```
1280 DATA 80,255,254,252,248,240,224
     ,192,128,88,1,3,7,15,31,63,127,
     255
1290 DATA 104,255,127,63,31,15,7,3,1
     ,120,128,192,224,240,248,252,25
     4,255,-1
1300 ? #6;"{CLEAR}":POKE 712,13:POKE
      708,7
1380 POSITION 7,1:? #6;"GOTCHA"
1400 POSITION 0,4:? #6;"USING THE JO
     YSTICK, GATHER AS MUCH OF
     {3 SPACES}THE MONEY AS YOU CANW
     ITHOUT BEING CAUGHT"
1401 POSITION 0,11:? #6;"YOU ARE %"
1402 POSITION 0,13:? #6;"YOU PLAY AG
     AINST '":GOTO 1510
1501 ? #6;"{CLEAR}":POSITION 6,1:? #
     6;"SCORE";" ";SC:POSITION 6,3:?
      #6;"HIGH";" ";HS:IF SC>HS THEN
      HS=SC:GOSUB 1550
1505 IF RD=0 THEN SC=0
1510 POSITION 2,20:? #6;"TRIGGER TO
     BEGIN":IF FL=1 THEN POSITION 6,
     22:? #6;"Q TO QUIT"
1512 POKE 764,255
1516 Z=PEEK(764):IF STRIG(0)<>0 AND
     Z<>47 THEN 1516
1518 IF Z=47 THEN POKE 764,255:GRAPH
     ICS 0:END
1520 POKE 712,0:POKE 708,13:FL=0:GOT
     O 200
1550 FOR CT=9 TO 11:POSITION 1,CT:?
     #6;" A NEW HIGH SCORE!!":NEXT C
     T
1560 FOR T=243 TO 109 STEP -2:SOUND
     0,T,10,15:FOR TT=1 TO 5:NEXT TT
     :NEXT T:SOUND 0,0,0,0:RETURN
1570 FOR I=1 TO 30+(RD*10)
1580 SP=INT(RND(0)*440)+SCR+20
1590 IF PEEK(SP)=0 THEN POKE SP,4:GO
     TO 1610
1600 GOTO 1580
1610 NEXT I:RETURN
```

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Richard Mansfield, Senior Editor

Program Forms

As you might be discovering, computer programming is one of the most seductive of hobbies. You create a basic outline, a skeletal program which works, but you keep seeing ways to make it more efficient, attractive, or powerful. And you can sit into the night, transforming programs, oblivious as the moon silently crosses the sky.

When you write a program it can easily be used as a *form* for other programs—many new programs can evolve out of the original structure. Let's write a metric conversion quiz, then take a close look at it to see what other programs it could become.

Program 1 is a simple quiz structure. It starts off by READing the first item in the DATA statements (*inches*, in this case) and memorizes that word as E$. It then checks to see if E$ is the word *end*. If so, it goes up to line 200 where it prepares to start the quiz over again. This method allows us to put in as many questions as we want by listing one per DATA statement. The alternative, using a FOR/NEXT loop, would require that we know in advance how many DATA statements we are going to use. The program wouldn't be as easily expanded that way.

Then line 30 puts a random number between 1 and 10 into the variable X, and line 40 reads the remaining two DATA items in line 500: 2.54 and centimeters. Now we're ready to ask the first quiz question. Line 50 will ask: X inches is equal to how many centimeters? Notice that we chose easily remembered variable names: M$ for Metric word, E$ for English, CF for Conversion Factor, TRY for the player's guess. Such names make programming easier.

Line 60 calculates the answer (A). The conversion factor, multiplied by X, will always give the correct answer in metric measurements. That's the way we set up the DATA. A is rounded off to two decimal places with the INT formula (see last month's column if this is unclear to you). In line 70, we get the player's guess and, if it's right, line 80 announces that happy fact, raises the player's total score (T), and goes up to line 100 (which itself just sends us back to start the second cycle of the quiz in line 10). Why GOTO 100 instead of GOTO 10? As is often the case, you solve a programming problem in several perfectly acceptable ways. This IF/GOTO structure is rather common, though, when you want to jump over something. Notice that line 90 does not need to test TRY to see if it equals A or not. Line 80 already did and, if it did equal A, line 80 would force the computer to jump up to line 100, and line 90 would never be activated.

When the quiz has finished all its cycles and has come to the word END, line 200 prints the score and if the player wants to try again, line 220 clears out all the variables (CLR resets T to zero and allows you to start reading the DATA from the bottom again). We could have used RESTORE which starts us over on DATA, but then we'd have had to add T=0. CLR is easier.

Going The Other Way

As it stands, this quiz prints the familiar English measurements and asks us to provide metric answers. How hard would it be to go in the other direction?

Program 2 reverses the quiz. You need only change these three lines.

Program 2: Metric To English

```
50 PRINT X;M$" IS EQUAL TO HOW MANY "E$
60 A=X/CF:A=INT(A*100+.5)/100
90 PRINT"NO, THE ANSWER IS "A;E$
```

Line 50 simply transposes M$ and E$. Line 60 divides rather than multiplies. Line 90 prints the correct E$ in the event of an error.

Program 3 is a considerable transformation, but still retains the essence of Program 1. Here, rather than asking about a mathematical relationship, we use the first two DATA items of each series to provide clues. The third item, C$, is the answer we're looking for. Neither the computer nor the player does any calculation. It's just factual knowledge we're after this time.

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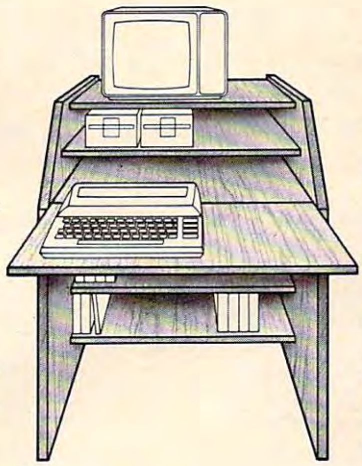

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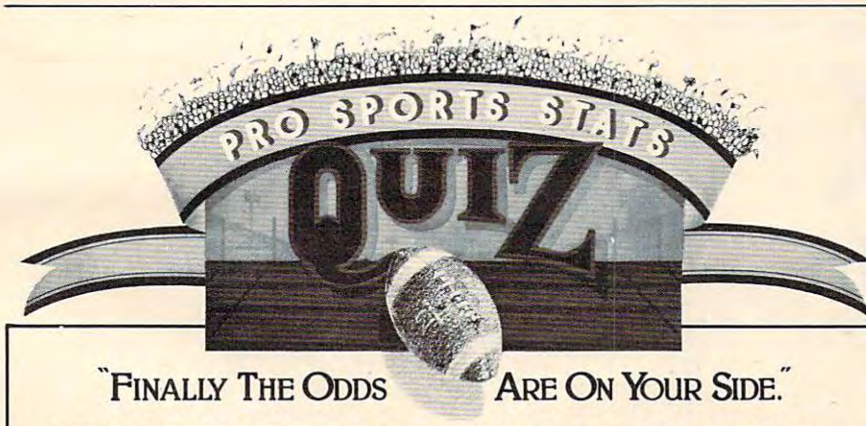

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Notice that the DATA statements can again be as extensive as you want; just end with END. Also, in this type of "word problem" quiz, it helps to repeat the quiz format as you write in each DATA line. Here the form is: A$ is a B$ in C$. That's why we need the leading *the* in four out of the five DATA lines. Each question will sound right to the player if you word the clues correctly.

Clearly, this programming form could be used in many ways. You could quiz about relationships (DASHIELL HAMMETT was the HUSBAND of ?); truisms (NECESSITY is the MOTHER of ?); history (DARIUS was the KING of ?); and many others. Or you could change this fill-in-the-blanks style test to multiple-choice. Simply expand the DATA statements to include, say, three possible answers. Print them out with the questions. And have the correct answer (number 2, for example) be one of the DATA items.

Beyond that, you can create flash card simulations, true-false tests, logic relationships (PULL is to PUSH as LIFT is to ?)—even reading comprehension tests with full paragraphs and questions about the text. Adding some sound effects and animated characters can make school lessons very appealing to children. And, following this basic form, you can easily enter new DATA for different lessons every week.

Special TI Notes

Users of TI console BASIC (without Extended BASIC) must make several adjustments to published program listings, these included. You must have only one statement per line, the THEN in IF/THEN structures can only reference a line number, and there must be spaces between all BASIC commands and variables. For example, line 20 in Program 1 will work correctly since the THEN sends the computer to line 200. But line 80 will need to reference some other lines which you must create within the program to accomplish what line 80 does in Program 1 as printed.

Program 1: English To Metric

```
10 READ E$
20 IF E$ = "END" THEN 200
30 X = INT(RND(1)*10)+1
40 READ CF: READ M$
50 PRINT X;E$" IS EQUAL TO HOW MANY "M$
60 A=X*CF:A=INT(A*100+.5)/100
70 INPUT TRY
80 IF TRY = A THEN PRINT"CORRECT.": T=T+1
   :GOTO 100
90 PRINT"NO, THE ANSWER IS "A;M$
100 GOTO10
200 PRINT"YOU GOT "T" CORRECT.{2 SPACES}W
    ANT TO PLAY AGAIN? (Y/N)
210 INPUT AS$
220 IF AS$="Y"THEN CLR: GOTO 10
500 DATA INCHES,2.54,CENTIMETERS
510 DATA FEET,30.48,CENTIMETERS
520 DATA YARDS,.9144,METERS
530 DATA MILES,1.609,KILOMETERS
540 DATA PINTS,.4732,LITERS
550 DATA QUARTS,.9464,LITERS
560 DATA GALLONS,3.785.LITERS
570 DATA POUNDS,4.448,NEWTONS
580 DATA END
```

Program 3: Geography

```
10 READA$
20 IF A$ = "END" THEN 200
30 READB$,C$
40 PRINTA$;" IS A ";B$;" IN"
50 INPUT TRY$
60 IF TRY$ = C$ THEN PRINT"CORRECT.": T=T
   +1:GOTO 10
70 PRINT"NO, THE ANSWER IS "C$
80 GOTO 10
200 PRINT"TOU GOT "T" CORRECT.{2 SPACES}W
    ANT TO PLAY AGAIN? (Y/N)
210 INPUT AS$
220 IF AS$="Y"THEN CLR: GOTO 10
500 DATA THE GOLDEN GATE,BRIDGE,SAN FRANC
    ISCO
510 DATA THE TAJ MAHAL,BUILDING,INDIA
520 DATA PERTH,CITY,AUSTRALIA
530 DATA THE GREAT PYRAMID,MONUMENT,EGYPT
540 DATA THE VOLGA,RIVER,RUSSIA
550 DATA END
```

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Questions Beginners Ask

Tom R. Halfhill, Features Editor

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

Q I have some questions about computer languages. First, what are the different languages? Second, what do they stand for (example: BASIC = Beginner's All-purpose Symbolic Instruction Code)? Third, can the VIC use any of these languages without a special cartridge, disk, cassette, or adapter?

A It would be impractical to list *all* of the different computer languages in this column—there are scores of them, maybe even as many computer languages as human languages. However, just as most human communication is expressed in a half-dozen or so common languages (Mandarin Chinese, English, Spanish, Russian, Hindi/Urdu, Arabic), most programs are written in a like number of computer languages.

Probably the most common computer languages are BASIC, COBOL (Common Business-Oriented Language), FORTRAN (FORmula TRANslator), Pascal (named after French mathematician Blaise Pascal), APL (A Programming Language), Forth (a "fourth-generation" language), LISP (LISt Processor), Logo (a graphics-oriented derivative of LISP), PILOT (Programmed Inquiry, Learning, Or Teaching), Ada (named after Ada Lovelace, thought to be the first computer programmer), and C (a Bell Laboratories language with a refreshingly short name).

Not all of these languages are common on personal microcomputers, and some of them are highly specialized. For example, Ada is a Department of Defense language implemented largely on mainframes. COBOL is a very popular business language because of its English-like syntax and record-handling structures. FORTRAN is favored by scientists and engineers because of its mathematical functions. Many educators choose to teach programming with Pascal because it encourages structured programming. Classroom teachers often find that PILOT's input and answer-matching routines make it ideal for writing educational programs. LISP is used by some artificial intelligence researchers. Various versions of Logo with turtle graphics are taught to young children. And BASIC has become virtually the standard programming language on small computers used in millions of homes and schools.

Actually, in a strict sense, these aren't "computer languages" at all. They are as foreign to computers as Chinese or English. Instead, they are languages which people have invented to program computers more easily.

The only true computer language is *machine language*, literally the language of the machine. Machine language is a set of very elementary instructions recognized by the computer's Central Processing Unit (CPU), its "brain." All the other computer languages mentioned are, themselves, written in machine language. For this reason they are referred to as *high-level* languages, because they are far removed from the actual machine's way of processing. A single instruction in a high-level language is made up of several simple machine language instructions.

High-level languages were invented because machine language programming can be more time-consuming, particularly for beginners. Generally, today's programmers use machine language to achieve greater program speed or compactness.

Almost all home/personal computers, including the VIC, can use languages other than the built-in BASIC. However, since a language is itself a large program, it must be loaded into memory from either tape or disk, or by plugging in a cartridge. Popular second languages for home computers include Logo, PILOT, and Forth.

Q Is there some command or series of instructions that can be used in direct mode to get a printer to work? Do all instructions to a printer have to be in a program or a word processing package?

A You can indeed send instructions and even text to a printer in direct mode. In some forms of BASIC (such as the Atari and TRS-80

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dialects) the command is LPRINT. It works just like the PRINT statement, except output is diverted to the printer instead of the screen. Here are some valid LPRINT statements:

```
LPRINT "HELLO, THIS IS A TEST."
X=10:Y=20:Z=30:LPRINT X+Y*Z
X=365:LPRINT"THERE ARE ";X;" DAYS IN A
  YEAR."
```

In Commodore BASIC, you must first open a channel to the printer, then use a special form of the PRINT statement to send output along that channel:

```
OPEN4,4:PRINT#4,"HELLO, THIS IS A TEST.":
  CLOSE4
```

You can send commands to the printer the same way. Printer manuals tell which codes activate which features. For example, to switch an Epson MX-80 into the expanded text mode:

```
LPRINT CHR$(14)
```

or

```
OPEN4,4:PRINT#4,CHR$(14):CLOSE4
```

Similar codes can be sent to switch on italics, underlining, condensed text, double-strike modes, etc., and to switch them off again on printers that support these features. ©

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The Book Of The Future: Electric, Unending, And Written In RAWM

Recently I went to a book publishers' conference in Baltimore and ran into an editor friend from a major New York publisher. My friend is an avid home computer user, and he edits science fiction books.

He loves to look into his editor's crystal ball, then tell what he sees there. When he looked into the future, he saw computers everywhere. But he didn't see books. He didn't see words, either, just pictures—computer-generated pictures—and sounds. "In the future, all novels, all information, all knowledge," he told me earnestly, "will be conveyed by computers electronically in the form of pictures and sounds."

According to my friend, "Computers can already read books to people automatically, so why should people learn how to read? Reading is becoming an obsolete skill, like speaking Latin."

Human Computers

Was my friend right? After all, look at what computers and calculators have done to people's computing skills. The word *computer* used to mean a person who could do arithmetic calculations swiftly inside his or her head. Most adults today still walk around with little multiplication tables inside their heads, along with a jumble of rules about how to do addition, subtraction, division, and other basic numerical operations.

But we don't use these rules too often anymore. We have slim calculators that fit inside our checkbooks, shirt pockets, and purses. Whenever we have to do any serious computing, we pull out the calculator, punch a couple of buttons, and get the answers we need. Why should we remember how to do arithmetic when a tiny electronic brain will remember for us?

Of course, most of us don't make a decision to abandon arithmetic. But, we are abandoning it nevertheless. The less often we practice, the more rusty our skills become, and the rules and tables inside our head begin to fade.

Annex To The Brain

The same thing is happening in our schools. Calculators are becoming as common as pencils and paper in math class. Teachers can rationalize this by explaining how they free their students to examine the concepts and theories behind the numbers. The calculators take care of the numbers, so the students can focus on the axioms, concepts, and rules underlying mathematics.

When a student uses a computer, math ceases to be a painful discipline of mechanically manipulating numbers and formulas. Instead it becomes a beautiful language—a dynamic, active process, a vocabulary of symbols that describe the world. A student doing math on a computer feels like a chemist working in a laboratory creating a bubbling, popping, hissing, odiferous chemical reaction. Math has texture, tangibility, and feel. It is alive and evolving. Young people can explore the world of mathematics using computer-enhanced tools, and they no longer have to get bogged down in a swamp of computational details.

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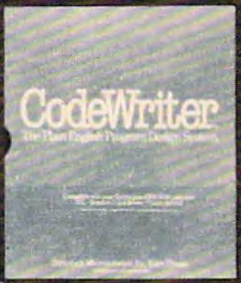

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Tape	$44.95	$39.00	$26.00
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machines because the world was getting too complicated for human brains to handle alone. Computers are an extension to the human brain. They amplify the power and speed of the brain in areas where the brain is the slowest and weakest. With the help of an "annexed" computer brain, a human brain can handle vast numbers of details; it can order and structure huge quantities of information, and perform arithmetic at lightning speeds.

Books That Are Hot

Numbers are just symbols. Pictures are symbols, too. So are musical notes. Letters and words, too, are symbols.

Computers are extraordinary symbol handlers. Researchers at several universities recognize this and are starting what are coming to be known as "electronic book" projects. The researchers believe that printed books, the dominant means to transfer information, ideas, and images since the 1500s, will soon be succeeded by electronic books—an amalgam of the personal computer, the TV set, the stereo, and the telephone.

Electronic books must have all of paper books' desirable attributes. Electronic book "players" and cartridges must be inexpensive, portable, and personal.

Electronic-book researchers share the opinion of my editor friend, at least in part. They feel that electronic books of the future can't rely solely on words. Instead they must make use of the full symbol-handling and interactive potential of the computer.

For example, they must be *hot*. According to Marshall McLuhan, a "hot" medium appeals to people's senses, the more senses the better. Electronic books may not have the same texture and smell of printed, paper books. But they will have hot substitutes—animated color cartoons, music, sound effects, and voices.

And they must be interactive. Readers interact with printed, paper books with the use of their memories and imaginations. Readers will interact with electronic books more explicitly—by answering the book's direct questions, by keying in information, by making choices and decisions.

"Participatory" books are on the horizon: participatory textbooks, participatory novels, and interactive mystery stories. The first generation of computer "electronic book" programs already runs on personal computers in the form of educational simulations and electronic adventure games.

Build-Your-Own-Book Kits

Electronic books of the future will be interactive, multimedia entities. But they will also be something more. They will not be static creations whose final form appears when they are first published. Instead they will be more like "build-it-yourself" book kits—like the new breed of arcade-game builder kits (for example, *Pinball Construction Set* from Electronic Arts and *Loderunner* from Brøderbund). They will be malleable, ongoing, and evolutionary. They will invite modification, polishing, and alteration.

More than 40 years ago, the great American scientist Vannevar Bush came up with an idea called Memex. Memex was to be, in part, an electronic book. It was to be a book that would never be fully written. Each time a person explored new associations, new information, and new knowledge, the book would grow and evolve.

Bush's ideas have been developed even further by Dr. Alan Kay, head scientist at Atari, and Dr. Andries Van Dam, at Brown University, in Providence, Rhode Island. Kay and Van Dam are using modern microelectronics technology to build electronic books in their laboratories.

Already, experimental desktop and lap-sized electronic books exist that include the best features of books and computers. And they are not a "read-only" medium (ROM)—they are a "read-and-write" medium (RAWM). They allow multi-authors. When a book is "published" in silicon, it will have lots of space in its "margins" for readers to make comments and annotations. Some books will even permit copies to be made, and alterations to the original book's content. In a sense, the books will never be completely written. Each new reader can become the book's author and change the book while he or she is reading it.

When readers make changes, they won't be working in only one medium—for example, print. Instead, they will be able to use a "book editor" program to alter all aspects of the book—its text, sound effects, its (static and animated) illustrations, its music, and voices.

The book will be a multimedia creation, and it will evolve in all media.

Mortal Foes

These speculations give little solace to librarians and to other book lovers. Lovers of printed, paper books are not about to jump on the electronic-book bandwagon. They still like bound-and-printed books too much.

Over the last couple of years I have spoken at several librarians' conferences. Many librarians have approached me and expressed the fear that my editor friend's vision of the future may come true.

Actually the librarians have two fears. They are worried that electronic books will supplant printed, paper books. And they are worried that the new computerized books will rely only on pictures and sounds and not on words.

