) – the *checksum*. A checksum is that value produced by taking the exclusive-OR of all bytes in test memory (see box).

Briefly, here is the sequence of operations for the test program:

1. Calculate a checksum value for the entire range of test memory, by exclusive-ORing all bytes.

2. Invert the state of the first bit in test memory – Bit 7 of the "start" location – but leave all other bits unchanged.

3. Calculate a new checksum value.

4. Invert the state of the altered bit position in the new checksum.

5. Compare the new (altered) checksum with the initial checksum.

6. The result of this comparison can cause either of two things to take place:

If the checksums are different, the program jumps to an error routine, to print out the bit position and address of the bad bit.

If the checksums are identical, the program restores the state of the test bit – by reinverting it – then branches back to Step 2, to test the next bit (Bit 6 of the "start" location).

This process continues until all bits have been tested, or until a mismatch is detected.

Will this nondestructive test program catch all of the fault conditions that can be detected by the previously published destructive test program? Probably not all of them. The nondestructive test program will not detect pattern sensitivity or soft errors (unless you modify the program to include a time delay), but it should be able to detect most other types of errors.

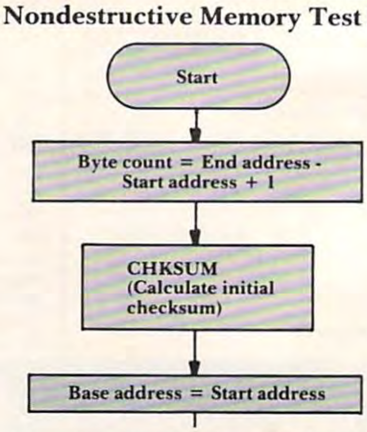
Program Flowchart

Now that you understand *what* the test program must do, and know *how* the program will do it, it's time to look at the structure of the program itself. This program is comprised of three parts: a main program loop, a checksum calculating subroutine and an error printout routine.

A flowchart for the main program loop is shown in Figure 1. As you can see, this flowchart is nothing more than a detailed version of the algorithm we defined in preceding Steps 1 through 6. The program begins by calculating the byte count, then calls the checksum subroutine (CHKSUM) to generate the initial value of the checksum. This done, the base address and byte index are initialized to reference the first byte in test memory.

Next, the bit mask index is initialized to reference the most significant bit, Bit 7. With this initialization out of the way, the program inverts the current test bit. The first time through the loop, this will be Bit 7 of the Start location. Now the

Figure 1: Nondestructive Memory Test Program



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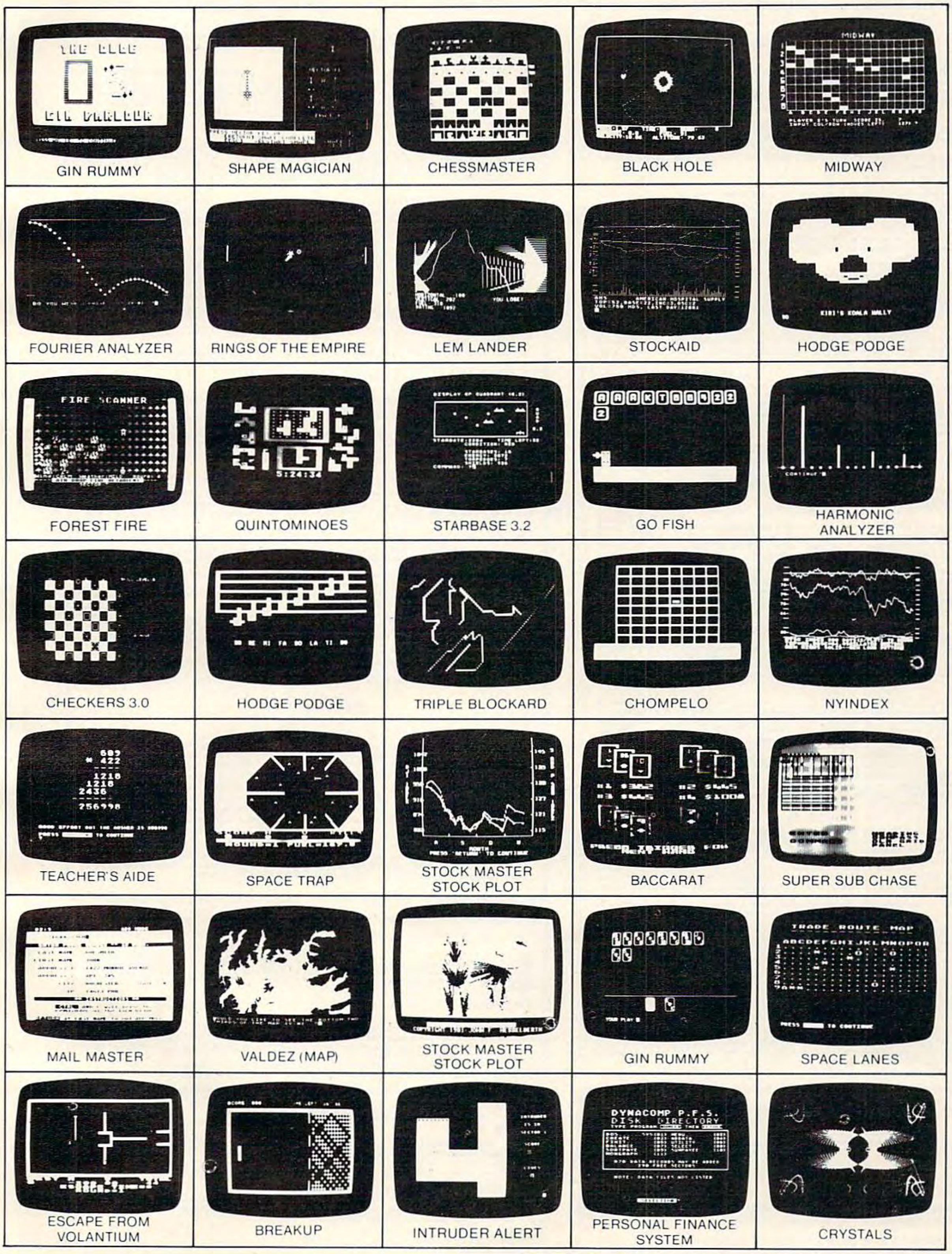

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DYNACOMP'S previous BRIDGE 2.0 customers may upgrade to BRIDGE MASTER for a nominal charge of $5.00 plus postage and handling (see ordering information box).

NEW
BACCARAT (Atari only) — Price $18.95 Cassette/$22.95 Diskette
This is the European card game which is the favorite of the Monte Carlo jet set. Imagine yourself at the gaming table with 007 to your left and Goldfinger to your right. Learn and play BACCARAT at your leisure on the Atari. Contains full high resolution color graphics and matching sound. Runs in 16K. Requires one joystick.

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POKER PARTY (Available for all computers) — Price: $19.95 Cassette/$23.95 Diskette
POKER PARTY is a draw poker simulation based on the book, POKER, by Oswald Jacoby. This is the most comprehensive version available for microcomputers. The party consists of yourself and six other (computer) players. Each of these players (you will get to know them) has a different personality in the form of a varying propensity to bluff or fold under pressure. Practice with POKER PARTY before going to that expensive game tonight! Apple cassette and diskette versions require a 32 K (or larger) Apple II.

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GO FISH (Available for all computers) — Price: $14.95 Cassette/$18.95 Diskette
GO FISH is a classic children's card game. The opponent is a friendly computer with user inputs that are simple enough for small children to easily master. The Apple and Atari versions employ high resolution graphics for the display of hands. A must for children! Runs in 16K.

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BLACKJACK COACH (32K TRS-80 only) — Price: $29.95 Cassette/$33.95 Diskette
BLACKJACK COACH is both a game and an educational tool. With this program you may quantitatively test standard and special playing and betting methods, including the several card count schemes. You can simply play, play with the computer as a coach, or statistically test your method under long run automatic play. All the standard player choices are included: insurance, splitting pairs, double downs and surrender (optional). The computer analyzes the technique and provides detailed summary reports which statistically pinpoint the strengths and weaknesses of your play. Don't risk your money at the tables until you have practiced with BLACKJACK COACH!

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MANAGEMENT SIMULATOR (Available for all computers) — Price: $25.95 Cassette / $29.95 Diskette
This program is both an excellent teaching tool as well as a stimulating intellectual game. Based upon similar games played at graduate business schools, each player or team controls a company which manufacturers three products. Each player attempts to outperform his competitors by setting selling prices, production volumes, marketing and design expenditures etc. The most successful firm is the one with the highest stock price when the simulation ends.

FLIGHT SIMULATOR (Available for all computers) — Price: $19.95 Cassette/$23.95 Diskette
A realistic and extensive mathematical simulation of take-off, flight and landing. The program utilizes aerodynamic equations and the characteristics of a real airfoil. You can practice instrument approaches and navigation using radials and compass headings. The more advanced flyer can also perform loops, half-rolls and similar aerobatic maneuvers. Although this program does not employ graphics, it is exciting and very addictive. See the software review in COMPUTRONICS. Runs in 16K Atari.

VALDEZ (Available for all computers) — Price: $17.95 Cassette/$21.95 Diskette
VALDEZ is a computer simulation of supertanker navigation in the Prince William Sound/Valdez Narrows region of Alaska. Included in this simulation is a realistic and extensive 256 × 256 element map, portions of which may be viewed using the ship's alphanumeric radar display. The motion of the ship itself is accurately modelled mathematically. The simulation also contains a model for the tidal patterns in the region, as well as other traffic (outgoing tankers and drifting icebergs). Chart your course from the Gulf of Alaska to Valdez Harbor! See the software reviews in 80 Software Critique and Personal Computing.

NEW
BACKGAMMON 2.0 (Available for all computers) — Price: $19.95 Cassette/$23.95 Diskette
This program tests your backgammon skills and will also improve your game. A human can compete against a computer or against another human. The computer can even play against itself. Either the human or the computer can double or generate dice rolls. Board positions can be created or saved for replay. BACKGAMMON 2.0 plays in accordance with the official rules of backgammon and is sure to provide many fascinating sessions of backgammon play.

CHESS MASTER (North Star and TRS-80 only) — Price: $19.95 Cassette/$23.95 Diskette
This complete and very powerful program provides five levels of play. It includes castling, en passant captures and the promotion of pawns. Additionally, the board may be preset before the start of play, permitting the examination of "book" plays. To maximize execution speed, the program is written in assembly language (by SOFTWARE SPECIALISTS of California). Full graphics are employed in the TRS-80 version, and two widths of alphanumeric display are provided to accommodate North Star users. See review in onComputing.

FOREST FIRE! (Atari only) — Price: $14.95 Cassette/$18.95 Diskette
Using excellent graphics and sound effects, this simulation puts you in the middle of a forest fire. Your job is to direct operations to put out the fire while compensating for changes in wind, weather and terrain. Not protecting valuable structures can result in startling penalties. Life-like variables are provided to make FOREST FIRE! very suspenseful and challenging. No two games have the same setting and there are 3 levels of difficulty.

BLACK HOLE (Apple only) — Price: $15.95 Cassette/$19.95 Diskette
This is an exciting graphical simulation of the problems involved in closely observing a black hole with a space probe. The object is to enter and maintain, for a prescribed time, an orbit close to a small black hole. This is to be achieved without coming so near the anomaly that the tidal stress destroys the probe. Control of the craft is realistically simulated using side jets for rotation and main thrusters for acceleration. This program employs Hi-Res graphics and is educational as well as challenging.

NEW
SPACE EVACUATION! (Available for all computers) — Price: $15.95 Cassette/$19.95 Diskette
Can you colonize the galaxy and evacuate the Earth before the sun explodes? Your computer becomes the ship's computer as you explore the universe to relocate millions of people. This simulation is particularly interesting as it combines many of the exciting elements of classic space games with the mystery challenge of ADVENTURE.

MONARCH (Atari only) — Price: $14.95 Cassette/$18.95 Diskette
MONARCH is a fascinating economic simulation requiring you to survive an 8-year term as your nation's leader. You determine the amount of acreage devoted to industrial and agricultural use, how much food to distribute to the populace and how much should be spent on pollution control. You will find that all decisions involve a compromise and that it is not easy to make everyone happy. Runs in 16K Atari.

CHOMPELO (Atari only) — Price: $14.95 Cassette/$18.95 Diskette
CHOMPELO is really two challenging games in one. One is similar to NIM; you must bite off part of a cookie, but avoid taking the poisoned portion. The other game is the popular board game REVERSI. It fully uses the Atari's graphics capability, and is hard to beat. This package will run on a 16K system.

AVAILABILITY

DYNACOMP software is supplied with complete documentation containing clear explanations and examples. Unless otherwise specified, all programs will run within 16K program memory space (ATARI requies 24K). Except where noted, programs are available on ATARI, PET, TRS-80 (Level II), NEC and Apple (Applesoft) cassette and diskette as well as North Star single density (double density compatible) diskette. Additionally, most programs can be obtained on standard (IBM 3740 single density/double density compatible format) 8" CP/M floppy disks for systems running under MBASIC or CBASIC (for example, Altos, Xerox 820, Heath/Zenith and many others). 5¼" CP/M diskettes are available for the North Star, SuperBrain and Osborne computer systems.

**ATARI, PET/CBM, NORTH STAR, CP/M, IBM, OSBORNE, SUPERBRAIN, NEC PC-8000 and XEROX are registered tradenames and/or trademarks.*
***Except where noted, all TRS-80 Model I software is available on cassette (only) for the TRS-80 Model III. Exceptions: VALDEZ, CRIBBAGE, GRAFIX, CHESSMASTER, TRS-80 diskettes are not supplied with either DOS or BASIC.*
****For most North Star disk-based systems.*
*****For Altair systems having Microsoft BASIC.*
******For SUPERBRAIN systems running under MBASIC or CBASIC (state which).*

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STARBASE 3.2 (Available for all computers) — Price: $13.95 Cassette/$17.95 Diskette
This is the classic space simulation, but with several new features. For example, the Croylins now shoot at the Invincible without warning while also attacking starbases in other quadrants. The Croylins also attack with both light and heavy cruisers and move when shot at! The situation is hectic when the Invincible is besieged by three heavy cruisers and a starbase S.O.S. is received! The Croylins get even! See the software reviews in A.N.A.L.O.G., 80 Software Critique and Game Merchandising.

NEW
LIL' MEN FROM MARS (Atari only) — Price: $19.95 Cassette/$23.95 Diskette
Defend yourself! The little men from Mars are out to get you if you don't get them first. This is a hilarious high resolution animated graphics (arcade) game which exercises much of the Atari's power. Requires one joystick.

SPACE TILT (Apple and Atari only) — Price: $14.95 Cassette/$18.95 Diskette
Use the game paddles to tilt the plane of the TV screen to "roll" a ball into a hole in the screen. Sound simple? Not when the hole gets smaller and smaller! A built-in timer allows you to measure your skill against others in this habit-forming action game.

NEW
ESCAPE FROM VOLANTIUM (Atari only) — Price: $15.95 Cassette/$19.95 Diskette
Bring the action and excitement of an arcade into your home with ESCAPE FROM VOLANTIUM! To escape you must maneuver your space ship around obstacles and laser blast the guardian (without being eaten). If he is killed with a direct shot (not just a leg lopped off), a door opens to the outside. However, the door does not stay open indefinitely. If you fail to escape in time, the door closes and a new guardian appears. Sometimes you can smash through the door by repeatedly chipping away at it. Other times it is impervious. At the higher levels of play more obstacles and guardians appear, adding to the excitement. Uses high resolution graphics and sound. Runs in 16K.

ALPHA FIGHTER (Atari only) — Price: $13.95 Cassette/$17.95 Diskette
Two excellent graphics and action programs in one! ALPHA FIGHTER requires you to destroy the alien starships passing through your sector of the galaxy. ALPHA BASE is in the path of an alien UFO invasion; let five UFO's get by and the game ends. Both games require the joystick and get progressively more difficult the higher you score! ALPHA FIGHTER will run on 16K systems.

THE RINGS OF THE EMPIRE (Atari only) — Price: $14.95 Cassette/$18.95 Diskette
The empire has developed a new battle station protected by rotating rings of energy. Each time you blast through the rings and destroy the station, the empire develops a new station with more protective rings. This exciting game runs on 16K systems, employs extensive graphics and sound and can be played by one or two players.

INTRUDER ALERT (Atari only) — Price: $15.95 Cassette/$19.95 Diskette
This is a fast paced graphics game which places you in the middle of the "Dreadstar" having just stolen its plans. The droids have been alerted and are directed to destroy you at all costs. You must find and enter your ship to escape with the plans. Five levels of difficulty are provided. INTRUDER ALERT requires a joystick and will run on 16K systems.

NEW
MIDWAY (Atari 32K only) — Price: $14.95 Cassette/$18.95 Diskette
MIDWAY is an exciting extension of the game of Battleship. It mixes the challenges of strategy and chance. Your opponent can be another human or the computer. Color graphics and sound are both included. Runs in 16K.

TRIPLE BLOCKADE (Atari only) — Price: $14.95 Cassette/$18.95 Diskette
TRIPLE BLOCKADE is a two-to-three player graphics and sound action game. It is based on the classic video arcade game which millions have enjoyed. Using the Atari joysticks, the object is to direct your blockading line around the screen without running into your opponent(s). Although the concept is simple, the combined graphics and sound effect lead to "high anxiety".

GAMES PACK I (Available for all computers) — Price: $14.95 Cassette/$18.95 Diskette
GAMES PACK I contains the classic computer games of BLACKJACK, LUNAR LANDER, CRAPS, HORSERACE, SWITCH and more. These games have been combined into one large program for ease in loading. They are individually accessed by a convenient menu. This collection is worth the price just for the DYNACOMP version of BLACKJACK.

GAMES PACK II (Available for all computers) — Price: $14.95 Cassette/$18.95 Diskette
GAMES PACK II includes the games CRAZY EIGHTS, JOTTO, ACEY-DUCEY, LIFE, WUMPUS and others. As with GAMES PACK I, all the games are loaded as one program and are called from a menu. You will particularly enjoy DYNACOMP's version of CRAZY EIGHTS.

Why pay $7.95 or more per program when you can buy a DYNACOMP collection for just $10.95?

NEW
MOON PROBE (Available for all computers) — Price: $12.95 Cassette/$16.95 Diskette
This is an extremely challenging "lunar lander" program. The user must drop from orbit to land at a predetermined target on the moon's surface. You control the thrust and orientation of your craft plus direct the rate of descent and approach angle. Runs in 16K Atari.

SPACE TRAP (Atari only, 16K) — Price: $14.95 Cassette/$18.95 Diskette
This galactic "shoot'em up" arcade game places you near a black hole. You control your spacecraft using the joystick and attempt to blast as many of the alien ships as possible before the black hole closes about you.

CHIRP INVADERS (PET/CBM only) — Price: $14.95 Cassette/$18.95 Diskette
CHIRP INVADERS is an addictive game using action graphics. A Federation space station must be reached before the Chirps conquer the Earth. Stationary obstacles, moving meteors, and the attacking Chirps must all be avoided for a successful journey. Good luck. 40 column PET/CBM only.

NEW
SUPER SUB CHASE (Atari only) — Price: $19.95 Cassette/$23.95 Diskette
SUPER SUB CHASE simulates a search and destroy mission. Set your course and keep an eye on the sonar readings as you hunt for the hidden submarine. Set the depth charge explosion depth and watch them sink towards the sub. This is an addictive game which takes advantage of the Atari's graphics and sound capabilities. One or two players. Joystick(s) required.

ADVENTURE

CRANSTON MANOR ADVENTURE (North Star, SuperBrain and CP/M only) — Price: $19.95 Diskette
At last! A comprehensive Adventure game for North Star and CP/M systems. CRANSTON MANOR ADVENTURE takes you into mysterious CRANSTON MANOR where you attempt to gather fabulous treasures. Lurking in the manor are wild animals and robots who will not give up the treasures without a fight. The number of rooms is greater and the associated descriptions are much more elaborate than the current popular series of Adventure programs, making this game the top in its class. Play can be stopped at any time and the status stored on diskette. Not available in 5¼" CP/M format.

GUMBALL RALLY ADVENTURE (North Star only, 48K) — Price: $21.95 Diskette
Take part in this outlaw race from the east coast to the west coast. The goal is to find your way to the finish line while maintaining the highest possible speed. You may choose one of five cars available at the garage. The choice will affect your speed and range. Remember to take spare parts and don't get caught speeding!

UNCLE HARRY'S WILL (North Star only, 40K) — Price: $24.95 Diskette
Uncle Harry has died and has left you everything. However, he has neglected to mention where everything is! Instead, his will consists of a poem which contains clues. You will have to travel all over the United States both by car and on foot to solve the puzzle, and there are over 300 locations to probe. Be careful and watch out for red herrings!

TYPE 'N' TALK

DYNACOMP is now distributing the new and revolutionary TYPE-'N-TALK™ (TNT) speech synthesizer from Votrax. Simply connect TNT to your computer's serial interface, enter text from the keyboard and hear the words spoken. TNT is the easiest-to-program speech synthesizer on the market. It uses the least amount of memory and provides the most flexible vocabulary available anywhere!

TYPE-'N'-TALK List price $375. DYNACOMP'S price $319.95 plus $5.00 for shipping and handling.

TALK TO ME (T'N'T Atari only, 24K) — Price: $14.95 Cassette/$18.95 Diskette
This program presents a superb tutorial on speech synthesis using the Atari 800 and TYPE 'N TALK™. TALK TO ME will illustrate normal word generation as well as phoneme generation. The documentation includes many helpful programming tips. TALK TO ME has been demonstrated on network (CBS) TV!
OTHER T'N'T PROGRAMS: MOON PROBE. TNT, CHOMPELO. TNT

MISCELLANEOUS

CRYSTALS (Atari only) — Price: $14.95 Cassette/$18.95 Diskette
A unique algorithm randomly produces fascinating graphics displays accompanied with tones which vary as the patterns are built. No two patterns are the same, and the combined effect of the sound and graphics are mesmerizing. CRYSTALS has been used in local stores to demonstrate the sound and color features of the Atari. Runs in 16K Atari.

NORTH STAR SOFTWARE EXCHANGE (NSSE) LIBRARY
DYNACOMP now distributes the 23 volume NSSE library. These diskettes each contain many programs and offer an outstanding value for the purchase price. They should be part of every North Star user's collection. Call or write DYNACOMP for details regarding the contents of the NSSE collection.
Price: $9.95 each/$8.95 each (4 or more)
The complete collection may be purchased for $159.95

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BUSINESS and UTILITIES

NEW **MAILMASTER (Atari diskette only)** — Price: $39.95 Diskette

MAILMASTER is a very versatile software package for managing and manipulating mail lists and mini data bases. Each disk can hold over 600 customer entries containing name, address, 38 letter key words and a phone number. The display is marked so that entries may be made and edited with ease. The status (e.g., disk space left, options, etc.) is shown at all times. Labels may be printed 1,2 or 3 up, and all sorting (zip code and alphabetic) is performed by a fast machine language program.

NEW **PERSONAL FINANCE SYSTEM (Available for all computers)** — Price: $39.95 Diskette

PFS is a single diskette, menu-oriented system composed of ten different programs. Besides recording your expenses and tax deductible items, PFS will sort and summarize expenses by payee, and display information on expenditures by any of 26 user defined codes by month or by payee. PFS will even produce monthly bar graphs of your expenses by category! This powerful package requires only one disk drive, minimal memory (24K Atari, 32K North Star) and will store up to 600 records per disk (and over 1000 records per disk by making a few simple changes to the programs). You can record checks plus cash expenses so that you can finally see where your money goes and eliminate guesswork and tedious hand calculations. Contains high speed machine language sort. PFS has been demonstrated on network (CBS) TV!

FAMILY BUDGET (Apple and Atari only) — Price: $34.95 Diskette

FAMILY BUDGET is a very convenient financial record-keeping program. You will be able to keep track of cash and credit expenditures as well as income on a daily basis. You can record tax deductible items and charitable donations. FAMILY BUDGET also provides a continuous record of all credit transactions. You can make daily cash and charge entries to any of 21 different expense accounts as well as to 5 payroll and tax accounts. Data are easily retrieved giving the user complete control over an otherwise complicated (and unorganized!) subject.

INTELINK (Atari only) — Price: $49.95 Diskette

This software package contains a menu-driven collection of programs for facilitating efficient two-way communications through a full duplex modem (required for use). In one mode of operation you may connect to a data service (e.g., The SOURCE or MicroNet) and quickly load data such as stock quotations onto your diskette for later viewing. This greatly reduces "connect time" and thus the service charge. You may also record the complete contents of a communications session. Additionally, programs written in BASIC, FORTRAN, etc. may be built off-line using the support text editor and later "uploaded" to another computer, making the Atari a *very* smart terminal. Even Atari BASIC programs may be uploaded. Further, a command file may be built off-line and used later as controlling input for a time-share system. That is, you can set up your sequence of time-share commands and programs, and the Atari will transmit them as needed; batch processing. All this adds up to saving both connect time and your time.

NEW **PAYFIVE (Apple II plus diskette, two drives required)** — Price: $149.95

This is an enormously flexible employee payroll system with extraordinarily good human engineering features. PAYFIVE prints checks and compiles the required federal, state and local forms for up to 148 employees. The pay methods may be hourly, salary, commission or any combination. There are multiple options for pay periods, and they also can be used in any combination. PAYFIVE includes *many* other features and comes extremely well documented with a 200 page manual. The manual may be purchased separately for $30, and that payment later applied to the software purchase.

SHOPPING LIST (Atari only) — Price: $12.95 Cassette/$16.95 Diskette

SHOPPING LIST stores information on items you purchase at the supermarket. Before going shopping, it will remind you of all the things you might need, and then display (or optionally print) your shopping list and the total cost. Adding, deleting, changing and storing data is very easy. Runs with 16K.

NEW **TAX OPTIMIZER (Available for all computers)** — Price: $59.95 Diskette

The TAX OPTIMIZER is an easy-to-use, menu oriented software package which provides a convenient means for analyzing various income tax strategies. The program is designed to provide a quick and easy data entry. Income tax is computed by all tax methods (regular, income averaging, maximum and alternate minimum tax). The user may immediately observe the tax effect of critical financial decisions. TAX OPTIMIZER has been thoroughly field tested in CPA offices and comes complete with the current tax tables in its data files. TAX OPTIMIZER is tax deductible!

NEW **UTIL (Apple only, 48K)** — Price: $19.95 Diskette

UTIL is a disk-oriented utility system which permits examining and changing of the contents of DOS 3.2 and 3.3 diskettes at the bit (nibble or byte) level. With UTIL you can easily examine the contents of a diskette sector by sector, restructure the sector pointers, reallocate sectors (e.g. bad sectors may be "hidden"), and perform many other sophisticated operations. For the experienced programmer.

NEW **TURNKEY AND MENU (Atari only)** — Price: $17.95 Diskette

TURNKEY is a utility program which allows you to create autoboot/autorun diskettes easily. Simply load and run TURNKEY, load the program diskette to be modified, and answer the questions! The TURNKEY diskette also comes with DOS 2.0 and includes another program, MENU. MENU lists the contents of your diskette alphabetically, and permits the running of any BASIC program on the diskette by typing a single key. TURNKEY and MENU provide you with the ability to run any program on your diskette by simply turning on the computer and pressing a single key.

NEW **STOCKAID (Atari only)** — Price: $29.95 Diskette

STOCKAID provides a powerful set of tools for stock market analysis. With STOCKAID you can display point and figure charts, as well as bar charts with oscillators. You can also examine long term moving averages and on-balance volume features. STOCKAID allows you to input daily data with a single diskette storage capability of 239 days × 16 stocks. Included are stock dividend and split adjustment capabilities. A very professional package!

NEW **SHAPE MAGICIAN (Apple II, 48K, diskette only)** — Price: $29.95

At last! An utility for painlessly creating graphics shapes for the Apple. Create, edit and save up to 30 shapes which can then be used to develop arcade games or to simply enhance your programs. Add that professional touch!

EDUCATION

HODGE PODGE (Apple 48K and Atari diskette only) — Price: $14.95 Cassette/$18.95 Diskette

Let HODGE PODGE be your child's teacher. Pressing any key on your Apple will result in a different and intriguing "happening" related to the letter or number of the chosen key. The program's graphics, color and sound are a delight for children from ages 1½ to 7. HODGE PODGE is a non-intimidating teaching device which brings a new dimension to the use of computers in education. See the excellent reviews of this very popular program in INFOWORLD and SOFTALK.

NEW **TEACHERS' AIDE (Atari only)** — Price: $13.95 Cassette/$17.95 Diskette

TEACHERS' AIDE consists of three basic modules contained in one program. The first module provides addition and subtraction exercises of varying levels of difficulty. The second module consists of multiplication problems in which the student may be tested both on the final answer and/or on the subtotal answers in the long hand procedure. Several levels of complexity are provided here as well. The third module consists of division problems; one particularly nice feature of the division module is that the long hand division steps can be displayed along with the remainder in order to clearly demonstrate the procedure by which the remainder is derived. Using TEACHER'S AIDE is not merely a drill, but rather a learning experience.

NEW **PHARMACOLOGY UPDATE (PET only)** — Price: $169.95 Cassette/$149.95 Diskette

This is DYNACOMP's first educational software entry for the medical profession (more are coming!). PHARMACOLOGY UPDATE was written by a R.N. as a masters project, with the aid of a practicing pharmacologist and an electronics instructor. This package comes in two parts. The first part is a 200 page manual which is divided into 11 sections. Each of these sections provides both concise information and probing questions. The second part consists of 11 programs that are keyed to the text and which test the degree of your understanding of the text material. This package has great educational value for the beginning student as well as the professional interested in an efficient way to review and update his or her knowledge. Available on cassettes (11) or diskette.

NEW **TEACHER'S GRADEBOOK (Apple 48K dual/single drive)** — Price: $49.95 Diskette

TEACHER'S GRADEBOOK is a *complete* password protected record-keeping system for the classroom. It supports up to nine users, and each user may have data for up to nine classes on one disk (with up to 90 students per class). Typical information which can be entered, edited and processed includes rosters, absences and grades. Summary reports may be displayed (on the screen) or printed in various ways, with automatic weighted averaging and conversion to letter grades. This system has been tested ("goof-proofed") in the class environment and is both well-written and well-documented.

ORDERING INFORMATION

All orders are processed and shipped within 48 hours. Please enclose payment with order and include the appropriate computer information. If paying by VISA or Master Card, include all numbers on card. Purchase orders accepted.

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8" CP/M Disks
Add $2.50 to the listed diskette price for each 8" floppy disk (IBM soft sectored CP/M format). Programs run under Microsoft MBASIC or BASIC-80.

5¼" CP/M Disks
All software available on 8" CP/M disks is also available on 5¼" disks, North Star and Osborne format.

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STATISTICS and ENGINEERING

DIGITAL FILTER (Available for all computers) — Price: $39.95 Cassette/$43.95 Diskette

DIGITAL FILTER is a comprehensive data processing program which permits the user to design his own filter function or choose from a menu of filter forms. In the explicit design mode the shape of the frequency transfer function is specified by directly entering points along the desired filter curve. In the menu mode, ideal low pass, high pass and bandpass filters may be approximated to varying degrees according to the number of points used in the calculation. These filters may optionally also be smoothed with a Hanning function. In addition, multi-stage Butterworth filters may be selected. Features of DIGITAL FILTER include plotting of the data before and after filtering, as well as display of the chosen filter functions. Also included are convenient data storage, retrieval and editing procedures.

DATA SMOOTHER (Not available for Atari) — Price: $19.95 Cassette/$23.95 Diskette

This special data smoothing program may be used to rapidly derive useful information from noisy business and engineering data which are equally spaced. The software features choice in degree and range of fit, as well as smoothed first and second derivative calculation. Also included is automatic plotting of the input data and smoothed results.

FOURIER ANALYZER (Available for all computers) — Price: $19.95 Cassette/$23.95 Diskette

Use this program to examine the frequency spectra of limited duration signals. The program features automatic scaling and plotting of the input data and results. Practical applications include the analysis of complicated patterns in such fields as electronics, communications and business.

TFA (Transfer Function Analyzer) — Price: $19.95 Cassette/$23.95 Diskette

This is a special software package which may be used to evaluate the transfer functions of systems such as hi-fi amplifiers and filters by examining their response to pulsed inputs. TFA is a major modification of FOURIER ANALYZER and contains an engineering-oriented decibel versus log-frequency plot as well as data editing features. Whereas FOURIER ANALYZER is designed for educational and scientific use, TFA is an engineering tool. Available for all computers.

HARMONIC ANALYZER (Available for all computers) — Price: $24.95 Cassette/$28.95 Diskette

HARMONIC ANALYZER was designed for the spectrum analysis of repetitive waveforms. Features include data file generation, editing and storage/retrieval as well as data and spectrum plotting. One particularly unique facility is that the input data need not be equally spaced or in order. The original data is sorted and a cubic spline interpolation is used to create the data file required by the FFT algorithm.

FOURIER ANALYZER, TFA and HARMONIC ANALYZER may be purchased together for a combined price of $51.95 (three cassettes) and $63.95 (three diskettes).

REGRESSION I (Available for all computers) — Price: $19.95 Cassette/$23.95 Diskette

REGRESSION I is a unique and exceptionally versatile one-dimensional least squares "polynomial" curve fitting program. Features include very high accuracy; an automatic degree determination option; an extensive internal library of fitting functions; data editing; automatic data, curve and residual plotting; a statistical analysis (eg: standard deviation, correlation coefficient, etc.) and much more. In addition, new fits may be tried without reentering the data. REGRESSION I is certainly the cornerstone program in any data analysis software library.

REGRESSION II (Available for all computers) — Price: $19.95 Cassette/$23.95 Diskette

PARAFIT is designed to handle those cases in which the parameters are imbedded (possibly nonlinearly) in the fitting function. The user simply inserts the functional form, including the parameters (A(1), A(2), etc.) as one or more BASIC statement lines. Data, results and residuals may be manipulated and plotted as with REGRESSION I. Use REGRESSION I for polynomial fitting, and PARAFIT for those complicated functions.

MULTILINEAR REGRESSION (MLR) (Available for all computers) — Price $24.95 Cassette/$28.95 Diskette

MLR is a professional software package for analyzing data sets containing two or more linearly independent variables. Besides performing the basic regression calculation, this program also provides easy to use data entry, storage, retrieval and editing functions. In addition, the user may interrogate the solution by supplying values for the independent variables. The number of variables and data size is limited only by the available memory.

REGRESSION I, II and MULTILINEAR REGRESSION may be purchased together for $51.95 (three cassettes) or $63.95 (three diskettes).

ANOVA (Not available on Atari cassette or for PET/CBM) — Price: $39.95 Cassette/$43.95 Diskette

In the past the ANOVA (analysis of variance) procedure has been limited to the large mainframe computers. Now DYNACOMP has brought the power of this method to small systems. For those conversant with ANOVA, the DYNACOMP software package includes the 1-way, 2-way and N-way procedures. Also provided are the Yates 2^{K-P} factorial designs. For those unfamiliar with ANOVA, do not worry. The accompanying documentation was written in a tutorial fashion (by a professor in the subject) and serves as an excellent introduction to the subject. Accompanying ANOVA is a support program for building the data base. Included are several convenient features including data editing, deleting and appending.

BASIC SCIENTIFIC SUBROUTINES, Volumes 1 and 2 (Not available for Atari)

DYNACOMP is the exclusive distributor for the software keyed to the popular texts *BASIC SCIENTIFIC SUBROUTINES, Volumes 1 and 2* by F. Ruckdeschel (see advertisements in BYTE magazine). These subroutines have been assembled according to chapter. Included with each collection is a menu program which selects and demonstrates each subroutine.

Volume 1
Collection #1: Chapters 2 and 3 - Data and function plotting; complex variables and functions.
Collection #2: Chapter 4 - Extended matrix and vector operations.
Collection #3: Chapters 5 and 6 - Random number generators (Poisson, Gaussian, etc.); series approximations.
Price per collection: $16.95 Cassette/$20.95 Diskette
All three collections are available for $44.95 (three cassettes) and $53.95 (three diskettes).

Volume 2
Collection #1: Chapter 1 - Linear, polynomial, multidimensional, parametric least squares.
Collection #2: Chapter 2 - Series approximation techniques (economization, inversion, reversion, shifting, etc.).
Collection #3: Chapter 3 - Functional approximations by iteration and recursion.
Collection #4: Chapter 4 - CORDIC approximations to trigonometric, hyperbolic, exponential and logarithmic functions.
Collection #5: Chapter 5 - Table interpolation, differentiation and integration (Newton, LaGrange, splines).
Collection #6: Chapter 6 - Methods for finding the real roots of functions.
Collection #7: Chapter 7 - Methods for finding the complex roots of functions.
Collection #8: Chapter 8 - Optimization by steepest descent.
Price per collection: $14.95 Cassette/$18.95 Diskette

All eight collections are available for $99.95 (eight cassettes) and $129.95 (eight diskettes).
Because the texts are a vital part of the documentation, *BASIC SCIENTIFIC SUBROUTINES, Volumes 1 and 2* are available from DYNACOMP:

BASIC SCIENTIFIC SUBROUTINES, Vol 1 (319 pages): $19.95 + 75¢ postage
BASIC SCIENTIFIC SUBROUTINES, Vol 2 (790 pages): $23.95 + $1.50 postage

See reviews in KILOBAUD and Dr. Dobbs.

NEW **SOFTNET (Apple II, 48K, diskette only)** — Price: $129.95

SOFTNET may be used to create models of liquid pipeline systems to evaluate their flow performance. Up to 150 nodes with up to 150 connecting elements may be simulated, and models may be combined to form yet larger models. If you are involved in water distribution systems, chemical fluid flow problems, building plumbing, or similar situations, this is an ideal analysis tool.

NEW **MATCHNET (TRS-80 only)** — Price: $19.95 Cassette/$23.95 Diskette

It often takes days to iteratively optimize an L, Pi or T matching network for a particular application. Take a few minutes with MATCHNET and you will have the Q, frequency response and reflection coefficients for any of twelve matching networks. You input the source and load impedance and MATCHNET calculates the R, C, (and L) values and plots (and/or prints) the frequency response and reflection coefficients for each configuration. The reviewer of this program remembers when he use to do this by hand and loves MATCHNET!

ACTIVE CIRCUIT ANALYSIS (ACAP) (48K Apple only) — Price: $35.95 Cassette/$39.95 Diskette

With ACAP you may analyze the response of an active or passive component circuit. The circuit may be probed at equal steps in frequency, and the resulting complex voltages at each component juncture examined; the frequency response of a filter or amplifier may be completely determined with respect to both amplitude and phase. In addition, ACAP prints a statistical analysis of the range of voltage responses which result from tolerance variations in the components. ACAP is easy to learn and use. Circuit descriptions may be saved onto cassette or diskette to be recalled at a later time for execution or editing. ACAP should be part of every circuit designer's program library.

LOGIC SIMULATOR (Apple only; 48K RAM) — Price: $35.95 Cassette/$39.95 Diskette

Test your complicated digital logic design with respect to given set of inputs to determine how well the circuit will operate. The elements which may be simulated include multiple input AND, OR, NOR, EXOR, EXNOR and NAND gates, as well as inverters, J-K and D flip-flops, and one-shots. Inputs may be clocked in with varying clock cycle lengths/displacements and delays may be introduced to probe for glitches and race conditions. A timing diagram for any given set of nodes may be plotted using HIRES graphics. Save your breadboarding until the circuit is checked by LOGIC SIMULATOR.

NEW **NUMBERKRUNCHER (TRS-80 only)** — Price:69.95 Cassette/$73.95 Diskette

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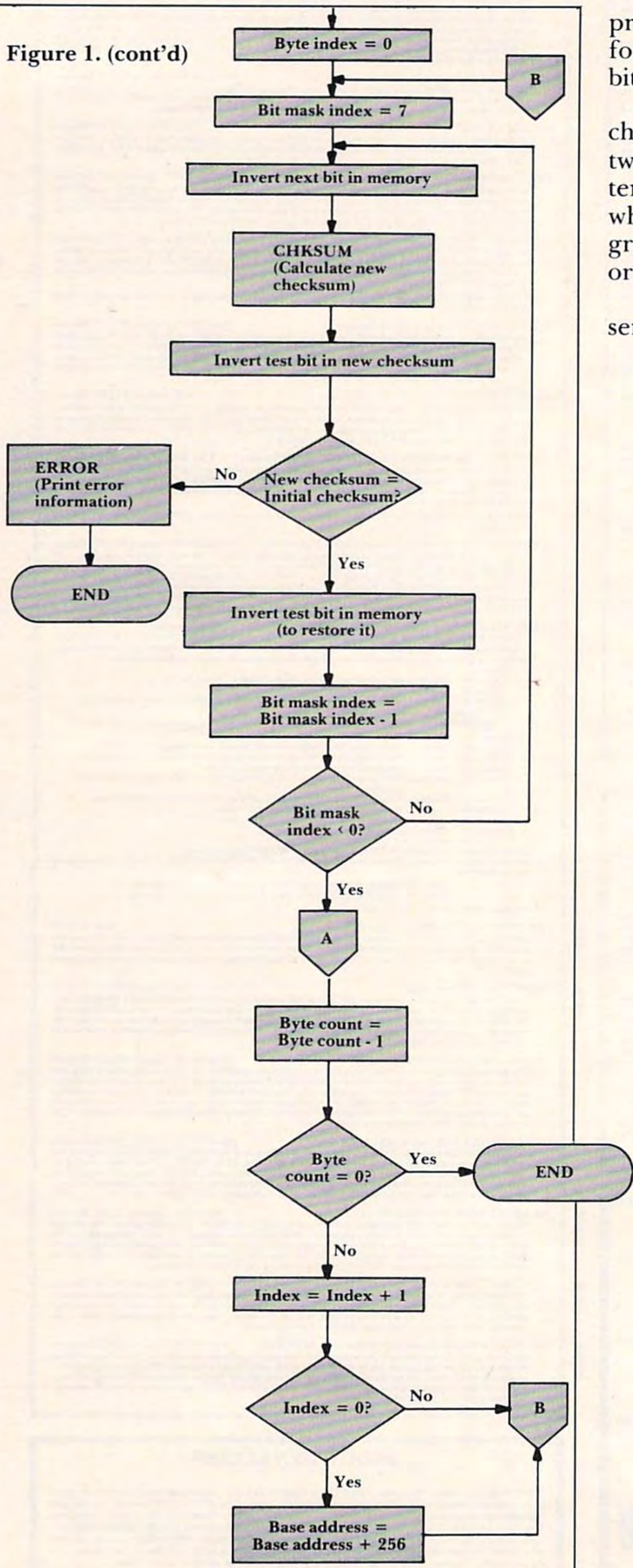
Figure 1. (cont'd)

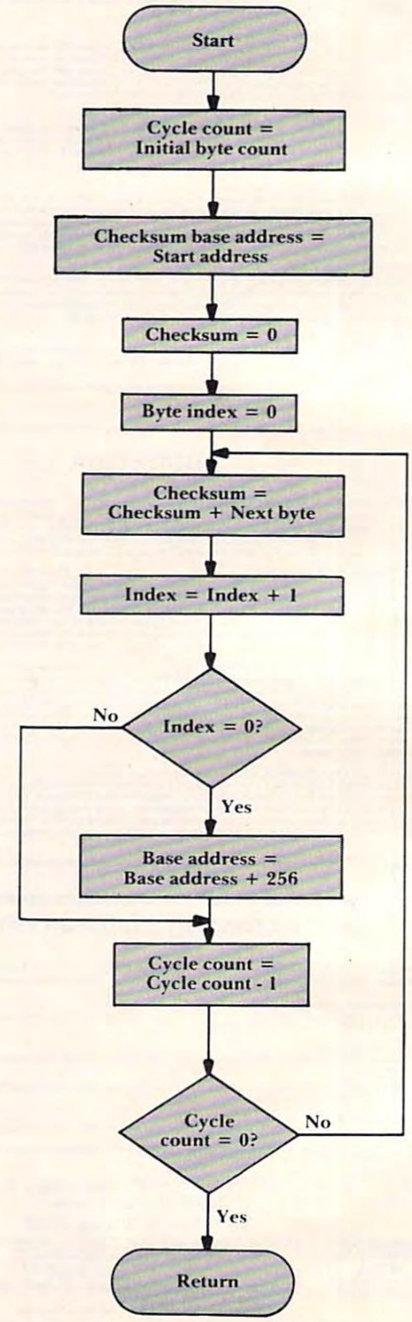


program calls CHKSUM again, to get the checksum for memory with one bit inverted, and inverts that bit position in the checksum.

This invert operation should make the new checksum identical to the initial checksum. If the two checksums are not identical, the program terminates by printing the bit position and address where the error was detected. Otherwise, the program reinverts the current test bit, to restore its original state.

The remainder of the program involves a series of three counter/index adjustment opera-

Figure 2: Checksum-Calculating Subroutine (CHKSUM)



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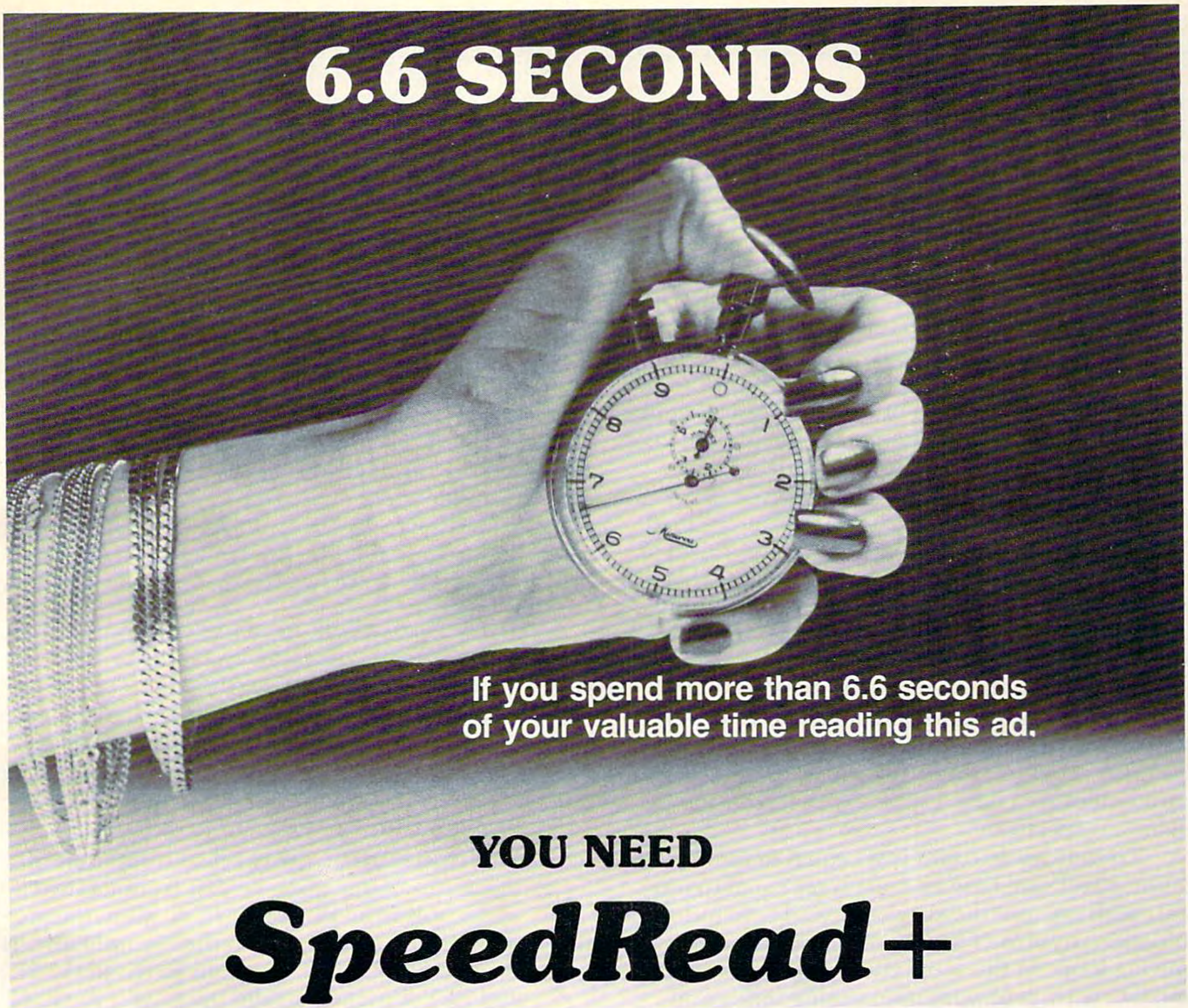

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tions, with each followed by a branch/no-branch decision. In the first of these operations, the bit mask index is decremented; if it is nonnegative, the program branches back to invert the next bit. Otherwise, the byte count is decremented; if all bytes have been tested, the program terminates, error free. Otherwise, the byte index is incremented. The byte index is eight bits long, and can hold values from 0 to 255 (decimal). If the incrementation caused the byte index to overflow to zero, the program increments the high order byte of the base address, then branches back to reinitialize the bit mask index. Otherwise, the branch takes place with no change to the base address.

Figure 2 shows the flowchart for the checksum subroutine, CHKSUM. This subroutine is called from two places in the program: (A) it is called at the beginning of the program, to calculate the initial checksum, and (B) it is called from within the main loop, to calculate a new checksum after a test bit has been inverted. This second source of call requires the subroutine to maintain its own, separate byte count and base address, so as not to disturb the current values of these parameters in the main program. In the flowchart, these "working" parameters are labeled *cycle count* and *checksum base address*, respectively.

To start, cycle count is set equal to initial byte count, checksum base address is set equal to test start address, and the checksum and byte index are initialized to zero. The rest of the subroutine is just one big loop. In this loop, the checksum is accumulated, byte by byte, with intervening index and cycle count adjustments. The loop is terminated when all bytes have been processed; that is, when cycle count has been decremented to zero.