The librarians' fears are well-founded. Paper

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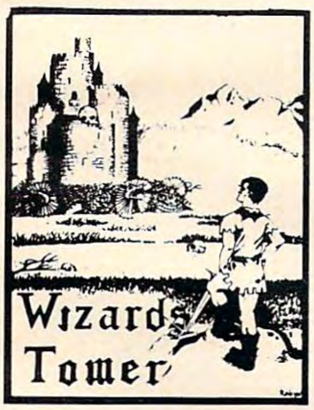

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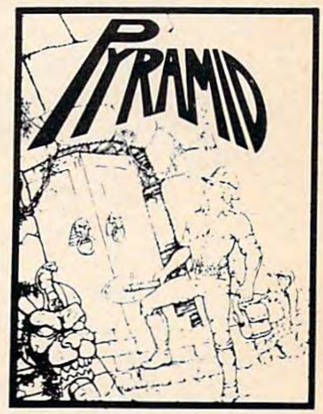

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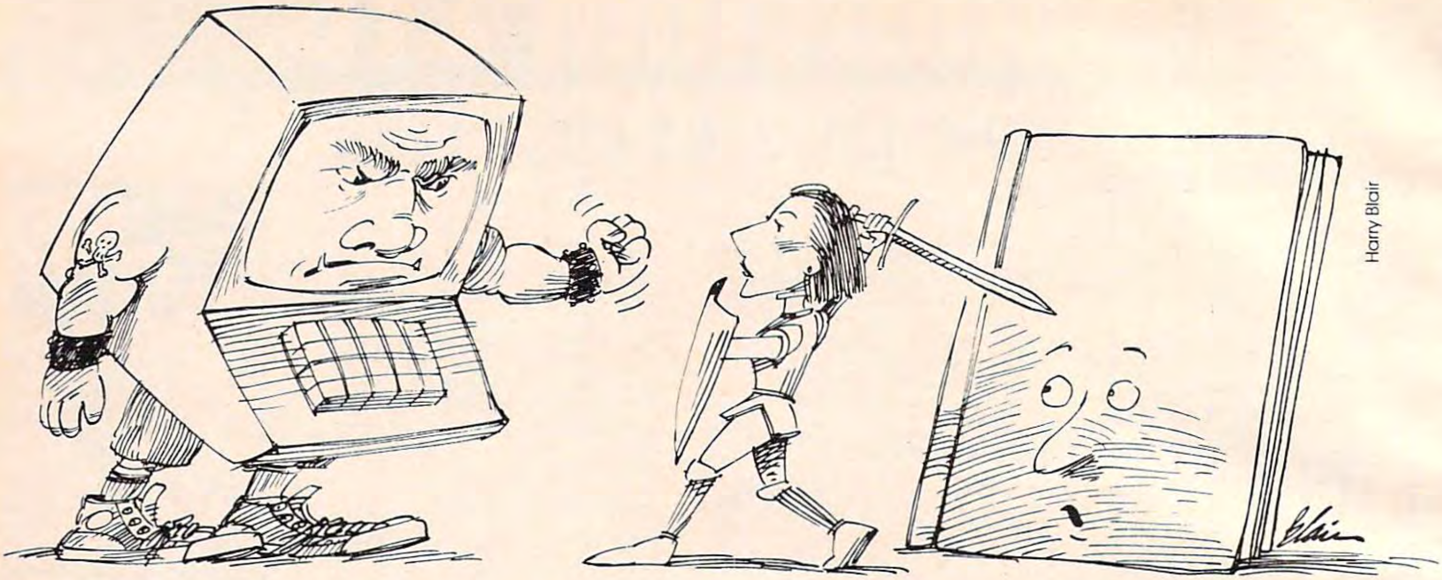
Harry Blair

is increasingly expensive as a medium for information storage and communication, while silicon is rapidly becoming less expensive. Second, the kind of information that paper can store is limited—chiefly printed symbols, photographs, and illustrations. But the kind of information that can be digitized and stored in silicon is unlimited. Music, voices, photographs, works of art, as well as printed text and other symbols, can all be stored in a silicon book. Then they can be altered, copied, and instantly transferred across thousands of miles and made available to other human beings at only a small cost.

This has the librarians worried. If words are no longer the dominant, or even most important, medium of human communication, reading and writing may become obsolete skills, just like calculating numbers, and speaking and writing Latin.

Librarians and other book lovers are not going to just sit back and watch this happen. They see themselves as caretakers, guardians, and protectors of books—of printed media, in general. They feel that a gigantic battle is looming on the horizon between printed media, on one hand, and nonprint, electronic media, on the other. Books and computers, they feel, are mortal foes that will soon be locked in battle.

And when the battle is over, only one foe will remain—the computer. Books already published will yellow and crumble, destroyed by the acid in their pages, and no new paper books will ever again be published.

With the emergence of the electronic book, the era of the printed, paper book may soon be over.

The Rise Of The Electronic Librarian

The gradual move from paper to silicon is inevitable. But it is not going to happen overnight. Nor does it have to mean the end of books, the end of words, or the end of librarians.

Recently I gave a speech at the annual convention of the Virginia Educational Media Association (VEMA), at Virginia Beach, Virginia. The title of my speech was "The Role of the Librarian in Helping Students, Parents, and Teachers Use Computers and Robots."

In my speech I expressed the hope that librarians would see themselves in a broader role. Librarians are not just caretakers of books and magazines. Rather, they are guardians of information, knowledge, wisdom, stories, tales, lives, art, music, and culture. They are the caretakers of civilization. How civilization is stored is not important as long as it is protected and readily accessible to all people.

Many librarians now call themselves *media specialists.* They are the guardians of the media on which civilization is stored—all media. They make it possible for children and adults to access civilization through those media.

As the 20th century comes to an end, it is a fact that more and more of our civilization is being digitized and stored on electronic media. This does not mean that librarians must be trained technologists and engineers. Nor does it mean they must become computer programmers, electronic technicians, and videodisc mechanics.

They just have to be able to use the new machines, because they are the doorways, the windows to the information. And they must be able to help others use these machines. As the bulk of our civilization shifts into an electronic format, it is up to the librarians to keep the doorways and windows open for the rest of us.

I have listed below some of the computer- and robot-related services that librarians can provide. I have suggested a pathway librarians can follow to create an electronic library of the future.

In my vision of the future, books, words, and librarians have a very important role to play.

The Armchair Computer

Most adults are not ready to approach computers. And most children have only a limited opportunity to spend time with computers. By mid-1984, even though all elementary and secondary schools in the U.S. will have at least one computer, each student will be able to spend only 15 minutes with a computer per week.

Yet many children and many adults want to learn more about computers. How can they learn more?

They can start by reading magazines and books. Children and adults can become armchair computer experts by reading the many excellent beginners' books and magazines about computers. The books and magazines will make the time a beginner spends on the computer more productive and exciting.

Computer Etiquette

Books and other print materials can also teach people how to use computers ethically. Computer literacy courses sometimes focus exclusively on a narrow skill such as BASIC programming and little attention is devoted to such pressing social issues as software piracy, computers and alienation, and computer crime. Good books and magazine articles can focus on these issues and broaden the scope of children's and adults' computer literacy.

Software Evaluation

Hundreds of computer programs and dozens of new computers have appeared in the last couple of years. Children and adults who are interested in computers are bewildered by all the choices open to them.

Libraries can perform a major public service by acquiring good software and hardware review materials published by such organizations as:

EPIE Institute
Box 620
Stony Brook, NY 11790
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Computers On TV

There are more and more computer programs on television—on network TV, cable TV, and public television. Librarians can contact the local TV station to find when computer programs will be aired. Then they can ask permission to videotape programs for use in the library. Programs can be used as part of classroom assignments on computers, by computer clubs, parent-teacher groups, and for in-service training of school faculty and administrators. Or the librarian could tape several programs and organize a unit during library period on the "electronic library of the future—the pros and cons."

Public TV, in particular, has a number of excellent programs on computers. One program I have participated in is the Educational Computing Profile, a monthly, half-hour, magazine-format show produced by Kentucky Educational Television, in Lexington, Kentucky. Every month the show is sent, via satellite, to public TV stations all over the country on the Public Broadcasting System (PBS). To find out more about the show, contact:

Luralyn Lahr
Associate Producer
KET Network Center
600 Cooper Drive
Lexington, KY 40502
606/233-3000

The Educational Computing Profile shows are cosponsored by EPIE (Educational Products Information Exchange) and Consumers Union.

A Software Library

Many librarians are creating a computer-and-robots section for their libraries. The section has print materials focusing on robotics, programming, computer literacy, computer ethics, computers and society, and software and hardware evaluations. It also has a growing selection of personal computers and computer *software*. Children and their parents can check out the software and use it in the library or at home. Teachers can check out the software and use it in their classes. Each software package comes in an envelope with a photocopy of one or more recent reviews and evaluations.

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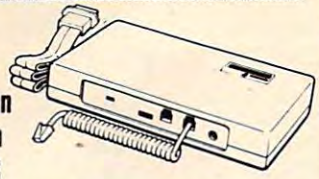

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Solid Oak 2 Level Stand for C64 or VIC	29
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CARDBOARD/5 Motherboard - C64	56
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PAPER CLIP Word Processor – CBM/C64	99
ORACLE Data Base from Batteries Included	109
SPINNAKER Software C64, Apple, IBM, Atari	
Compute!'s First Book of PET/CBM	11
POWER ROM Utilities for PET/CBM	78
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VISICALC for PET, ATARI, or Apple	189
PET-TRAX PET to Epson Graphics Software	40
SM-KIT enhanced PET/CBM ROM Utilities	40
PET Spacemaker II ROM Switch	36
2 Meter PET to IEEE or IEEE to IEEE Cable	40
Dust Cover for PET, CBM, 4040, or 8050	8
CmC Interfaces (ADA1800, ADA1450, SADI in stock)	
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Compute!'s Machine Language for Beginners	11
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Library Robots

Almost all librarians can use more help. Many librarians are "adopting" robot mascots. A robot can act as a librarian's assistant and "public relations agent."

A librarian who adopts a robot can't expect it to shelve books or file cards in the card catalog. Today's robots are too primitive for that kind of assignment. But there is still a lot they can do.

Robots are extremely powerful attention-getters.

A talking robot can lead library activities and announce upcoming library events.

A mobile robot can roll around the room carrying a sign or wearing a billboard advertising the library's new books or attracting the kids' attention to the librarian's messages and new services.

When a robot arrives from the factory, it is usually "naked." Kids in art class can design a wardrobe for the robot. The robot can wear the school emblem and the school colors. It can wear special costumes for holidays like Halloween, Easter, Chanukah, and Christmas.

Children can design a musical language for the robot, and teach it library manners.

A robot makes a terrific librarian's assistant, and it is one of the less expensive computer peripherals. Robots like the Tiny Turtle from Harvard Associates and FRED and TOPO from Androbot are less than $500. (FRED is only $200.) For more information, write or call:

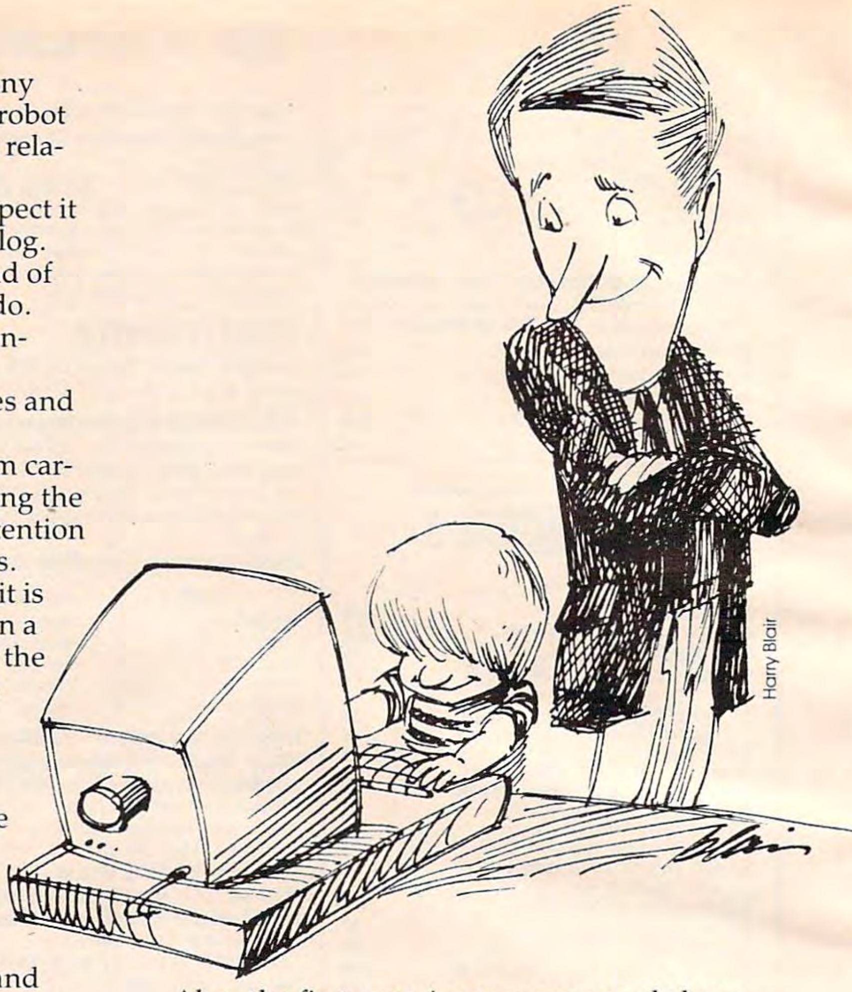
Androbot
101 East Daggett Drive
San Jose, CA 95134
408/262-8676

Harvard Associates
260 Beacon Street
Somerville, MA 02143
617/492-0660

Computer Intimacy

Everyone is pressing children and adults to become computer literate, but before anyone can truly become computer literate, they must first become computer *intimate*. To be computer intimate they don't need to know how the computer works, only how to make it work. They must be comfortable and relaxed with the computer and be able to use it to work, learn, or play.

Often there isn't time for children to become intimate with a computer during the school day. There are just too many students and too few computers. And adults who are interested in computers are frequently too fearful and wary of computers to shop for one in a relaxed and objective manner.



Also, the first experience many people have with computers is pretty dreary. They are expected to dive immediately into the technical details of computer programming, or they are subjected to a dry, textbookish CAI program to learn vocabulary words or arithmetic skills, or they are shown a screen full of numbers or dull, uninteresting files and records.

Most people first use computers in a class or on the job. Thus, they must learn something serious or work-related.

But a computer in a library is different. It is there as a resource, a tool, a thoughtful, challenging game, and *as a way to spend one's time learning about things one wants to learn about*.

A library is a place where a person can become intimate with computers.

Librarians should look for computer programs which are attractive, easy and enjoyable to use, and which children and adults can use for hobbies, supplementary, self-motivated and self-guided learning, and for personal enrichment.

The library computer can become each person's personal learning companion and tutor.

Homework And Community Loan

Libraries can also buy computer programs that turn the computer into a general-purpose tool to help students with class assignments and homework. The computer can have a word processing program so students can work on book reports in the library. It can have graphics and music "builder kits" to help kids with art and music assignments. Children and adults can use data management, listmaker, calendar, and time management programs as electronic notebooks and to schedule and prepare assignments. New computer math tools help children with math classes in arithmetic, geometry, algebra, and trigonometry.

Libraries can also work with parents in the community to get donations of old computers, programs, and computer equipment. Everything can be cataloged, then loaned to low-income families in the community who are interested in computers but unable to afford them.

Computer And Robot Activities

Older students can program the library robot to become a tutor for younger children. The robot can teach directionality, counting, letters of the alphabet, spelling, colors, and other basic kinds of knowledge and skills.

Older students can form a library software department and write software to help the library—especially learning programs for different classes in school, and programs that maintain an electronic data base of computer and robot resources available at the library. Librarians should especially encourage team programming projects where groups of students work together.

Students can be encouraged to use the library computers to create their own electronic "choose your own adventure" stories. The program listings for the stories can be printed out and bound by the art classes and put on a special bookshelf in the library. The stories should be public domain so that students can copy the original stories, add to them, change them, and make them into new stories. The stories can become ongoing, evolving electronic books.

The Electronic Library

Each personal computer in the library should have a modem or acoustic coupler attached. This device lets the library computer talk to electronic data banks and information services via the telephone. These services are an electronic "annex" to the library.

Most information services are easy to use and relatively inexpensive. There is no need to organize elaborate, formal projects around these services at first. It is very educational for librarians and child and adult patrons to "browse" through these services and the information they offer. After everyone becomes comfortable using the electronic library, activities and uses will suggest themselves naturally.

Watch Me!

Perhaps the greatest justification for having computers and robots in libraries is so the librarians can learn more about these devices—in the manner they choose and at their own pace. They can control and regulate the influx of new technology rather than be overwhelmed by it.

The best way for librarians to become comfortable with the new technology is for them to look over the shoulders of the children who are teaching the robot and computers new tricks. They'll pick up the children's love and enthusiasm for these machines quickly, and they'll find themselves learning how robots and computers work. Pretty soon they'll be dreaming up new projects for the computers and thinking about adopting a second robot.

As more and more of our knowledge, information, stories, and culture are converted to an electronic format, it will be up to the librarian to acquire the machines and the expertise to give everyone access. These machines and the librarian's expertise are the windows and doorways to the information people need. The librarian's job is to be there to make sure that the windows and doorways are open wide so that the riches stored inside these machines are available to everyone. ©

Glenn M. Kleiman

Potentials And Limitations

This month marks the beginning of the third year of the "Learning With Computers" column. During the past 24 months, we have discussed many of the ways computers can be used in education and we have reviewed many programs and publications. These columns were intended to provide readers with information about specific applications and products that would help them use computers as educational tools.

In this and next month's columns, we will step back from the specifics to get a broader perspective. This month we'll consider the nature of computers, their potential educational applications, and their limitations. Next month we'll explore issues educators face when incorporating computers into their schools.

The Nature Of Computers

In order to understand what computers can and cannot do, it is helpful to know something about their basic nature. Two main points are essential to begin understanding computers. The first is that computers are tools for working with information—words, numbers, pictures, and sounds. Tools expand our capabilities. Some tools, such as hammers and pulleys, expand our physical capabilities. Other tools, such as telescopes and telephones, expand our sensory capabilities. Computers are tools that expand our mental capabilities.

Other machines, such as tape recorders and calculators, also help us work with information. However, each of these machines is limited to performing specific operations (such as storage or calculation) upon specific types of information (such as sounds or numbers). An advantage of computers is that they can perform a wide variety of processes upon all types of information. Computers can help us store, retrieve, organize, compare, modify, communicate, and analyze words, numbers, pictures, and sounds.

The second important point about computers is that in order to do anything at all, they must be given instructions in the form of a *program*. A program is a set of detailed, step-by-step instructions, written in a language the computer can process. Computers obey the instructions in a program exactly. They have no common sense or knowledge of how things are typically done. They cannot interpret a vague or ambiguous instruction, no matter how obvious it would be to a person. Therefore, whenever you hear "The computer did...," you should interpret it to mean "The computer was programmed to do...."

Each program tells the computer how to perform certain functions. The remarkable flexibility of computers is due to their ability to follow the instructions of an infinite variety of different programs.

The Potential Of Computers In Education

The flexible information processing capability of computers makes them potentially useful in a wide variety of educational applications. They can facilitate teaching and learning at all levels, from preschool children mastering the alphabet to doctors learning new diagnostic techniques. And they can be used effectively in all subjects.

Computers open new ways of developing thinking and problem-solving skills, and they provide new possibilities for learning through active exploration. They can make lessons, drills, tests, and record keeping more efficient, thereby freeing teachers to spend more time providing individualized instruction. They can make many types of lessons more interesting and motivating for students, and they can make enormous amounts of information readily available.

The widespread availability of computers could lead to fundamental changes in classroom teaching and learning, more successful remediation of learning problems, new means of educating handicapped individuals, and expanded opportunities for self-directed and home-based education.

Seven Categories

We can divide the educational applications of computers into seven general categories:

1. Computer tools for creative writing, art, and music. Computerized word processing makes creating and revising any type of writing much easier. It encourages students to write, revise, and edit more, and thereby leads to improved writing. Students can also use computers as a new way to create art and music. Computer art makes new possibilities, such as animations and special effects, readily available to children. Students can also create their own musical compositions and experiment with notes and rhythms, even if they haven't yet learned to play any instrument.

2. Computer tools for gathering, organizing, and analyzing information. Personal computers can be connected to large computers via modems and telephone lines and then used to access all sorts of information. Once the needed information is obtained, computers can be used to store, organize, and analyze it.

3. Computer programming. By learning to program, students acquire a better understanding of the nature of computers. Programming also helps students develop their thinking and problem-solving skills, as well as careful, systematic work habits. In addition, many students find that controlling a computer by writing their own programs is fun and exciting.

4. Computer simulations. Simulations enable students to explore situations and events created within the computer. For example, students can learn about the business world by managing a simulated business. Complex interactions and effects over long periods of time can be simulated almost instantly. Students can perform many types of simulated explorations and experiments that would be too expensive, dangerous, or time-consuming to perform in actuality. Simulations encourage active, exploratory learning, and they can lead to insights into phenomena that cannot be brought into the classroom in any other way.

5. Computerized playful exercises for the mind. These are games, puzzles, and creative tools which help children develop reading, math, memory, problem-solving, and other mental abilities.

6. Computerized lessons. Computers make it possible to tailor lessons appropriate for each individual. Good instructional programs present information, ask questions, give immediate feedback, provide information to clarify students' misconceptions, and adjust the difficulty and speed of presentation to each student's level.

7. Computerized drill and practice. Computers have special advantages for repetitive drill work. They can continuously adjust the level of the drill to be appropriate for each individual, and they can immediately let the student know whether each response was correct or incorrect, slow or fast. Furthermore, computers never show signs of fatigue or impatience, no matter how many repetitions a student needs.

One of the critical questions teachers, parents, and school administrators face is: In which of these ways should computers be used? Unfortunately, the easy answer—all of them—is not feasible with available budgets, time, and personnel. We will discuss this question further next month.

The Limitations Of Computers

While computers can serve many valuable educational functions, they do not magically solve all problems. They don't help us decide what to teach or how to teach it. Computers can be used whether we choose to emphasize basic reading, writing, and arithmetic skills; rote memorization; or thinking skills. They can be used in the most competitive settings and the most cooperative ones, in the most structured classrooms and the most open ones. They can be used in conjunction with the best teaching practices and the worst. Depending upon how we use them, computers can bore or motivate, intimidate or encourage, threaten or challenge.