The Test Program

Now that you understand the criteria of the program and its sequences, we can look at the program itself. Program 1 shows the source code for the nondestructive test program, which was flowcharted in Figure 1. Note that before executing the program, the starting address must be stored in locations 00 and 01 (00 holds low byte) and the ending address must be stored in locations 02 and 03 (02 holds low byte).

Besides these four locations, the program uses 13 other zero page locations, as working storage. These include six parameters that are used in the main program – initial byte count (IBYTES), byte count (BYTES), base address (BADDR), initial checksum (CSUM) and temporary storage for the X and Y registers (SAVEX and SAVEY), and two parameters that are used in the checksum subroutine, a working copy of the byte count (CYCLES) and a checksum base address (CBADDR). Of these parameters, only IBYTES and CSUM remain unchanged throughout the program; all six other parameters will change during execution.

Following these reserve equates come three equates that reference subroutines in the AIM 65 monitor: CRLOW initializes the display and printer to their START positions; NUMA prints the contents of the accumulator, as two ASCII digits; OUTPRI sends one character to the print buffer. Other 6502-based computers have equivalent subroutines.

The actual code that follows is straightforward, so you should have no problem following it if you studied the flowchart in Figure 1. Some readers may wonder why I chose to save X and Y in zero page (locations SAVEX and SAVEY), rather than on the stack, during the call to CHKSUM in the main loop. There are two reasons why this was done:

1. The instructions used to save X and Y in zero page execute eight cycles faster than those to save X and Y on the stack (12 cycles versus 20 cycles). If you consider that for each byte tested, CHKSUM is called eight times – once for each bit position – saving X and Y in zero page saves 64N microseconds for an N-byte test run.

2. We need to use the checksum contents of the accumulator upon return from CHKSUM, and a pull from the stack (PLA) always loads the stack information into the accumulator. If the 6502 had the instructions PHX, PHY, PLX and PLY, the stack would have been the likely place to hold X and Y, but unfortunately it has no such instructions.

Programmers may also be interested in the way the bit masks are accessed by the EOR BMASK,X instructions that follow the labels INVERT and NXTBIT. The bit mask table, BMASK (shown at the end of Program 2), is arranged by *ascending* bit position. That is, the mask for Bit 0 comes first, followed by the mask for Bit 1, and so on. However, this table is accessed in *descending* order; Bit 7 is tested first and Bit 0 is tested last. This allows us to initialize the bit mask index to 7 (LDX #7 at label IBMSK), then decrement this index until it goes negative. Otherwise, working with a descending table and an incrementing index, the program would have to include a CPX #8 instruction to make the done/not done branch decision. By using the ascending table and decrementing index approach we've eliminated that compare instruction. Since the CPX #8 instruction executes in just two cycles, the difference in approaches is not significant, but the backwards access is a handy gimmick for your programming bag of tricks.

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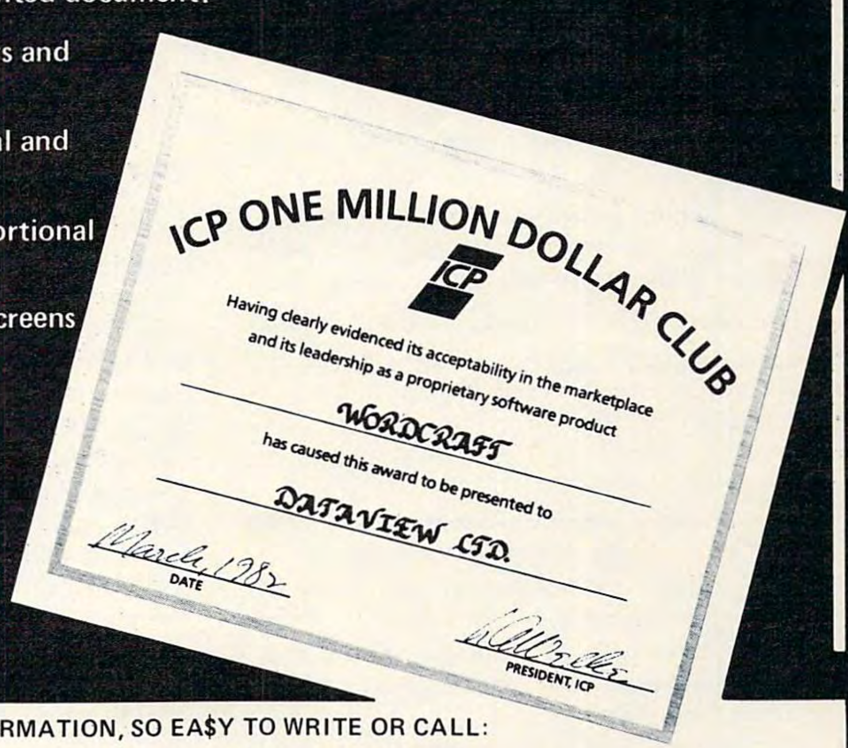

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Program 2 shows the code for the checksum calculating subroutine, CHKSUM, which was flowcharted in Figure 2. It follows the flowchart closely, and needs no additional explanation. Program 2 also includes the previously mentioned bit mask table, BMASK, and the text for the error message.

This program will produce one of two messages. If the test memory is error free, the message *OKAY!* will be printed, otherwise an error message of the form *BIT n OF LOC. aaaa* will be printed. In the error message, the bit position and address that are printed identify the bit that was being tested when the checksum mismatch occurred. It's possible, of course, that inverting that bit actually caused some other bit in the memory to be inverted, due to crosstalk, so the printout position may not be the actual culprit. One way of finding out is to run a second test, starting at the location following the printout location; that is, rerun the test starting at "aaaa + 1."

Execution Times For The Test Program

As you can see from the listings, the program occupies slightly less than a page of memory; to be exact, it occupies 245 bytes. Of even greater significance, however, is the amount of time it takes to execute. That is, the amount of time it takes to test a selected portion of memory. In a test that I ran, the program took just over four minutes to check out a 1K portion of memory (1024 bytes).

At first I suspected that something was wrong with the program, but after a few calculations I became convinced that this was indeed a respectable time, in light of what the program was doing. First, consider that in a 1K byte test, the CHKSUM subroutine is called 8193 times; once to get the initial checksum, then once more for each of the 8192 bit positions in the 1024 byte test memory. The CHKSUM subroutine takes 28 + (29 x N) cycles to calculate the checksum for an N-byte memory, so it takes 29,724 cycles (microseconds) for a 1024 byte memory. Cranking out the math, we find that with

Exclusive-ORs And Checksums

An exclusive-OR is a logical operation in which two byte operands are combined to produce a result byte with these characteristics:

- For each bit position in which the operands are different (one is logic 0, the other is logic 1), the result will contain a logic 1.
- For each bit position in which the operands are the same (both logic 0 or both logic 1), the result will contain a logic 0.

These rules can be summarized as follows:

Bit Operand #1	Bit Operand #2	Result Bit
0	0	0
0	1	1
1	0	1
1	1	0

All of the popular 8-bit microprocessors have an exclusive-OR instruction. In the 6502, it has the mnemonic *EOR*. The EOR instruction operates on the contents of the accumulator with an immediate value or a value in memory, and leaves the result in the accumulator.

For example, if the accumulator contains the value $AB (where $ denotes hexadecimal) and location $40 contains the value $0F, the instruction *EOR $40* will produce a value of $A4 in the accumulator. The binary arithmetic looks like this:

	0000 1111	**Contents of location $40 = $0F**
⊕	**1010 1011**	**Contents of accumulator = $AB**
	1010 0100	**Result in accumulator = $A4**

Note what has happened here. The value $0F in location $40 has caused the four low order bits (0 through 3) to be *inverted*, but has left the four high order bits (4 through 7) intact.

This shows one of the primary uses for the EOR instruction: to invert some selected bits, but leave all other bits unchanged. In fact, the test program in this article uses the EOR instruction to invert a single bit in memory, by reading the appropriate memory byte into the accumulator, then exclusive-ORing it with a "mask" value that has just one bit set to logic 1. To invert Bit 7, the program applies a mask value of 10000000_2 ($80); to invert Bit 6, the program applies a mask value of 01000000_2 ($40); and so on.

The program in this article also uses a series of EOR instructions to calculate a *checksum* value. As mentioned in the article, the checksum is the exclusive-OR of all bytes being tested. For example, if locations $0400, $0401 and $0402 are being tested, the program will perform this type of operation:

	0010 1101	**($0400) = $2D**
	1010 0011	**($0401) = $A3**
⊕	**0001 1000**	**($0402) = $18**
	1001 0110	**Checksum = $96**

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8193 calls, the program spends about 4.06 minutes in the CHKSUM subroutine!

Since the program is spending virtually all of its time in the CHKSUM subroutine, the total execution time of the program is directly dependent on the efficiency of this subroutine. If any readers have suggestions on how to streamline CHKSUM, I'd be happy to hear from them.

Program 1: Source Code for Nondestructive Test Program

```
ADDR   OBJECT     LABEL   SOURCE              PAGE 0001

2000                      ; THIS PROGRAM PERFORMS A NONDESTRUCTIVE TEST
2000                      ; ON RAM MEMORY, BY CALCULATING A SERIES OF CHECKSUMS.
2000                      ; BEFORE EXECUTING, STORE THE STARTING ADDRESS
2000                      ;  AT LOCS. 00 AND 01, AND THE ENDING ADDRESS
2000                      ;  AT LOCS. 02 AND 03.
2000                      ; IF THE TEST IS SUCCESSFUL, AN 'OKAY!' MESSAGE
2000                      ; IS PRINTED.  OTHERWISE, THE BAD BIT POSITION
2000                      ; AND ADDRESS ARE PRINTED.

2000                      ; USER-SUPPLIED PARAMTERS

2000                              *=0
0000                      START   *=*+2           ; STARTING ADDRESS
0002                      END     *=*+2           ; ENDING ADDRESS

0004                      ; EQUATES FOR WORKING STORAGE IN ZERO PAGE

0004                      IBYTES  *=*+2           ; INITIAL BYTE COUNT
0006                      BYTES   *=*+2           ; BYTE COUNT
0008                      CYCLES  *=*+2           ; WORKING COPY OF BYTES
000A                      BADDR   *=*+2           ; BASE ADDRESS
000C                      CBADDR  *=*+2           ; BASE ADDRESS FOR CHECKSUM SUBR.
000E                      CSUM    *=*+1           ; INITIAL CHECKSUM
000F                      SAVEX   *=*+1           ; TEMP. STORAGE FOR X REGISTER
0010                      SAVEY   *=*+1           ; TEMP. STORAGE FOR Y REGISTER

0011                      ; AIM 65 MONITOR SUBROUTINES

0011                      CRLOW   =$EA13          ; RESET DISPLAY & PRINTER
0011                      NUMA    =$EA46          ; PRINT A, AS TWO ASCII CHARS.
0011                      OUTPRI  =$F000          ; OUTPUT A TO PRINT BUFFER

0011                              *=$200
0200   38                         SEC             ; BYTE COUNT = END ADDR. - START
                                                    ADDR. + 1
0201   A5 02                      LDA END
0203   E5 00                      SBC START
0205   85 04                      STA IBYTES
0207   85 06                      STA BYTES
0209   A5 03                      LDA END+1
020B   E5 01                      SBC START+1
020D   85 05                      STA IBYTES+1
020F   85 07                      STA BYTES+1
0211   E6 04                      INC IBYTES
0213   E6 06                      INC BYTES
0215   D0 04                      BNE GETSUM
0217   E6 05                      INC IBYTES+1
0219   E6 07                      INC BYTES+1
021B   20 B1 02   GETSUM  JSR CHKSUM      ; CALCULATE INITIAL CHECKSUM
021E   85 0E                      STA CSUM        ;  AND SAVE IT IN MEMORY
0220   A5 00                      LDA START       ; BASE ADDRESS = START ADDRESS
0222   85 0A                      STA BADDR
0224   A5 01                      LDA START+1
0226   85 0B                      STA BADDR+1
0228   A0 00                      LDY #0          ; BYTE INDEX = 0
022A   A2 07      IBMSK   LDX #7          ; BIT MASK INDEX = 7
```

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```
022C  B1 0A     INVERT LDA (BADDR),Y    ; INVERT NEXT BIT IN MEMORY
022E  5D DF 02         EOR BMASK,X
0231  91 0A            STA (BADDR),Y
0233  86 0F            STX SAVEX        ; SAVE X AND Y IN MEMORY
0235  84 10            STY SAVEY
0237  20 B1 02         JSR CHKSUM       ; CALCULATE NEW CHECKSUM
023A  A6 0F            LDX SAVEX        ; RETRIEVE X AND Y
023C  A4 10            LDY SAVEY
023E  5D DF 02         EOR BMASK,X      ; INVERT TEST BIT IN NEW CHECKSUM
0241  C5 0E            CMP CSUM         ; NEW CHECKSUM = INITIAL CHECKSUM?
0243  D0 39            BNE ERROR        ;  NO.  PRINT ERROR INFO.
0245  B1 0A     NXTBIT LDA (BADDR),Y    ;  YES.  INVERT TEST BIT IN MEMORY
0247  5D DF 02         EOR BMASK,X
024A  91 0A            STA (BADDR),Y
024C  CA               DEX              ;  NO.  DECREMENT BIT MASK INDEX
024D  10 DD            BPL INVERT       ; BIT MASK INDEX NEGATIVE?
024F  C6 06            DEC BYTES        ;  YES.  DECREMENT BYTE COUNT
0251  E4 06            CPX BYTES
0253  D0 02            BNE BCNTO
0255  C6 07            DEC BYTES+1
0257  A6 06     BCNTO  LDX BYTES        ; BYTE COUNT = 0?
0259  D0 1B            BNE INCIDX
025B  A6 07            LDX BYTES+1
025D  D0 17            BNE INCIDX
025F  A0 00            LDY #0           ;  YES.  ALL DONE, WITH NO ERRORS
0261  B9 70 02  OKLOOP LDA OKMSG,Y
0264  20 00 F0         JSR OUTPRI
0267  C8               INY
0268  C0 06            CPY #6
026A  D0 F5            BNE OKLOOP
026C  20 13 EA         JSR CRLOW
026F  00               BRK

0270  20 4F     OKMSG  .BYT ' OKAY!'

0276  C8        INCIDX INY              ;  NO.  INCREMENT BYTE INDEX
0277  D0 B1            BNE IBMSK        ; BYTE INDEX=0?
0279  E6 0B            INC BADDR+1      ;  YES.  ADD 256 TO BASE ADDRESS
027B  4C 2A 02         JMP IBMSK
027E

027E                   ; THIS ROUTINE PRINTS OUT THE BIT POSITION
027E                   ; AND ADDRESS AT WHICH THE MISMATCH OCCURRED

027E  20 13 EA  ERROR  JSR CRLOW        ; RESET DISPLAY & PRINTER
0281  A0 00            LDY #0           ; PRINT FIRST PART OF TEXT
0283  B9 E7 02  LOOP1  LDA EMSG,Y
0286  20 00 F0         JSR OUTPRI
0289  C8               INY
028A  C0 05            CPY #5
028C  D0 F5            BNE LOOP1
028E  8A               TXA              ; PRINT BIT PATTERN
028F  09 30            ORA #$30
0291  20 00 F0         JSR OUTPRI
0294  B9 E7 02  LOOP2  LDA EMSG,Y       ; PRINT SECOND PART OF TEXT
0297  20 00 F0         JSR OUTPRI
029A  C8               INY
029B  C0 0E            CPY #14
029D  D0 F5            BNE LOOP2
029F  A5 10            LDA SAVEY        ; ERROR ADDRESS = BASE ADDRESS +
                                          INDEX
02A1  18               CLC
02A2  65 0A            ADC BADDR
02A4  48               PHA
02A5  A9 00            LDA #0
02A7  65 0B            ADC BADDR+1
02A9  20 46 EA         JSR NUMA         ; PRINT ERROR ADDRESS
```

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```
01-1220   02AC   68                   PLA
01-1230   02AD   20 46 EA             JSR NUMA
01-1240   02B0   00                   BRK                 ; RETURN TO MONITOR
```

Program 2: Source Code for CHKSUM Subroutine

```
 LINE#    ADDR   OBJECT      LABEL  SOURCE                PAGE 0004

01-1260   02B1               ; THIS SUBROUTINE ACCUMULATES THE CHECKSUM,
01-1270   02B1               ; BY EXCLUSIVE-ORING ALL BYTES

01-1290   02B1   A5 04       CHKSUM LDA IBYTES          ; CYCLE COUNT = BYTE COUNT
01-1300   02B3   85 08              STA CYCLES
01-1310   02B5   A5 05              LDA IBYTES+1
01-1320   02B7   85 09              STA CYCLES+1
01-1330   02B9   A5 00              LDA START           ; BASE ADDRESS = START ADDRESS
01-1340   02BB   85 0C              STA CBADDR
01-1350   02BD   A5 01              LDA START+1
01-1360   02BF   85 0D              STA CBADDR+1
01-1370   02C1   A9 00              LDA #0              ; CHECKSUM = 0
01-1380   02C3   A0 00              LDY #0              ; BYTE INDEX = 0
01-1390   02C5   51 0C       ACCUM  EOR (CBADDR),Y      ; CHECKSUM = CHECKSUM EOR NEXT BYTE
01-1400   02C7   C8                 INY                 ; INCREMENT INDEX
01-1410   02C8   D0 02              BNE DECCYC          ; INDEX = 0?
01-1420   02CA   E6 0D              INC CBADDR+1        ;  YES.  ADD 256 TO BASE ADDRESS
01-1430   02CC   A2 FF       DECCYC LDX #$FF            ;  NO.  DECREMENT CYCLE COUNT
01-1440   02CE   C6 08              DEC CYCLES
01-1450   02D0   E4 08              CPX CYCLES
01-1460   02D2   D0 02              BNE CYCZ
01-1470   02D4   C6 09              DEC CYCLES+1
01-1480   02D6   A6 08       CYCZ   LDX CYCLES          ; CYCLE COUNT = 0?
01-1490   02D8   D0 EB              BNE ACCUM           ;  NO.  GO PROCESS NEXT BYTE
01-1500   02DA   A6 09              LDX CYCLES+1
01-1510   02DC   D0 E7              BNE ACCUM
01-1520   02DE   60                 RTS                 ;  YES.  RETURN WITH CHECKSUM IN A


01-1550   02DF               ; MASKS USED TO INVERT BITS IN MEMORY

01-1570   02DF   01          BMASK  .BYT 1,2,4,8,$10,$20,$40,$80
01-1570   02E0   02
01-1570   02E1   04
01-1570   02E2   08
01-1570   02E3   10
01-1570   02E4   20
01-1570   02E5   40
01-1570   02E6   80

01-1590   02E7               ; ERROR MESSAGE TEXT

01-1610   02E7   20 42       EMSG   .BYT ' BIT '
01-1620   02EC   20 4F              .BYT ' OF LOC. '
01-1630   02F5                      .END

ERRORS = 0000

END OF ASSEMBLY = 02F4
:
```

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A simple game illustrating a most sophisticated topic. The idea of recursive subroutines *is one of the more complex notions in programming – a subroutine which is its own subroutine. "Towers of Brahma," a child's game with pegs and disks, is used to illustrate how recursion works with versions here for PL/I and Microsoft (Commodore, Apple, OSI) and Atari BASICs.*

Recursive BASIC Subroutines

Earl Wuchter
Catasauqua, PA

Recursive *(adj): of, relating to, or constituting a procedure that can repeat itself indefinitely, or until a specified condition has been met.*

Subroutine *(n): a sequence of computer instructions for performing a specified task that can be used repeatedly in a program or in different programs.*

– Webster's New Collegiate Dictionary

Used together, these two words describe one of the most powerful, and most fascinating entities in programming, but it is a rare bird.

Recursive subroutines are most useful in compiled languages, but are seldom allowed. On the other hand, an interpreted language like BASIC can't help but allow a subroutine to reenter itself, but some serious problems must be overcome before the technique is of any use.

The problem with BASIC is that all variables are *global.* (When any variable is changed in a subroutine it is changed for the whole program.) To see what is missing in BASIC, look at a *call* statement and a subroutine statement in a typical compiled language. The variables in parentheses are called arguments or parameters:

```
CALL TRY (A,X)
SUBROUTINE TRY (A,Z)
```

When TRY is invoked, A and Z will take on the values of A and X from the calling routine. On return, A and X will receive the values of A and Z. Even though both routines use the variable A, the A in the calling routine will not be changed until a return is executed. The status (global or local) of other variables is normally up to the programmer.

BASIC subroutines do not have arguments. The normal programming practice is to have the calling routine assign values to subroutine variables before the GOSUB is executed. To prevent a subroutine from inadvertently affecting any other routine, we give it a set of local variables by using names that do not appear in any other routine.

A Solution to Passing BASIC Variables

Now you can see the problem with recursive code. How can we give a subroutine a set of variables that are different from those in the calling routine when they are one and the same routine?

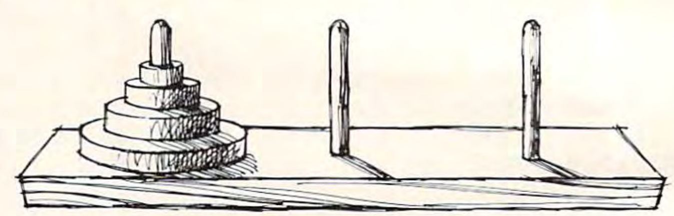
There is a solution. We can create an array of arguments and have each generation of the subroutine use its own "row" in the array.

The Towers Of Brahma

The "Towers of Brahma" is one problem that is best solved with a recursive subroutine. The solution, in turn, best illustrates the capability of recursive code. The two seem to have been made for each other.

This interesting mathematical problem is often found disguised as a child's toy: a board with three pegs and four or five disks of varying diameters that fit on the pegs. The disks are initially arranged on the first peg in order of their diameters, with the smallest one on top. They are to be moved one at a time, always keeping the smaller ones on top, until they are on the third peg.

Towers of Brahma



When the recursive solution to this problem is coded in the proper language, it is a thing of beauty. A PL/I version of the subroutine is shown below. This will be the model for a BASIC version. The main routine is not shown. The main routine simply inputs the number of disks and makes the initial call:

```
CALL MOVE (NDISKS,1,3);
```

Note: In this version of PL/I, arguments passed in as expressions become dummy arguments and do not change anything in the calling routine. Adding zero to a variable makes it an expression without altering its value. This feature provides for extremely compact code.

```
MOVE: PROCEDURE (N,F,T) RECURSIVE;
IF N=0 THEN RETURN;
CALL MOVE (N-1,F+0,6-F-T);
PUT SKIP DATA (N,F,T);
```

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@ (type "N" keyboard)
< (type "B" keyboard)
! (original keyboard)
> (for 'wedge' users)

These commands may be used interchangably, to perform the following dos support functions.

Command	Function
@	Display disk status / send command
@N	Format (header) a new diskette
@I	Force initialize diskette
@V	Validate diskette (collect)
@D	Duplicate diskette
@C	Copy or concatenate disk file(s)*
@R	Rename file
@S	Scratch file(s)*
@$	List directory*
@U:	Reset disk drive
@L	List disk file or BASIC program*

* Added/enhanced disk command.

EXTENDED EDITOR

Command	Function
/	Quick load from disk
↑	Quick load from disk with auto run
APPEND	Append from disk to end of current program
AUTO	Auto line number (allows header)
BLOAD	Load machine language (binary) file
BRUN	Load and execute machine language program
CHANGE	Change pattern to another pattern
CLOSE	Close one or all files
CMD	Set output to file (does not send "READY.")
DELETE	Delete a range of lines from program
DUMP	Dump all scalar variables to screen or file
EXEC	Execute a file as keyboard commands
FIND	Find occurances of a pattern
GET	Read a sequential file into editor
KEY	Define a key as a special function
KEYS	Turn key functions on
KILL	Disable SYSRES™
KILL*	Disable SYSRES™ and unreserve memory
LIST	Improved BASIC LIST command
LOAD	Defaults to disk drive
MERGE	Merge from disk into current program
MON	Break to current machine language monitor
OLD	Restore program after "NEW"
PUT	Send program to disk as text file
RENUMBER	Renumber all or part of program
RUN	Run current program, ignores screen garbage
SAVE	Defaults to disk drive, allows replace
SETD	Set disk device #, allows multiple drives
SETP	Set printer channel, format mode, paging
TRACE	Select 1 of 3 trace/step modes and speed
VERIFY	Compare current program against disk/tape
WHY	Print position of last error
WHY?	List line of break or error
*	Send output to printer
#	Display current version of SYSRES™

COMPARE SPECIFICATIONS!	SYSRES™	POWER™
Number of ADDED commands	33	13
Number of IMPROVED BASIC commands	7	none
Number of DOS SUPPORT commands	11	none
Approximate added syntax options	1200	60
Instruction manual length	86 pages	75 pages
Instruction manual style	structured	conversational
Re-loactable?	yes	no
Use on more than one (any) PET/CBM™	yes	no
Upgradable	yes	no

COMPARE FEATURES!	SYSRES™	POWER™
Automatic printer output?	yes	no
Selectable ASCII conversion?	yes	no
List programs without loading them?	yes	no
Formatted program listings?	yes	no
Dump SEQuential/RELative files?	yes	no
Edit data files?	yes	no
True program merge?	yes	no
Auto number with **AUTO TEXT**?	yes	no
Load machine language programs?	yes	no
Auto-execute machine language programs?	yes	no
Directory (menu) file commands?	yes	no

COMPARE "EQUIVALENT" FUNCTIONS!