The introduction of computers does not solve the issues of equal opportunity in schools. In fact, it brings these issues into sharp relief. Will computers be available in the inner-city schools as well as the suburban schools? Will computers be introduced in a way that will encourage boys to learn programming but discourage girls? Will computers be used to direct remedial students in drills, but to encourage creativity and problem-solving for others? That is, will some children learn to be directed by computers while others learn how to direct computers?

Computers are tools, not decision makers. No matter how powerful computers become, they can never resolve the difficult, classical issues of education—what we choose to emphasize in schools, what teaching methods we employ, how we organize our schools and our classrooms, what standards we set for students, and how we can best distribute the limited resources available for education. ©

Susan Semancik & Wini Benvenuti

Special Education Applications

Educational handicaps can be devastating, not only to a student's personal and career development, but also as obstacles to achieving a high self-esteem, as well as gaining peer group respect.

We know from our mail that computer applications in special education are of great interest to our readers, so we will be exploring ways the computer can be used to help and evaluate special education students. The Delmarva Computer Club has purchased an Atari computer and tape recorder, which will be loaned to a special education teacher for use in one of our local public elementary schools.

The Atari was chosen for several reasons: a) relatively inexpensive; b) ability to easily display different sized and colored letters, numbers, and characters; c) ability to play taped voices over the TV set; d) sound capability; e) standard joystick interface; and f) familiarity of several club members with the system.

By working closely with the teacher, we hope to develop computer programs and methods to enhance the special education program in our area, and to share some of these programs, results, and insights with our readers in this column. We would appreciate suggestions for program ideas and techniques, as well as feedback from those trying the programs we develop.

The communication series we just concluded in this column relied heavily on menus as an input method for the motor-impaired. Menus can also be used advantageously in special education. All options are shown on the screen. If they are self-explanatory, they should eliminate complicated or lengthy directions to be mastered before the program can be used.

Eliminating The Keyboard

Another technique that simplifies the use of the computer for very young special education students is eliminating the keyboard as an input device. Using a joystick or light pen to select the options presented on the screen reduces the number of choices, and the student may feel less threatened or confused.

Part of the problem some students have with counting, for example, involves a loss of continuity when they can't remember the next counting number. When provided with the next number, some students can't continue counting from that point, but must start again from the beginning.

The program presented here is our first attempt at a computer aid for this learning difficulty. A target number is shown at the top of the screen, indicating how high the student must count. The student can enter a number by typing any of the digits from 0 through 9, followed by a RETURN key. We are using graphics mode 2, which gives the largest characters in any of four colors. The number being entered appears in blue at the right edge of the screen. If it is the next counting number, it moves to the left and changes to a gold color, joining the previously entered correct numbers in line. If it is wrong, the entered digits for the number disappear. When the student does enter the correct number, it will appear as red digits in the line, so both the teacher and the student can see the numbers with which the student has problems.

In this graphics mode, the screen width is only 20 characters wide. By using the joystick, the student can scroll the entered numbers left or right to view whatever part of the line is desired. By moving the joystick down, the student will instantly see the number line from the first entered number; and by moving it up, the number line can be viewed at the end of the numbers entered.

By having the computer offer an enjoyable version of a repetitive task, the student will have a more positive attitude which should improve the learning environment.

Menu Selection With A Joystick

```
5 DIM S$(300),T$(40)
10 W=20:S$(1)=" ":S$(W)=" ":S$(2)=S$(1)
20 T=30:P=W+1:FOR I=1 TO T:T$=STR$(I):L=LEN(T$):FOR J=1 TO L
30 IF T$(J,J)="0" THEN T$(J,J)="O"
40 NEXT J:T$(L+1)=" ":S$(P)=T$:P=P+L+1:NEXT I
45 GRAPHICS 2+16:POKE 752,1
46 T$=STR$(T):POSITION W/2-LEN(T$)/2,0:FOR I=1 TO LEN(T$):K=ASC(T$(I,I))
47 IF K=48 THEN K=79
48 ? #6;CHR$(K);:NEXT I
50 N=0:PS=1:PE=W:OPEN #1,4,0,"K:"
55 C=0
60 V=0:L=0:T$=""
70 IF N=T THEN CLOSE #1:? S$:END
80 POSITION 0,5:? #6;S$(PS,PE);
90 POKE 764,255
95 IF STICK(0)<>15 THEN 95
100 IF PEEK(764)=255 AND STICK(0)=15 THEN 100
110 IF STICK(0)<>15 THEN 250
120 GET #1,K
130 IF K=155 THEN 200
140 IF K<48 OR K>57 THEN 90
150 V=V*10+K-48
160 PS=PS+1:POSITION 0,5:? #6;S$(PS,PE);
170 IF K=48 THEN K=79
175 L=L+1:T$(L,L)=CHR$(K-32+64*(K=79)):POSITION W-L,5:? #6;T$
180 GOTO 90
200 IF V<>N+1 THEN PS=PS-L:C=C+1:GOTO 60
210 N=N+1:PS=PS+1:PE=PE+L+1:IF C=0 THEN 60
220 T$=STR$(N):L=LEN(T$):A=ADR(S$)-1:FOR I=PE-L TO PE-1:POKE A+I,PEEK(A+I)+96+64*(PEEK(A+I)=79):NEXT I:GOTO 55
250 IF V THEN 90
255 XS=PS:XE=PE
260 Z=STICK(0):IF Z=15 THEN 260
270 IF Z=13 THEN XS=3:XE=W+2:GOTO 400
280 IF Z=14 THEN 70
290 IF Z<>7 THEN 320
295 IF XE>=PE THEN 70
300 A=ADR(S$):P=PE:FOR I=XE+1 TO PE:IF PEEK(A+I)=32 THEN P=I:I=PE
310 NEXT I:A=P-XE:XS=XS+A:XE=XE+A:GOTO 400
320 IF Z<>11 THEN 260
325 IF XS<=3 THEN 260
330 A=ADR(S$):P=1:FOR I=XE-1 TO 1 STEP -1:IF PEEK(A+I-1)=32 THEN P=I:I=1
340 NEXT I:A=XE-P:XS=XS-A:XE=XE-A
400 POSITION 0,5:? #6;S$(XS,XE):GOTO 260
```

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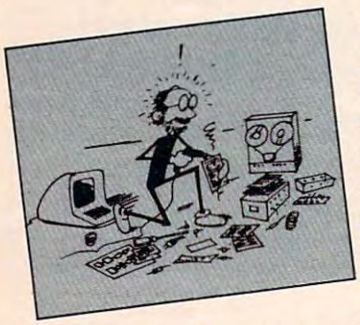
Computing To Read

Fred D'Ignazio, Associate Editor



When Catie was four years old, lots of children used to come to our house to play with our computers. Many of the children were older than Catie, and their favorite programs were the graphics-and-text adventure games.

Older children (8 to 14) used to spend hours at our house playing Epyx's *Crush, Crumble and Chomp! The Movie Monster Game*, Sirius Software's *Copts and Robbers*, and On-Line Systems' *Cranston Manor*.

The games are a lot like the "choose-your-own-adventure" books from Bantam, TSR Hobbies, Pocket Books/Archway, and other publishers. They are electronic "interactive novels," with the child playing the lead role—as hero, heroine, villain, or monster.

In the computer's story world, the child is important; what she does matters. When she makes a decision it changes the whole course of the story. She enters a world where she alone is at the center of the stage.

In addition, the child gets to choose the pace of the story. When she boots up the disk (most of these story games appear on disk or cartridge, since they are based on very long programs), a picture appears on the screen. This is the first frame in the electronic picture book. Underneath the picture are a couple of brief sentences and a question. The statements might say something like "You are in a purple maze. All the doors are locked." The question might ask, "What do you do now?"

The child must decide what to do. But she isn't rushed. She can proceed through the story world inside the computer at her own pace. Or she can leave that world and walk into the kitchen for a glass of apple juice or a cookie. She can talk to a friend on the telephone. When she is ready to reenter the story world, she can come back to the computer and slide back into the story.

Power Words

Catie spent hours watching the older children play the story games. At first she was happy to stand nearby and watch them play. Then she got bored just watching. She began climbing up on the kids' laps and begging to push some of the buttons.

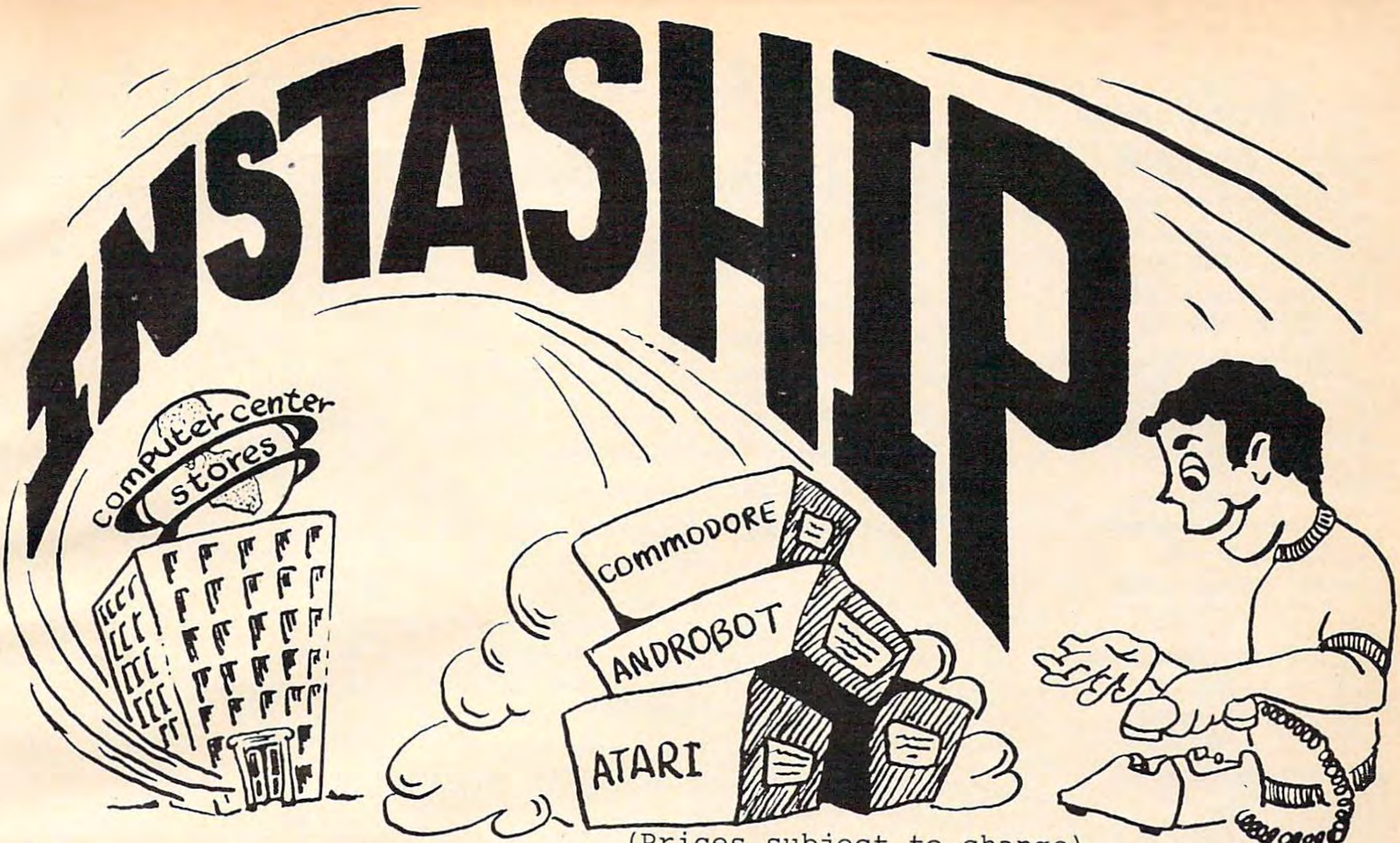
She wanted, at first, to push the buttons the other children had chosen. Later on, this was not enough; she wanted to choose the buttons herself. Eventually, she made herself such a nuisance that the others stopped playing with her. For a brief time my wife, Janet, and I had to ban her from the computer room because she was so disruptive.

That's when Catie began to play the games on her own.

The older kids were so relieved that they helped Catie by writing down lots of the key words she would need to know to play the games. They wrote these *power words* down on little scraps of pink and blue paper, and Catie taped them to the

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

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



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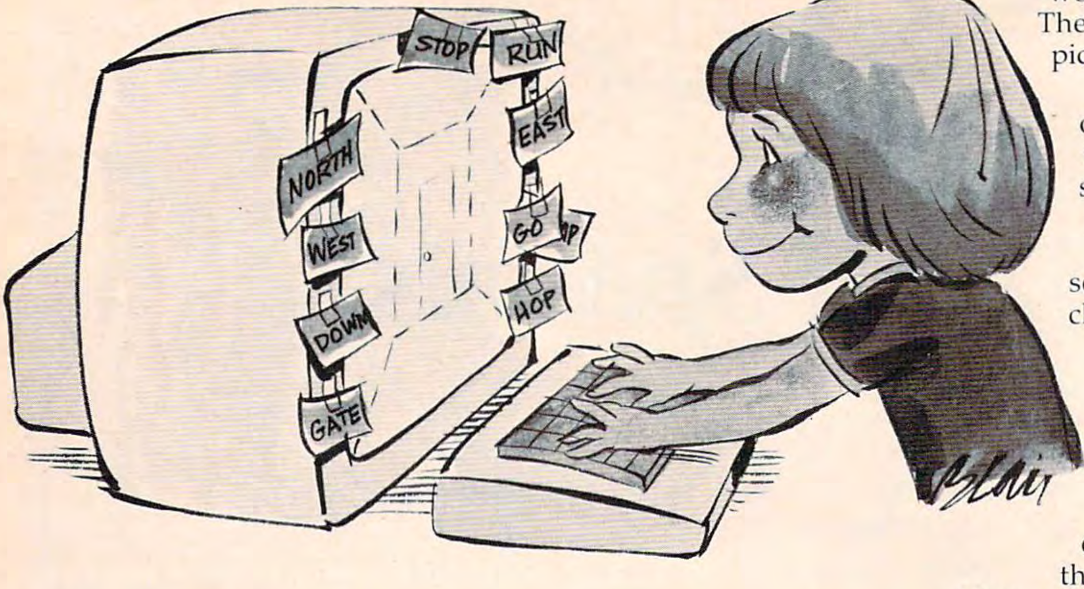

side of the monitor and across the top of the computer.

As Catie grew more adept at playing the games, the number of scraps of paper taped to the computer grew, until the front of the display screen began to look like a bulletin board. It got so hard to see the computer screen that the older kids had to squeeze the words onto fewer paper scraps.

The power words Catie learned enabled her to answer the computer's questions, avoid the monsters lurking in the computer's mazes, and survive longer inside the computer's game world. They included direction words like up, down, left, and right; and the points on the compass—North, South, East, and West. She learned simple verbs like go, stop, run, jump, hop, and climb. And she learned lots and lots of nouns, like candle, flashlight, food, box, treasure, window, gate, and house.

The words were important to Catie because using them gave her power. They let Catie make choices, go where she wanted to go, and do what she wanted to do.

And they had meaning within the context of her adventure inside the computer. But they were not words that appeared on a page, or even on the display screen. They were words on paper scraps outside the computer, in Catie's world. Catie had to type the words herself and enter them into the computer's world. They were keys on a key ring that Catie herself carried. At first, Catie wasn't sure which key opened which door, but she quickly learned to match the doors with the keys. When a key worked, its effects were immediate and dramatic.

Catie could control the microworld she entered by using the right power words. But the world was not made up entirely of words. It was really an electronic "picture book" world, half words and half pictures. The words reinforced the pictures, and vice versa.

Since Catie saw the older children playing the adventure games, she didn't think of the pictures as being part of a picture book—something for younger children. Catie saw the adventure games as something only big kids could master, and she wanted to be like the big kids.

Catie had the opportunity to act like the big kids because the challenge was not too great. She had to simultaneously develop her logical, puzzle-solving, and memory skills, along with her reading and writing skills, as she played the games. But Catie could follow the pathway to these skills by taking small, child-sized steps.

Catie could play the games at her own pace—with no one looking over her shoulder or telling her what to do. This meant that she had to live with the consequences of her actions. She got to experience a certain independence inside the computer without a watchful adult hovering over her.

When Catie turned on the computer, the world inside became Catie's world. She was the only human there.

A Closet Reader

One afternoon, after Catie had been playing the adventure games by herself for several weeks, I entered the computer room and noticed that all the paper scraps had disappeared from the picture screen of Catie's game computer. Catie was playing one of the games (*Mystery House* by On-Line Systems), but she was flying solo, without any help from the power words or older children.

I was going to say something, but Catie distracted me by telling me to watch her whiz through the multicolored *Copts and Robbers* mazes, capture four jewelled rings and a vase, and take them to the Vault room so she could win the game. I remember being amazed at her manual dexterity as she pushed the four arrow buttons on the computer keyboard, and I totally forgot to ask her about the paper scraps.

Catie entered kindergarten that fall and reports from her teacher about her reading began filtering home. One day my wife was talking to Catie's teacher and learned that Catie was, perhaps, the best reader in the class. She was reading books intended for children in second, third, and fourth grade.

The teacher asked us how we had taught Catie to read. My wife said that we had never taught Catie to read. If Catie had learned, she must have taught herself.

That night my wife asked Catie how and when she had learned to read. Catie said that she had known how to read all during the previous summer but that she had been too shy to tell us.

My wife and I were shocked. We had been reading picture books to Catie all summer, while secretly Catie had been reading books written for much older children. We had a daughter who was a "closet" reader.

Once Catie came out of the closet about her reading, we couldn't hold her back. That fall and winter she had her nose in a book all the time. She began bringing home six or seven Nancy Drew books a week. She read her way through Beverly Cleary, Judy Blume, Paula Danziger, Mary Norton, C.S. Lewis, and Katherine Paterson. She read all of Donald Sobol's *Encyclopedia Brown* books and Bantam's Choose Your Own Adventure books. Then she returned to fairy tales and began reading her way through the Brothers Grimm.

Books And Computers

My wife and I are not certain how Catie learned to read, but we are sure that the computer played a big part.

Of course, the computer was not the only factor. Janet and I both love books, and we have read books to Catie from the time she was four months old. Before she learned how to read, Catie already had a library of dozens of picture books. I write books, and both Janet and I collect children's books. We are compulsive readers, and now Catie is, too.

But, as far as we know, Catie never did any reading on her own until after she had begun playing the computer adventure games. So I feel that those games were the key factor in turning her from an almost-reader into a reader. She was probably on the verge of reading, and the games gave her the boost she needed to get started.

Reading: Pain Before Pleasure

We book lovers sometimes think that reading has always been an effortless and pleasurable experience. This just isn't true. It wasn't true for us, and it's not true for our children. For beginning readers, the process of decoding thousands of strange-looking letters, punctuation symbols, and words on a printed page approaches pure agony. The decoding process is slow, painful, and can be extremely frustrating.

This is where computers can play a valuable role. They can break reading skills into small, manageable pieces. They can turn each small step a child takes into a mastery, an accomplishment, or a reward. And they can bring the whole process of learning to read more under the child's control and more personally meaningful to the child.

In an adventure game the child is in supreme control. Each time he types in the right power word and advances to a new screen, he feels a sense of accomplishment and mastery. And the stories have meaning because he himself is the central actor in the computer's story world.

Electronic Fairy Tales

When Catie learned to read, the only adventure games were for older children or adults. Now there are adventure games for younger children. These include *Gertrude's Puzzles* and *Gertrude's Secrets* from the Learning Company; *In Search of the Most Amazing Thing, Trains,* and *Snooper Troops* from Spinnaker; *Dragon's Keep* from Sierra On-Line; and the many voice-enhanced adventure games and stories from PDI (Program Design, Inc., in Greenwich, Connecticut).

In two months, in this column, I will take a look at some of the newer children's adventure games, and offer suggestions about other techniques that parents, teachers, and librarians can employ to help children develop reading and writing skills using computers. ©

Submarine Simulations For Commodore

Dale F. Brown

Subwar 64 for the Commodore 64 provides a different sort of challenge. A black-and-white version of the program, titled *Submarine Warfare*, is available for the CBM 8032 and 4032.

Subwar 64 has the perfect balance of simplicity, realism, and complexity. However, it is by no means easy. You must master so many controls aboard your attack submarine that the package comes with three "training" programs.

The Pressure Of The Sea

The first trainer program explains how to trim the ship (balance it horizontally and laterally for best performance), how to make it dive and surface, and how to control its speed. It is a simple text presentation with operating examples of how each command works.

The controls do not respond immediately to the touch of a button (the programs are all written in BASIC), so you must lead your commands in order to keep from overfilling a ballast tank or diving below your desired depth. This program is fast and informative, so you will move on to the next program rapidly after practicing this one a few times.

You next run an initialization program, and then you can try the Ship Control Trainer. You now apply what you learned in the first program to an actual running vessel. Your sub will start out of port badly out of trim.

You, the dive control officer, must trim the sub and then respond to the captain's orders to dive or submerge. You must pump water from trim tank to trim tank, ballast tank to sea, or take on water to correctly balance the weight.

In addition, a few malfunctions are introduced to kill your engines, flood a certain part of your ship, or prevent you from controlling pumps or maneuvering planes. Then, if you're slow to respond to your captain's orders, you may be sunk by depth charges or crushed by the pressure of the sea.

Controls Take Practice

A little patience is required here. The controls are a bit tricky, and it does take a few seconds for your commands to take effect, so a little preparation and foresight will help. If you open a valve, for example, and you want to take on only a few thousand pounds of water for trim, be prepared to shut it off immediately or you may have to start all over again and rebalance the weight. Some of the emergencies or malfunctions that occur are very difficult to solve. A flooded compartment, for example, may make it nearly impossible to keep your sub level.

The third training program introduces you to the attack center, where, now as captain of the vessel, you pursue and attack surface ships. The Attack Center Trainer sets your depth and trim for you. You use sonar, hydrophones (underwater microphones), and a periscope to locate ships. Once you locate a target, you maneuver your sub to the proper firing course and fire your torpedoes. In the Attack Center Trainer, your targets will take little evasive action and will not counterattack, so you can shoot away until your 24 torpedoes are expended.

The 20-page manual is an excellent aid to learning how to use the various devices and controls, and it shows how to perfectly set up and execute a torpedo run.

Some Real Action

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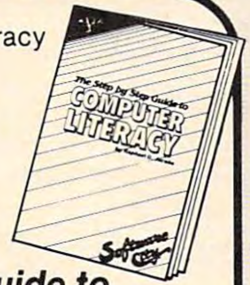

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three-part training program. Load and RUN the *Subwar* program itself and get ready for some *real* action.

As in the trainer program, your sub steams out of port in very bad trim. You don't have much time to trim your ship before the captain orders you to a cruise depth of 200 feet. Soon afterwards, he orders you to periscope depth (65 feet), and you begin your attack. At first, it may take you this long just to finish trimming the ship, let alone starting an attack. Level the sub off near the commanded depth, trim her the best you can, and switch over to "attack center." You will remain at the same depth when you go to "attack center" mode, but if your ship hasn't been trimmed properly, you will bob to the surface or sink rapidly when you switch back from "attack center" to "full ship control" modes.

The vessel you're tracking will not simply sit there and wait to be sunk. If you get too close, or use your active sonar to prepare for your torpedo run, your target will turn and start dropping depth-charges, and you will automatically switch from "attack center" mode to "full ship control" mode to evade its attack.

Malfunctions can occur at any time, and even your torpedoes can go astray after firing and spoil a perfectly executed torpedo run. A good idea is to return to "full ship control" mode right after firing torpedoes, dive to a safer depth, then switch back to "attack center" mode to see if your torpedoes hit. Your target's retaliation can come quickly, and you can't fire a second salvo of torpedoes until the first torpedoes either hit or miss.

Your score is computed from the number of enemy vessels you sink, the number of enemy attacks you survive or evade, and the skill level (beginner, advanced, or expert) you selected at the beginning.

Subwar 64 is an excellent game simulation for all levels of computer players. It may tax the abilities of younger players, but a few practice shakedown cruises will be in order for almost everyone who gives this game a try. The sounds are excellent, and the graphics and the overall presentation are very good. It will take some careful reading of the manual to explain the sub's operation, but you will soon master the vessel and move up quickly in skill and proficiency. This excellent game simulation is highly recommended.

Subwar 64
Submarine Warfare
Clockwork Computers, Inc.
4612 Holly Ridge Road
Rockville, MD 20853
(301) 924-5509
64 version, $15.95 tape, $19.95 disk
CBM version, $18.95 tape, $22.95 disk

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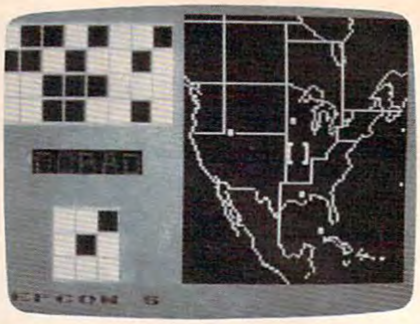
Computer War For Atari, VIC, And TI

Dan Gutman



Incoming missiles are shown at right in opening screen of Computer War *(Atari version).*

The success of the movie *War-Games* has spawned several post-*Missile Command* "end of the world" games, most notably Probe 2000's *War Room* and Thorn E.M.I.'s *Computer War*. Coleco, which owns the rights to the title *WarGames*, has yet to be heard from. There will certainly be others.

Computer War is a game in three parts. In the first phase, you see a map of the United States with four American missile bases highlighted. Also highlighted is the computer at NORAD (North American Air Defense System). Suddenly, small white blips move into view, indicating that nuclear missiles are headed for American targets.

But wait! Upon closer examination (of the instructions, that is), you realize that the missiles aren't enemy missiles—somebody has tapped into NORAD to activate a nuclear war simulation program. Since the computer can't tell the difference between real missiles and fake ones, it's going to launch a volley of American missiles as soon as NORAD headquarters is in danger. You've got to knock out the missiles in the computer's memory banks and crack the code to shut down the bases.

Find The Missiles

This first section consists merely of zooming from the map of the United States to individual missiles. The joystick controls an onscreen cursor. When the cursor overlaps the missile blip and the fire button is pressed, that area of the map zooms into view. This exercise is fairly easy. In fact, I would prefer that the blips move a little faster to make this part of the game more challenging. As it is now, zooming in on the missiles is merely a formality.

The graphics on the map screen, however, are the most impressive of the game.

You will zoom to a close-up view of the missiles' target area. Aside from the mountains in the distance, the landscape is totally barren. In fact, you may wonder just what it is you are defending. There are no people or buildings around. Why not just let the missiles harmlessly explode and avoid all the complications?

No, the security of the world is in your hands. The joystick can swivel your gunsight left and right and move it up and down also. A little box on one side of the screen indicates which direction to turn to see the missile, and rapid beeping tells you it is about to appear. The fire button launches your fire—two small rockets that arc across the sky and converge in the middle.

The missile will zip back and forth across the screen much faster than you can turn your gunsight. This means that to hit it, you have to fire before it appears onscreen. If you miss, you'll turn far past the target and have to wait for your slow-moving gunsight to change directions. The gunsight should probably move faster, or the missiles slower.

If you fail at this task, the missiles will reach U.S. bases and the DEFCON (Defense Condition) count will deteriorate. If it reaches DEFCON 1 (it starts at DEFCON 5), global war will begin.

Crack The Code

But if you succeed, you reach the third and most interesting part of the game. There are two banks of flashing squares on the left of the screen. Suddenly they freeze in random checkerboard patterns. With your joystick, you have to match the pattern of the smaller box with a section of the pattern of the larger box—kind of like fitting the peg in the correct hole. You have just a few seconds to do this, and you may have to rotate the box to complete the task.

If you match the two patterns (cracking the code), you have earned the right to shut down one of the U.S. missile bases. Of course, there are three more ready to launch everything they've got, so you've got to blow up more missiles, crack more codes, and so on.

Even though I love shooting games, I found that the last part of *Computer War*—cracking the code—was the most intriguing. Since *Space Invaders*, we have shot down so many enemies that the whole ordeal has become a little routine. But when you have five seconds to find a way to fit one pattern into another pattern—*that* can get the adrenaline flowing again. Mental challenges like this can stand up as games by themselves, and they should—they're exciting and they provide the brain with a little exercise.

Computer War is a single-player, single-difficulty level game. It captures the overall feel of *WarGames* without attempting the complexity of *War Room*, in which you must not only stop the missiles, but also rebuild cities, control production of goods and services, and pick up enemy spies.

Computer War's graphics are sometimes good (locating the missiles) and sometimes poor (shooting the missiles). You get the feeling that the game was programmed by two designers with different styles. The music in the beginning is excellent—serious and ominous. The scoring is much too low—40–50 points for knocking out a nuclear missile flying over your hometown. The game is available for Atari computers, VIC-20, and TI-99/4A. Fans of the movie *WarGames* who want to relive it will surely enjoy this game.

Computer War
Thorn E.M.I. Home Video
1370 Avenue of the Americas
New York, NY 10019
$39.95

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Flip And Flop For Atari, Commodore 64

Stephen Levy, Editor, COMPUTE! Books

Maze games have been popular for a very long time. Game books that include page after page of maze puzzles for the reader to solve are eagerly snatched up. And schoolchildren often spend many hours designing their own mazes for friends to solve. They enjoy including long paths that seem to go on and on and finally end in a dead end, forcing the player to backtrack to find the right path to the treasure at the end of the maze.

It's no surprise that maze games quickly became popular with videogame enthusiasts. The first games had simple mazes. Then creators of video mazes began to add new dimensions, impossible on paper. They took advantage of the fact that a video screen was more than just a reflection of the printed page. Players demanded action, color, sound—things computers can do so well.

Flip and Flop is a maze game, a chase game, and more. The author, Jim Nangano, has combined some of the concepts that make maze games fun to play with the thrill and fast action of a good chase game. But he didn't stop there. He added some new twists that should make this game a favorite.

Flip And Mitch

Flip is a kangaroo. Mitch is his friend, a monkey. It seems they have been taken away from their friends in the circus and put into a zoo. They're trying to escape. Your job is to help Flip and Mitch return to the circus.

The Atari version's playfield (there is also a Commodore 64 version available) consists of a series of maze-type platforms that Flip and Mitch must alternately solve. Each platform contains squares which must be flipped. Once all the squares have been flipped, the player moves to the next level. Flip must complete the odd-numbered levels and Mitch the even. Like any healthy monkey, Mitch does his flipping while hanging by his hands.

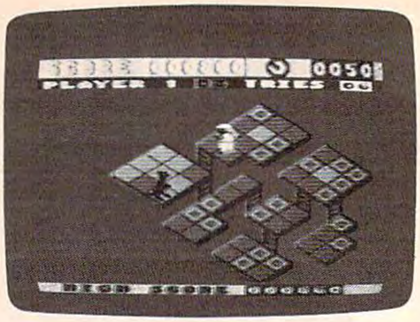
Levels 1 and 2 are really for practice. This is where you learn how to maneuver up and down the ladders from one platform to another. If you try to go off the maze (a platform), you will fall off the platform and lose one of your tries. Each time you successfully complete a level, one more try will be added to your total.

Thirty-Six Levels

Flip and Flop is a game for one or two players with either one or two joysticks. If two players are playing, each takes a turn. They are not playing head to head, just competing to see who can score the highest number of points. Scores are based on the number of tiles flipped and the amount of time remaining when a player completes a level.

There are 36 levels. Levels 1 to 13 build the platforms, with level 1 having the fewest squares and the fewest platforms. The game becomes more difficult as you move from level to level. Above level 14, it's a real challenge.

In levels 1 and 2, you simply race against the clock. After level 2 the chase begins. Flip is being chased by the zookeeper and Mitch by his net. At the lower levels it is not too difficult to keep your distance and complete the level without being caught. But each level gets increasingly difficult as the playfield gets bigger and the chasers become



Flip the kangaroo tries to keep clear of the zookeeper in First Star Software's Flip and Flop.

more intense. At the highest levels you must flip the indicated tiles twice to complete the level—no easy task.

A Game Of Strategy

On each level there are sticky squares. If either the animal or the chaser steps on a sticky square, he must stay there for a few seconds. These squares are to the player's advantage. They can be used to trick the chaser into getting stuck, so that Flip or Mitch can get away. The use of sticky squares must be planned, since each can be used only once on a level.

Playing this game takes practice. Maneuvering the joystick is really easy once you learn the relationship between the stick and the playfield. What is more difficult to learn is how to outwit the chasers. Since you are able to choose which level to begin (1 to 13), you can practice any level until you've mastered the techniques you need. You must complete each level from 13 on up in order to advance to the next. This is where the pause feature comes in very handy. If you manage to get to a high level and are getting tired (and this is likely), hit the space bar; the game will pause until you press the space bar again.

Some Of The Best Graphics You'll Ever See

The playfield is a series of platforms which are drawn to create a 3-D effect. The platforms are some of the best examples of computer graphics you may ever

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see. The two animals and the chasers move smoothly. The music and sound effects are well done, demonstrating that sound can be simple, yet add greatly to the enjoyment of a game.

Perhaps the best answer to the question "Was it fun?" is to say that I continued to play this game over and over. Once I had mastered the first five levels, I thought I had it figured out, but I was wrong: The challenge continued. I managed to get to level 14, and as soon as I can I'll go back to Mitch and Flip to see if I can return them to their friends.

Flip and Flop
First Star Software, Inc.
22 East 41st Street
New York, NY 10017
32K Atari 400/800, disk or tape, $29.95
16K Atari, cartridge, $39.95
Commodore 64, disk or tape, $29.95; cartridge, $34.95

The Cosmic Balance II For Apple, Atari

Robert L. Hurt

After blasting away wave after wave of space invaders and wacka-wacking through endless *Pac-Man* imitations, you may find yourself looking for something different to while away the hours. If you've always had a yen for galactic domination, *The Cosmic Balance II* may be for you.

This game, published by Strategic Simulations for the Apple II+ and Atari 400/800, is a sequel to *The Cosmic Balance*. But while the first game involves detailed ship-to-ship combat, *The Cosmic Balance II* is a strategic game involving interstellar sagas of exploration, colonization, and conquest.

With this sequel, variety is the key word. The game may be played by one (with four skill levels) or by two players. The player may create his own scenario or select from five existing ones. These trace the history of Humanity, from Earth's expansion into space, to the first contact with a hostile race, to the Final Conflict between Humanity and the Empire.

The game divides the near reaches of space into 16 sectors, each with a maximum of 40 habitable worlds. The sectors are displayed graphically as a multitude of irregular interlocking patterns—a nice touch, much more pleasing to behold than squares or hexagons, which would have been easier to implement. The play turns are broken up into several segments to make the complex sequences easier to manage.

Production Phase

During this phase, the player tallies his Industrial Output points, supplies his ships, and uses the remaining IOs to buy more supplies or construct more ships. There are 15 different ship classes to choose from, ranging from small escorts and merchants to battle cruisers and colony ships.

The IOs come from either active terran-type worlds or supply networks. Terran planets are those rare worlds with the proper blend of resources and climate to become self-sufficient. Less ideal farming, mining, and industrial worlds may also be linked together with cargo ships to form an interdependent commerce net.

First Movement Phase

Here is where most of the strategy is worked out. Sector by sector, each player gives orders to his ships. The available options are: Garrison, guarding friendly planetary systems; Commerce Mission, providing transport lines linking a commerce net (and thus generating IOs); Supply Mission, shipping goods to create or maintain colonies; Patrol, attempting to intercept enemy ships; Invasion, attempting to take over an enemy world; Commerce Raid, assaulting an enemy commerce mission; Planetary Raid, attempting to decimate an enemy planet; and Scout, exploring the sector for usable planets.

The computer maintains an updated listing of which ships have been assigned to which missions. This aids tremendously in assigning the proper orders to the right number of ships.

Execution Phase

Here the computer takes each sector and resolves the combat, battle by battle. It starts by displaying the mission and the ships on each side. Pressing a key will resolve the combat instantly, showing casualties for both sides and stating whether the mission was successful. Gamers owning *The Cosmic Balance I* have an interesting option of resolving each combat using that game. While much more satisfying, this would slow down the game considerably and is best reserved for critical combats.

Colony Supply Phase

Now each player has the option to start new colonies, supply existing ones, or aid devastated worlds in a state of "ecolapse." It is very important to have sent ships on supply missions so supplies will be available in this phase (untransported supplies are assumed to be stockpiled somewhere in the sector but unavailable at this point). There are few things more frustrating than having a successful attack on a minor farming world put the entire commerce net out of action simply because there are no supplies to bring it back to an active status.

Empires Fall More Slowly Than Starships

This phase allows a few types of ships outfitted with two warp generators to move once more, towing up to one more ship along. This is quite necessary when invading enemy territory. Until bases have been established there, ships must use hit-and-run tactics or be destroyed due to lack of supplies in the next production phase.

The Cosmic Balance II displays game information in a clear, usable manner. At the beginning of each phase the player is asked to enter his choice of sectors and is then given the option of viewing several displays before giving orders. The general display gives a summary of the numbers of each type of ship and world in the sector. There are also more detailed ship and planet displays available.

A reasonable effort is made to prevent the user from making mistakes. In the production and supply phases, for example, he is forced to give orders to each sector he controls. Unfortunately, this is not the case with the movement phase, so it is disturbingly easy to exit from it before giving orders.

The computer is a worthy opponent and makes its moves very quickly. Execution is also very rapid; it really deserves its label "RapidFire." By far the most time-consuming aspect is entering orders (expect to spend a minimum of ten minutes per player per turn. For the more complex scenarios, it may take 20 minutes).

All in all, the game works quite well. It takes a concept usually found only in tactical wargames and adapts it fully to a computerized format, with the computer efficiently handling the drudgery of record-keeping and execution.

But there are drawbacks. This game lacks the fast-paced excitement of arcade games or even *The Cosmic Balance I* (after all, each turn represents a period of a year or so). And empires are much slower to fall than starships.

A complex scenario with several sectors on each side could take many hours to play, and the Final Conflict literally could take months. If *The Cosmic Balance I* Combat Option is used, playing time would greatly increase. This system easily lends itself to extended campaigns. Fortunately, provisions have been made for saving a game in progress.

So if you're in the mood for building an empire and have time to spare, this might be the game for you. Just remember—the Federation wasn't built in a day.

The Cosmic Balance II
Strategic Simulations, Inc.
883 Stierlin Road
Building A-200
Mountain View, CA 94043
$39.95 ©

COMMODORE 3-D Drawing Master

Donald E. Smith

"Drawing Master" helps you create complex three-dimensional drawings by making use of your computer's high-resolution graphics mode. Originally written for VIC with 16K expander; versions also are included for 64 and Apple.

Drawing with a joystick is fun, but it lacks the precision and flexibility that artists and designers expect in a drawing instrument. With "Drawing Master," you can create complex drawings on the screen. Just provide the points on the screen where each line begins and ends, and Drawing Master fills in the lines for you.

You can define the starting points of two lines and the point where they meet (Figure 1a), or the places where a single line changes direction (Figure 1b), or you can define the points along a curved line (Figure 1c). Drawing Master also lets you define open and closed two-dimensional shapes (Figure 2) as well as complex drawings utilizing a combination of two- and three-dimensional shapes (Figure 3).

Cartesian Coordinates

Drawing Master makes use of your computer's high-resolution graphics mode, which allows you to draw by controlling the individual pixels (specks of light) on the screen. In high-resolution mode, you find a specific pixel's position by using the Cartesian Coordinate System, the common X-Y coordinate system widely used in plotting charts and graphs. The X coordinates represent points on a horizontal plane, and the Y coordinates represent points on a vertical plane. You can locate any point on the screen by its horizontal and vertical distances from a point of origin. It's like the way you can locate a particular street on a city map by looking for it in the square called F-5 or C-2.

X coordinate points begin at the left of the screen and increment to the right, and Y coordinate points begin at the top of the screen and increment down the screen. Position (0,0) is the HOME position, in the upper-left corner of the screen. So, Position (36,45) in Figure 3 is 36 X points to the right of, and 45 Y points down from, Position (0,0).

The VIC high-resolution screen has 175 X coordinates and 160 Y coordinates, for a total of 28,000 individual points on the screen. (The 64 has 320 X coordinates and 200 Y coordinates, for a total of 64,000; and the Apple has 280 X coordinates and 192 Y coordinates, for a total of 53,760.)

To illustrate how Drawing Master uses this plotting system, let's create the drawing in Figure 3 step by step, using a plotting routine from Paul F. Schatz's article, "High Resolution Plotting," in *COMPUTE!'s First Book of VIC*.

First, type in the program and SAVE it. Next, turn the VIC off and then back on. Before LOADing the program, you must move the start of BASIC to 8192 (to accommodate the 16K expander) by entering this line in the immediate mode:

```
POKE44,32:POKE8192,0:NEW
```

(This must be done each time you LOAD the program.)

(The 64 version includes Programs 2 and 3. Type in each program separately and SAVE each one to tape or disk. LOAD and RUN Program 2 before you RUN Program 3.)

Drawing Master In Action

Now LOAD the program and RUN it.

Drawing Master begins by displaying a menu with seven options:

D–Define Object
R–Read Object
S–Save Object

V–View Object
T–Translate Object
M–Main Menu
E–End Session

Select D to define the object that you wish to draw on the screen.

In this practice run, you will be defining the different shapes contained in Figure 3, a box with two windows in the front. If you break down the drawing into its components, you have one three-dimensional part, the box, and two two-dimensional parts, the windows.

Pressing D begins a series of prompts asking you to provide data for the object. The first prompt is for the number of 2-D (two-dimensional) parts, which you can think of as the number of flat surfaces which you want to represent on the screen. In Figure 3, the box is drawn to simulate three dimensions, but the two windows are drawn as flat rectangles, so you respond with 2 for the number of 2-D parts.

These two-dimensional parts are defined with the next series of prompts. You are asked for the number of points in part one. Window 1 has 4 points, so you enter 4. Drawing Master then prompts you for the X and Y coordinates of each point. (Remember our X,Y coordinate system.) For the sake of clarity and consistency, enter the coordinates in clockwise order. Be sure you have entered each set of coordinates correctly before you press RETURN. Drawing Master has no editor, and a mistake can cause you to have a lopsided figure. Each time you press RETURN, you will be prompted for the coordinates of the next point.

```
X,Y [ENTER] 84,80
X,Y [ENTER] 99,73
X,Y [ENTER] 99,116
X,Y [ENTER] 84,122
```

Since you have two windows (two 2-D parts), the next prompt asks for the data for the second window. Drawing Master allows you to make a second window from data already entered for the first. (If you wanted a third window, you would copy it from the completed second window.)

```
COPY LAST PART? (Y/N) Y
```

Respond with Y, because you want both windows to be alike, but in different positions on the screen. The next prompt asks for the translation of the figure in both X and Y directions. This prompt determines how far horizontally (X) or vertically (Y) from its original position you want to copy the first window to produce the second window.