Function: Change occurances of one pattern to another.

Feature	SYSRES™	POWER™
Command word	CHANGE	@
'Wild cards' in search string?	yes	yes
'Wild cards' in replace string?	yes	no
Selectable range?	yes	yes
Match in entire text?	yes	yes
Match in commands only?	yes	no
Match exact variable names?	yes	no

Function: Define special one-key functions.

Feature	SYSRES™	POWER™
Command word	KEY	REM"
Requires BASIC program changes?	no	yes
Destroys variables?	no	yes
Re-define any key?	yes	no
Maximum string length	255	73
Quotes and carriage-return allowed	yes	no
Re-define any token key?	yes	no
Retain user keys from program to program?	yes	no

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* List BASIC programs, sequential and relative files without loading them into memory!
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* Load and run machine language programs with parameter passing!
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Brief Definitions

Some of the terms used in this article might be unfamiliar. Here's a short description of the main ideas:

CODE – Refers to the statements, the lines, or the entirety of a program, as in the phrase "there's an error in your code at line 110." Also used as a verb, as another word for programming: "I'm coding a subroutine."

COMPILED LANGUAGE – Unlike BASIC (an *interpreted language*) there are three steps to getting a program to run when you're working with a compiled language: 1. Write it. 2. Compile it. 3. Run it. After you write the program, a separate program called a *compiler* translates what you've written into a form of *machine language*. This results in a program which can then be executed (run).

Some examples of compiled languages are FORTRAN, COBOL, and PL/I. The language the program is written in (step 1, above) is called the *source language* and when you finish typing it you've got not surprisingly, the *source program*. Step 2 is where you instruct the compiler to "examine" and transform the source program into an *executable* (it can be executed) program called the *object* or *target* program.

You can write, easily read, and easily modify source programs, but you can't run them. Object programs, on the other hand, do run, but they are difficult to read (they're not written in words like PUT IF THEN DECLARE, but rather in machine or assembly language.)

INTERPRETED LANGUAGE – Step 2 (above) does not take place in an interpreted language. There are only two steps to writing an interpreted language program (BASIC is an example): 1. Write it. 2. RUN it. However, while the program is RUNning, a separate program in the computer is "interpreting" the meaning of words like PRINT and INPUT. In other words, the computer slows down somewhat while the interpreter decides what PRINT means and just what kind of PRINT is involved (to the screen, the printer, a disk file?). Then the interpreter sets up pointers and flags and variables and momentarily sends control to the machine language subroutine (in a library of such subroutines) which can do a PRINT.

All of this translating and interpreting is going on *during* the RUN of the program. It's obvious why interpreted programs tend to RUN more slowly than compiled programs. On the other hand, because you can write it/RUN it, it is easier to test parts of a program immediately and make the necessary changes to the program itself. Debugging is easier simply because the program you write is the same program that you will RUN.

PARAMETER PASSING – This generally refers to the ways that variables are made available to several programs at once, (or, if the variables are local, to several parts of the same program at once). For example, if the variable CASH "holds" 15.98, we might want to "pass" that value (15.98, the parameter) to another program. Some computers will cancel all variables when a new program is LOADed into RAM memory. How can the 15.98 be "passed" to the new program?

Likewise, if variables are local, the value of CASH will be different in subroutines from what is in the main body of the program unless 15.98 is "passed" to the subroutines.

Passing parameters is handled in different ways depending on which computer or language is being used. Compiled languages often allow you to put the variables in parentheses on the same line as a CALL to or RETURN from a subroutine. The example CALL SUB3 (CASH, TOTAL) *passes* the values of CASH and TOTAL to the subroutine SUB3. It can later pass variables back to the main routine in the same way, using parameters (also called *arguments*).

PL/I – A "high level" language (as opposed to lower level, closer to machine language) which combines attributes of FORTRAN and COBOL.

DUMMY ARGUMENTS – Parameters which have no effect other than to take up some necessary space. An example is the FRE(1) statement in Microsoft BASIC where the value within the parentheses can be anything. It's just there because the computer will not recognize FRE().

NESTING – When something is contained by something else. FOR I = 1 TO 10: FOR J = 1 TO 2: NEXT J: NEXT I. This J loop is said to be *nested* within the I loop.

STACK – The computer must be able to remember "return addresses." 100 GOSUB 500 will turn over control to whatever is on line 500, but eventually there will be a RETURN. So, before GOSUBbing, the "address" to RETURN to is put on the computer's *stack* and later pulled off the stack by RETURN. There is a limit to how many return addresses can be pushed on the stack. This is normally no problem since most subroutines go right back via RETURN, relieving the stack of the address number. Recursive, self-calling subroutines, however, aren't RETURNing. It's GOSUB-GOSUB-GOSUB, etc. Unless the recursion is carefully managed, the stack could quickly fill with return addresses and is then said to *overflow*.

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EPSON MODEL	ROM MODEL
MX70	Not Available
MX80 (serial no. to 359999)	EPG80 (EPG82, 3 ROM Version)
MX80 (serial no. after 360000)	EPG81 (EPG83, 3 ROM Version)
MX80FT	EPG8F
MX80 Graftrax	Not Available
MX80 Graftrax Plus	EPG8G+
MX80FT Graftrax Plus	EPG8G+
MX100	Not Available
MX100 Graftrax Plus	EPG10G+

The Epson-PET Graphics ROM Pack has been designed to furnish you with PET/CBM graphics printing in the easiest way possible. This is done by furnishing a high speed machine language program that is "hidden" at the top of your PET/CBM memory.

The machine language program serves 3 major functions.

1: Translates PET-ASCII code to ASCII code for program listing.

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CALL MOVE (N-1,6-F-T,T+0);
END MOVE;

The BASIC program has arrays for variables N, F, and T. Variable G serves as the index to the arrays. G represents the number of nested GOSUBs. The subroutine increments G on each entry and decrements it on each return, thereby keeping count of its own generation number. Arguments are passed to the next generation by putting values into the arrays at (G+1) before each GOSUB. The variable G is always the current subscript for any generation of the subroutine.

This method of using arrays requires that you know beforehand what the maximum nesting depth will be in order to dimension the arrays. This number is a function of the problem, but may be limited by the BASIC interpreter.

Solving 21 Disks Would Take More Than Eight Days

The program runs in less than 2K. The internal stack size of my PET restricts the number of disks to 21. When I try to run more than 21 I get an "OUT OF MEMORY" message. Your system may allow more or less, but don't expect to run this many disks to completion. The time required to complete 21 disks (at a rate of approximately three moves per second) will be more than eight days, and one more disk would double that.

The BASIC program here shows the moves to be made, along with a plot of the nesting level made down the left side of the screen. Each increase in the length of the plotted line indicates a GOSUB. Each decrease in length indicates a RETURN. You can see a more detailed view of the process by replacing the plot with a printout of the current array variables.

Program 1. Microsoft Version

```
10 REM TOWERS OF BRAHMA (RECURSIVE)
11 DIM N(22),F(22),T(22)
12 P$="----+----+----+----+--"
13 INPUT"N DISKS (1 TO 21) ";N(1)
14 IFN(1)<1 OR N(1)>22 THEN 13
15 F(1)=1
16 T(1)=3
17 GOSUB 31
18 END :::::::::::::::::::::::
31 G=G+1
32 PRINT LEFT$(P$,G)
33 IF N(G)=0 THEN 43
34 N(G+1)=N(G)-1
35 F(F+1)=F(F)
36 T(G+1)=6-F(G)-T(G)
37 GOSUB 31
38 PRINT TAB(19)"DISK#"N(G)"FROM"F(
   G)"TO"T(G)
39 N(G+1)=N(G)-1
40 F(G+1)=6-F(G)-T(G)
41 T(F+1)=T(F)
42 GOSUB 31
43 G=G-1
44 PRINT LEFT$(P$,G)
45 RETURN
```

Program 2. Atari Version

```
11 DIM N(22),F(22),T(22),P$(20)
12 P$="----+----+----+----+---"
13 ? "N DISKS (1 TO 21)";:INPUT T:N(1)=T

14 IF T<1 OR T>21 THEN 13
15 F(1)=1
16 T(1)=3
17 GOSUB 31
19 END
31 G=G+1
32 IF G THEN ? P$(1,G)
33 IF N(G)=0 THEN 43
34 N(G+1)=N(G)-1
35 F(G+1)=F(G)
36 T(G+1)=6-F(G)-T(G)
37 GOSUB 31
38 ? ,"DISK #";N(G);" FROM ";F(G);" TO "
;T(G)
39 N(G+1)=N(G)-1
40 F(G+1)=6-F(G)-T(G)
41 T(G+1)=T(G)
42 GOSUB 31
43 G=G-1
44 IF G THEN ? P$(1,G)
45 RETURN
```

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Tricky Tutorials (except #5) require 16K memory for cassette orders and 24K for disk. The price is $19.95 each. Tricky Tutorials #1 to 6 in a notebook cost only $99.95, a $30 savings.

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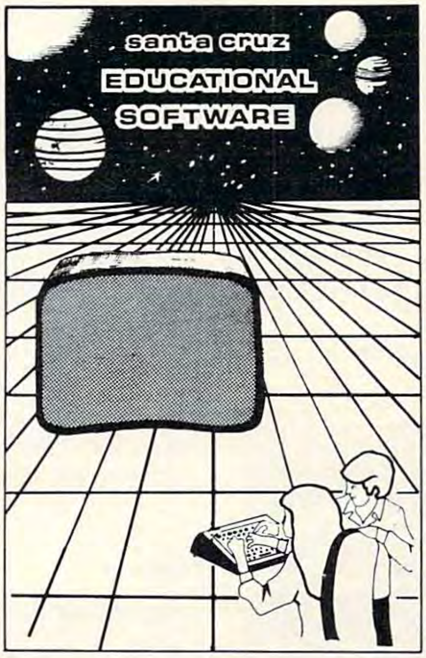

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#7: DISK UTILITIES TUTORIAL — This Tutorial both offers you several programs to aid in the use of your 810 Disk drive, and teaches you how these utilities were written at the same time. The utilities included are a Menu program, a Disk inspector (look at sectors on the disk), a Disk Directory printout program, a Format utility to quickly format large numbers of disks, and a utility that allows your programs to start running by just turning on the 810 (Autorun.sys). Requires 32K of memory and costs only **$29.95**

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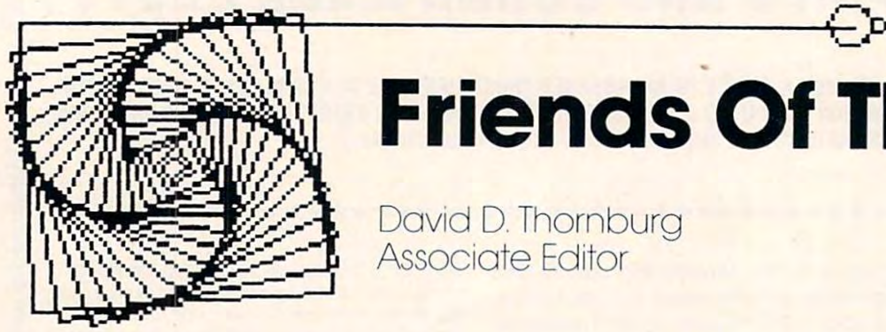


A Monthly Column

Friends Of The Turtle

David D. Thornburg
Associate Editor

A Fractal Of My Former Self...

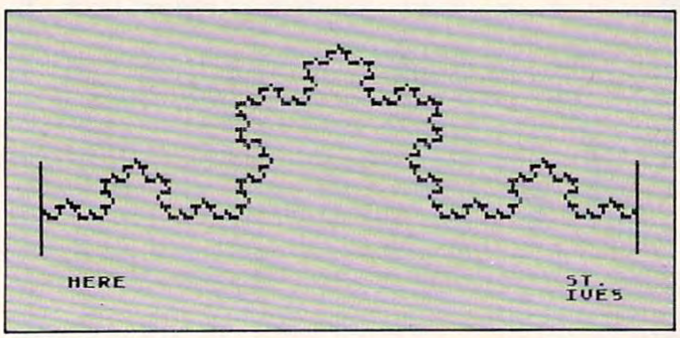
As I was going to St. Ives,
I met a man with seven wives.
Each wife carried seven sacks;
And in each sack was seven cats;
And with each cat was seven kits.
Kits, cats, sacks, and wives,
How many were going to St. Ives?

If you remember this puzzle from your childhood you probably remember that the answer is one.

Well, that may not be very exciting; but suppose you are walking to St. Ives and you want to know how far it is from some other location – Here, for example. The first thing we might do is look at a map.

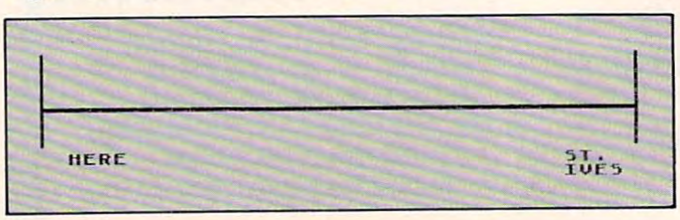
From the map we see that St. Ives and Here are both coast towns located near bays. In between, the coast juts out to sea.

Figure 1.



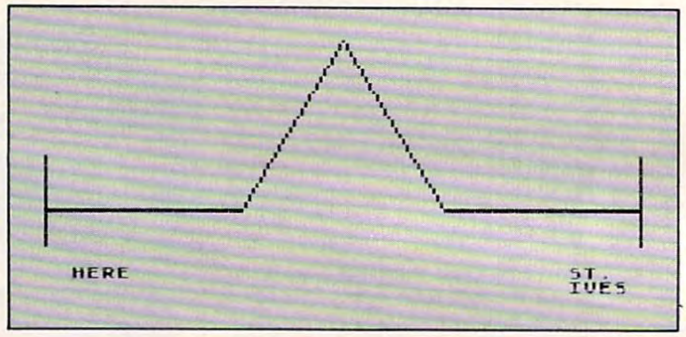
How long is the coastline between the towns of Here and St. Ives? If we set a pair of dividers to span the distance between the two towns we get one measurement. This distance is one kilometer.

Figure 2.



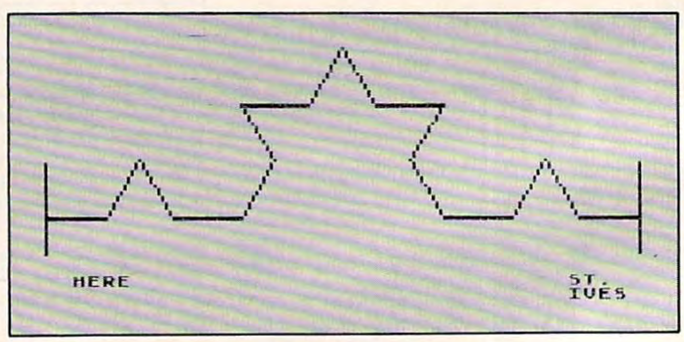
But this path doesn't take us along the coast. If we set our dividers to measure in units of 1/3 of a kilometer, we can trace a path which more closely follows the coastline.

Figure 3.



By counting each 1/3 kilometer increment we can see that this path is 4/3 kilometer in length. Next, let's set the dividers to 1/9 of a kilometer and measure the distance again.

Figure 4.



This looks more like the actual coastline and gives us a distance of 16/9 kilometers. Since we replaced each straight line in Figure 3 with a replica of Figure 3, we can see that the length of the coast in Figure 4 can be written as 4/3 * 4/3.

Now let's set the dividers to 1/27 of a kilometer and measure again.

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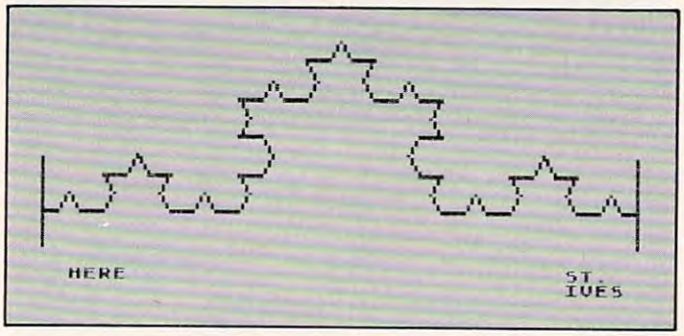
Figure 5.



This brings us even closer to the coastline and gives us a distance of 4/3 * 4/3 * 4/3 or 64/27 kilometers – more than twice our original estimate.

By now it should be obvious that each time we reduce the setting of our dividers by 1/3, the path length increases by a factor of 4/3. If we were to walk along the coast by following every nook and cranny, the distance would be 4/3 * 4/3 * 4/3 * 4/3 * 4/3,... etc. In other words, the length is infinite.

The reason for this is that each part of the coastline is an infinite set of replicas of the overall shape shown in Figure 3: If you were to look at a high magnification view of the coastline it would be just as bumpy as a lower magnification view.

Real coastlines don't have infinite lengths, of course, but our imaginary coastline does because it is made from a type of self-similar curve called a *fractal*. Mathematical expressions of this type have been known for some time but were not studied much because mathematicians thought their properties were too strange. For an insight into just how strange these functions are, you might want to look at the book *Fractals: Form, Chance, and Dimension* by Benoit Mandelbrot (Freeman 1977). This book discusses the properties of curves such as the one I chose for the imaginary coastline. This function is called a Triadic Koch curve and was discovered by von Koch in the early 1900's.

Mandelbrot's book provides an interesting glimpse of this strange mathematical world, but is quite frustrating in that he doesn't show the reader how to express these curves so that a computer could draw them.

Have you guessed that the turtle might hold the key to drawing fractals?

First, let's look at Figure 3, since this is the basic building block from which all the other curves are made. A procedure for creating this figure is shown below in both Apple LOGO and Atari PILOT. (This also lets you see the similarities and differences between these two languages.)

Apple LOGO	Atari PILOT
TO F0 :SIZE	*F0
FORWARD :SIZE	GR: DRAW #A
LEFT 60	GR: TURN -60
FORWARD :SIZE	GR: DRAW #A
RIGHT 120	GR: TURN 120
FORWARD :SIZE	GR: DRAW #A
LEFT 60	GR: TURN -60
FORWARD :SIZE	GR: DRAW #A
END	E:

If you move the turtle to the left edge of the screen and turn it to face right, then, by using the procedure F0, a replica of the curve in Figure 3 should appear on your display. For a line length of 81 units (a good size for Apple LOGO) you would type F0 81. In Atari PILOT you might want to use a line length of 54 units (because of screen resolution differences between the Atari and Apple graphics). To do this, just type:

```
C: #A=54
U: *F0
```

and you should see a curve similar to that in Figure 3.

Now, what about Figure 4? In our coastline, each straight line section is replaced with a copy of Figure 3 which has been reduced by one-third. Let's call the procedure to do this F1.

Apple LOGO	Atari PILOT
TO F1 :SIZE	*F1
F0 :SIZE/3	U: *F0
LEFT 60	GR: TURN -60
F0 :SIZE/3	U: *F0
RIGHT 120	GR: TURN 120
F0 :SIZE/3	U: *F0
LEFT 60	GR: TURN -60
F0 :SIZE/3	U: *F0
END	E:

Suppose we next want to draw the next level of this curve. All we need to do is create a copy of F1 (called F2) in which references to F0 are replaced by references to F1. Each time this procedure is used it will use F1 which will use F0. If you follow this process a few more times, you might make a procedure called F20 which uses F19, and so on.

How far do we need to go? If our original curve (Figure 3) used a line length of 27, for example, then each line should be 9 units long for F1,3 units long for F2 and 1 unit long for F3. Since the display can't show lines less than 1 dot long, it hardly makes sense for use to try to make this curve with any finer resolution.

In a future column we will show how LOGO lets you create these curves with just one procedure. Meanwhile, you can test your abilities by using a different figure as a starting pattern:

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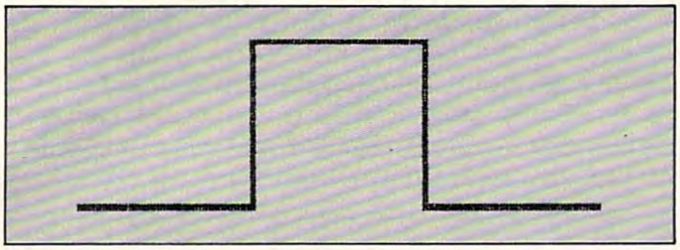
Figure 6.



Because of the 90 degree turns in this figure, those of you with WSFN will also be able to make this fractal curve.

Here is the first procedure you will need:

Apple LOGO	Atari PILOT
TO F0 :SIZE	*F0
FORWARD :SIZE	GR: DRAW #A
LEFT 90	GR: TURN -90
FORWARD :SIZE	GR: DRAW #A
RIGHT 90	GR: TURN 90
FORWARD :SIZE	GR: DRAW #A
RIGHT 90	GR: TURN 90
FORWARD :SIZE	GR: DRAW #A
LEFT 90	GR: TURN -90
FORWARD :SIZE	GR: DRAW #A
END	E:

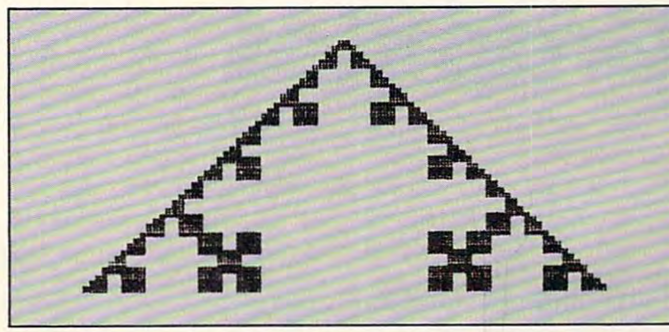
In WSFN you would create the procedure *A this way:

```
=*A(F6RF2RF2RF6RF)
```

(You might want to have the turtle move forward more with each step for the first few levels so you can see what is going on more easily.)

Here is what you should get for your final picture:

Figure 7.



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How to move and rotate objects on screen. These ideas are adaptable to many computer graphics problems and can ease the task of creating games, simulations, etc. An Atari and Commodore version are presented as complete programs and the author describes the modifications necessary for other computers.

Screen Graphics

Ian Paull
Rochester, NY

Many computer simulations and games use graphics to represent a mathematical event or model in the program. In a lunar lander program, for example, the lander position is first calculated by the model (taking operator input into account) and then displayed. Another simulation might calculate how a machine or robot should be responding to computer control, and then graphically display this information.

Programs of these general types can benefit from graphics routines which can illustrate an object at any location on a video screen (translation) and at any angle (rotation). The BASIC program presented here uses a 25 x 40 screen area to display a user-generated figure at any location and angle that the screen can represent.

The screen is treated as an X Y coordinate system, with the X axis running from left to right, the Y axis running from top to bottom, and the origin (0,0) located at the upper left corner. (See Figure 1.) The plotting routine is the main section which can be modified. Briefly, line 1060 clears the screen. Line 1080 computes the memory address to be POKEd, from the X and Y values computed elsewhere. The POKEd address is the screen position which will be turned on. Line 1090 insures that only points on the screen will be POKEd. This line may be deleted for slightly faster running time if you are sure to always remain on screen.

Lines 1070 to 1110 form a loop that plots all points in the figure to be displayed. For computers with continuous memory mapped display, you may need to change the values of SS (screen start address), SE (screen end address), RL (row length), and the character code for a completely lit cell (160 for the PET, line 1100). The PET can support greater resolution (50 x 80) with additional software, replacing the PLOT subroutine. (See references 1 and 2.)

Visible Errors

Note that due to the coarseness of the display, rotated lines will often appear warped. This is because, with only a limited number of points on the screen to choose from, the computer must pick points as close as it can to the spot where the point should go, often resulting in visible error. This program is thoroughly REMarked, so the user should have little difficulty changing or omitting statements to suit his particular needs or computer.

The ten point example does one rotation in little more than one second.

The subroutines actually doing the graphics manipulations begin at line 830 for rotation and 970 for translation. Since translation is simpler, let's look at it first.

In moving a point from one spot on a graph to another, the X and Y processing can be handled separately. (See Figure 2.) In travelling from point X_0, Y_0, to X_1, Y_1, the difference in X (shown as $\triangle X$) is simply added to X_0, and the difference in Y, a negative value in this example (shown as $\triangle Y$), is added to Y_0. For this single point translation, then:

$$X_1 = X_0 + \triangle X$$
$$Y_1 = Y_0 + \triangle Y$$

Subroutine 970 performs these additions for each translation of X and Y, for each point in the figure, and replaces the old X and Y values for each point with the new values. It also keeps a running total on the X and Y translation, to be used in the Rotation subroutine. Also, the Plot routine is called here to display the new, translated points.