Look at Figure 3 again. In relation to the HOME position (0,0), Window 2 is farther to the right and higher than Window 1. To make the example as painless as possible, the exact distances have been computed for you: Window 2 is to be translated 35 X points to the right of, and 13 Y positions higher than, Window 1. Drawing Master prompts you with:

```
PART2/TRANSLATION:
RIGHT = +X   LEFT = -X
DOWN = +Y   UP = -Y
```

This tells you that your X translation is positive if you are translating the figure to the right, and negative if translating to the left. The Y translation is positive if you are translating down, and negative if you are translating up from the original position.

You will be prompted X TRANS? and you type 35. In answer to Y TRANS? you type –13. Since the windows are not three-dimensional, you respond with N to the prompt:

```
IS PART 3D? N
```

You have not yet created the box which surrounds the windows.

When the prompt asks:

```
# OF 3D PARTS?
```

respond with 1, for the box.

You can now create the 3-D simulation by creating certain sides of the box and letting Drawing Master fill in the rest of the box for you. Look at Figure 4. This is a simulated three-dimensional drawing of a box similar to the one you are about to create. (The dotted lines would be hidden if the box were solid.) This box has six sides, or *faces*: front (Face 1), back (Face 2), top (Face 3), bottom (Face 4), and the left and right sides, which, to avoid clutter, are not labeled. Each face is a closed, four-sided shape. (See Figures 4b and 4c.)

First you are prompted for the number of points on each face:

```
# OF POINTS ON EACH FACE? 4
IS THE SIDE CLOSED? Y
```

Now enter the points for two opposite sides.

```
Face 1
X,Y 36,45
X,Y 70,70
X,Y 70,139
X,Y 36,111

Face 2
X,Y 114,17
X,Y 148,41
X,Y 148,111
X,Y 114,84
```

When you press RETURN after entering the fourth set of coordinates, you return to the main menu. From this menu, you may view your figure by pressing V. After you view it, press M to return to the main menu. You can save your drawings on disk or tape (disk only for Apple), and load them back into memory using the R option in the main menu.

Figure 1a

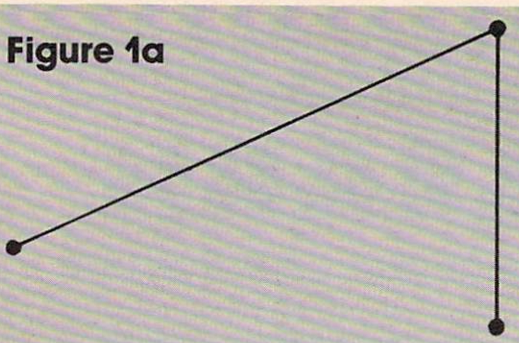


Figure 1b

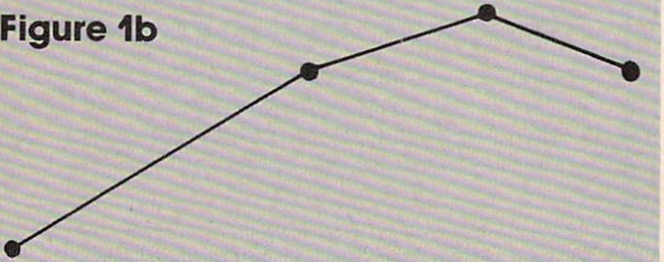


Figure 1c

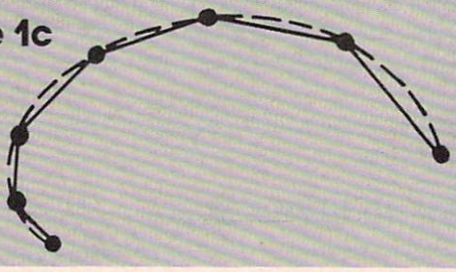


Figure 2

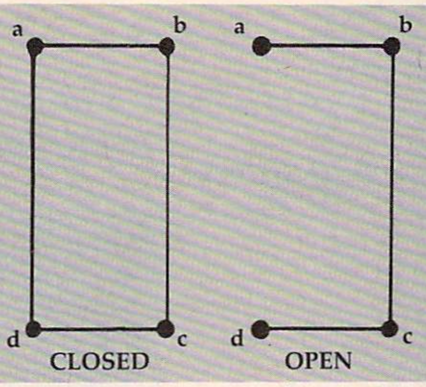


Figure 3

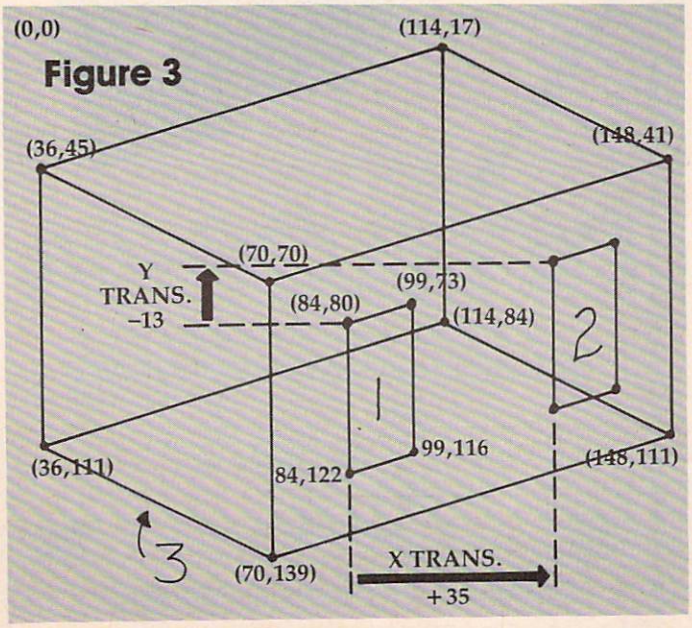


Figure 4a

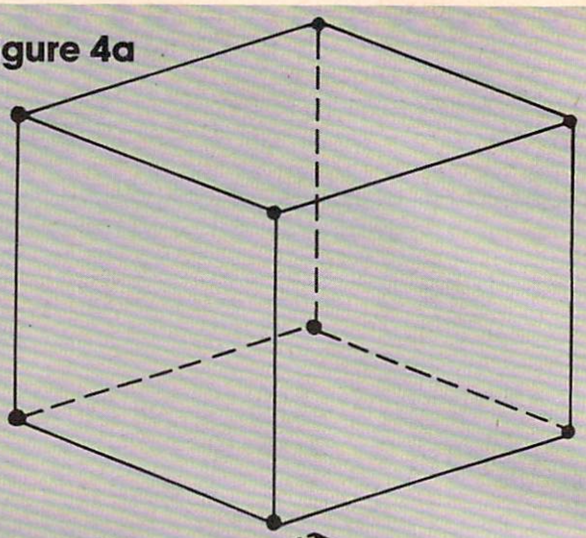


Figure 4b

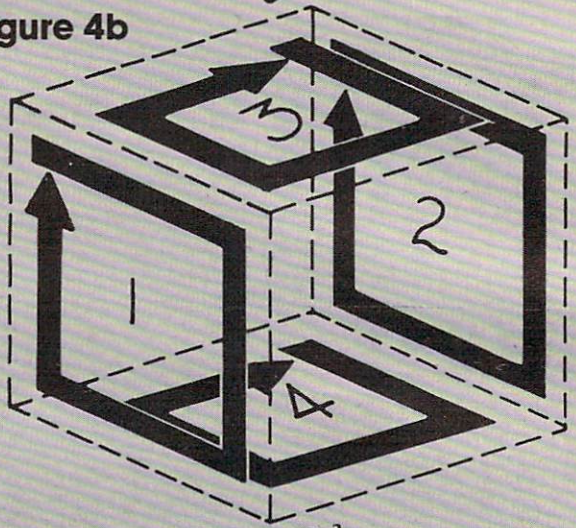
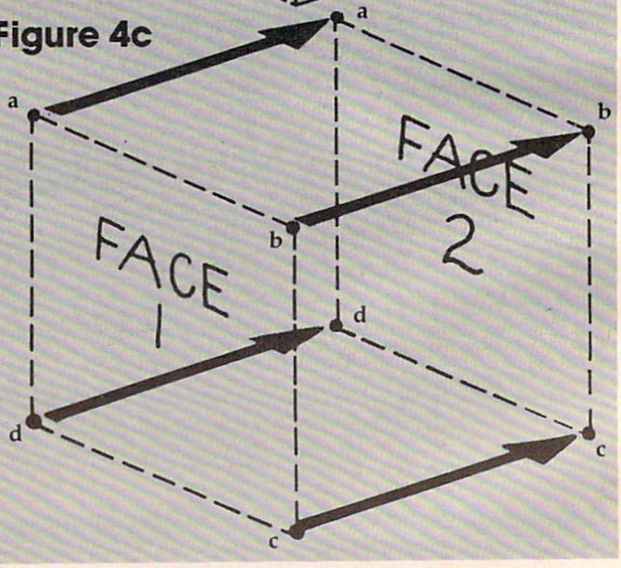


Figure 4c



Translation

An extra utility in Drawing Master is the ability to move the entire object around the screen. Translation works like Copy. It prompts you for the X and Y translation numbers. It can be used for centering the object or for other purposes. It physically alters the data base. If you don't wish to keep

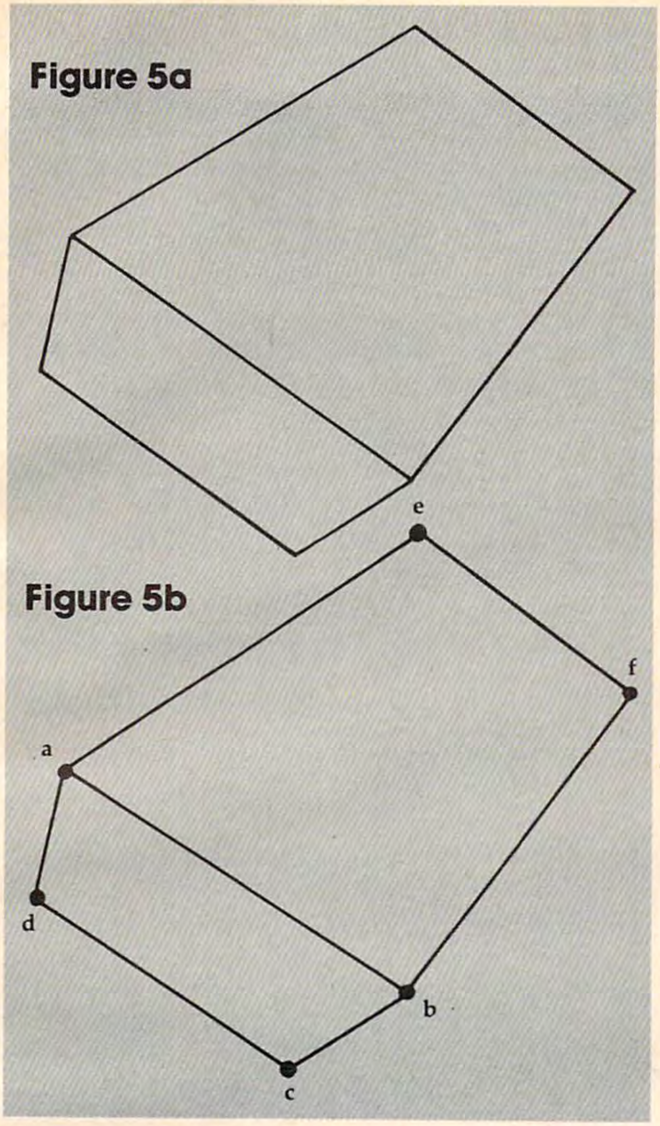


Figure 5a

Figure 5b

the translation after VIEWing it, don't SAVE it.

The program makes it possible to VIEW an object positioned half on and half off the screen. Drawing Master has a safety device that does not allow POKEing locations outside the screen area. The plotter will continue to compute those points, but they will not be POKEd.

Viewing Tips

You may have noticed that after you pressed V, there was a pause and perhaps you saw some random graphics as the screen locations were being cleared out. This is normal. Even when there is no garbage displayed, the "clearing" process is going on. Be patient, and soon your image will begin to form. When you pressed M to return to the menu, the image was "cleared" in the same way.

As your image appears, you will notice that vertical lines are wider than horizontal ones. This has to do with the way the screen plot works. A character space is normally eight bits wide and eight bits high. In order to increase the size of the plotting area without heavy demands on memory size, the character cell size has changed to 8 bits wide by 16 bits high. For a further explanation, see Paul Schatz's article.

You may be puzzled by the way Drawing Master draws diagonal lines. Rather than drawing a straight line, it draws a very small staircase between two points. This is a product of the VIC's resolution. Any raster scan system, no matter how sharp the resolution, will give the same effect to some extent. The stairsteps are less noticeable if you draw as large as possible. Try to use the whole screen.

Hidden Lines In 3-D

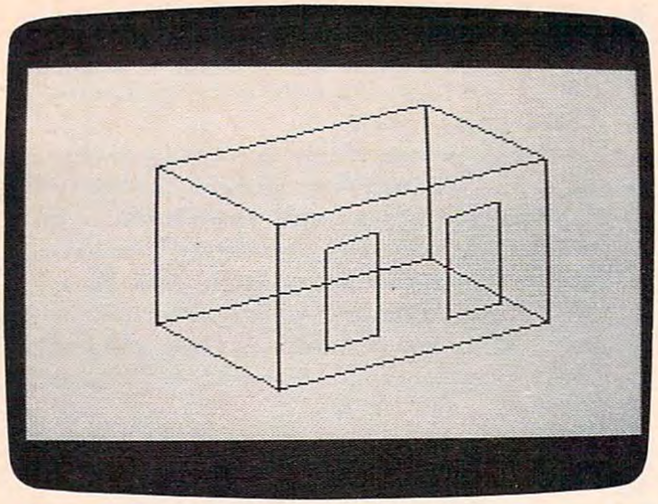
3-D mode normally draws a representation of the object as if it were transparent; you can see all edges at once. This is sometimes confusing. Drawing Master has no algorithms for removing hidden lines automatically, but under certain conditions you can fool the 3-D mode into drawing as if it did. Figure 5a shows a hidden line drawing for a rectangular solid in perspective. Only the visible edges are showing. You could draw it in 2-D as two parts (two rectangular shapes). Or we can make 3-D draw it as one part. Here's the secret. Nothing prohibits you from using the same point *twice*.

The first face is entered as usual: starting with point a, then b, c, and d. The second face is entered differently: point e, f, b, and a. If you follow the way the VIC plots, you'll see that it traces the same line more than once. But the result is the image you want (Figure 5b).

A Plotting Table

In order to define your object accurately in terms of its points, you will need to make a plotting table. All you need is a pencil, a ruler, and a piece of paper approximately 12 by 20 inches. Across the page from left to right, draw 18 vertical lines one inch apart. From top to bottom, draw 17 horizontal lines ¾ inch apart. Label the vertical lines from 0 to 170 by tens (0, 10, 20...) and the horizontal lines from 0 to 160, also by tens. Be as accurate as possible. Now divide every square into ten equal sections (with nine lines) horizontally and vertically. You will note that the vertical lines stop at 170. You must add six small sections out beyond the last line to 175: the maximum right position (X coordinate) on the screen.

You now have a plotting table for use with Drawing Master. The object or scene you want to reproduce on the screen should be drawn or traced onto tissue paper and laid over the plotting table. Then note on the drawing the X and Y coordinate for each important point. In standard notation, the X coordinate is given first, followed by the Y, with a comma separating them (ax,ay).



This VIC-20 display results after following the steps to create a three-dimensional box with two windows in one face using "3-D Drawing Master."

Program 1: Drawing Master, VIC Version

```
15 DIM A(2Ø,2,26)
2Ø Q$=""
49 REM MENU
5Ø PRINT"{CLR}"
51 PRINTSPC(4)"DRAWING MASTER":PRINT:PRIN
   T:PRINT
52 PRINTSPC(3)"D-DEFINE OBJECT":PRINT
53 PRINTSPC(3)"R-READ OBJECT":PRINT
54 PRINTSPC(3)"S-SAVE OBJECT":PRINT
55 PRINTSPC(3)"V-VIEW OBJECT":PRINT
57 PRINTSPC(3)"T-TRANSLATE OBJECT":PRINT
58 PRINTSPC(3)"M-MAIN MENU":PRINT
59 PRINTSPC(3)"E-END SESSION"
6Ø GOSUB 37ØØ
65 ON-(Q$="D")-2*(Q$="R")-3*(Q$="S")-4*(Q
   $="V")-5*(Q$="T")GOTO1ØØ,16ØØ,18ØØ,3ØØ
   ,1399
68 IF Q$="E"THEN38ØØ
7Ø GOTO5Ø
99 REM DEFINE
1ØØ PRINT"{CLR}"
1Ø1 REM 2D MODE
1Ø2 PRINT"MAXIMUMS:":PRINT"2Ø PARTS":PRIN
    T"12 PTS PER PART/FACE":PRINT
1Ø3 INPUT"# OF 2D PARTS";P1
1Ø4 PA=P1+2:Q$="":A(Ø,Ø,Ø)=P1
1Ø6 IF P1=ØTHEN2ØØ
1Ø7 FOR PT=2TOP1+1
1Ø8 PRINT:PRINT"PART";PT-1
1Ø9 IF PT=2 THEN 12Ø
11Ø PRINT"COPY LAST PART?(Y/N)":GOSUB 37Ø
    Ø
111 IF Q$="N"THEN12Ø
115 GOSUB1ØØØ
117 GOTO14Ø
12Ø INPUT"# OF POINTS";PO
125 PRINT"CLOSED?(Y/N)":GOSUB37ØØ
127 IF Q$="Y" THEN A(PT,Ø,1)=1:GOTO 129
128 A(PT,Ø,1)=2
129 A(PT,Ø,Ø)=PO
13Ø TA=2
135 FORT=2TOPO+1:INPUT"X,Y";A(PT,Ø,TA),A(
    PT,Ø,TA+1):TA=TA+2:NEXT
14Ø NEXT PT
199 REM 3D MODE
2ØØ INPUT"# OF 3D PARTS";P2
2Ø2 IF P2=Ø THEN A(1,Ø,Ø)=Ø:GOTO49
2Ø4 Q$="":A(1,Ø,Ø)=P2
2Ø5 FOR PT=PATO P2+PA-1
2Ø6 PRINT:PRINT"PART";PT-1
2Ø7 IF PT=PA THEN 212
2Ø8 PRINT "COPY LAST PART?(Y/N)":GOSUB37Ø
    Ø
2Ø9 IF Q$="N" THEN212
21Ø GOSUB1ØØØ
211 GOTO 229
212 PRINT"# OF POINTS?"
213 INPUT"ON EACH FACE";PO
214 A(PT,Ø,Ø)=PO
216 PRINT"CLOSED?(Y/N)":GOSUB37ØØ
217 IF Q$="Y" THEN A(PT,Ø,1)=1:GOTO22Ø
218 A(PT,Ø,1)=2
22Ø TA=2
222 FOR TT=1 TO 2
223 PRINT "FACE";TT
225 FOR T=2 TO PO+1:INPUT "X,Y";A(PT,TT,T
    A),A(PT,TT,TA+1):TA=TA+2:NEXT
226 TA=2
227 NEXT TT
229 NEXT PT
298 GOTO 5Ø
299 REM VIEW MOVE RAM
3ØØ POKE36866,15Ø:POKE36869,24Ø:POKE648,3
    Ø
31Ø FORJ=217TO228:POKEJ,158:NEXT:FORJ=229
    TO25Ø:POKEJ,159:NEXT
32Ø POKE36865,3Ø:POKE36867,21:POKE36869,2
    52:POKE36879,3Ø
33Ø FORI=ØTO219:POKE768Ø+I,I:NEXT
333 CO=Ø
335 FOR I=Ø TO 219:POKE384ØØ+I,CO:NEXT
34Ø FORI=4Ø96TO7615:POKEI,Ø:NEXT
349 REM 2D READ
35Ø P1=A(Ø,Ø,Ø):PA=P1+2
351 IFP1=ØTHEN449
352 FOR PT=2 TO P1+1
353 PO=A(PT,Ø,Ø)
354 TA=2
355 FOR T=2 TO PO+1
36Ø X1=A(PT,Ø,TA):Y1=A(PT,Ø,TA+1)
399 REM VIEW 1ST COMPARE
4Ø5 IFT=PO+1ANDA(PT,Ø,1)=1 THENX2=A(PT,Ø,
    2):Y2=A(PT,Ø,3):GOSUB5ØØ
41Ø IF T=PO+1 THEN445
42Ø X2=A(PT,Ø,TA+2):Y2=A(PT,Ø,TA+3)
43Ø GOSUB5ØØ
435 TA=TA+2
44Ø NEXT T
445 NEXT PT
449 REM 3D READ
45Ø P2=A(1,Ø,Ø)
451 IFP2=ØTHEN8ØØ
452 FOR PT=PA TO P2+PA-1
454 PO=A(PT,Ø,Ø)
458 FOR TT=1 TO 2
459 TA=2
46Ø FOR T=2 TO PO+1
462 X1=A(PT,TT,TA):Y1=A(PT,TT,TA+1)
464 IF T=PO+1 AND A(PT,Ø,1)=1 THEN X2=A(P
    T,TT,2):Y2=A(PT,TT,3):GOSUB 5ØØ
466 IF T=PO+1 THEN 476
468 X2=A(PT,TT,TA+2):Y2=A(PT,TT,TA+3)
47Ø GOSUB5ØØ
472 TA=TA+2
474 NEXT T
476 NEXT TT
478 TA=2
48Ø FOR FA=1 TO PO
482 X1=A(PT,1,TA):Y1=A(PT,1,TA+1)
484 X2=A(PT,2,TA):Y2=A(PT,2,TA+1)
```

```
486 GOSUB500
488 TA=TA+2
490 NEXT FA
492 NEXT PT
498 GOTO800
499 REM VIEW 2ND COMPARE
500 X=0:Y=0:SI=1
510 IFX1>X2ANDY1>Y2THENSI=-1
520 IF(X2-X1)<(Y2-Y1)ANDY1<Y2 THEN525
522 GOTO530
525 IF(Y2-Y1)>(X1-X2)THEN640
527 SI=-1:GOTO540
530 IF(X2-X1)<(Y1-Y2)ANDY1>Y2THEN620
540 IFY1=Y2 AND X1=X2THENRETURN
550 IFY1=Y2THEN3500
599 REM VIEW PLOT LOOPS
600 FORYY=Y1TOY2 STEPSI*((Y2-Y1)/(X2-X1))
    :Y=INT(YY):X=X1:GOSUB3000:GOSUB3200:N
    EXTYY
610 GOTO660
620 IF(Y1-Y2)>(X1-X2)THENSI=-1:GOTO640
630 GOTO540
640 IF X1=X2THEN3600
650 FORXX=X1TOX2STEPSI*((X2-X1)/(Y2-Y1)):
    X=INT(XX): Y=Y1:GOSUB3000:GOSUB3300:N
    EXTXX
660 RETURN
799 REM VIEW GO MENU
800 A$=""
810 GETA$:IFA$=""THEN810
820 IF A$<>CHR$(77)THEN810
830 FORI=4096TO7615:POKEI,0:NEXT
840 POKE36865,25:POKE36867,46:POKE36869,2
    40:POKE36879,27
850 PRINTCHR$(147)
860 GOTO 50
898 END
999 REM COPY PART
1000 PRINT"{CLR}":PRINT"PART";PT-1;"/TRAN
     SLATION:"
1005 PRINT"RIGHT=+X LEFT=-X"
1010 PRINT"DOWN=+Y UP=-Y":PRINT
1015 INPUT"X TRANS.";TX
1020 INPUT"Y TRANS.";TY
1025 PRINT"IS PART 3D?(Y/N)":GOSUB3700
1030 IF Q$="Y" THEN 1100
1035 A(PT,0,0)=A(PT-1,0,0):A(PT,0,1)=A(PT
     -1,0,1)
1040 TA=2
1045 FOR T=2 TO A(PT,0,0)+1
1050 A(PT,0,TA)=A(PT-1,0,TA)+TX
1055 A(PT,0,TA+1)=A(PT-1,0,TA+1)+TY
1060 TA=TA+2
1065 NEXT T
1068 PRINT"{CLR}"
1070 RETURN
1100 A(PT,0,0)=A(PT-1,0,0):A(PT,0,1)=A(PT
     -1,0,1)
1105 FOR TT=1 TO 2
1110 TA=2
1115 FOR T=2 TO A(PT,0,0)+1
1120 A(PT,TT,TA)=A(PT-1,TT,TA)+TX
1125 A(PT,TT,TA+1)=A(PT-1,TT,TA+1)+TY
1130 TA=TA+2
1135 NEXT T
1140 NEXT TT
1142 PRINT"{CLR}"
1145 RETURN
1399 REM TRANS
1400 PRINT"{CLR}":PRINT"TRANSLATION:"
1405 PRINT"RIGHT=+X LEFT=-X"
1410 PRINT"DOWN=+Y UP=-Y":PRINT
1415 INPUT"X TRANS.";TX
1420 INPUT"Y TRANS.";TY
1430 P1=A(0,0,0):PA=P1+2
1435 FOR PT=2 TO P1+1
1440 PO=A(PT,0,0)
1445 TA=2
1450 FOR T=2 TO PO+1
1455 A(PT,0,TA)=A(PT,0,TA)+TX
1460 A(PT,0,TA+1)=A(PT,0,TA+1)+TY
1465 TA=TA+2
1470 NEXT T
1475 NEXT PT
1480 P2=A(1,0,0)
1485 FOR PT=PA TO P2+PA-1
1490 PO=A(PT,0,0)
1495 FOR TT=1 TO 2
1500 TA=2
1505 FOR T=2 TO PO+1
1510 A(PT,TT,TA)=A(PT,TT,TA)+TX
1515 A(PT,TT,TA+1)=A(PT,TT,TA+1)+TY
1520 TA=TA+2
1525 NEXT T
1530 NEXT TT
1535 NEXT PT
1540 GOTO 50
1599 REM READ
1600 PRINT"{CLR}":PRINT"TAPE OR DISK":INP
     UT OU$
1601 INPUT"NAME OF PICTURE FILE";F$
1602 IFLEFT$(OU$,1)="T"THENOU=1:GOTO1605
1603 OU=8
1605 OPEN1,OU,0,F$
1610 INPUT#1,A(0,0,0),A(1,0,0)
1615 FOR PT=2 TO A(0,0,0)+1
1620 TA=2
1625 INPUT#1,A(PT,0,0),A(PT,0,1)
1630 FOR T=1 TO A(PT,0,0)+1
1635 INPUT#1,A(PT,0,TA),A(PT,0,TA+1)
1640 TA=TA+2
1645 NEXT T
1650 NEXT PT
1655 FOR PT=A(0,0,0)+2 TO A(1,0,0)+A(0,0,
     0)+1
1657 INPUT#1,A(PT,0,0),A(PT,0,1)
1660 FOR TT=1 TO 2
1665 TA=2
1675 FOR T=2 TO A(PT,0,0)+1
1680 INPUT#1,A(PT,TT,TA),A(PT,TT,TA+1)
1685 TA=TA+2
1690 NEXT T
1700 NEXT TT
1710 NEXT PT
1715 CLOSE 1
1720 GOTO 50
1799 REM FILE
1800 PRINT"{CLR}":PRINT"TAPE OR DISK":INP
     UT IN$
1801 INPUT"NAME OF PICTURE FILE";F$
1803 IFLEFT$(IN$,1)="T"THENIN=1GOTO1805
1804 IN=8
1805 OPEN1,IN,1,F$
1810 R$=CHR$(13)
1815 PRINT#1,A(0,0,0);R$;A(1,0,0)
1820 FOR PT=2 TO A(0,0,0)+1
1825 TA=0
1830 FOR T=0 TO A(PT,0,0)+1
1835 PRINT#1,A(PT,0,TA);R$;A(PT,0,TA+1)
1840 TA=TA+2
1845 NEXT T
1850 NEXT PT
1855 FOR PT=A(0,0,0)+2 TO A(1,0,0)+A(0,0,
     0)+1
1857 PRINT#1,A(PT,0,0);R$;A(PT,0,1)
1860 FOR TT=1 TO 2
1865 TA=2
1870 FOR T=2 TO A(PT,0,0)+1
```

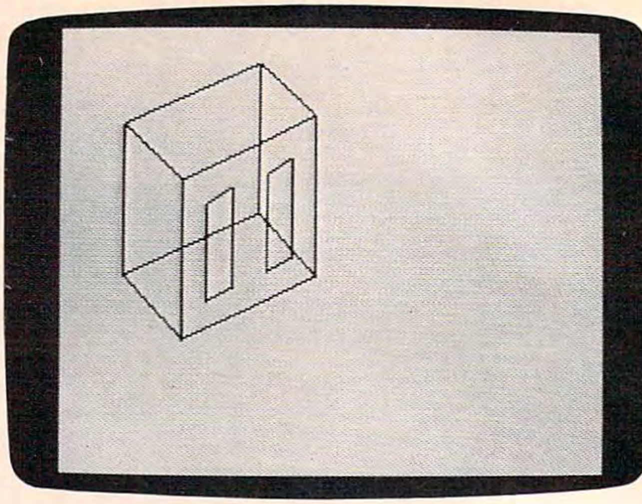
```
1880 PRINT#1,A(PT,TT,TA);R$;A(PT,TT,TA+1)
1885 TA=TA+2
189Ø NEXT T
1895 NEXT TT
19ØØ NEXT PT
191Ø CLOSE 1
1915 GOTO 5Ø
2999 REM PLOT SUB
3ØØØ IF X>176 OR X<Ø THEN RETURN
3Ø1Ø IF Y>16Ø OR Y<Ø THEN RETURN
3Ø2Ø CH=INT(Y/16)*22+INT(X/8)
3Ø3Ø RO=(Y/16-INT(Y/16))*16:BY=4Ø96+16*CH
     +RO
3Ø4Ø BI=7-(X-INT(X/8)*8):POKEBY,PEEK(BY)O
     R (2↑BI):RETURN
3199 REM Y LOOP SUB
32ØØ IFX1<X2THENX1=X1+1:RETURN
321Ø X1=X1-1:RETURN
3299 REM X LOOP SUB
33ØØ IF Y1<Y2THENY1=Y1+1:RETURN
331Ø Y1=Y1-1:RETURN
3499 REM Y1=Y2
35ØØ IFX1>X2THENSI=-1
351Ø FORXX=X1TOX2STEPSI*1:X=INT(XX):Y=Y1:
     GOSUB3ØØØ:NEXTXX
352Ø RETURN
3599 REM X1=X2
36ØØ IFY1>Y2THENSI=-1
361Ø FORYY=Y1TOY2STEPSI*1:Y=INT(YY):X=X1:
     GOSUB3ØØØ:NEXTYY
362Ø RETURN
3699 REM Q$
37ØØ Q$=""
37Ø2 GET Q$:IF Q$=""THEN 37Ø2
371Ø RETURN
3799 REM END SESSION
38ØØ PRINT"{CLR}":END
```

Program 2: Drawing Master, 64 Loader

```
1ØØ POKE16384,Ø:POKE16385,Ø
145 POKE641,Ø:POKE642,64
15Ø POKE43,1:POKE44,64:POKE55,Ø:POKE56,12
    8:POKE646,1:PRINT"{CLR}"
```

Program 3: Drawing Master, 64 Main Program

```
1Ø2Ø DIM A(2Ø,2,26)
1Ø3Ø Q$=""
1Ø4Ø REM MENU
1Ø5Ø PRINT"{CLR}"
1Ø6Ø PRINTSPC(12)"DRAWING MASTER":PRINT:P
     RINT
1Ø7Ø PRINTSPC(12)"D-DEFINE OBJECT":PRINT
1Ø8Ø PRINTSPC(12)"R-READ OBJECT":PRINT
1Ø9Ø PRINTSPC(12)"S-SAVE OBJECT":PRINT
11ØØ PRINTSPC(12)"V-VIEW OBJECT":PRINT
111Ø PRINTSPC(12)"T-TRANSLATE OBJECT":PRI
     NT
112Ø PRINTSPC(12)"M-MAIN MENU":PRINT
113Ø PRINTSPC(12)"E-END SESSION"
114Ø GOSUB 37ØØ
115Ø GP=-(Q$="D")-2*(Q$="R")-3*(Q$="S")-4
     *(Q$="V")-5*(Q$="T")
1155 ONGPGOTO119Ø,3ØØØ,325Ø,167Ø,27ØØ
116Ø IF Q$="E"THEN374Ø
117Ø GOTO1Ø5Ø
118Ø REM DEFINE
119Ø PRINT"{CLR}"
12ØØ REM 2D MODE
121Ø PRINT"MAXIMUMS:":PRINT"2Ø PARTS":PRI
     NT"12 PTS PER PART/FACE":PRINT
122Ø INPUT"# OF 2D PARTS";P1
```

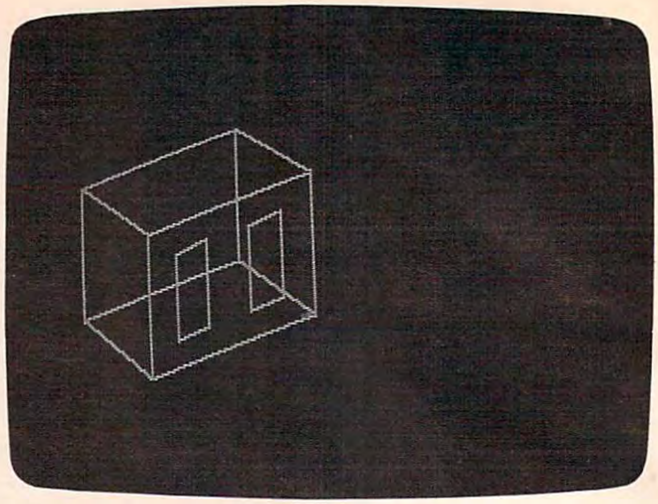


"3-D Drawing Master," 64 version.

```
123Ø PA=P1+2:Q$="":A(Ø,Ø,Ø)=P1
124Ø IF P1=ØTHEN141Ø
125Ø FOR PT=2TOP1+1
126Ø PRINT:PRINT"PART";PT-1
127Ø IF PT=2 THEN 132Ø
128Ø PRINT"COPY LAST PART?(Y/N)":GOSUB 37
     ØØ
129Ø IF Q$="N"THEN132Ø
13ØØ GOSUB243Ø
131Ø GOTO139Ø
132Ø INPUT"# OF POINTS";PO
133Ø PRINT"CLOSED?(Y/N)":GOSUB37ØØ
134Ø IF Q$="Y" THEN A(PT,Ø,1)=1:GOTO 136Ø
135Ø A(PT,Ø,1)=2
136Ø A(PT,Ø,Ø)=PO
137Ø TA=2
138Ø FORT=2TOPO+1:INPUT"X,Y";A(PT,Ø,TA),A
     (PT,Ø,TA+1):TA=TA+2:NEXT
139Ø NEXT PT
14ØØ REM 3D MODE
141Ø INPUT"# OF 3D PARTS";P2
142Ø IF P2=Ø THEN A(1,Ø,Ø)=Ø:GOTO1Ø4Ø
143Ø Q$="":A(1,Ø,Ø)=P2
144Ø FOR PT=PATO P2+PA-1
145Ø PRINT:PRINT"PART";PT-1
146Ø IF PT=PA THEN 151Ø
147Ø PRINT "COPY LAST PART?(Y/N)":GOSUB37
     ØØ
148Ø IF Q$="N" THEN151Ø
149Ø GOSUB243Ø
15ØØ GOTO 163Ø
151Ø PRINT"# OF POINTS?"
152Ø INPUT"ON EACH FACE";PO
153Ø A(PT,Ø,Ø)=PO
154Ø PRINT"CLOSED?(Y/N)":GOSUB37ØØ
155Ø IF Q$="Y" THEN A(PT,Ø,1)=1:GOTO157Ø
156Ø A(PT,Ø,1)=2
157Ø TA=2
158Ø FOR TT=1 TO 2
159Ø PRINT "FACE";TT
16ØØ FOR T=2 TO PO+1:INPUT "X,Y";A(PT,TT,
     TA),A(PT,TT,TA+1):TA=TA+2:NEXT
161Ø TA=2
162Ø NEXT TT
163Ø NEXT PT
164Ø GOTO 1Ø5Ø
165Ø REM VIEW MOVE RAM
167Ø POKE53272,(PEEK(53272)OR8):POKE53265
     ,PEEK(53265)OR32
17ØØ FORI=ØTO999:POKE1Ø24+I,1:NEXT
171Ø CO=Ø
```

```
1730 FORI=8192TO8192+7999:POKEI,Ø:NEXT
1740 REM 2D READ
1750 P1=A(Ø,Ø,Ø):PA=P1+2
1760 IFP1=ØTHEN19ØØ
1770 FOR PT=2 TO P1+1
1780 PO=A(PT,Ø,Ø)
1790 TA=2
1800 FOR T=2 TO PO+1
1810 X1=A(PT,Ø,TA):Y1=A(PT,Ø,TA+1)
1820 REM VIEW 1ST COMPARE
1830 IFT=PO+1ANDA(PT,Ø,1)=1 THENX2=A(PT,Ø
     ,2):Y2=A(PT,Ø,3):GOSUB216Ø
1840 IF T=PO+1 THEN189Ø
1850 X2=A(PT,Ø,TA+2):Y2=A(PT,Ø,TA+3)
1860 GOSUB216Ø
1870 TA=TA+2
1880 NEXT T
1890 NEXT PT
1900 REM 3D READ
1910 P2=A(1,Ø,Ø)
1920 IFP2=ØTHEN234Ø
1930 FOR PT=PA TO P2+PA-1
1940 PO=A(PT,Ø,Ø)
1950 FOR TT=1 TO 2
1960 TA=2
1970 FOR T=2 TO PO+1
1980 X1=A(PT,TT,TA):Y1=A(PT,TT,TA+1)
1990 IF T=PO+1 AND A(PT,Ø,1)=1 THEN X2=A(
     PT,TT,2):Y2=A(PT,TT,3):GOSUB 216Ø
2000 IF T=PO+1 THEN 205Ø
2010 X2=A(PT,TT,TA+2):Y2=A(PT,TT,TA+3)
2020 GOSUB216Ø
2030 TA=TA+2
2040 NEXT T
2050 NEXT TT
2060 TA=2
2070 FOR FA=1 TO PO
2080 X1=A(PT,1,TA):Y1=A(PT,1,TA+1)
2090 X2=A(PT,2,TA):Y2=A(PT,2,TA+1)
2100 GOSUB216Ø
2110 TA=TA+2
2120 NEXT FA
2130 NEXT PT
2140 GOTO234Ø
2150 REM VIEW 2ND COMPARE
2160 X=Ø:Y=Ø:SI=1
2170 IFX1>X2ANDY1>Y2THENSI=-1
2180 IF(X2-X1)<(Y2-Y1)ANDY1<Y2 THEN22ØØ
2190 GOTO222Ø
2200 IF(Y2-Y1)>(X1-X2)THEN23ØØ
2210 SI=-1:GOTO223Ø
2220 IF(X2-X1)<(Y1-Y2)ANDY1>Y2THEN228Ø
2230 IFY1=Y2 AND X1=X2THENRETURN
2240 IFY1=Y2THEN362Ø
2250 REM VIEW PLOT LOOPS
2260 FORYY=Y1TOY2 STEPSI*((Y2-Y1)/(X2-X1)
     ):Y=INT(YY):X=X1
2265 GOSUB35ØØ:GOSUB356Ø:NEXTYY
2270 GOTO232Ø
2280 IF(Y1-Y2)>(X1-X2)THENSI=-1:GOTO23ØØ
2290 GOTO223Ø
2300 IF X1=X2THEN366Ø
2310 FORXX=X1TOX2STEPSI*((X2-X1)/(Y2-Y1))
     :X=INT(XX): Y=Y1
2315 GOSUB35ØØ:GOSUB359Ø:NEXTXX
2320 RETURN
2330 REM VIEW GO MENU
2340 A$=""
2350 GETA$:IFA$=""THEN235Ø
2360 IF A$<>CHR$(77)THEN235Ø
2370 FORI=8192TO8192+7999:POKEI,Ø:NEXT
2380 POKE53272,21:POKE53265,27
2390 PRINTCHR$(147)
2400 GOTO 1Ø5Ø
2410 END
2420 REM COPY PART
2430 PRINT"{CLR}":PRINT"PART";PT-1;"/TRAN
     SLATION:"
2440 PRINT"RIGHT=+X LEFT=-X"
2450 PRINT"DOWN=+Y UP=-Y":PRINT
2460 INPUT"X TRANS.";TX
2470 INPUT"Y TRANS.";TY
2480 PRINT"IS PART 3D?(Y/N)":GOSUB37ØØ
2490 IF Q$="Y" THEN 259Ø
2500 A(PT,Ø,Ø)=A(PT-1,Ø,Ø):A(PT,Ø,1)=A(PT
     -1,Ø,1)
2510 TA=2
2520 FOR T=2 TO A(PT,Ø,Ø)+1
2530 A(PT,Ø,TA)=A(PT-1,Ø,TA)+TX
2540 A(PT,Ø,TA+1)=A(PT-1,Ø,TA+1)+TY
2550 TA=TA+2
2560 NEXT T
2570 PRINT"{CLR}"
2580 RETURN
2590 A(PT,Ø,Ø)=A(PT-1,Ø,Ø):A(PT,Ø,1)=A(PT
     -1,Ø,1)
2600 FOR TT=1 TO 2
2610 TA=2
2620 FOR T=2 TO A(PT,Ø,Ø)+1
2630 A(PT,TT,TA)=A(PT-1,TT,TA)+TX
2640 A(PT,TT,TA+1)=A(PT-1,TT,TA+1)+TY
2650 TA=TA+2
2660 NEXT T
2670 NEXT TT
2680 PRINT"{CLR}"
2690 RETURN
2700 REM TRANS
2710 PRINT"{CLR}":PRINT"TRANSLATION:"
2720 PRINT"RIGHT=+X LEFT=-X"
2730 PRINT"DOWN=+Y UP=-Y":PRINT
2740 INPUT"X TRANS.";TX
2750 INPUT"Y TRANS.";TY
2760 P1=A(Ø,Ø,Ø):PA=P1+2
2770 FOR PT=2 TO P1+1
2780 PO=A(PT,Ø,Ø)
2790 TA=2
2800 FOR T=2 TO PO+1
2810 A(PT,Ø,TA)=A(PT,Ø,TA)+TX
2820 A(PT,Ø,TA+1)=A(PT,Ø,TA+1)+TY
2830 TA=TA+2
2840 NEXT T
2850 NEXT PT
2860 P2=A(1,Ø,Ø)
2870 FOR PT=PA TO P2+PA-1
2880 PO=A(PT,Ø,Ø)
2890 FOR TT=1 TO 2
2900 TA=2
2910 FOR T=2 TO PO+1
2920 A(PT,TT,TA)=A(PT,TT,TA)+TX
2930 A(PT,TT,TA+1)=A(PT,TT,TA+1)+TY
2940 TA=TA+2
2950 NEXT T
2960 NEXT TT
2970 NEXT PT
2980 GOTO 1Ø5Ø
2990 REM READ
3000 INPUT"{CLR}NAME OF PICTURE FILE";F$
3001 PRINT"{CLR}TAPE OR DISK":INPUTOU$
3003 IFOU$<>"T"ANDOU$<>"D"THEN3ØØ1
3005 IF OU$="T"THENOU=1:GOTO3Ø2Ø
3008 OU = 8
3020 OPEN1,OU,Ø,F$
3030 INPUT#1,A(Ø,Ø,Ø),A(1,Ø,Ø)
3040 FOR PT=2 TO A(Ø,Ø,Ø)+1
3050 TA=2
3060 INPUT#1,A(PT,Ø,Ø),A(PT,Ø,1)
3070 FOR T=1 TO A(PT,Ø,Ø)+1
3080 INPUT#1,A(PT,Ø,TA),A(PT,Ø,TA+1)
```

```
3090 TA=TA+2
3100 NEXT T
3110 NEXT PT
3120 FOR PT=A(0,0,0)+2 TO A(1,0,0)+A(0,0,
     0)+1
3130 INPUT#1,A(PT,0,0),A(PT,0,1)
3140 FOR TT=1 TO 2
3150 TA=2
3160 FOR T=2 TO A(PT,0,0)+1
3170 INPUT#1,A(PT,TT,TA),A(PT,TT,TA+1)
3180 TA=TA+2
3190 NEXT T
3200 NEXT TT
3210 NEXT PT
3220 CLOSE 1
3230 GOTO 1050
3240 REM FILE
3250 PRINT"{CLR}"
3260 INPUT"{CLR}NAME OF PICTURE FILE";F$
3261 PRINT"{CLR}TAPE OR DISK":INPUTIN$
3263 IFIN$<>"T"ANDIN$<>"D"THEN3261
3265 IF IN$="T"THENIN=1:GOTO3270
3268 IN = 8
3270 OPEN1,IN,1,F$
3280 R$=CHR$(13)
3290 PRINT#1,A(0,0,0);R$;A(1,0,0)
3300 FOR PT=2 TO A(0,0,0)+1
3310 TA=0
3320 FOR T=0 TO A(PT,0,0)+1
3330 PRINT#1,A(PT,0,TA);R$;A(PT,0,TA+1)
3340 TA=TA+2
3350 NEXT T
3360 NEXT PT
3370 FOR PT=A(0,0,0)+2 TO A(1,0,0)+A(0,0,
     0)+1
3380 PRINT#1,A(PT,0,0);R$;A(PT,0,1)
3390 FOR TT=1 TO 2
3400 TA=2
3410 FOR T=2 TO A(PT,0,0)+1
3420 PRINT#1,A(PT,TT,TA);R$;A(PT,TT,TA+1)
3430 TA=TA+2
3440 NEXT T
3450 NEXT TT
3460 NEXT PT
3470 CLOSE 1
3480 GOTO 1050
3490 REM PLOT SUB
3500 IF X>320 OR X<0 THEN RETURN
3510 IF Y>199 OR Y<0 THEN RETURN
3520 CH=INT(X/8):LN =YAND7
3530 RO=INT(Y/8):BY=8192+RO*320+8*CH+LN
3540 BI=7-(XAND7):POKEBY,PEEK(BY)OR(2↑BI)
     :RETURN
3550 REM Y LOOP SUB
3560 IFX1<X2THENX1=X1+1:RETURN
3570 X1=X1-1:RETURN
3580 REM X LOOP SUB
3590 IF Y1<Y2THENY1=Y1+1:RETURN
3600 Y1=Y1-1:RETURN
3610 REM Y1=Y2
3620 IFX1>X2THENSI=-1
3630 FORXX=X1TOX2STEPSI*1:X=INT(XX):Y=Y1:
     GOSUB3500:NEXTXX
3640 RETURN
3650 REM X1=X2
3660 IFY1>Y2THENSI=-1
3670 FORYY=Y1TOY2STEPSI*1:Y=INT(YY):X=X1:
     GOSUB3500:NEXTYY
3680 RETURN
3690 REM Q$
3700 Q$=""
3710 GET Q$:IF Q$=""THEN 3710
3720 RETURN
3730 REM END SESSION
3740 PRINT"{CLR}":END
```