The Rotation subroutine at line 830 is more complicated. The relationship between an existing point (X_0, Y_0) and the new computed point (X_1, Y_1) can be expressed as:

$$X_1 = X_0 \cos(a) - Y_0 \sin(a)$$
$$Y_1 = X_0 \cos(a) + Y_0 \cos(a)$$

where a is the angle of rotation. For details on the derivation of these relationships, see reference 3.

The Method Of Rotation

These equations describe rotation of a point about the origin. On initial entry of data for the pattern to be displayed, coordinates are chosen so the axis of rotation is at the origin. Then, if we later wish to

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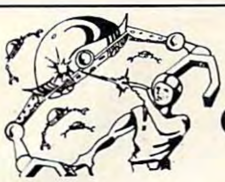

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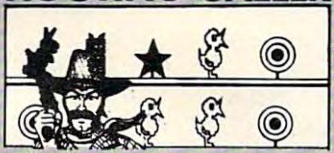

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A unique new approach to computer gaming. RICHOCHET combines diabolical strategy with fast action to yield a game that satisfies your intellect as well as your senses. You have 6 playing pieces to move around, plus 2 ball launchers. Each turn consists of either repositioning the pieces or launching a ball. Points are scored each time the ball ricochets. Simple? Deceptively so. Easy to master? Definitely not! 1 or 2 players.

32K Disk $19.95

K-RAZY SHOOT OUT

From K-Byte
Get this collector's item while you can: It's the first non-Atari game in a ROM cartridge. Just slip the cartridge into the slot and you can instantly be playing this action-packed arcade game. The object is to move your Space Commander through the Alien Control Sectors, shoot the Alien Droids and escape from the sectors. The sectors are a maze of passages and barriers that can be used for protection, but don't let your commander touch them—they're electrified!

ROM Cartridge $49.95

GHOST HUNTER

From Arcade Plus
The exciting haunted house maze game where you must get the ghosts before they get you! When you eat the pulsating "energizers," the ghosts start pulsating and become vulnerable to your attack. 51 different game variations keep things interesting. Play alone or in the "head-to-head" mode.

16K Tape .... $29.95 16K Disk $34.95

JAW BREAKER

By John Harris from On-Line
If you like arcade games with action, you'll love JAWBREAKER. Guide your chompers through a candystore maze, eating "wifesavers" as you go. You are pursued by variously colored "smilies," determined to knock your teeth out. Eat a jawbreaker and the "smilies" turn to blue "frownies," and you can eat them! It's one of the best examples of Atari graphics and sound we've seen...you'll love it!

16K Disk or Tape $29.95

LUNAR LANDER

By Wall, Moncrief & Jessee from A.I.
Grab your joystick and sweat out the touch-down of your LEM. Choose from four lunar landscapes, with many choices for landing sites. Select a more difficult site and get more points—if you can land successfully. You have complete control of your LEM via main engines and small side thrusters, and five successful landings are heralded with a patriotic event. Great fun!

24K Tape .... $14.95 32K Disk $20.95

EASTERN FRONT 1941

By Chris Crawford from APE
A map-based simulation of Operation Barbossa, the German invasion of Russia. A complex and accurate war game, EASTERN FRONT pits you, as German Commander, against the terrain, the weather, and the Russian forces. Good use of colorful graphics and sound, and well written documentation make this game a winner!

16K Tape or 32K Disk $29.95

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rotate about this axis after the figure has been translated elsewhere on the screen, we must first translate the figure back to the origin, do the rotation, and then translate back to where the figure had been. Naturally, these intermediate steps are not displayed on the screen.

The pattern of points which makes up the displayed figure is in the DATA statement of line 230. The first number is an X value, next comes its associated Y value, and so on until all points are described. The sequence in which points are described here is the sequence with which they will be plotted. (See Figure 3.)

Before branching to the ROTATION subroutine, the following variables must be initialized:

NP = Number of points in displayed pattern.

IA = Incremental angle of rotation, in radians.

AX, AY = Absolute X and Y values that the axis of rotation has been translated from the origin.

XP (NP), YP (NP) = Arrays containing X Y coordinates.

Before branching to the Translation subroutine, you must initialize:

XT, YT = Value of X and Y translation.
NP, XP (NP), YP (NP) = As before.

Note that AX and AY are normally updated in the Translation subroutine and should be set to zero at the start of the program.

When entering this program, the user can, if desired, omit all REMarks, since there are no branches to REM statements. When running the program, the figure will first appear in the upper left of the screen, partially hidden by the screen edge and wrapped around the display. Pressing the numeric keys translates the figure, a lop-sided plus sign, according to the standard scheme of Figure 4. In addition, pressing the zero will rotate the pattern 15 degrees counter-clockwise, and pressing the five will rotate 15 degrees clockwise.

As with most BASIC programs which manipulate graphics, these routines work slowly with large numbers of points. The ten point example does one rotation in little more than one second. If the program must rotate quickly, either the incremental angle of rotation can be increased, or sections of this program can be rewritten in machine language.

References

1) *High-Resolution Plotting for the PET*, J. Sherburne, Micro No. 10, March 1979, Machine language routine.

2) *Workbook 3*, Total Information Services, Basic routine for hi-res. plotting, PET.

3) *The Mathematics of Computer Graphics*, J. Posdamer, Byte Vol. 3, No. 9, Sept. 1978.

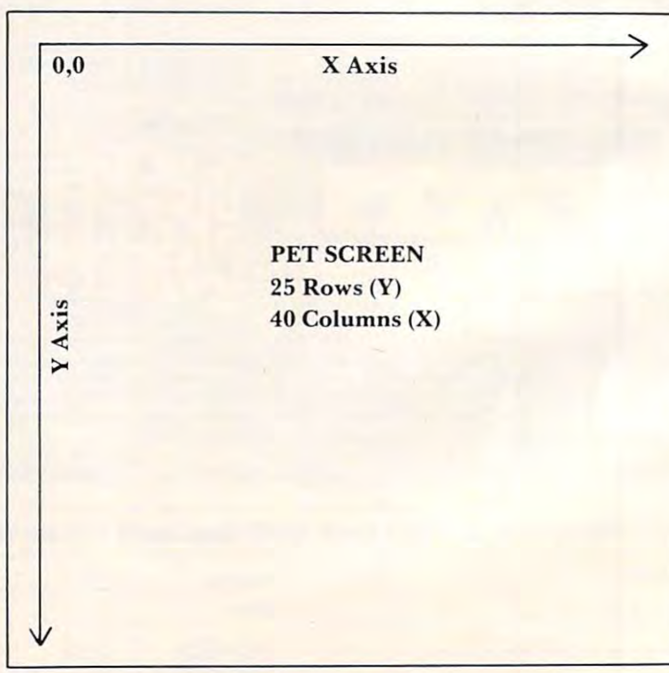
Notes For Atari Users

The Atari version of this routine closely parallels the PET version. Instead of screen POKEs, ordinary X,Y PLOTting is used, and instead of using the numeric keypad to generate the values for the translation routine, this program uses a joystick to move (translate) the figure around the screen. The less-than "<" and greater-than ">" keys are used to rotate the figure. Because of the general nature of this program, it can be run in Applesoft BASIC with only minor changes, such as changing GRAPHICS 3 + 16 to GR ; COLOR 1 to COLOR = 1, TRAP to ONERR GOTO, GET #1,A to GET A$:A = ASC(A$), etc., and using the keyboard, paddles, or a joystick to get the values for XT and YT (1,0, or -1).

Other Machines:

If your BASIC supports X,Y PLOTting, use the Atari version as a guide, otherwise modify variables SS, SE, and RL in the PET/CBM version if you have a memory-mapped text display. (See the article for details.)

Figure 1.



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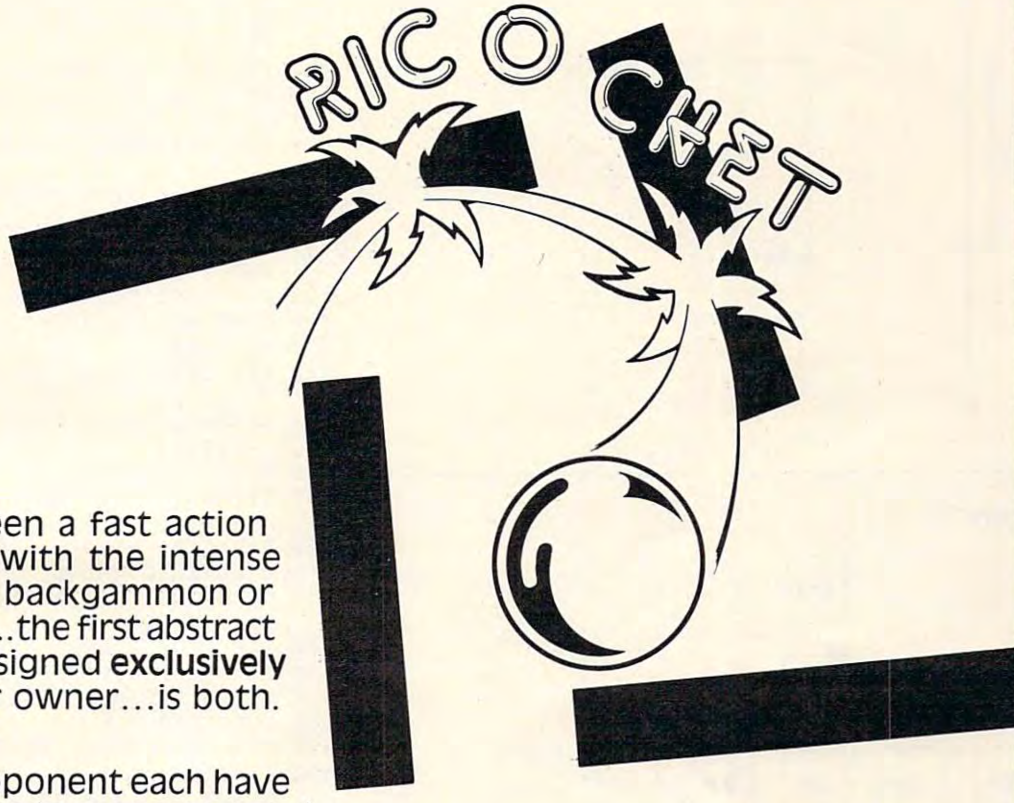

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Figure 2.

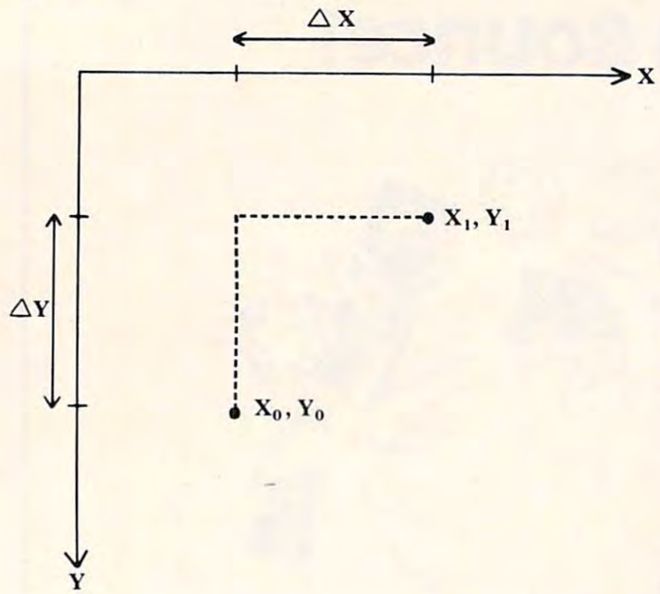


Figure 3.

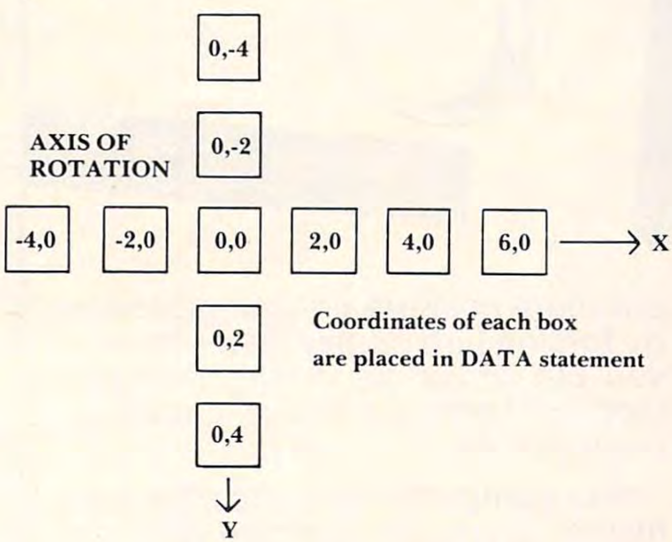
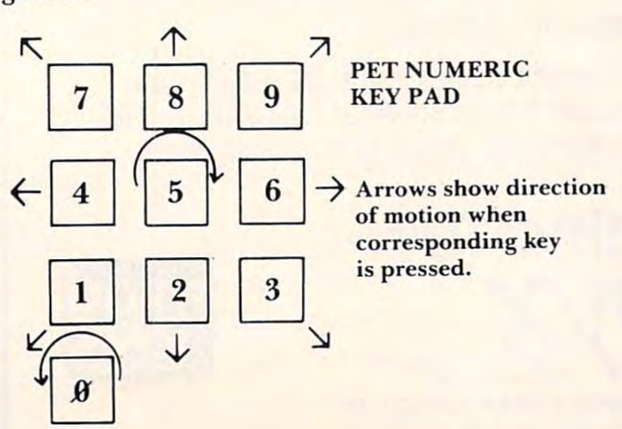


Figure 4.



Program 1. Commodore Microsoft Version

```
100 REM 2-D GRAPHICS SUBROUTINE DEMO
110 REM BY IAN PAULL
120 PRINT"{CLEAR}":REM CLEAR SCREEN
130 DIM XP(10),YP(10):REM ENLARGE FOR MORE ~
    POINTS
140 REM INITIALIZE
150 POKE 59468,12:REM PUTS PET IN STANDARD ~
    CHARACTER MODE
160 NP=10:SS=32768:SE=33767:RL=40:AX=0:AY=0

170 REM NP=NUMBER OF POINTS; SS=SCREEN STAR
    T ADDRESS; SE=SCREEN END ADDRESS
180 REM RL=ROW LENGTH; AX,AY=ACCUMULATED X ~
    AND Y VALUES (NET XLATION SO FAR)
190 FOR KZ=1 TO NP:REM READ FIGURE COORDS
200 READ XP(KZ),YP(KZ)
210 NEXT KZ
220 REM DATA BELOW ARE FIGURE COORDS. FORMA
    T FOR EACH POINT IS X,Y
230 DATA-4,0,-2,0,0,0,2,0,4,0,6,0,0,4,0,2,0
    ,-2,0,-4
240 GOSUB 1060:REM PLOT
250 GETA$:IFA$=""THEN250:REM LOOPS UNTIL AN
     INPUT
260 A=VAL(A$)+1:REM CONVERTS STRING INPUT T
    O NUMERIC VALUE
270 ON A GOTO 290,370,420,470,520,330,570,6
    20,670,720
280 REM CCW ROTATE, FIXED ANGLE 15 DEG
290 IA=-(15/360)*(2*):REM_=PI
300 GOSUB 780:REM ROTATE ROUTINE
310 GOTO 250
320 REM CW ROTATE, FIXED ANGLE 15 DEG
330 IA=(15/360)*(2*):REM_=PI
340 GOSUB 780:REM ROTATE ROUTINE
350 GOTO 250
360 REM XLATE DOWN AND LEFT
370 XT=-1
380 YT=1
390 GOSUB 970:REM XLATE ROUTINE
400 GOTO 250
410 REM XLATE DOWN
420 XT=0
430 YT=1
440 GOSUB 970:REM XLATE ROUTINE
450 GOTO 250
460 REM XLATE DOWN AND RIGHT
470 XT=1
480 YT=1
490 GOSUB 970:REM XLATE ROUTINE
500 GOTO 250
510 REM XLATE TO LEFT
520 XT=-1
530 YT=0
540 GOSUB 970
550 GOTO 250
560 REM XLATE TO RIGHT
570 XT=1
580 YT=0
590 GOSUB 970
600 GOTO 250
610 REM XLATE UP AND LEFT
620 XT=-1
630 YT=-1
640 GOSUB 970
650 GOTO 250
660 REM XLATE UP
670 XT=0
```

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```
680 YT=-1
690 GOSUB 970
700 GOTO 250
710 REM XLATE UP AND TO RIGHT
720 XT=1
730 YT=-1
740 GOSUB 970
750 GOTO 250
760 REM ROTATE CONTROL
770 REM FIRST, XLATE TO ORIGIN
780 FOR KZ=1 TO NP
790 XP(KZ)=XP(KZ)-AX
800 YP(KZ)=YP(KZ)-AY
810 NEXT KZ
820 REM DO ROTATION ABOUT 0,0
830 SA=SIN(IA):CA=COS(IA)
840 FOR KZ=1 TO NP
850 KN=XP(KZ)
860 XP(KZ)=KN*CA-YP(KZ)*SA
870 YP(KZ)=KN*SA+YP(KZ)*CA
880 NEXT KZ
890 REM XLATE BACK
900 FOR KZ=1 TO NP
910 XP(KZ)=XP(KZ)+AX
920 YP(KZ)=YP(KZ)+AY
930 NEXT KZ
940 GOSUB 1060: REM PLOT
950 RETURN
960 REM XLATE
970 AX=AX+XT:REM KEEP TRACK OF ABS X
980 AY=AY+YT:REM KEEP TRACK OF ABS Y
990 FOR KZ=1 TO NP:REM SHIFT X AND Y
1000 XP(KZ)=XP(KZ)+XT
1010 YP(KZ)=YP(KZ)+YT
1020 NEXT KZ
1030 GOSUB 1060: REM PLOT
1040 RETURN
1050 REM PLOT
1060 PRINT"{CLEAR}":REM CLR SCREEN
1070 FOR KZ=1 TO NP:REM FIGURE ADDRESSES TO ~
 BE POKED
1080 LOC=(SS+RL*INT(YP(KZ)+.5)+INT(XP(KZ)+.5
 ))
1090 IF LOC<SS OR LOC>SE THEN NEXT KZ:RETURN
 :REM DON'T POKE OFF SCREEN
1100 POKE LOC,160:REM LIGHT CHARACTER CELL A
 T SCREEN LOCATION 'LOC'
1110 NEXT KZ
1120 RETURN
1130 END
```

Program 2. Atari Version

```
110 OPEN #1,4,0,"K"
120 GRAPHICS 3+16
130 DIM XP(10),YP(10):REM ENLARGE DIMENS
ION FOR MORE POINTS
140 REM INITIALIZE
160 AX=0:AY=0:NP=10:PI=3.1415927
170 REM NP=NUMBER OF POINTS
190 FOR KZ=1 TO NP
200 READ T:XP(KZ)=T:READ T:YP(KZ)=T
210 NEXT KZ
220 REM DATA BELOW ARE FIGURE COORDS.
225 REM FORM FOR EACH POINT IS X,Y
230 DATA -4,0,-2,0,0,0,2,0,4,0,6,0,0,4,0
,2,0,-2,0,-4
240 GOSUB 1060:REM PLOT
250 IF PEEK(764)<255 THEN 300
260 ST=STICK(0):IF ST=15 THEN 250
270 XT=-(ST>8 AND ST<12)+(ST>4 AND ST<8)

280 YT=(ST=9 OR ST=5 OR ST=13)-(ST=10 OR
 ST=14 OR ST=6)
290 GOSUB 970:REM XLATE ROUTINE
295 GOTO 250
300 GET #1,A
310 IF A<>60 AND A<>62 THEN 250
320 IA=(-(A=60)+(A=62))*(15/360)*(2*PI)
330 GOSUB 780:REM ROTATE ROUTINE
340 GOTO 250
760 REM ROTATE CONTROL
770 REM FIRST, XLATE TO ORIGIN
780 FOR KZ=1 TO NP
790 XP(KZ)=XP(KZ)-AX
800 YP(KZ)=YP(KZ)-AY
810 NEXT KZ
820 REM DO ROTATION ABOUT 0,0
830 SA=SIN(IA):CA=COS(IA)
840 FOR KZ=1 TO NP
850 KN=XP(KZ)
860 XP(KZ)=KN*CA-YP(KZ)*SA
870 YP(KZ)=KN*SA+YP(KZ)*CA
880 NEXT KZ
890 REM XLATE BACK
900 FOR KZ=1 TO NP
910 XP(KZ)=XP(KZ)+AX
920 YP(KZ)=YP(KZ)+AY
930 NEXT KZ
940 GOSUB 1060:REM PLOT
950 RETURN
960 REM XLATE
970 AX=AX+XT:REM KEEP TRACK OF ABS X
980 AY=AY+YT:REM KEEP TRACK OF ABS Y
990 FOR KZ=1 TO NP:REM SHIFT X AND Y
1000 XP(KZ)=XP(KZ)+XT
1010 YP(KZ)=YP(KZ)+YT
1020 NEXT KZ
1030 GOSUB 1060:REM PLOT
1040 RETURN
1050 REM PLOT
1060 GRAPHICS 3+16:SETCOLOR 0,0,10:COLOR
 1
1070 FOR KZ=1 TO NP
1080 TRAP 1090
1085 PLOT XP(KZ),YP(KZ):TRAP 40000
1090 NEXT KZ
1100 RETURN
1130 END
```

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A Monthly Column

The World Inside The Computer

Fred D'Ignazio is a computer enthusiast and author of several books on computers for young people. He is presently working on two major projects: he is writing a series of books on how to create graphics-and-sound adventure games. He is also working on a computer mystery-and-adventure series for young people. As the father of two young children, Fred has become concerned with introducing the computer to children as a wonderful tool rather than as a forbidding electronic device.

The Computer Playground

Fred D'Ignazio
Associate Editor

Eric ran over to the royal-blue sliding board, standing like a petrified monolith in the corner of his school playground. He looked up, searching

for the top of the sliding board. It was lost somewhere in the drifting clouds. The metal rail glinted in the sun, resembling the arm of a giant crane. The dirty blue stairs seemed to go up and up, maybe ending somewhere in heaven.

Although Eric was only three, he confidently grabbed onto the sliding board's steel handrail and began clinging the steep metal stairs. After he got to the top, Eric stopped, panted like a puppy, and surveyed his playmates, screeching and dashing around the playground. His friends looked strangely small, since Eric was so high up.

Eric stretched on his tip-toes and grabbed the chinning bar above the sliding board. He swung back and forth wildly.

"Karla, watch!" he yelled to his teacher.

Halfway through each arc, he smacked his feet against the top of the sliding board. Loud percussion noises echoed across the playground.

Suddenly, Eric let go and went flying down the sliding board. He slid dizzily round and round the board's corkscrew spirals. He flew off the end of the board, sailed across a mud puddle, and demolished a sand castle being built by two of his friends. His friends went crying to their teacher. Eric howled. When he landed on the sandpile, he had scraped his bottom on the tip of an upturned shovel.

Moments later, the two kids were at work on another sand castle, undisturbed about the prospect of new children falling from the sky.

Eric was far away, on the opposite side of the playground. His cheeks were splashed with gritty tears, and his ears were filled with sand, but he was smiling. He had a new project. He was crab crawling across the green-shingled roof of the school's playhouse, trying to work up his courage to jump into the old rowboat beached under the house's eaves. Eric thought maybe he could do it. After all, what's jumping off a roof to a three-year-old who can climb to heaven and drop from clouds and clobber castles?

The Computer Alchemists

The dark-suited men were frowning and fiercely

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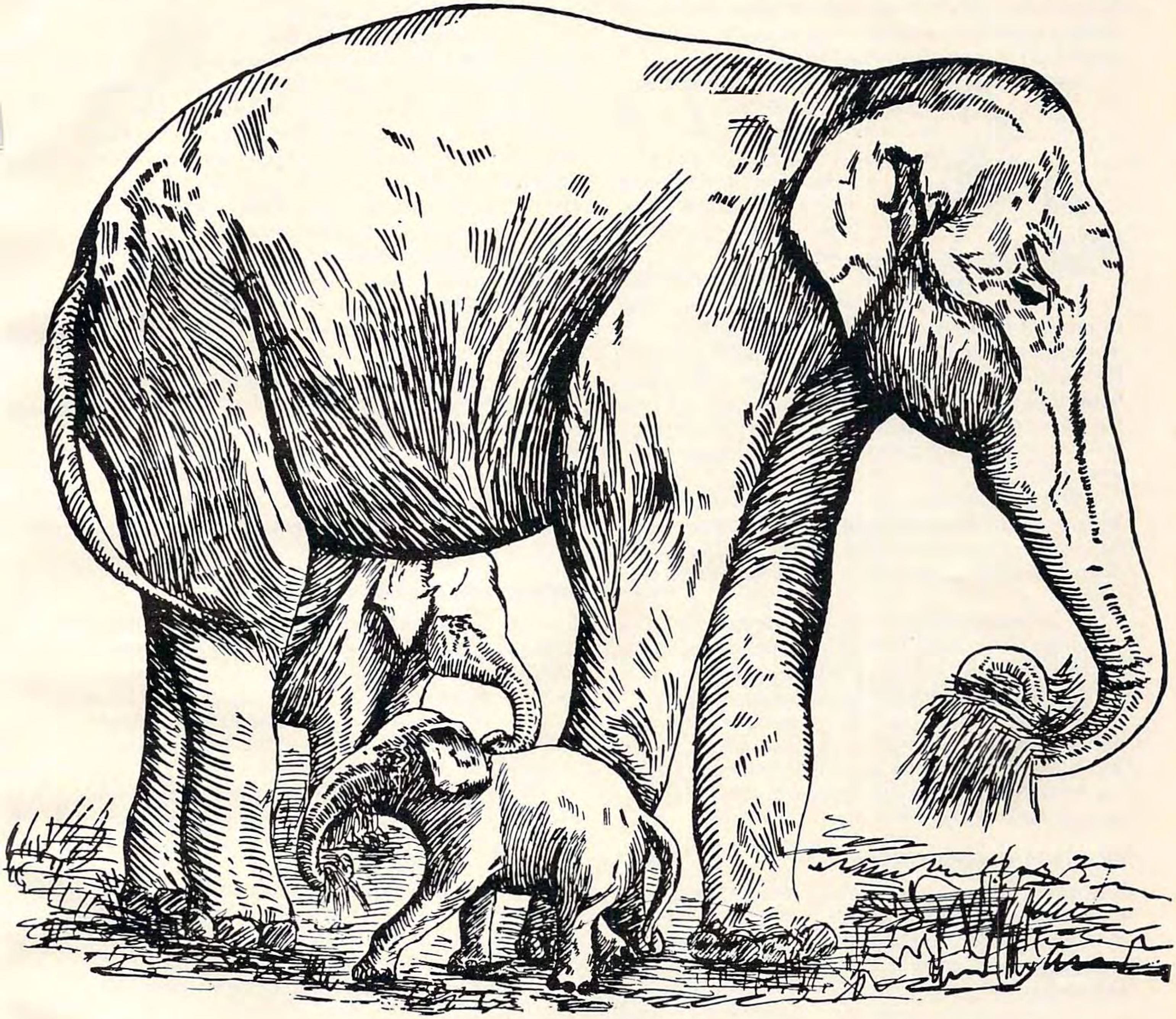

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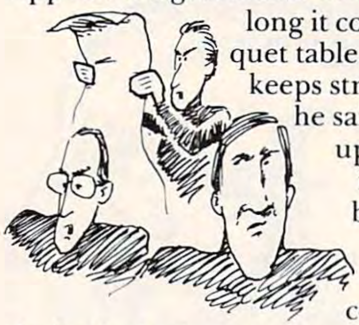
intent. They spoke a cryptic, arcane language. "Disk error in sector five," said one. "Uh-huh," said another. "We'll have to bleed the accumulator." A third stared at a wide piece of paper he had just ripped off a green-and-white sheet of paper so



long it could have covered a banquet table." The 0S slave program keeps stripping the control bits!" he said angrily. He crumpled up the paper and tossed it into a navy-green wastebasket under his spotless desk.

The men worked in a cool, almost Arctic room, drained of color by the overwhelming bath of white light emanating from the banks of flourescent lamps fastened to the ceiling. Tall panels of lights winked like a city's streetlights viewed from a distant hill. Rows of metal boxes were filled with rotating platters and reels of gleaming tape that spun and whirred.

Staccato, machine-gun noises filled the room, as three of the boxes disgorged endless sheets of paper. The paper looked like a giant, jerking tongue or an impossibly long scarf pulled from a magician's sleeve.

The men were only vaguely aware of the tap-dancing printer and the clacking tape drives. These sounds were muffled by a loud whooshing noise that seemed to cover everything in the room like an invisible volcanic ash. The noise came from air pouring through the wall grates from huge cooling and filtering fans. After several hours in the room, the noise could numb a person's whole body and make it feel wrapped in a cocoon of cotton candy.

When Alien Worlds Collide

Eric on the sliding board and the men in the cotton-candy room seem to be worlds apart. Eric is a toddler having fun on a playground. The men are high-level programmers and analysts designing a new computer system.

Eric is outdoors in the sun. The men are buried deep in the bowels of the Pentagon, in a guarded, windowless computer room.

Eric is covered with dirt and sand, and sweating from his exertions. The men are covered with plastic badges that proclaim their dedication and their utter seriousness about their craft. Dust and dirt are not permitted in their room. Only, sweat – cold sweat.

I used to be one of those men. And Eric is my son. Now Eric's world and the world where I once worked have intersected, like alien worlds colliding.

When did the collision take place? It occurred when I first turned Eric loose on my home computer.

The shock was antic. It was also profound.

Eric is a person of arbitrary, random action. He is a person driven by fantasy, by enormous appetites and desires. His energy seems boundless. His temper is formidable. He vibrates to the tune of unchecked emotions and enthusiasms. He cringes from invisible monsters that scare him half silly, then walks unconcerned past real monsters he still hasn't learned to fear. To my most careful, clearly put instructions, he answers, "What?"

Computers, on the other hand, are creatures of reason and precision. They are powerful tools, the product of advanced technology. Computers are predictable. If we put in the right command, we get the right answer. Or, if we feed the computer garbage, we get garbage back.

Computers and three-year-olds seem worlds apart. Just imagine a computer that acted like a three-year-old. Or imagine a three-year-old that acted like a computer.

Three-year-olds are hardy and tough. Computers are finicky and delicate. Three-year-olds revel in dirt, mud, and grime. Computers like to be clean. They work better that way.

Knives, Forks, And Attila The Hun

Eric has lots of nicknames: Little Hulk, Commando Kid, Tank, and the Lone Ranger, among others. My favorite, though, is Attila the Hun. This is an apt nickname because Eric, at heart, is a barbarian.

Can a barbarian ever learn to eat with a knife and fork? Can he be trusted in the same room as a computer?

Sometime, over a year ago, I was on the phone in the kitchen talking with someone in California. I was trying to obtain some photos for a book I was writing.

Eric was home with me all day, back then, while his mommy went to work and his sister went to school. I didn't worry about Eric while I talked on the phone, since Eric was busy crayoning on a piece of scrap paper on the floor of my study. Or so I thought.

I was deeply engrossed in the conversation, trying hard to visualize the Californian's robot turtle, which I had never seen. Then I happened to look up, and my heart stopped.

There, on the kitchen floor, Eric was hard at work, creating a flagstone sidewalk made out of my floppy disks. My *floppy disks.* I had stored all my books and programs on those disks. Eric must have known how important the disks were because he had carefully removed each disk from its protective case and gently dropped it on the floor. He had placed all the disks in a neat row that ended at the refrigerator. Now that he was finished building his

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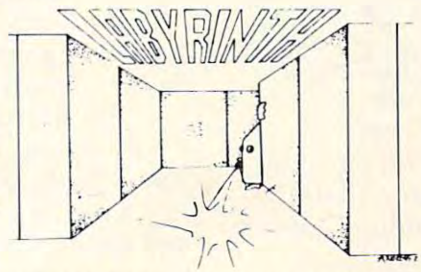

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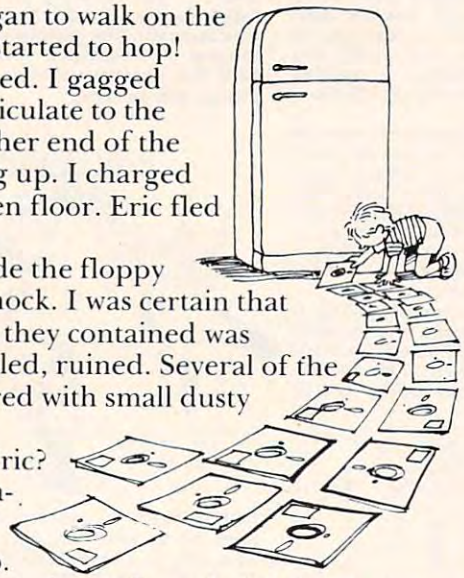

sidewalk, he began to walk on the disks. Then he started to hop! "Eric!" I screamed. I gagged something inarticulate to the person at the other end of the phone and hung up. I charged across the kitchen floor. Eric fled to his bedroom.

I knelt beside the floppy disks. I was in shock. I was certain that the information they contained was squished, trampled, ruined. Several of the disks were covered with small dusty footprints.

Did I flog Eric? Was my information destroyed?

Happily, no.

But that was only the first of a brief, but emotional, series of incidents involving Eric and the floppy disks. The problem was he couldn't keep his hands off them. Something perverse inside him told him he had me by the throat. All he had to do was point to a disk, and I flew into a tizzy. Every time I left my study, he would sneak in and rob several disks and hide them under his bed. For awhile, things got so bad, I began sealing my disk drawer shut with strapping tape, just to thwart Eric.

Then I had an inspiration. I gave Eric a disk of his own. It was an old disk that was no longer reliable. I wrote Eric's name on the disk in big green, magic-marker letters. I wrapped the disk up and gave it to him as a present.

He was delighted. He still keeps the disk in a place of honor on his bookshelf.

And he stopped robbing my disks.

Now You See It, Now You Don't!

I have two kids. Eric, of course, and Catie, who is six.

I have several computers, and I have turned my study into a videogame arcade and a computer programming workshop for neighborhood kids.

The kids can use all the computers in the room except one, my writing computer. That computer is supposed to be off limits.

One day, while the kids were banging away at the other computers, I got up from my computer to stretch and make a snack in the kitchen. On my way back into the room, five minutes later, I happened to glance at my computer screen. Before I left, the screen had been filled with words – a section of a new book chapter I was writing. Now the screen was empty.

I panicked. I ran into the room yelling at the kids. "Who messed with my computer?" I hollered. "My chapter's gone. I've lost hours of work."

Then I checked the computer. I was sure it had been turned off, but it was still on. I did some more checking. Finally, I noticed the screen brightness switch. I turned it. Magically, my words reappeared. My chapter was untouched. Nothing was lost.

Just then, a very contrite five-year-old boy came up to me with his head drooping. "I did it, Mr. D'Ignazio," he said. "I didn't mean to kill your computer."

Joystick Tug Of War

Another time, I was in the kitchen eating dinner with my family. Several children were still playing computer games in the study. All of a sudden, from the study came shouts and scuffling noises.

"It's my turn to blast them!" one child cried.

"You just blasted them!" cried another child. "Now it's my turn!"

I ran into the study and found a six-year-old and a nine-year-old (brother and sister) doing their best to rip two joysticks out of a computer.

"What are you two doing?" I shouted.

The kids turned toward me. Frightened, they dropped their joysticks. One broke open on the study's hardwood floor.

"Out! Out!" I yelled.

They dashed past me and ran out the front door of the house.

How Come This Doesn't Fit?

Another time, I was in the kitchen preparing dinner for my family. It was close to five-thirty, and my wife, Janet, would be home soon from the office. As usual, the study was filled with kids playing with the computers.

I was slicing up some carrots for the salad, when I heard strange grunting noises coming from the study. Were the kids in there wrestling among the computers?

Hurriedly I dried my hands and went to see what was the matter.

When I got to the study door, I couldn't believe what I saw. A five-year-old boy was standing in front of one of the floppy disk drives. That was okay. I had taught all the kids – even Eric – how to insert disks properly into the drive.

But this kid wasn't inserting a disk. He was trying to shove a game cartridge into the drive. He was trying to squeeze an inch-thick plastic box into a hole designed for a disk only a sixteenth of an inch thick. He grunted loudly because he was trying so hard. He knew it was a tough thing to do, and he was giving it his best shot.

Strategies For Survival

Given these tales of abused and violated computers,

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what is the best strategy for mixing young people and computers?

You could put a lock on the computer room door until the kids all turn sixteen. Or until they leave home.

You could keep the computer in the car trunk and only bring it in the house after the kids are asleep.

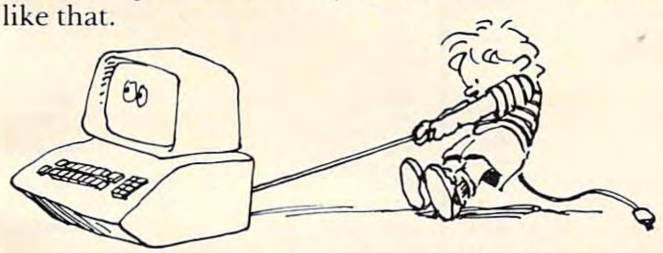
You could even fortify the computer, beef it up, and make it indestructible, the way the military does with computers onboard tanks, guided missiles, and submarines.

You could do these things, but I would advise against it. In their place, I would advise a "Computer Orientation Session," followed by frequent "refresher" courses. I would also recommend a few simple precautions. And trust – lots of trust.

Based on my experience, I know that even toddlers can be taught to use computers properly.

Sure, there are lapses. (Oh, boy, are there lapses.) But, for the most part, Eric and his little friends do an amazing job with the computers. They turn them on and off. They adjust the TV screen. They insert and remove disks and cartridges, even tapes. They know how to call up programs and operate the keyboard, joysticks, and other controls.

But they must be taught first. You need to sit them down and go over the "etiquette" of using a computer. Compare it to the family pet. You shouldn't pull its tail or try to ride on it. It wouldn't like that.



Instead, you need to be gentle with it and take care of it. If you do the right things, it will be nice to you and give you pleasure.

Frequent drills on specific rules help a lot, here.

It would help if you give the kids some responsibilities for the computer's care that are just their own. Like keeping the keyboard free of cookie crumbs. Keeping the screen wiped clean of fingerprints and all sorts of unmentionable objects. Or reporting any irregularities such as wires in the wrong place, or anything that looks dangerous.

Remind the kids frequently that computers run on electricity, and that electricity, like fire, can serve them or hurt them.

Also, if you can afford it, give them their own floppy disk, cartridge, or tape. Help them store their favorite programs and games. Give them a small case to store their printouts, game instructions, and other computer-related materials. This way, the computer will become partly theirs. As its owners, they will try harder to care for the computer and protect it.

The following precautions, like the advice above, are just common sense. For example, I learned to put rugs on my study floor. Then, when computer objects dropped, there was a smaller chance that they'd actually break.

Also, back up *all* your important programs and files. Then keep those backup copies in your office, your bedroom, or in a locked safe. I can tell you, it's a lot easier to keep your cool when your child puts your floppy disk in the toaster, if you have a backup to the disk.

Keep all plugs, wires, and cables (anything electric) hidden and out of the line of fire. My kids could trip on a paper clip. How about yours?

Put all your equipment on top of large, sturdy tables, surrounded by lots of sturdy chairs.

Keep your cartridges, disks, tapes, manuals, programs, etc. organized. Make everything accessible to your children. But make them respect and adhere to your organization.

Teach them standards. All devices must be shut off after use. Disks and tapes must not be left out after use. Everything has a place. (Nag them about this rule, if only to preserve your sanity.)

Two last elements of strategy. First, try hard not to get upset when it looks like your kids have done something to the computer. Most of the time things are a lot better than they seem at first. We've had dozens of accidents with computers here at the "D'Ignazio Arcade," yet we've never broken a computer. At least not completely.

Second, don't push your kids to use the computers. Your three-year-old doesn't have to use educational programs to benefit from the computer. Your six-year-old doesn't have to learn to program.

Just the exposure to computers is doing your kids a world of good. Just switching buttons off and on. Or typing letters and shapes on the keyboard and watching them appear on the screen.

If you make kids' computer time synonymous with drudgery, with work, with tension, or with pressure, the kids won't like computers.

Don't push the kids. Just open the door, and sit back and watch. Computers fascinate kids, and that fascination will motivate them to learn on their own.

And congratulate yourself on your accomplishment. You are bringing together two very different worlds. And the results? The results are anybody's guess. ©

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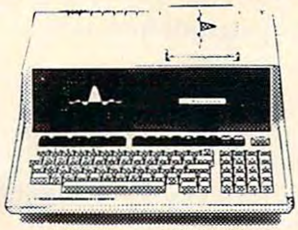

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With versions for the VIC and Atari computers, this program illustrates how to make games and learning programs easy for preschoolers to use.

Answer Selection With Joysticks

Stephen Levy
Bowie, MD

One of my major objectives in purchasing a computer was to create educational programs for my young son. Realizing that a preschool child might have difficulty using the keyboard, I decided that using the joystick to input responses was the answer. Not that learning to use the keyboard is not important, but if that is not the purpose of the program, it might get in the way and cause frustration.

Al Baker's two articles in *COMPUTE!'s First Book Of Atari* gave me ideas and the little extra push I needed.

The purpose of this educational program is to give a young child practice in deciding which of four words is different from the other three on the screen. The child uses the joystick to make his selection and is allowed as many tries as needed. Once the correct response is picked, a short explanation appears and the child can then decide whether to do another problem or to end the program. All this is done with the joystick.

The program is very straightforward. All data for problems are in lines 20 to 199, with even-numbered lines containing the words and explanations in the odd-numbered lines. I have included only four series of words (lines 20,22,24,26) so that the reader may add his own. You must adjust line 220 to equal the number of even-numbered data lines (total series of words); in my example there are only four.

example: 220 Q=INT(RND(0)*A)+10:RESTORE Q*2 where A equals the number of problems.

Lines 210-215 randomly select the background colors.

Since my purpose is to demonstrate the use of the joystick in an educational program, I have not added any graphic displays, but I would suggest "dressing up" the program for use with young children in order to maintain their interest. Below is an explanation of the program by line.

Lines	
5-10	Initialization.
20-27	Data for questions.
28-199	To be used for additional data for questions. Data placed as follows: Four choices, then joystick position of correct answer. In the order that they appear in data line. If the first answer is correct then the number should be, 14; second, 11; third, 7; fourth, 13.
200	Sets mode and turns off cursor.
210-215	Randomly selects background color and print.
220	Randomly selects data to be used. The number multiplied by RND(0) should be equal to the number of questions.
230-270	Reads data and positions words on screen.
300-350	Positions @ symbol in the direction of user's answer.
360	Checks for correct answer.
385-390	Clears @ from incorrect answer.
395	Gives user another try at the same question.
400-420	Reads and prints explanations on screen.
440-470	Gives user the option of another problem.

Program 1. Atari Version

```
1 REM D:JOYSTICK
2 REM STEPHEN LEVY
3 REM 3511 MORLOCK LN, BOWIE, MD.20715
4 REM 301-464-2052
5 DIM Q1$(20),Q2$(20),Q3$(20),Q4$(20),E$
(40),B$(1),C$(1),CLEAR$(1)
10 B$=" ":CLEAR$=CHR$(125):C$="@"
15 GOTO 200
20 DATA APPLE,PEAR,HAT,ORANGE,7
21 DATA HAT IS NOT A FRUIT
22 DATA A,E,I,S,13
23 DATA 'S' IS NOT A VOWEL
24 DATA BLUE,GREEN,RED,SAD,13
25 DATA THESE WORDS ARE COLORS
26 DATA APE,APPLE,ATE,FUN,13
27 DATA THESE WORDS BEGIN WITH 'A'
200 GRAPHICS 2:POKE 752,1
210 C=RND(0)*16:SETCOLOR 1,9,2:SETCOLOR
4,C,8:SETCOLOR 2,11,8
215 SETCOLOR 0,C,1
220 Q=INT(RND(0)*4)+10:RESTORE Q*2
230 READ Q1$,Q2$,Q3$,Q4$,A
240 POSITION 10-INT((LEN(Q1$))/2),1:PRIN
T #6;Q1$
250 POSITION 10-INT((LEN(Q4$))/2),9:PRIN
T #6;Q4$
260 POSITION 14,5:PRINT #6;Q3$
270 POSITION 7-LEN(Q2$),5:PRINT #6;Q2$
280 PRINT :PRINT :PRINT "PUSH STICK IN T
HE DIRECTION OF"
```

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ARTWORX. IT'S A WHOLE NEW WORLD OF SOFTWARE.

Scene from BETA FIGHTER during creation using the DRAWPIC graphics editor.

HODGE PODGE: by Marsha Meredith (Atari and Apple)
NOW AVAILABLE FOR ATARI!!! This captivating program is a marvelous learning device for children from 18 months to 6 years. HODGE PODGE consists of many cartoons, animation and songs which appear when any key on the computer is depressed. A must for any family containing young children.
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☐ **PM EDITOR:** by Dennis Zander (Atari, 16K)
Create your own fast action graphics game for the Atari 400 or 800 using its player missile graphics features. By using player data stored as strings, players can be moved or changed (for animation) at machine language speed. All this is done with string variables (PO$(Y)=SHIP4). This program is designed to permit creation of up to 4 players on the screen, store them as string data and then immediately try them out in the demo game included in the program. Instructions for use in your own game are included. PM EDITOR was used to create the animated characters in **ARTWORX** RINGS OF THE EMPIRE and ENCOUNTER AT QUESTAR IV.
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☐ **ROCKET RAIDERS** by Richard Petersen (Atari 24K)
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☐ **FOREST FIRE TWO:** by Richard Petersen (Atari 24K)
FOREST FIRE has been enhanced and now offers a two player mode for head to head competition to see who can survive, suffer the least damage and put their fire out first. User input now determines landscape, wind and weather conditions, offering limitless game variation. FOREST FIRE's excellent color graphics have been made even better, turning your computer into a super-detailed fire scanner.
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☐ **GIANT SLALOM:** by Dennis Zander (Atari, 16K)
Bring the Winter Olympics to your computer anytime of the year! Use the joystick to guide your skier's path down a giant slalom course consisting of open and closed gates. Choose from three levels of difficulty. Take practice runs or compete against from two to eight additional skiers.
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☐ **THE PREDICTOR** by Thomas Barker
(Apple, Atari, TRS-80, North Star and CP/M (M-BASIC)
This is a complete package that covers least squares fitting of parameters for two or more variables. THE PREDICTOR can be used for predicting sales and process behavior, trend analysis, model building and many other uses calling for multilinear regression techniques. Each option in the program is prompted with simple YES/NO commands making it **very** easy to use.
PRICE **$29.95** diskette

☐ **PILOT:** by Michael Piro (Atari, 16K)
Pilot your small airplane to a successful landing using both joysticks to control throttle and attack angle. PILOT produces a true perspective rendition of the runway, which is constantly changing. Select from two levels of pilot proficiency.
PRICE . . . . **$16.95** cassette **$20.95** diskette

☐ **TEACHER'S PET:** by Arthur Walsh (Atari, Apple, TRS-80, PET, North Star and CP/M (MBASIC) systems)
This is an introduction to computers as well as a learning tool for the young computerist (ages 3-7). The program provides counting practice, letter-word recognition and three levels of math skills.
PRICE . . . . **$14.95** cassette **$18.95** diskette

☐ **MAIL LIST 3.0:** (Atari, Apple and North Star)
The very popular MAIL LIST 2.2 has now been upgraded. Version 3.0 offers enhanced editing capabilities to complement the many other features which have made this program so popular. MAIL LIST is unique in its ability to store a maximum number of addresses on one diskette (typically between 1200 and 2500 names!). Entries can be retrieved by name, keyword(s) or by zip codes. They can be written to a printer or to another file for complete file management. The program produces 1, 2 or 3-up address labels and will sort by zip code (5 or 9 digits) or alphabetically (by last name). Files are easily merged and MAIL LIST will even find and delete duplicate entries! The address files created with MAIL LIST are completely compatible with **ARTWORX** FORM LETTER SYSTEM.
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☐ **THE VAULTS OF ZURICH:** by Felix and Greg Herlihy (Atari, 24K, PET)
Zurich is the banking capital of the world. The rich and powerful deposit their wealth in its famed impregnable vaults. But you, as a master thief, have dared to undertake the boldest heist of the century. You will journey down a maze of corridors and vaults, eluding the most sophisticated security system in the world. Your goal is to reach the Chairman's Chamber to steal the most treasured possession of all: THE OPEC OIL DEEDS!
PRICE . . . . **$21.95** cassette **$25.95** diskette

☐ **BRIDGE 2.0** by Arthur Walsh (Atari (24K), Apple TRS-80, PET, North Star and CP/M (MBASIC) systems)
Rated #1 by Creative Computing, BRIDGE 2.0 is the only program that allows you to both bid for the contract and play out the hand (on defense or offense!). Interesting hands may be replayed using the "duplicate" bridge feature. This is certainly an ideal way to finally learn to play bridge or to get into a game when no other (human) players are available.
PRICE . . . . **$17.95** cassette **$21.95** diskette

☐ **ENCOUNTER AT QUESTAR IV:** by Douglas McFarland (Atari, 24K)
As helmsman of Rikar starship, you must defend Questar Sector IV from the dreaded Zentarians. Using your plasma beam, hyperspace engines and wits to avoid Zentarian mines and death phasers, you struggle to stay alive. This BASIC/Assembly level program has super sound, full player missile graphics and real time action.
PRICE . . . . $21.95 cassette $25.95 diskette

NEW PROGRAMS!

HAZARD RUN: by Dennis Zander (Atari, 16K)
The sheriff has spotted you and you must make the treacherous run through Crooked Canyon past Bryan's Pond to the jump at Hazard Creek and safety. You can even put the joystick-controlled GEE LEE car up on two wheels to make it through some tight spots. A lead foot is not always the answer as you dodge trees, rocks and chickens in this nerve-racking game. HAZARD RUN employs full use of player/missile graphics, re-defined characters and fine scrolling techniques to provide loads of fast action and visual excitement.
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BETA FIGHTER: by Douglas McFarland (Atari, 16K)
See who will be the ace gunner in this action game set on a spectacular Martian landscape. BETA FIGHTER can be played with one or two players and uses player/missile graphics and delightful sound effects.
PRICE. . . . .**$16.95** cassette **$20.95** diskette

DRAWPIC: by Dennis Zander (Atari 16K)
DRAWPIC provides the user with an unbelievably easy way to create screens in graphics modes 3-7. Just sit back with your joystick and use POINT PLOT, DRAW LINE, RUBBER BAND fill and COLOR SET to create beautiful images on your Atari. Full or partial screen images are saved as string data in the program and can be instantly recalled and combined into new images using machine language subroutines. These graphic images can be easily incorporated into your own programs. The images of HODGE PODGE and the landscape of BETA FIGHTER were made using DRAWPIC.
PRICE . . . .**$29.95** cassette **$33.95** diskette

POKER TOURNEY: by Edward Grau (Atari 32K, Northstar)
You are entered in a high stakes Draw Poker Tournament facing six opponents including Lakewood Louie, Shifty Pete and Dapper Dan. Each has his own style of play and of bluffing. POKER TOURNEY utilizes the Joker, has true table stakes play and each hand is played based on pot odds. The Atari version's graphics and sound are superb of course (programmed by Jerry White) making POKER TOURNEY the class program of its type.
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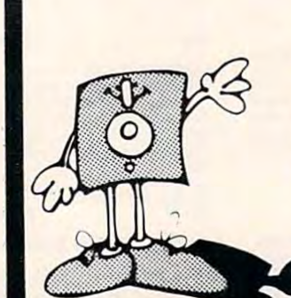
```
290 PRINT :PRINT "      CORRECT ANSWER."