The Apple version of "3-D Drawing Master" produces its image in reverse.

Program 4:
Drawing Master, Apple Version

```
1020  DIM A(20,2,26)
1030 Q$ = ""
1040  REM  MENU
1050  HOME
1060  PRINT  SPC( 13)"DRAWING MASTER": PRINT
     : PRINT : PRINT
1070  PRINT  SPC( 12)"D-DEFINE OBJECT":
     PRINT
1080  PRINT  SPC( 12)"R-READ OBJECT": PRINT
1090  PRINT  SPC( 12)"S-SAVE OBJECT": PRINT
1100  PRINT  SPC( 12)"V-VIEW OBJECT": PRINT
1110  PRINT  SPC( 12)"T-TRANSLATE OBJEC
    T": PRINT
1120  PRINT  SPC( 12)"M-MAIN MENU": PRINT
1130  PRINT  SPC( 12)"E-END SESSION"
1140  GOSUB 3700
1150 GP = (Q$ = "D") + 2 * (Q$ = "R") +
     3 * (Q$ = "S") + 4 * (Q$ = "V") +
     5 * (Q$ = "T")
1155  ON GP GOTO 1190,3000,3250,1670,27
     00
1160  IF Q$ = "E" THEN 3740
1170  GOTO 1050
1180  REM  DEFINE
1190  HOME
1200  REM  2D MODE
1210  PRINT "MAXIMUMS:": PRINT "20 PART
    S": PRINT "12 PTS PER PART/FACE": PRINT
1220  INPUT "# OF 2D PARTS ? ";P1
1230 PA = P1 + 2:Q$ = "":A(0,0,0) = P1
1240  IF P1 = 0 THEN 1410
1250  FOR PT = 2 TO P1 + 1
1260  PRINT : PRINT "PART ";PT - 1
1270  IF PT = 2 THEN 1320
1280  PRINT "COPY LAST PART? (Y/N) ": GOSUB
    3700
1290  IF Q$ = "N" THEN 1320
1300  GOSUB 2430
1310  GOTO 1390
1320  INPUT "# OF POINTS ? ";PO
1330  PRINT "CLOSED ? (Y/N)": GOSUB 3700
1340  IF Q$ = "Y" THEN A(PT,0,1) = 1: GOTO
     1360
1350 A(PT,0,1) = 2
1360 A(PT,0,0) = PO
1370 TA = 2
1380  FOR T = 2 TO PO + 1: INPUT "X,Y ?
     ";A(PT,0,TA),A(PT,0,TA + 1):TA =
     TA + 2: NEXT
```

```
1390  NEXT PT
1400  REM  3D MODE
1410  INPUT "# OF 3D PARTS ? ";P2
1420  IF P2 = Ø THEN A(1,Ø,Ø) = Ø: GOTO
     1040
1430 Q$ = "":A(1,Ø,Ø) = P2
1440  FOR PT = PA TO P2 + PA - 1
1450  PRINT : PRINT "PART";PT - 1
1460  IF (PT = PA) THEN 1510
1470  PRINT "COPY LAST PART ? (Y/N)": GOSUB
     3700
1480  IF Q$ = "N" THEN 1510
1490  GOSUB 2430
1500  GOTO 1630
1510  PRINT "# OF POINTS?"
1520  INPUT "ON EACH FACE ? ";PO
1530 A(PT,Ø,Ø) = PO
1540  PRINT "CLOSED ? (Y/N) ": GOSUB 3700
1550  IF Q$ = "Y" THEN A(PT,Ø,1) = 1: GOTO
     1570
1560 A(PT,Ø,1) = 2
1570 TA = 2
1580  FOR TT = 1 TO 2
1590  PRINT "FACE ";TT
1600  FOR T = 2 TO PO + 1: INPUT "X,Y ?
     ";A(PT,TT,TA),A(PT,TT,TA + 1):TA =
     TA + 2: NEXT
1610 TA = 2
1620  NEXT TT
1630  NEXT PT
1640  GOTO 1050
1650  HGR2 : HCOLOR= 3
1670  HGR2 : HCOLOR= 3
1740  REM  2D READ
1750 P1 = A(Ø,Ø,Ø):PA = P1 + 2
1760  IF P1 = Ø THEN 1900
1770  FOR PT = 2 TO P1 + 1
1780 PO = A(PT,Ø,Ø)
1790 TA = 2
1800  FOR T = 2 TO PO + 1
1810 X1 = A(PT,Ø,TA):Y1 = A(PT,Ø,TA + 1
     )
1820  REM  VIEW 1ST COMPARE
1830  IF T = PO + 1 AND A(PT,Ø,1) = 1 THEN
     X2 = A(PT,Ø,2):Y2 = A(PT,Ø,3): GOSUB
     2160
1840  IF T = PO + 1 THEN 1890
1850 X2 = A(PT,Ø,TA + 2):Y2 = A(PT,Ø,TA
     + 3)
1860  GOSUB 2160
1870 TA = TA + 2
1880  NEXT T
1890  NEXT PT
1900  REM  3D READ
1910 P2 = A(1,Ø,Ø)
1920  IF P2 = Ø THEN 2340
1930  FOR PT = PA TO PPA - 1
1940 PA = A(PT,Ø,Ø)
1950  FOR TT = 1 TO 2
1960 TA = 2
1970  FOR T = 2 TO PO + 1
1980 X1 = A(PT,TT,TA):Y1 = A(PT,TT,TA +
     1)
1990  IF T = PO + 1 AND A(PT,Ø,1) = 1 THEN
     X2 = A(PT,TT,2):Y2 = A(PT,TT,3): GOSUB
     2160
2000  IF T = PO + 1 THEN 2050
2010 X2 = A(PT,TT,TA + 2):Y2 = A(PT,TT,
     TA + 3)
2020  GOSUB 2160
2030 TA = TA + 2
2040  NEXT T
2050  NEXT TT
2060 TA = 2
2070  FOR FA = 1 TO PO
2080 X1 = A(PT,1,TA):Y1 = A(PT,1,TA + 1)
2090 X2 = A(PT,2,TA):Y2 = A(PT,2,TA + 1
     )
2100  GOSUB 2160
2110 TA = TA + 2
2120  NEXT FA
2130  NEXT PT
2140  GOTO 2340
2150  REM  VIEW 2ND COMPARE
2160  GOSUB 3500: RETURN
2330  REM  VIEW GO MENU
2340  GOSUB 3700
2360  IF Q$ <  > CHR$ (77) THEN 2340
2380  TEXT
2390  HOME
2400  GOTO 1050
2410  END
2420  REM  COPY PART
2430  HOME : PRINT "PART";PT - 1;"/TRAN
     SLATION:"
2440  PRINT "RIGHT=+X LEFT=-X
2450  PRINT "DOWN=+Y UP=-Y": PRINT
2460  INPUT "X TRANS.";TX
2470  INPUT "Y TRANS.";TY
2480  PRINT "IS PART 3D?(Y/N)": GOSUB 3
     700
2490  IF Q$ = "Y" THEN 2590
2500 A(PT,Ø,Ø) = A(PT - 1,Ø,Ø):A(PT,Ø,1
     ) = A(PT - 1,Ø,1)
2510 TA = 2
2520  FOR T = 2 TO A(PT,Ø,Ø) + 1
2530 A(PT,Ø,TA) = A(PT - 1,Ø,TA) + TX
2540 A(PT,Ø,TA + 1) = A(PT - 1,Ø,TA + 1
     ) + TY
2550 TA = TA + 2
2560  NEXT T
2570  HOME
2580  RETURN
2590 A(PT,Ø,Ø) = A(PT - 1,Ø,Ø):A(PT,Ø,1
     ) = A(PT - 1,Ø,1)
2600  FOR TT = 1 TO 2
2610 TA = 2
2620  FOR T = 2 TO A(PT,Ø,Ø) + 1
2630 A(PT,TT,TA) = A(PT - 1,TT,TA) + TX
2640 A(PT,TT,TA + 1) = A(PT - 1,TT,TA +
     1) + TY
2650 TA = TA + 2
2660  NEXT T
2670  NEXT TT
2680  HOME
2690  RETURN
2700  REM  TRANS
2710  HOME : PRINT "TRANSLATION:"
2720  PRINT "RIGHT=+X LEFT=-X
2730  PRINT "DOWN=+Y UP=-Y": PRINT
2740  INPUT "X TRANS. ? ";TX
2750  INPUT "Y TRANS. ? ";TY
2760 P1 = A(Ø,Ø,Ø):PA = P1 + 2
2770  FOR PT = 2 TO P1 + 1
2780 PO = A(PT,Ø,Ø)
2790 TA = 2
2800  FOR T = 2 TO PO + 1
2810 A(PT,Ø,TA) = A(PT,Ø,TA) + TX
2820 A(PT,Ø,TA + 1) = A(PT,Ø,TA + 1) +
     TY
2830 TA = TA + 2
2840  NEXT T
2850  NEXT PT
2860 P2 = A(1,Ø,Ø)
2870  FOR PT = P TO PP2 + PA - 1
2880 PO = A(PT,Ø,Ø)
2890  FOR TT = 1 TO 2
2900 TA = 2
2910  FOR T = 2 TO PO + 1
2920 A(PT,TT,TA) = A(PT,TT,TA) + TX
2930 A(PT,TT,TA + 1) = A(PT,TT,TA + 1) +
     TY
```

```
2940 TA = TA + 2
2950  NEXT T
2960  NEXT TT
2970  NEXT PT
2980  GOTO 1050
2990  REM  READ
3000  HOME : INPUT "NAME OF PICTURE FIL
     E";F$
3008 OU = 8
3020  PRINT  CHR$ (4);"OPEN";F$: PRINT
     CHR$ (4);"READ";F$
3030  INPUT A(0,0,0),A(1,0,0)
3040  FOR PT = 2 TO A(0,0,0) + 1
3050 TA = 2
3060  INPUT A(PT,0,0),A(PT,0,1)
3070  FOR T = 1 TO A(PT,0,0) + 1
3080  INPUT A(PT,0,TA),A(PT,0,TA + 1)
3090 TA = TA + 2
3100  NEXT T
3110  NEXT PT
3120  FOR PT = A(0,0,0) + 2 TO A(1,0,0)
     + A(0,0,0) + 1
3130  INPUT A(PT,0,0),A(PT,0,1)
3140  FOR TT = 1 TO 2
3150 TA = 2
3160  FOR T = 2 TO A(PT,0,0) + 1
3170  INPUT A(PT,TT,TA),A(PT,TT,TA + 1)
3180 TA = TA + 2
3190  NEXT T
3200  NEXT TT
3210  NEXT PT
3220  PRINT  CHR$ (4);"CLOSE";F$
3230  GOTO 1050
3240  REM  FILE
3250  HOME
3260  HOME : INPUT "NAME OF PICTURE FIL
     E";F$
3268 IN = 8
3270  PRINT  CHR$ (4);"OPEN";F$: PRINT
     CHR$ (4);"WRITE";F$
3280 R$ = ","
3290  PRINT A(0,0,0): PRINT A(1,0,0)
3300  FOR PT = 2 TO A(0,0,0) + 1
3310 TA = 0
3320  FOR T = 0 TO A(PT,0,0) + 1
3330  PRINT A(PT,0,TA): PRINT A(PT,0,TA
     + 1)
3340 TA = TA + 2
3350  NEXT T
3360  NEXT PT
3370  FOR PT = A(0,0,0) + 2 TO A(1,0,0)
     + A(0,0,0) + 1
3380  PRINT A(PT,0,0): PRINT A(PT,0,1)
3390  FOR TT = 1 TO 2
3400 TA = 2
3410  FOR T = 2 TO A(PT,0,0) + 1
3420  PRINT A(PT,TT,TA): PRINT A(PT,TT,
     TA + 1)
3430 TA = TA + 2
3440  NEXT T
3450  NEXT TT
3460  NEXT PT
3470  PRINT  CHR$ (4);"CLOSE";F$
3480  GOTO 1050
3490  REM  PLOT SUB
3500  IF X1 > 279 OR X1 < 0 OR X2 < 0 OR
     X2 > 279 THEN  RETURN
3510  IF Y1 > 190 OR Y1 < 0 OR Y2 < 0 OR
     Y2 > 190 THEN  RETURN
3515  HPLOT X1,Y1 TO X2,Y2: RETURN
3690  REM  Q$
3700  IF  PEEK ( - 16384) < 127 THEN 3700
3710  GET Q$
3720  RETURN
3730  REM  END SESSION
3740  HOME : END
```

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Speedy BASIC For VIC And 64

Frank C. Gutowski

Though these valuable rules will make your Commodore programs run faster, they're also applicable to Color Computer and Apple BASIC.

In order to understand what makes BASIC fast or slow, we must look at how Commodore BASIC handles numbers.

Rule 1

In Rule 1, we look at integers. Machine language integer arithmetic is fast, while BASIC's simulation of integer operations is slow. The reason: An integer is converted to a floating point number (a number with a decimal point), the operation is done in floating point, and then the result is reconverted to integer. There are valid reasons for this conversion, but program execution speed suffers.

An example of a slow integer statement would be:

100 A% = B% + C%/D%

In this example, at least five conversions are performed. Unless you need the eight bytes this statement saves, do not use one like it. The faster equivalent to this form would be:

100 A = B + C/D

Rule 2

Rule 2 may surprise you. If converting integers takes time, converting ASCII numbers takes even more. You might say, "I never use ASCII numbers," but you do, every time you make a statement like:

100 POKE 7680,1

The numbers in this statement are stored in memory as ASCII characters. The BASIC interpreter converts these ASCII numbers to integers, then into floating point in case they are to be operated on, and then back into integers for use as addresses and bytes of data to be POKEd into them. We can help the system out by converting ASCII-to-integer and integer-to-floating point ahead of time, with a line at the start of the program like, B=7680:A=1. In the case of numbers which will be used many times, as in POKEs within a FOR/NEXT loop to fill screen memory, this simple action can *double* the speed of the POKE.

This same rule applies to statements other than POKEs and PEEKs which involve certain fixed constants, as in the following FOR/NEXT loop:

```
100 FOR I=1TO100
110 A(I)=A(I)+22
120 NEXT
```

This loop would run faster if written:

```
100 B=22
120 FOR I=1TO100
130 A(I)=A(I)+B
140 NEXT
```

In the second example, the conversion of 22 from ASCII to integer to floating point is done only once. Replacing the 1 or 100 in the FOR statement with predefined variables will not increase execution speed, since these are converted once, at the beginning of the looping process.

Rule 3

Rule 3 involves the use of a period in place of zero. When the BASIC Interpreter finds a period by itself in a line, it interprets it as a floating point zero, directly. The time variation involved is demonstrated in the benchmark program. This information is most useful in speeding up a statement like:

100 IF X = 0 THEN 200

A faster version is:

```
100 IF X=. THEN 200
```

Just think of how many times you have written a line like the first example.

Rule 4

IF statements help us decide which of two paths to take. The "fall-through" path, the one taken when the IF statement is false, is the least time-consuming path. Construct your IF statements to take advantage of this. That is, the statement you will be executing most often should be the one to be executed when the IF comparison is false.

Rule 5

This one involves string variables when used in a PRINT statement. In addition to execution time spent on ASCII conversion, BASIC must look up the value of a variable before it can be printed. Thus the statement PRINTA$, when A$ has been defined as A$="A", is slower than PRINT "A". PRINT CHR$(65) is slower yet. Because we use PRINT statements so often, the use of literal strings can make a real difference in the speed of program execution.

The benchmark program is written in two sections. The first, from lines 100 to 290, uses fast and slow methods of statement construction. This is done with a mixture that may be present in the average BASIC program. There is a 1 to 1.37 ratio in speed between the fast and slow sections. The speed differential is also observed in the animation that is produced. If the difference in animation is all that you desire to see, remove some of the arithmetic and PRINT and IF statements.

The second section of the benchmark is the most interesting and shows dramatic timing variations. Some speed differences are only 10 percent, while others are better than 100 percent.

Time lost in the FOR/NEXT loop, which is used in each of the subsections, is measured and subtracted from all timing loops. This will keep measurements accurate. The time is measured in *jiffies* (1/60 second).

Program 1 is the benchmark for the VIC-20. Program 2 shows the necessary changes to Program 1 for a 64 benchmark. The table gives sample results of the VIC and 64 benchmarks.

The benchmark times for the 64 are between 6 and 7 percent slower than the VIC-20 on the average. This is due to the way the 6566 VIC-II video chip in the Commodore 64 shares the system bus.

The line POKE53265,PEEK(53265)AND239 will cause the screen to blank. The 6510 microprocessor will then have full use of the system bus and the times will be equal for the 64 and VIC-20. POKE53265,PEEK(53265)OR16 will restore the screen display and return the processor to normal speed. This slight difference in speed is a small price to pay for the enhanced capabilities of the 64.