300 IF STICK(0)=15 THEN POSITION 10,5:PR
INT #6;C$:GOTO 300
310 IF STICK(0)<>15 THEN POSITION 10,5:P
RINT #6;B$
315 SOUND 0,90,10,10:FOR S1=1 TO 20:NEXT
 S1
320 IF STICK(0)=14 THEN POSITION 10,3:PR
INT #6;C$
330 IF STICK(0)=11 THEN POSITION 8,5:PRI
NT #6;C$
335 SOUND 0,60,10,8:FOR S1=1 TO 20:NEXT
S1
340 IF STICK(0)=7 THEN POSITION 12,5:PRI
NT #6;C$
345 SOUND 0,0,0,0
350 IF STICK(0)=13 THEN POSITION 10,7:PR
INT #6;C$
360 IF STICK(0)=A THEN GOTO 400
370 PRINT CLEAR$:PRINT :PRINT "PLEASE TR
Y ANOTHER ANSWER"
372 FOR X=1 TO 100:NEXT X
375 FOR S1=1 TO 150:SOUND 0,200,10,8:NEX
T S1
380 FOR S1=1 TO 100:SOUND 0,230,10,8:NEX
T S1
381 SOUND 0,0,0,0
385 FOR X=3 TO 7 STEP 4:POSITION 10,X:PR
INT #6;B$:NEXT X
390 POSITION 8,5:PRINT #6;B$:POSITION 12
,5:PRINT #6;B$
395 GOTO 280
400 RESTORE (Q*2)+1
410 READ E$
420 PRINT CLEAR$;"GOOD, ";E$
425 FOR S2=1 TO 70:S3=INT(RND(0)*50)+50:
SOUND 0,S3,10,8:FOR S1=1 TO 7:NEXT S1
427 SOUND 0,0,0,0:NEXT S2
440 PRINT :PRINT "PRESS BUTTON FOR ANOTH
ER PROBLEM"
450 PRINT :PRINT "     PUSH STICK TO END
"
460 IF STRIG(0)=0 THEN GOTO 200
470 IF STICK(0)=15 THEN GOTO 460
480 PRINT :PRINT :PRINT "               G
AME OVER"
490 FOR X=1 TO 1000:NEXT X
500 GRAPHICS 0
```

Program 2: VIC Version

```
10 DD=37154:P1=37151:P2=37152
15 GOTO 200
20 DATA APPLE,PEAR,HAT,ORANGE,1
21 DATA HAT IS NOT A    FRUIT
22 DATA A,E,I,S,2
23 DATA 'S' IS NOT A    VOWEL
24 DATA SAD,BLUE,GREEN,RED,-2
25 DATA THESE WORDS ARE COLORS
26 DATA APE,FUN,ATE,APPLE,-1
27 DATA THESE WORDS      BEGIN WITH 'A'
200 PRINT"{CLEAR}"
210 Q=INT(4*RND(1)+1)
220 RESTORE
230 FOR I=1 TO Q
240 READ Q1$,Q2$,Q3$,Q4$,A,AN$
250 NEXT
260 PRINT"{RED}";TAB(11-LEN(Q1$)/2);Q1$;"{0
    5 DOWN}"
270 PRINT"{GRN}"TAB(11-LEN(Q4$)/2);Q4$;"{04
     UP}"
280 PRINTTAB(14);"{PUR}"Q3$
290 PRINT"{UP}{CYN}"TAB(7-LEN(Q2$));Q2$;"{B
    BLU}"
300 PRINT"{04 DOWN}PUSH STICK IN":PRINT"DIR
    ECTION OF THE"
310 PRINT"CORRECT ANSWER
320 PRINT"{HOME}{04 DOWN}";TAB(10);"Q"
330 GOSUB 500:IFH=0ANDV=0THEN330
340 PRINT"{HOME}{04 DOWN}";TAB(10);" "
350 PRINT"{HOME}{03 DOWN}";LEFT$("{02 DOWN}
    ",1+V);TAB(10+H);"Q"
360 IF(V*2+H)=A THEN 400
370 PRINT"{CLEAR}PLEASE TRY AGAIN"
380 GOTO 220
400 PRINT"{07 DOWN}":PRINT"{REV}GOOD, ";AN$

410 PRINT:PRINT
415 GOSUB500:IF(V*2+H)=ATHEN415
420 PRINT"{DOWN}PUSH STICK FOR ANOTHERPROBL
    EM"
430 PRINT"PUSH {RED}BUTTON{BLU} TO END"
440 GOSUB500:IF(HORV)THEN200
450 IFFB=0THEN440
460 PRINT"{DOWN}    GAME OVER"
499 END
500 REM JOYSTICK SUB
510 POKEDD,127:P=PEEK(P2)AND128
520 H=-(P=0)
530 POKEDD,255:P=PEEK(P1)
540 V=-((PAND8)=0)
550 H=((PAND16)=0)+H
560 V=((PAND4)=0)+V
570 FB=-((PAND32)=0)
580 RETURN
```

©



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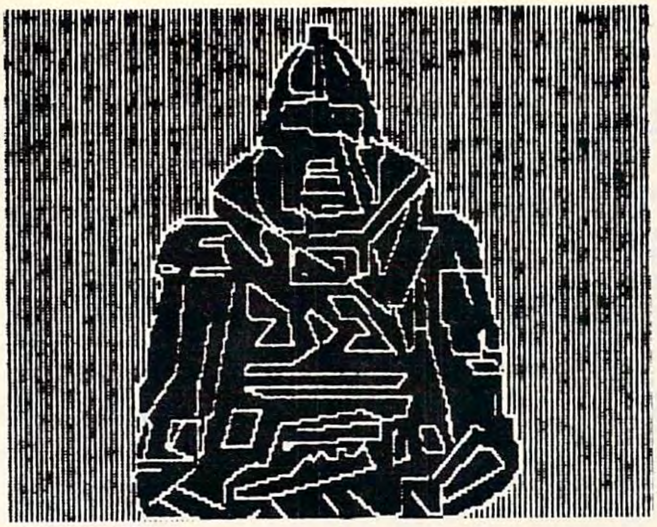

FOR ATARI

The above is a graphics 8 screen printout on the EPSON, with our new AESD II(tm).
It was drawn with Versawriter graphics tablet.

★ ★

002 ATARI EPSON SCREEN DUMP II
This is a screen dump program which allows you to copy anything from the screen. It also supports all graphics modes and text modes. It supports all the features of the EPSON(tm) MX-80 and MX-100. The program is in machine language and is relocatable. .... (C) $26.95
(D) $29.95

005 BINARY LOAD CASSETTE TO DISK
This utility will take binary load cassette files like SPACE INVADERS (tm) and allow their transfer to disk. No more waiting for loading! The duplicate is AUTO-BOOTING and uncopyable. .... (D) $21.95

007 DOWNLOADER
This is a true SMART TERMINAL EMULATOR PROGRAM which allows you to upload and download files between computers and save to DISK, CASSETTE, or a PRINTER. ALSO WORKS WITH THE D.C. HAY'S SMARTMODEM.
(C) $26.95
(D) $29.95

009 ELECTRONIC CALCULATOR
This program is a tool for the electronics hobbyist. It makes the necessary resistive and capacitive calculations for both series and parallel circuits. It shows formula, decodes resistors, plus power calculations for both AC and DC circuits. .... (C) $19.95
(D) $21.95

011 ELBBARCS
This is a word game program which is in high resolution graphics. .... (C) $19.95
(D) $21.95

012 UTILITY PAK 1
These four utility's are for the serious programmer. XREF is a variable cross reference utility which tells you where and when a variable is used in a program. VARIABLE-CHANGER is a program that allows you to easily change the name of any or all of the variables in your program. Lister and Denumber are also included. .... (C) $19.95
(D) $21.95

013 PIE BAR UTILITY
This utility is designed to provide a screen dump capability for the ATARI® GRAPH IT(tm) using EPSON® MX-80 printer. Features STORAGE and RECALL of both Pie and Bar Charts. Runs in 32K of RAM Screen Dump feature can be used separately in 24K of RAM. .... (C) $19.95
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Learning With Computers

Teaching Johnny To Program

Glenn Kleiman
Teaching Tools: Microcomputer Services
Palo Alto, CA

I expect within the next few years someone will write a book charging many schools with a misguided approach to teaching children about computer programming. This book, probably entitled *Why Johnny Can't Program,* will claim that teaching LOGO is the only proper approach, and that teaching BASIC is almost evil. Such extreme claims have already been made. For example, Seymour Papert, a leading advocate of LOGO, has written in *Mindstorms: Children, Computers and Powerful Ideas:*

> [It is] as unacceptable for children to enter the computer culture by learning computer languages such as BASIC as it would be to confine their access to English poetry to pidgin English translations (p. 211).

BASIC is the standard language for all personal computers. LOGO is a newer language, available for Apple II and TI 99/4 computers and being developed for several others. The advocates of LOGO claim it should, and will, replace BASIC – especially for teaching children. In order to evaluate this claim, we first must consider what features we want in a computer language taught to children.

What Children Need

1. The language should make small but interesting programs easy to write. This is useful for motivating students and alleviating anxieties about programming.

2. The language should make it easy to debug programs. Beginners quickly realize the need for exactness in programming but have trouble getting all the details right. Clear error messages and other features that facilitate debugging prevent a lot of frustration in teaching and learning.

3. The language should be designed for working with pictures and words. Most people, particularly young people, would rather use computers to create pictures and dialogues than to solve mathematical problems.

4. Learning the language should provide a good basis for learning more advanced programming. The students should master concepts common to all computer languages and develop good programming techniques.

5. The language should be compatible with the ways children think, and working with the language should facilitate the development of general thinking skills.

Comparing BASIC and LOGO

Now that we have some criteria, how do BASIC and LOGO compare?

Ease of getting started. BASIC and LOGO were both designed with novice programmers in mind. In either language, you can write small programs with a few simple commands. The programs will be of different types. A typical first BASIC program performs simple mathematical operations such as converting between centigrade and fahrenheit degrees. A typical first LOGO program creates shapes such as squares and triangles.

Ease of debugging. BASIC and LOGO are both interactive or conversational languages. When using an interactive language, you can get immediate responses from the computer without having to go through any other steps (such as the compiling step required with many languages). This makes it easier to find and correct errors in programs. With either BASIC or LOGO you can stop a program at any time, ask the computer questions such as the values of variables, and then continue the program from where it was stopped. The two languages also give helpful information about exactly where errors occur.

Working with pictures. LOGO contains an excellent Turtle Graphics system which makes it easy to create pictures. The child commands a "turtle" marker to move and draw on the screen. The commands include move forward or backward a number of steps, turn left or right a number of degrees, select a pen of a specified color, and raise or lower the pen to control whether the turtle draws as it moves. Here is a simple program to draw a square:

```
TO SQUARE
  FORWARD 40
  RIGHT 90
  FORWARD 40
  RIGHT 90
  FORWARD 40
  RIGHT 90
  FORWARD 40
  RIGHT 90
END
```

This program can be condensed to:

```
TO SQUARE
  REPEAT 4 [FORWARD 40 RIGHT 90]
END
```

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Turtle graphics, originally developed as part of LOGO, has since been incorporated into other languages, including Atari PILOT which I will review in next month's column. See Dave Thornburg's Friends of the Turtle column for more examples of turtle graphics.

BASIC typically uses a coordinate graphic system in which you specify the horizontal and vertical locations of things to appear on the screen. Here is a BASIC program to draw a square:

```
100 DRAW 0,0 TO 40,0
110 DRAW 40,0 TO 40,40
120 DRAW 40,40 TO 0,40
130 DRAW 0,40 TO 0,0
```

Each DRAW command draws a line between the coordinates specified.

There are many dialects of BASIC. In some the graphic commands are limited to plotting points and drawing lines. Others, such as the Radio Shack Color Computer Extended BASIC and the IBM Personal Computer BASIC, include more powerful graphic commands for drawing circles, arcs and boxes, filling areas with color, and moving pictures on the screen to create animations. The ease of creating pictures in BASIC depends to a large extent on which version is used.

Working with words. In BASIC, sets of letters are grouped together to form strings. Commands are available for testing whether strings match, for combining strings and for selecting parts of strings.

In LOGO, letters combine to form words, which are analogous to strings in BASIC. In addition, LOGO has lists. A list consists of an ordered set of words or simpler lists. That is, you can have a list of lists, or a list of lists of lists, and so on. This is very useful for working with language – a list of words forms a sentence, a list of sentences forms a paragraph, and a list of paragraphs forms a discourse. LOGO contains procedures for checking whether a list contains a specified word, testing whether two lists match, combining lists and selecting parts of lists. The commands for working with language in LOGO are far more powerful than those in BASIC.

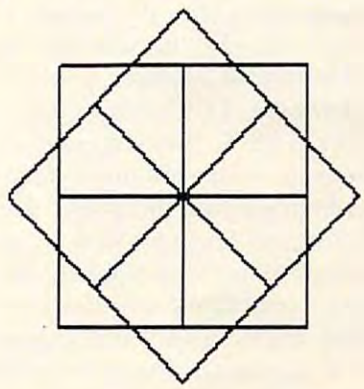
Learning general programming concepts. When learning either BASIC or LOGO, children become familiar with many concepts important in all programming. These concepts include variables, branching, iteration (repetition of sets of commands), conditionals (if/then decisions), and modules (subroutines or procedures). LOGO adds the concept of recursion (procedures that call themselves).

Learning good programming techniques. Programming techniques have advanced since BASIC was developed, and BASIC is often faulted for not encouraging good programming practices. As computers have become faster and memory less expensive, emphasis has shifted from writing programs which execute quickly and take little memory, to programs that are easy to write, understand, test, debug and modify.

An important part of good programming is dividing the overall goals of the program into simpler subgoals, each of which can be handled in its own part of the program. This is called modular programming. While modular programming is possible in BASIC, the language does not facilitate this approach.

LOGO was designed for modular programming. You define procedures, each of which tells the computer how to do something. Once a procedure is defined, it can be used in other procedures in exactly the same way as any of the "primitive" procedures built into the language. That is, each procedure you create can be used as a module in a larger program. For example, once the SQUARE procedure given above is created, it can be used in a procedure to create a more complex picture such as:

```
REPEAT 8 [SQUARE RIGHT 45]
```



Since a created procedure can be used just like a built-in one, LOGO lets you design your own language by creating a set of procedures to suit your purposes.

Compatibility with children's ways of thinking. Children are best able to understand things in terms of concrete images and their own actions, rather than in terms of abstract concepts. Turtle graphics therefore provides an excellent means of introducing programming to children. Commands to the turtle are in terms of processes children can act out. A child might create a SQUARE procedure by first drawing a square with a pencil and paper (or walking the shape of a square) and observing his own movements. The child can then tell the turtle how to follow the same pattern of movement. In contrast, the graphics commands typical of

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BASIC require an understanding of the coordinate system and do not reflect the processes of drawing.

While the turtle graphics component of LOGO suits children very well, I am less certain about the rest of LOGO. The commands for working with words are powerful but may not be simple for children to use. Most teachers using LOGO have so far focused on turtle graphics. I am waiting for more information from teachers and children who are exploring the non-graphics aspects of LOGO.

In BASIC, children generally find it easy to understand the individual string processing commands and to write small programs with them. However, the difficulty of BASIC programming increases rapidly as the size of the program increases.

Developing thinking skills. To program in any language, one must analyze the task the computer is to perform, divide it into sub-steps, carefully communicate the sub-steps to the computer, and test and debug the program. Many teachers report that when children learn programming they also acquire ways of approaching many types of problems and gain an appreciation of the need for careful work. This leads to improvements in much of their school work.

I believe the critical factor in whether learning to program facilitates general thinking skills is not which language is taught, but whether the teaching encourages careful task analysis, problem solving, and testing. However, LOGO does have some advantages over BASIC. Since it encourages modular programming, it also encourages careful analysis of problems and good programming practices. LOGO contains features well adapted to certain problem solving strategies (such as progressively reducing a problem to similar but simpler problems). And working with turtle graphics can lead children to an intuitive understanding of concepts of geometry and symmetry.

Which Language Should Children Be Taught?

More people know BASIC than any other computer language and there are a greater number of books and programs available to help teach BASIC. I know many children and adults who have gotten a great deal out of learning BASIC – knowledge about computers, an understanding of general concepts of programming, appreciation of the need for careful thinking and attention to details, and joy and pride in being able to control the computer with their own programs.

LOGO has been used in a number of test projects and is beginning to be tried in many classrooms. As I've discussed, it has several excellent features for teaching children, particularly in the turtle graphics component. I expect materials to help learn and teach LOGO will become available rapidly.

Children enjoy and benefit from learning either BASIC or LOGO. Why shouldn't they learn both?

Versions Of LOGO For Apple II Computers

Two versions of LOGO are now available for Apple computers, one developed at MIT and the other developed by Logo Computer Systems, Inc. (LCSI). LCSI LOGO is marketed by Apple through its dealers. Two companies market the MIT version: Terrapin Inc. (678 Massachusetts Ave. #205, Cambridge MA 02139), and Krell Software (21 Millbrook Drive, Stony Brook, NY 11790). Both versions require a 48K Apple II with a 16K RAM card (or language card) and one disk drive. The two versions have far more similarities than differences, but each has several features not found in the other.

The MIT version has three features which are particularly useful with children: (1) The ability to change the shape of the turtle. This is useful for animations – you can create your own shape and move it on the screen with turtle commands. (2) A trace function which lets you run a program step-by-step. This is useful for carefully analyzing programs and for finding bugs. (3) The ability to save pictures to disk and retrieve them from a program. MIT LOGO also has a feature for machine language programmers: it lets you add your own machine language routines.

LSCI LOGO, while not having the features mentioned above, has several features not found in the MIT version. These include more advanced list processing capabilities, convenient ways of working with sets of procedures, the ability to re-define primitive commands, and good error trapping capability. These features are particularly useful for advanced programmers.

An important part of a LOGO package is the documentation. LCSI LOGO comes with two manuals, an excellent turtle graphics tutorial and a good reference manual. Terrapin has its own tutorial, which covers both turtle graphics and language processing. I only have a draft available for review, but it looks like a very useable manual. Krell provides a minimal amount of written documentation and a tutorial on disk. The Krell tutorial is severely lacking – it demonstrates many of the capabilities of LOGO but does not teach anyone how to use them.

The prices of the three LOGO packages, with documentation and back-up copy, are: LCSI – $175; Terrapin – $165 ($150 + $15 for back-up disk); Krell – $179. I recommend either LCSI or Terrapin. Krell cannot be recommended due to

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the lack of adequate documentation.

LOGO Books

Four books that tell you more about LOGO are available:

Logo by Harold Abelson (Byte/McGraw Hill Publishers, 1982). A guide to using LOGO which is a good addition to the LCSI and Terrapin manuals.

Special Technology for Special Children by Paul Goldenberg (University Park Press, 1979). Discusses uses of LOGO with severely handicapped children.

Mindstorms: Computers, Children and Powerful Ideas by Seymour Papert (Basic Books, 1980). The case for LOGO, strongly stated.

Turtle Geometry by Harold Abelson and Andrea diSessa (MIT Press, 1980). A technical book on using turtle graphics to teach concepts of plane geometry, vectors and topology and other areas.

An Inexpensive Turtle Graphics Program

Many people want to try turtle graphics without investing in the full package and the necessary memory expansion. An excellent program which lets you do so was published in *Nibble* magazine (Vol. 3, No. 1, 1982). This program, written in Applesoft by David Krathwohl, provides the main turtle graphics commands, the ability to write procedures and call them from other procedures, iteration, some minimal use of variables, and saving programs to disk. You can find a copy of the magazine and type the program into your Apple or order a disk (with documentation and two other programs) for $29.95 plus $1.50 postage from Nibble: Box 325, Lincoln MA 01773. ©

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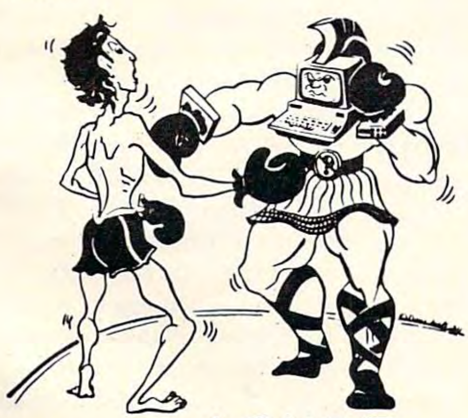

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Apple Game Paddles

John K. Elberfeld
Rochester, NY

Understanding the functions of the Apple game paddles was my first step toward interfacing the Apple with the "real world." The simplicity of the paddles is a result of the amazing versatility of the game In/Out connector (where the game paddles are plugged in) on the computer mother board. The Apple Reference Manual, pages 23, 24, 100, and 114, provides the basic facts about the paddles and the connector. This article will attempt to unify these facts into an understandable explanation of the Integrated Circuit electronics used every time Little Brick Out is RUN.

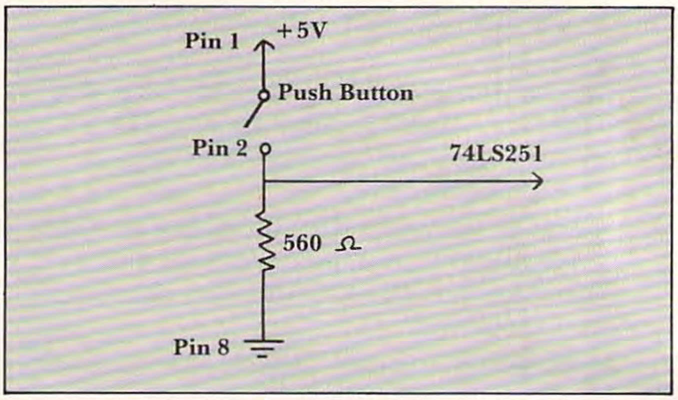
The push button control on the paddles is a normally open momentary switch. No electricity may flow through this switch until it is pushed down. As soon as it is released, the flow of electricity stops. The source of voltage is pin 1 on the game I/O connector, which supplies +5 volts through the connecting wires to one side of the switch. When the button is pressed and the switch is closed, this +5 volts passes through the switch and back through the wires to pin 2 on the I/O connector. Pin 2 is connected to a standard Transistor-Transistor Logic (TTL) Integrated Circuit (IC) on the Apple mother board. When +5 volts is applied to pin 2, this IC causes the memory location of (-16287) or ($C061) to be greater than 128. The actual circuitry allows three push buttons to be used, but this article will supply details for button 0 only.

When pin 2 is grounded, the value of (-16287) will fall below 128. However, *not* applying +5 volts to pin 2 is *not* the same as grounding the pin. To make the pin grounded when no voltage is applied, a 560 ohm resistor is permanently connected between pin 2 and ground. Any electricity which might deceive pin 2 into thinking that 5 volts was being connected to it disappears through the resistor and into the ground. This resistor is located in the 16-pin DIP Header – the black box at the end of the paddle wires. This resistor is small enough to effectively ground pin 2 when no voltage is applied, but large enough so the current through it is very small when +5 volts is applied.

Figure 1 shows this information.

The game controller analog inputs (knobs which turn) are physically very simple. The following details apply to PADDLE 0, but the concept is the same for all paddles. Just the pin numbers are different.

Figure 1. Push Button



Pin 1 again supplies +5 volts through the connecting wires to one end of a 150,000 ohm variable resistor. The other end of the resistor is connected through the wires to pin 6. Turning the game control varies the resistance between the 5 volt supply voltage and pin 6 on the game I/O connector. When the resistor is turned so the resistance in the circuit is large, very little current can flow back to pin 6. A low resistance setting of the game control allows a large current to flow back to pin 6.

Pin 6 is a direct connection to a capacitor on the mother board. A capacitor is designed to store electric charge, but this capacitor starts out with *no* charge. Electric current which flows through pin 6 to the capacitor will build up the charge on the capacitor until it reaches a predetermined level. When the Apple is instructed to read the value of the game control through the BASIC command PDL(0), it uses a machine language monitor routine. This command starts a counting routine, consisting of a loop and a counter, to time how long it takes the electric current through the game controller resistor to charge the capacitor back up from its zero starting charge. The number of times that the computer executes this timing loop is the value reported when PRINT PDL(0) is RUN.

To limit the electric current flow into the capacitor when the game control is applying zero resistance, a small 100 ohm resistor is connected in series between the capacitor and the game controller. If too much current flowed into the capacitor in a very short time, the power supply or other circuits could be damaged.

How can the computer tell when a capacitor is charged? The Apple uses a 558 quad timer Integrated Circuit which is designed specifically to

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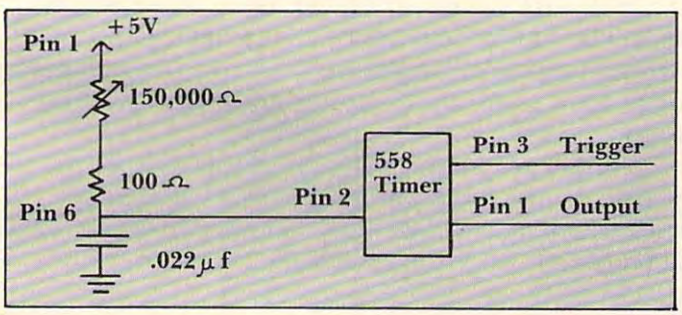
accomplish this. This circuit is similar to four 555 timers on one chip and allows up to four game paddles to be used at one time. The 558 IC is carefully designed to have a high output when the capacitor is charged to *less* than 2/3 of the supply voltage, and a low output after it reaches 2/3 of the supply voltage.

The timing cycle is started when the 558 is triggered – accomplished by PEEKing at location 49264 (-16272 or $C070). After the 558 is triggered, the output goes high, and the capacitor is allowed to charge up from the current through the game controller. When the capacitor reaches 2/3 of the supply voltage, the output goes low and remains low until triggered again. The 558 then automatically discharges the capacitor and waits for another trigger. Memory location $C064 is high (greater than 128) while the output of the 558 timer is high, and low (less than 128) when the output of the timer is low. How a high output from the 558 affects the value in a memory location is a good topic for some other author.

Figure 2 shows the circuit used for Paddle 0 on the Apple. The other game controllers have similar circuits but different memory locations.

Figure 2. Game Control Paddle



The Apple Reference Manual, Page 144, lists the following monitor routine for reading the value of the game controller. These directions are permanently stored in the Read Only Memory (ROM) of the Apple and are used during the execution of BASIC commands in regular programs. The following explanation assumes some knowledge of machine language programming.

```
PREAD LDA PTRIG
      LST ON
      LDY #$00
      NOP
      NOP
PREAD LDA PADDL0,X
      BPL RTS2D
      INY
      BNE PREAD2
      DEY
RTS2D RTS
```

PTRIG is location $C070. LDA to this location triggers all 4 timers on the 558 chip on the mother board. This forces all the outputs of the 558 chip to go high and remain high until the capacitors are charged. This trigger also allows the capacitor to start charging.

LST ON is not a machine language command, but is probably a note to indicate that the timer has been triggered.

LDY #$00 loads the Y register with a value of zero to initialize it for the timing loop.

NOP means no operation. These are dummy commands used to take up some time before the timing loop is entered.

LDA PADDL0,X stores in the accumulator (A) the value of the memory location indicated by PADDL0, with the location address increased by the value stored in the X register. This allows a single routine to time all four allowable game controllers. The number of the controller (0 through 4) must be loaded in the X register before the routine is entered. PADDL0 is the memory location $C064, the memory location which is high when the current through paddle zero has not charged the capacitor. When register X has 0 stored in it, this location is read. When register X has the value "1" stored in it, the value in memory location $C064 + 1 = $C065 is loaded in the accumulator. $C065 is the memory location which is high when paddle 1 is in the process of charging its capacitor.

BPL RTS2D commands the computer to branch to location RTS2D if the value loaded into A is positive. RTS2D contains the command RTS which stops the timing loop and returns control to the BASIC commands which first called in the routine. A byte is considered negative when bit 7, the eighth bit from the right, is "1," and positive when this bit is "0." This seventh bit is also used as the flag to indicate that the output of the timer is still high. While the capacitor is in the process of being charged by the current through the game controller, this seventh bit in location $C064 is set to "1," the computer considers the value of the entire byte negative, and no branching occurs. The computer continues down the list of instructions. When the seventh bit is "0," it means the capacitor is charged enough, the timing stops with the value in Y indicating the number of times the program executed the loop, and the program branches to RTS2D which returns control back to the BASIC program. This is the normal END for this monitor subroutine.

INY commands the computer to increase the value of the Y register by 1. The Y register is now a counter which indicates how many times the computer passes this point in the loop. It is this value stored in Y which is the "value" of the game con-

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troller setting.

BNE PREAD2 commands the computer to branch back in the loop to the location of PREAD2 (the LDA PADDL0,X command) if the value of the Y register is *not* equal to zero. If the resistance is very high in game controller, the Y register may have counted up to 255, the largest number it can store. (All 8 bits are set to 1). Adding 1 more to 255 does *not* result in 256, but changes all the 1's to 0's (255 + 1 = 0). At this point the computer realizes it has gone too far, and it does not branch back to continue the loop.

DEY decreases the value of Y by one. Since Y must be zero to reach this point in the program, Y changes from 0 back to 255 because 000 - 1 = 255. This is the largest number that may be a paddle reading. At this point the timing loop is halted.

RTS then returns control to the BASIC program which called the subroutine. The value in Y is the value of the paddle reading.

The loop of:

```
READ2 LDA PADDL0,X   (5 CYCLES)
      BPL RTS2D      (2 CYCLES–NO BRANCH)
      INY            (2 CYCLES)
      BNE PREAD2     (3 CYCLES–SUCCESSFUL
                      BRANCH)
```

is repeated until the capacitor is charged or until Y reaches a reading of 256 (000). The loop uses 12 clock cycles or about 12 microseconds. The maximum amount of time this program can measure is 255 loops or 3060 microseconds. The time needed to charge sufficiently the .022 mfd capacitor on the mother board through 150,000 ohm game controller is 1.1 * 150,000 * .022 E-06 = .0036 seconds = 3600 microseconds. This extra time guarantees that the maximum value can be reached when the game controller is set for maximum resistance.

Where can this information lead? It is possible to substitute a thermistor in place of the game controller so the reading of a paddle will indicate the temperature. A game controller with a resistance differing from the 150,000 ohm Apple Controller can be adapted to this circuit. A tilt sensitive switch could replace the pushbutton to indicate changes in position. The possibilities are endless and challenging. For more information on these circuits, see:

Mims, Forrest M.
Engineer's Notebook
Radio Shack, 1979

Lancaster, Don
TTL Cookbook
Howard W. Sams, 1974

Semiconductor Reference Guide
Radio Shack, 1981

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In this interesting article, the author, a quadriplegic, describes techniques he has learned to effectively work with his computer. His suggestions may be of interest to other handicapped programmers and, at the end, he has a program-typing hint for everyone.

Computing Techniques For The Handicapped

George Leotti
Glenolden, PA

Being a physically disabled individual I faced some unique problems in making my computer, and peripherals, usable. First, I'd like to briefly describe my disability and then pass along some hints that may help other people, disabled and able alike.

I'm a C5-C6 quadriplegic. What that basically means is that my legs are totally paralyzed. My arms are partially paralyzed. I can't move my fingers or thumbs at all, but I can flex my wrists. Now, on to the hints.

There are many devices available to hold pencils, pens, and paintbrushes that will hold a stick which may be used to press keys on your keyboard. I use a universal holder with an L bar that holds a pencil, eraser-side down. Use whatever is comfortable for you.

To protect the faces on my small keyboard PET, I have someone cut out the fingers of a surgical glove, put them over the eraser, and tape it securely to the pencil. This way the eraser will not fragment and get stuck between the keys. Plus, wear and tear on the keys is reduced.

A New On-Off Switch

The first problem I encountered when I bought my PET was how to turn it on and off by myself. As you know, the PET and Commodore peripherals have their power switches located on the back panels. Why? I don't know. But I do know it is impossible for me to reach them.

The solution was simple. I had another switch mounted on the front panel, above the keyboard. The new switch "jumpers" the power switch in the rear. The Commodore switch now stays in the on position. The new switch turns power on and off.

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Its switch is a toggle switch which can be purchased at any Radio Shack, part number 275-651.

I had the same done on my 2023 printer. The switch is mounted an inch to the right of the paper advance button.

Who will install switches for you? My brother, an electronics engineer, installed them for me. If you have no one able to perform this operation for you I suggest you: contact a local electronics/computer store, appliance repair shop, or television repair shop. If you go this route be sure the person is insured and knows exactly what you need. If your machine is still under warranty, contact the manufacturer first. They (or the store where you bought it) may install a switch for you.

Another solution to the problem would be to have a switching center installed by a competent electrician. In this way you would not deface your machine and you could have all the power switches in one convenient location.

Operating Tape And Disk Drives

The next problem was how to push the PLAY and RECORD keys at the same time. I found that if you put something in the jaws of a nutcracker to space the ends the proper width, and then tape the ends to hold the spacer, you have a tool that works on the tape drive. This, when held in the mouth, makes pushing those buttons easy. Since most nutcrackers are made of metal, however, it would be easier on your teeth to contact your friendly occupational therapist for something made of plastic or wood.

Just recently, I purchased a 2031 single disk drive because of an overflow of cassettes. It is a remarkable, machine, of course, very fast and efficient, but when I tried to change its diet (remove one diskette and put in another) I found I could not pull out the diskette.

Some tape and toothpicks solved this one. On the left side (front) of my diskettes I have between five and six inches of tape folded in half and fixed to the top and bottom of each diskette with a toothpick at the fold in the tape. Now I can pull out a diskette with one finger.

I used strapping tape (tape with fibers) and round toothpicks. Instead of toothpicks you could use small plastic rings that you can put a finger, or your pushstick, through. Be sure not to cover the write-protect notch on the disk.

Shopping For Machines

If you are disabled and deciding which computer to buy, go to a computer store. Try each model or brand you are interested in. Look for accessibility. I have found that the PET has very accessible keyboards. For me, the separate numeric keypad reduces arm fatigue when entering programs manually.

Also, anyone who has a disability that affects the hands should consider the tractor feed type printer. I have the problem of my paper coming out of alignment almost every time I tear a sheet out of the printer. I have to use my mouth to grip the paper and pull it. So far, I've come up with no practical solution to this problem...

Something For Everyone

Here's a hint which might solve a general problem. When entering a program from **COMPUTE!**, do your eyes sometimes wander the page looking for your place? In the back of **COMPUTE!** you will find a card that is used for foreign subscriptions. If you live in the US, or subscribe, tear this card out.

Use a sharp hobby knife to cut out a "window" in the card. Cut out, on the address side, the words (sorry about this) **COMPUTE!** Magazine. You may need to widen it to equal a whole line of a program. Place the card on the page that has the program, leaving the lines you want, showing through the window. As you enter the program, just move the card down the page.

These ideas are offered as suggestions. Neither **COMPUTE!** nor Mr. Leotti can be held responsible for any damages resulting from their use. ©

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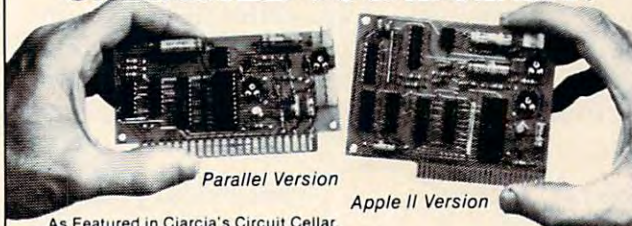

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Apple II Version

As Featured in Ciarcia's Circuit Cellar, Byte Magazine, September 1981.

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For Commodore computers, this program allows you to add very large numbers together.

Multidigit Addition

Zoltan Szepesi
Pittsburgh

A microcomputer generally cannot handle more than 8 to 12 digits of precision. However, special programs can be written in BASIC or machine language to increase the precision of the calculations.

In this program, Multadd, the addition is made in eight-digit groups. The two numbers to be added together (the *addenda*) are entered as two strings between lines 70 to 120, using a modified version of Gary Greenberg's simulated input routine (**COMPUTE!**, May/June, 1980, #4). This way, up to 254 digits can be entered for each number. The two addenda can have different numbers of digits. Lines 140 to 160 make them equal in length by placing zeros in front of the shorter number.

Lines 170 to 250 divide the strings into eight-digit groups and transform these substrings into numeric values. Then lines 260 to 300 do the addition, and 310 to 380 reconvert the groups to eight-digit strings, taking care to fill up the empty places with zeros, and eliminating the spacing between the groups. The result is printed out as a continuous string.

```
10 PRINT"{CLEAR}          MULTIDIGIT ADDITI
   ON"
40 PRINT"{DOWN}THE NUMBERS TO BE ADDED CAN
    HAVE MAX."
50 PRINT"254 DIGITS.TYPE THE DIGITS CONTIN
   UALLY, THEN PRESS 'RETURN'."
60 PRINT"CORRECT WRONG NUMBER WITH 'DEL'."

70 PRINT"{DOWN}       FIRST ADDENDUM:A=":PR
   INT"{RIGHT}";
80 GOSUB 500
90 A$="Ø"+Z1$
100 PRINT:PRINT"      SECOND ADDENDUM:B=":P
   RINT"{RIGHT}";
110 GOSUB 500
120 B$="Ø"+Z1$
130 T1=TI:PRINT:PRINT"         {REV}WORKING
   "
140 LA=LEN(A$):LB=LEN(B$):D$=""
150 IF LB<LA THEN LD=LA-LB:FOR I=1 TO LD:D$
   =D$+"Ø":NEXTI:B$=D$+B$
160 IF LA<LB THEN LD=LB-LA:FOR I=1 TO LD:D$
   =D$+"Ø":NEXTI:A$=D$+A$:LA=LEN(A$)
170 M=INT(LA/8):Q=LA-8*M:IF Q>Ø THEN M=M+1
180 DIM A(M),B(M),C(M),D(M),R(M),R$(M),F$(M
   )
190 FOR I=Ø TO M:D(I)=Ø:C(I)=Ø:R(I)=Ø:NEXT
   I
200 IF M=1 THEN A(1)=VAL(A$):B(1)=VAL(B$):G
   OTO26Ø
210 IF Q>Ø THEN A(1)=VAL(LEFT$(A$,Q)):B(1)=
   VAL(LEFT$(B$,Q)):X=1:GOTO 23Ø
220 A(1)=VAL(LEFT$(A$,8)):B(1)=VAL(LEFT$(B$
   ,8)):X=Ø
230 FOR I=2 TO M
240 A(I)=VAL(MID$(A$,(I-1-X)*8+1+Q,8)):B(I)
   =VAL(MID$(B$,(I-1-X)*8+1+Q,8))
250 NEXT I
260 FOR I=M TO 1 STEP -1
270 C(I)=A(I)+B(I)+D(I)
280 D(I-1)=INT(C(I)/1E8)
290 R(I)=C(I)-D(I-1)*1E8
300 NEXT I
310 PRINT:PRINT"  THE SUM:A+B=":R$(1)=STR$(
   R(1)):IF R(1)=ØTHENR$(1)="{RIGHT}"

320 PRINT R$(1);:IFM=1 GOTO39Ø
330 FOR I=2 TO M:R$(I)=STR$(R(I))
340 P=LEN(R$(I)):R$(I)=RIGHT$(R$(I),P-1):F$
   (I)=""
350 FOR J=8 TO 2 STEP -1
360 IF P<=J THEN F$(I)=F$(I)+"Ø":NEXTJ
370 R$(I)=F$(I)+R$(I)
380 PRINT R$(I);:NEXT I:PRINT
390 PRINT:PRINT"        EXECUTION TIME:";IN
   T((TI-T1)*100/60+.5)/100;"SEC"
400 PRINT:PRINT"DO YOU WANT TO CONTINUE? (Y
    OR N)"
410 GET V$:IF V$=""GOTO 41Ø
420 IF V$="Y" THEN CLR:PRINT"{CLEAR}{DOWN}"
   :GOTO 7Ø
430 IF V$<>"N" GOTO 4ØØ
440 IF V$="N" GOTO62Ø
500 Z$="":Z1$=""
510 PRINT "${LEFT}";
520 GET Z$:IF Z$="" GOTO 51Ø
530 PRINT " {LEFT}";
540 IF Z$<>CHR$(2Ø) GOTO 58Ø
550 IF Z$="" GOTO 51Ø
560 ZZ=LEN(Z1$):IF ZZ<1 GOTO 51Ø
570 Z1$=LEFT$(Z1$,ZZ-1):PRINT "{LEFT}";:GOT
   O51Ø
580 IF Z$=CHR$(13) OR Z$=CHR$(141) GOTO 61Ø
590 PRINT Z$;
600 Z1$=Z1$+Z$:GOTO 51Ø
610 RETURN
620 END
```

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A Direct Access File Editor

Charles Brannon
Editorial Assistant

What's in a file? A payroll program might keep a list of employees, social security numbers, status, etc., on a disk file. A check balancing program would probably save the information gathered during the run of the program such as check number, payee, and amount paid on a file.

Most files are very similar – a list of numbers and strings (words, names, etc.). Each line of the file is "sent" to the file with some variant of the PRINT statement, such as PRINT#1,A$ or PRINT#1, ZX(I,J). [*PRINT#1; A$ on Atari.*] Each line (also called a *field*) ends with a carriage return.

This carriage return is used to separate each line in the file. Otherwise, the file would be just a long block of characters, each line running into the next. These separators are called *delimiters*. On many computers, the comma and colon can also be used (but can cause trouble) as delimiters. This is important, as we will see later.

A File Editing Tool

You probably use files every day, even if you're not a programmer. If you use any commercial software such as a word processor, or a prepackaged accounting program, you are unknowingly generating files. Such software writes files to the disk to save the results of calculations and your input, then later *reads* the file, when you run the program anew, to "restore" the original conditions and information.

Unfortunately, few programs let you *edit* this information (excepting a word processor, of course). You may have a check-balancing program that writes to disk all checks that you enter in order to use this information for taxes at the end of the year. This file simply accumulates information. If you later discover that you've made a mistake on a check entered, there is no easy way to find or correct that check. What you need is a program that can read the entire file into memory, let you view it and make selective changes, then rewrite the corrected file back out to the disk.

The program here is a *file editor*. Basically, it asks you for the name of the file you want to edit, reads it in, and lets you "page" through the file 19 lines at a time. You can edit, replace, insert, and delete lines, as well as search the file for any sequence of characters.

This program only works with a file organized in the common "list" structure previously mentioned (which limits it to *sequential* files on the PET/CBM).

The two versions presented here, for the Atari and the PET/CBM, are different, but they both perform similar functions. After you enter the file name, the file is read into a string array. If the file is too large to fit into memory, the message "FILE TOO LONG" will appear. You can change the variable MAX (maximum number of lines in file) if you have enough memory. The file is displayed as numbered lines in the top 19 lines of the screen. Your input is taken at the bottom. When prompted for a line, always enter the *number* of the line.

Miscellaneous

If you enter any command that you don't want to perform (such as Replace when you meant to type Edit), you can usually exit the command with a null input (just press ‹RETURN›) on the PET/CBM, or by pressing the ESC (escape) key on the Atari.

Since commas and colons are used as delimiters on the PET/CBM, you can't enter or edit a line containing commas. To enter such a line, hold down SHIFT when you press the command key such as SHIFT-E for Edit, SHIFT-I for Insert, etc. A quote will automatically be printed at the start of the line, permitting you to enter commas and colons without the infamous ?EXTRA IGNORED message. After you enter the line, all commas (CHR$(44)'s) are converted to "fake commas" that look like commas, but don't work as delimiters (CHR$(108)).

Create A "Fake File"

You could even use this program to *create* files if you can create a "fake file" containing only one item such as:

```
OPEN 1,8,8,"0:filename" (on the PET)
PRINT#1,"X":CLOSE1
OPEN#1,8,0,"D:filename" (Atari)
PRINT#1;"X":CLOSE#1
```

You can then Replace the first line (the "X"), and use Append to add to the file.

I'll leave you with one important reminder: remember to re-SAVE a file after you edit it or your changes will have been in vain.

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Editing Commands

PET/CBM	Atari	Command	Description
<RETURN>	N	Next page	Displays the next 19 lines.
E	E	Edit	The primary "change" command. You enter the number of the line to be changed. The line is displayed at the bottom of the screen with the cursor on the first character. You can use your computer's editing keys to change the line (just like in an INPUT statement). Press <RETURN> when finished.
R	R	Replace	You just enter a completely new line to replace any line in the file.
I	I	Insert Line	For Atari: you enter the number of the line you want to insert a new line at. That line and all following lines are "pushed down," and the word "*** INSERT ***" is inserted. You can then use Replace to add a new line. For PET/CBM: you enter the number of the line you want to insert a line at, and then you enter the line you want inserted.
D	D	Delete Line	Enter the number of the line to be deleted. The following lines will be "pulled up" to fill the gap. For PET/CBM: If you use SHIFT-D (shifted D), you can enter the starting and ending lines of a block of lines you'd like deleted.
A	A	Append Line	After you type "A" you can enter a new line which will be added to the end of the file.
P	P	Print	Enter the starting and ending lines of the block of lines you would like printed to the printer. For the PET/CBM, this is device number four. You can just hit <RETURN> to both prompts to print the entire file (Atari version).
S	W	Save/Write	Stores the file on disk. PET/CBM: scratches the old file, then writes the new file. Atari: Replaces the old file, unless you save the file under another name.
X	Q	Exit/Quit	Lets you end the program.
0/1	[START]	Re-run	Atari version: If you press the START key at the prompt "Which?" you can RUN the program over again. PET/CBM version: Entering zero or one specifies which drive to use for the next file you want to edit. You can then enter the new file name.
G	G	Go to line	Lets you "skip around" in the file. Enter the number of the line you want to see.
n/a	O	Other menu	There are two menus in the Atari version, since the bottom of the screen can only hold so many commands. The other menu contains the commands Length, Search, and Next Search. You can add your own commands to this menu.
H	n/a	Help	Unlike the Atari version, the PET/CBM version doesn't constantly display all choices. Just type H to see a list of all options.
K	n/a	Kill File	Lets you scratch a file from within the program.
Z	n/a	—	Flips the character set.
F Q	S* N*	Find/Search Quick Find Next Search **Use (O)ther Menu*	You enter a series of characters you want to find in the file. In the PET/CBM version, all matching lines are displayed. Press any key to abort the search. The Atari version only displays the first occurrence of the match. The Next Search command is used to find the next occurrence of the same search string. You can search either by character or by line. The character search will search the entire file character-by-character for the string, where the line search only matches the search string with the beginning of the line, and is naturally faster. The PET/CBM version has a separate command, Quick Find, to search by line.
L	L	Length	Displays the number of lines in the file.

Program 1. PET/CBM Version

```
100 PRINT"{CLEAR}{REV}"TAB(15-20*(PEEK(213)
    =79))"*FIXFILE*"
110 PRINTCHR$(14);:POKE59468,12
120 MAX=1000:REM MAXIMUM NUMBER OF LINES AL
    LOWED
130 DIMA$(MAX):REM CHANGE TO SUIT MEMORY/FI
    LE REQUIREMENTS
140 PRINT"{DOWN}ON WHICH DISK WILL WE WORK?
    ";
150 GETD$:IFD$<"0"ORD$>"1"THENK=1-K:PRINTMI
    D$("{REV}{OFF}",K+1,1);" {LEFT}";:
    GOTO150
160 PRINT"{OFF}"D$
170 OPEN15,8,15:FILE$="  *"
180 INPUT"WHAT IS THE FILE'S NAME? *{03 LEF
    LEFT}";F$:IFF$="*"THENF$=MID$(FI$,
    3)
190 FIL$=D$+":"+F$
200 OPEN8,8,8,FIL$+",S,R":J=0
210 INPUT#15,EN,EM$
220 IFENTHENPRINTEM$:GOTO1420
```

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