Written in Commodore BASIC, sections of the program may be adapted to any computer that has a clock accessible from BASIC. If you happen to run this on another machine, I think you will be delighted with how the VIC and 64 compare to some of their big brothers, although if a true benchmark were to be run between systems, you would want to include more detailed arithmetic sections.

Let's review the rules we have established.

Rule 1: Never use integer variables unless the memory saved is a higher priority than speed.

Rule 2: Predefine numbers as variables, rather than using a number in a statement. This cuts

Run Times From Benchmark For 64 And VIC-20

All times given in jiffies for 500 line executions.

Time for standard FOR loop	
64—32	VIC—30
Time for variable FOR loop	
64—32	VIC—30
Time for number in statement	
64—91	VIC—85
Time for variable in statement	
64—73	VIC—67
Time for IF, no compare	
64—81	VIC—74
Time for IF,compare	
64—100	VIC—92
Time for PEEK, address in statement	
64—203	VIC—181
Time for PEEK, address as variable	
64—92	VIC—81
Time for POKE, address and data in statement	
64—208	VIC—187
Time for POKE, variable as address and data	
64—89	VIC—79
Time for PRINT, data in statement	
64—45	VIC—46
Time for variable in PRINT statement	
64—70	VIC—67
Time for CHR$ in PRINT statement	
64—258	VIC—244
Time for 0 in statement	
64—64	VIC—58
Time for variable 0 in statement	
64—51	VIC—46
Time for period in place of 0 in line	
64—46	VIC—41
Time for integer add	
64—170	VIC—162
Time for floating add	
64—77	VIC—72
Time for ASCII add	
64—96	VIC—90
Times for combination loop	
Slow Loop	**Fast Loop**
64—801	64—578
VIC—743	VIC—542

down the number of conversions BASIC will have to make.

Rule 3: Wherever a zero must be used, use a period instead. This is the only known variance to rule 2.

Rule 4: In an IF statement, the fall-through path is the fastest. Make this the path most often used.

Rule 5: When using strings, include them in the statement, in quotes, rather than predefining them. If you must use the CHR$ function, use it to predefine a string variable for later use.

Rule 6: Although I have not discussed it, you should follow the standard rules for program reduction. Combine statements in one line when possible. Eliminate all spaces that are not in quotes. Put frequently used subroutines and loops at the lowest line numbers possible.

These rules are by no means restricted to the VIC-20 and Commodore 64. They can be applied to TRS-80, Apple, and others with little revision. Follow them and I am sure that you will be pleased with the results. You also can use the timing methods set down in the benchmark to test your own loops to see if they can be improved, and you may make some interesting discoveries about how BASIC works.

Program 1: VIC Benchmark

```
10 REM****************
11 REM BASIC BENCHMARK
12 REM****************
13 REM****************
14 REM*NOTE:*
15 REM REMOVE REM STATEMENTS WHEN RUN
16 REM THEY MAY ALTER TIMES
17 REM*******************
100 POKE36879,88
110 PRINT"{CLR}":C=7680:D=1:E=10:F=21:A=1
    3:B=12:G=90:H=88
120 C$=CHR$(147):H$=CHR$(19):T=TI
121 REM***************
122 REM START OF COMBINATION LOOP
123 REM***************
130 FORI=DTOE:PRINTH$"{21 +}":FORJ=DTOF
    :X=PEEK(C+J):IFX=GTHEN150
140 POKEC+J,H
150 POKEC+J,G
160 K=A+B:K=D:PRINTH$A,B:NEXT:NEXT:TY=TI-
    T:PRINT"{CLR}":T=TI
170 FORI=1TO10:PRINTCHR$(19)"{21 +}"
180 FORJ=1TO21
190 X%=PEEK(7680+J)
200 IFX%<>90THEN220
210 POKE7680+J,90
220 POKE7680+J,88
230 A%=5+8:B%=10+2
240 PRINTCHR$(19) 13,12
250 NEXTJ
260 NEXTI
270 TX=TI-T
280 PRINT"SLOW","FAST",TX,TY
290 FORI=1TO2000:NEXT
291 REM***************
292 REM END OF COMBINATION LOOP
293 REM START OF STATEMENT TIMING SECTION
294 REM***************
300 PRINTC$:GOSUB890
310 T=TI
320 FORI=1TO500:NEXT
330 T1=TI-T
340 T=TI
350 FORI=ATOB:NEXT
360 T2=TI-T
370 T=TI
380 FORI=ATOB:D=2+3:NEXT
390 T3=(TI-T)-T2
400 T=TI
410 FORI=ATOB:D=E+F:NEXT
420 T4=(TI-T)-T2
430 T=TI
440 FORI=ATOB:IFI=CTHEN450
450 NEXT:T5=(TI-T)-T2
460 T=TI
470 FORI=ATOB:IFI>CTHEN480
480 NEXT:T6=(TI-T)-T2
490 T=TI
500 FORI=ATOB:X=PEEK(7680):NEXT
510 T7=(TI-T)-T2
520 T=TI
530 FORI=ATOB:X=PEEK(G):NEXT
540 T8=(TI-T)-T2
550 T=TI
560 FORI=ATOB:POKE7680,1:NEXT
570 T9=(TI-T)-T2
580 T=TI
590 FORI=ATOB:POKEG,A:NEXT
600 T0=(TI-T)-T2
610 T=TI
620 FORI=ATOB:PRINT"A{LEFT}";:NEXT
630 TA=(TI-T)-T2
640 T=TI
650 FORI=ATOB:PRINTA$;:NEXT
660 TB=(TI-T)-T2
670 T=TI
680 FORI=ATOB:PRINTCHR$(65)CHR$(157);:NEX
    T
690 TC=(TI-T)-T2
700 T=TI
710 FORI=ATOB
720 X=0:NEXT:TD=(TI-T)-T2
730 T=TI
740 FORI=ATOB
750 X=C:NEXT:TE=(TI-T)-T2
760 T=TI
770 FORI=ATOB
780 X=.:NEXT:TF=(TI-T)-T2
790 T=TI:A%=1:B%=2:C%=3
800 FORI=ATOB
810 A%=B%+C%:NEXT:TG=(TI-T)-T2
820 T=TI
830 FORI=ATOB
840 F=E+A:NEXT:TH=(TI-T)-T2
850 T=TI
860 FORI=ATOB
870 F=2+1:NEXT:TJ=(TI-T)-T2
880 GOTO900
881 REM***************
882 REM END OF STATEMENT TIMING SECTION
883 REM***************
890 A=1:B=500:C=0:E=2:F=3:G=7680:A$="A"+C
    HR$(157):RETURN
891 REM****************
892 REM LINE 900 FOR
893 REM PRINTER LIST
894 REM ONLY. CHANGE
895 REM IT AND LINE 1100
```

```
896 REM FOR SCREEN LIST
897 REM****************
900 OPEN3,4:CMD3
902 PRINT"ALL TIMES GIVEN IN JIFFIES FOR
     {SPACE}500"
903 PRINT"LINE EXECUTIONS."
904 PRINT:PRINT
910 PRINT"{RVS}TIME FOR STANDARD FOR LOOP
     ":PRINTT1
920 PRINT"{RVS}TIME FOR VARIABLE FOR LOOP
     ":PRINTT2
921 PRINT
930 PRINT"{RVS}TIME FOR NUMBER IN STATEME
     NT":PRINTT3
940 PRINT"{RVS}TIME FOR VARIABLE IN STATE
     MENT":PRINTT4
941 PRINT
950 PRINT"{RVS}TIME FOR IF, NO COMPARE":P
     RINTT5
960 PRINT"{RVS}TIME FOR IF, COMPARE":PRIN
     TT6
961 PRINT
970 PRINT"{RVS}TIME FOR PEEK, ADDRESS IN
     {SPACE}STATEMENT":PRINTT7
980 PRINT"{RVS}TIME FOR PEEK, ADDRESS AS
     {SPACE}VARIABLE":PRINTT8
981 PRINT
990 PRINT"{RVS}TIME FOR POKE, ADDRESS & D
     ATA IN STATEMENT":PRINTT9
1000 PRINT"{RVS}TIME FOR POKE, VARIABLE A
      S ADDRESS & DATA":PRINTT0
1001 PRINT
1010 PRINT"{RVS}TIME FOR PRINT, DATA IN S
      TATEMENT":PRINTTA
1020 PRINT"{RVS}TIME FOR VARIABLE IN PRIN
      T STATEMENT":PRINTTB
1030 PRINT"{RVS}TIME FOR CHR$ IN PRINT ST
      ATEMENT":PRINTTC
1031 PRINT
1040 PRINT"{RVS}TIME FOR 0 IN STATEMENT":
      PRINTTD
1050 PRINT"{RVS}TIME FOR VARIABLE 0 IN ST
      ATEMENT":PRINTTE
1060 PRINT"{RVS}TIME FOR PERIOD IN PLACE
      {SPACE}OF 0 IN LINE":PRINTTF
1061 PRINT
1070 PRINT"{RVS}TIME FOR INTEGER ADD":PRI
      NTTG
1080 PRINT"{RVS}TIME FOR FLOATING ADD":PR
      INTTH
1090 PRINT"{RVS}TIME FOR ASCII ADD":PRINT
      TJ:PRINT
1091 PRINT:PRINT"TIMES FOR COMBINATION LO
      OP":PRINT"SLOW","FAST":PRINT"LOOP","
      LOOP"
1100 CLOSE3:END
```

Program 2: 64 Benchmark

```
100 POKE53280,1:POKE53281,0:PRINT"{WHT}"
110 PRINT"{CLR}":C=1024:D=1:E=10:F=21:A=1
     3:B=12:G=90:H=88
190 X%=PEEK(1024+J)
210 POKE1024+J,90
220 POKE1024+J,88
280 PRINT"SLOW","FAST",,,TX,TY
500 FORI=ATOB:X=PEEK(1024):NEXT
560 FORI=ATOB:POKE1024,1:NEXT
890 A=1:B=500:C=0:E=2:F=3:G=1024:A$="A"+C
     HR$(157):RETURN
901 PRINT"RUN TIMES FROM BENCHMARK FOR C-
     64"
```
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Jim Butterfield, Associate Editor

ML Factors
Part2

Last month we presented a machine language program which would find the prime factors of very large numbers—up to 19 digits. This month we'll pick apart the ML to see how it works. Here's the commented machine language for the PET/CBM version. The VIC/64 version is identical except for the address references.

Note that in both the PET/CBM and VIC/64 versions the actual machine language was preceded by a number of lines of BASIC which provided instructions and called the ML. These are not discussed here.

First, a few variables. BCOUNT counts bits during division. EXP is the exponent value which appears in the output. CHAR is the equals character or the plus character, depending on where we are working on the output line. ZSUP is a flag for zero suppression. INDEX counts through a table of divisor offsets.

```
BCOUNT   = $0348
EXP      = BCOUNT+1
CHAR     = EXP+1
ZSUP     = CHAR+1
INDEX    = ZSUP+1
```

Next, arrays. NUMBER holds the number we have input; it reduces as factors are found. VALUE holds the original number. BASE holds a multiple of 30; we'll add the index number to it to get divisors of 31, 37, 41, etc. DVSR is the actual number we're dividing by. REMDR is the remainder after division; it is partially combined with QUOT, which holds the quotient. DECIML holds a decimal number being built for output. ZZY is not used, but shows the end of DECIML.

```
NUMBER   = $0350
VALUE    = NUMBER+8
BASE     = VALUE +8
DVSR     = BASE+8
REMDR    = DVSR+4
QUOT     = REMDR+4
DECIML   = REMDR+12
ZZY      = DECIML+10
```

Here we go. Let's print a RETURN to start a new line, followed by a prompt character, and reset a few values.

```
0500  A9 0D      START  LDA  #$0D       ;RETURN
0502  20 D2 FF          JSR  $FFD2      ;.. PRINT
0505  20 BA 05          JSR  PRPT       ;PROMPT
0508  A9 3D             LDA  #$3D       ;'EQUALS'
050A  8D 4A 03          STA  CHAR
050D  A2 0F             LDX  #15
050F  A9 00             LDA  #0         ;CLEAN HOUSE
0511  9D 50 03   SLP    STA  NUMBER,X
0514  9D 58 03          STA  VALUE,X
0517  9D 60 03          STA  BASE,X
051A  CA                DEX
051B  10 F4             BPL  SLP
```

It's time to get digits. We scan the keyboard, and ignore everything that's not a legitimate numeric key or RETURN. Subroutine DODIG will work the digit into the total we are building. An error (usually number too big) will cause a question mark to be printed.

```
051D  20 E1 FF   GDIG   JSR  $FFE1      ;TEST RUN/STOP
0520  F0 17             BEQ  QUIT       ;NEEDED FOR
                                        VIC/64
0522  20 E4 FF          JSR  $FFE4      ;GET CHARACTER
0525  C9 0D             CMP  #$0D       ;RETURN?
0527  F0 11             BEQ  CALC       ;YUP,CALCULATE
0529  20 C4 05          JSR  DODIG      ;NOPE,DO DIGIT
052C  B0 03             BCS  ERR
052E  4C 1D 05          JMP  GDIG       ;.. AND LOOP.
0531  A9 3F      ERR    LDA  #$3F       ;'?'
0533  20 D2 FF          JSR  $FFD2      ;.. PRINT
0536  4C 00 05          JMP  START
0539  60         QUIT   RTS
```

We now have a number. We wipe out the prompt character and then get to the main calculation; but first we check to make sure that the number is nonzero.

```
053A  A9 20      CALC   LDA  #$20       ;SPACE
053C  20 D2 FF          JSR  $FFD2      ;..PRINT
053F  A9 14             LDA  #$14       ;DELETE
0541  20 D2 FF          JSR  $FFD2      ;..PRINT
0544  A2 07             LDX  #7         ;FOR EACH DIGIT
```

```
0546 BD 50 03  CAP0  LDA NUMBER,X
0549 D0 05           BNE CAP1       ;..NOT A ZERO?
054B CA              DEX
054C D0 F8           BNE CAP0
054E F0 E1           BEQ ERR        ;OOPS, ALL ZERO
```

Division Attempts

Here we go. We try dividing by two, three, and five; in each case, we check to see if it's time to quit. The subroutine FLOOK will print factors if it finds them; all we do here is name the divisors.

```
0550 A9 02     CAP1  LDA #2         ;TRY TWO
0552 20 7A 06        JSR FLOOK
0555 90 4B           BCC WRAP
0557 A9 03           LDA #3         ;TRY THREE
0559 20 7A 06        JSR FLOOK
055C 90 44           BCC WRAP
055E A9 05           LDA #5         ;TRY FIVE
0560 20 7A 06        JSR FLOOK
0563 90 3D           BCC WRAP
```

Once we go above a divisor of five, we change to a different system. We pick offset numbers out of a table, and add them to a "base" number (which starts at zero). This gives us 7, 11, 13, 17, etc. When the offset number reaches 29, we increase the base by 30 and start over: This will give us 31, 37, 41, 47, etc. Note that we are working in four-byte numbers, so additions take more code.

```
0565 A2 00           LDX #0         ;START INDEX
0567 8E 4C 03        STX INDEX      ;.. AT SEVEN.
056A 20 E1 FF  MLP1  JSR $FFE1      ;RUN/STOP?
056D F0 CA           BEQ QUIT       ;YES, QUIT
056F AC 4C 03        LDY INDEX
0572 C8              INY            ;NEXT INCREMENT
0573 C0 08           CPY #8         ;TOO FAR?
0575 90 12           BCC MOK1       ;NO, KEEP GOING
0577 A0 00           LDY #0         ;YES, RESET
0579 18              CLC
057A A9 1E           LDA #30        ;AND ADD 30
057C A2 03           LDX #3         ;..TO 3-BYTE
057E 7D 60 03  MLP2  ADC BASE,X     ;..BASE
0581 9D 60 03        STA BASE,X
0584 A9 00           LDA #0
0586 CA              DEX
0587 10 F5           BPL MLP2
0589 8C 4C 03  MOK1  STY INDEX      ;STORE INDEX
058C B9 65 07        LDA TABLE,Y    ;GET VALUE
058F 18              CLC            ;..ADD
0590 A2 03           LDX #3         ;..3-BYTE
0592 7D 60 03  MLP3  ADC BASE,X     ;..BASE
0595 9D 68 03        STA DVSR,X     ;..SUM TO
                                    DIVISOR
0598 A9 00           LDA #0
059A CA              DEX
059B 10 F5           BPL MLP3
059D 20 7D 06        JSR FLOOP      ;TRY THIS FACTOR
05A0 B0 C8           BCS MLP1
```

When we reach WRAP, our quotient is greater than our divisor, which means that we're not going to find any more factors. We wind it up, printing the remaining number unless it's equal to one.

```
05A2 AE 57 03  WRAP  LDX NUMBER+7;IS IT ONE?
05A5 CA              DEX
05A6 D0 0C           BNE DWRAP      ;NOPE, PRINT
05A8 A2 06           LDX #6         ;6 HIGH BYTES
05AA BD 50 03  WLP   LDA NUMBER,X
05AD D0 05           BNE DWRAP
05AF CA              DEX
05B0 10 F8           BPL WLP
05B2 30 03           BMI DEND       ;IT'S 1, SKIP
05B4 20 B9 06  DWRAP JSR SRAP       ;ELSE PRINT IT
05B7 4C 00 05  DEND  JMP START
```

This part prints the prompt. I've picked the numbers symbol (call it the pounds symbol if you wish); after we print it we backspace so that the next input will type over it.

```
05BA A9 23     PRPT  LDA #$23       ;'#'
05BC 20 D2 FF        JSR $FFD2      ;PRINT IT
05BF A9 9D           LDA #$9D       ;BACKSPACE
05C1 4C D2 FF        JMP $FFD2      ;PRINT & RETURN
```

Number Input

Here's where we do most of the work inputting a number. We reject nonnumeric keys; the numerics we echo and convert to binary with an AND. Now we multiply the previous value by ten; we use subroutine GROT to multiply the eight-byte value by two. Our method is: times two, times two, add the original value, times two. Then we can add in the new digit.

```
05C4 C9 30     DODIG CMP #$30       ;LESS THAN 0?
05C6 90 42           BCC DOEX       ;YUP, IGNORE IT
05C8 C9 3A           CMP #$3A       ;MORE THAN 9?
05CA B0 3D           BCS DOEX1      ;YUP, IGNORE IT
05CC 20 D2 FF        JSR $FFD2      ;ELSE PRINT
05CF 29 0F           AND #$0F       ;CHANGE TO
                                    BINARY
05D1 A8              TAY
05D2 20 BA 05        JSR PRPT       ;DO PROMPT
05D5 20 0B 06        JSR GROT       ;TIMES 2
05D8 B0 30           BCS DOEX
05DA 20 0B 06        JSR GROT       ;TIMES 2
05DD B0 2B           BCS DOEX
05DF A2 07           LDX #7         ;EIGHT BYTE
05E1 18              CLC            ;ADD
05E2 BD 50 03  GLP3  LDA NUMBER,X ;ORIGINAL
                                    NUMBER
05E5 7D 58 03        ADC VALUE,X
05E8 9D 50 03        STA NUMBER,X
05EB CA              DEX
05EC 10 F4           BPL GLP3
05EE B0 1A           BCS DOEX
05F0 20 0B 06        JSR GROT       ;TIMES 2
05F3 B0 15           BCS DOEX
05F5 A2 07           LDX #7         ;EIGHT BYTE
05F7 98              TYA            ;NEW DIGIT
05F8 18              CLC            ;ADD
05F9 7D 50 03  GLP5  ADC NUMBER,X
05FC 9D 50 03        STA NUMBER,X
05FF 9D 58 03        STA VALUE,X
0602 A9 00           LDA #0
0604 CA              DEX
0605 10 F2           BPL GLP5
0607 B0 01           BCS DOEX
0609 18        DOEX1 CLC
060A 60        DOEX  RTS
060B A2 07     GROT  LDX #7         ;EIGHT BYTE
060D 18              CLC            ;LEFT SHIFT
060E 3E 50 03  GLP1  ROL NUMBER,X
0611 CA              DEX
0612 10 FA           BPL GLP1
0614 60              RTS
```

Next month we'll conclude our commented listing by taking a look at the division and print routines. ©

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64Key And VICKey

Daniel Bingamon

This might be the last program you type in the traditional way. 64Key and VICKey allow you to print a BASIC instruction just by pressing one shifted key. VICKey will work on an unexpanded or 3K expanded VIC. Any additional memory must be removed or disabled to use this utility.

"64Key" (Program 1) is a Commodore 64 version of Thomas Henry's "VICKey" (Program 2), originally published in the August 1982 issue of COMPUTE!. It allows you to print a BASIC keyword just by pressing one shifted key. For example, pressing SHIFT-A prints ASC, SHIFT-B prints STEP, SHIFT-C gives CHR$, and so on. It makes typing in long programs faster and easier.

To use 64Key, type in the program, SAVE it, and type RUN. If you have mistyped a DATA statement, the program will tell you so. The program POKEs 64Key into the $C000 block of free RAM. Type SYS52557 to activate 64Key. You will get the READY message back as though nothing has happened. But try typing a SHIFTed letter. Presto! A keyword appears.

Now instead of typing out a keyword, you can simply hit the appropriate key as shown in the table. Of course, you can always type the keyword normally (you must if the keyword is not in the table). Be sure to type NEW before typing in your program.

Like VICKey, 64Key checks location $D4 (212) to see if the editor is in quote mode. If you hit a SHIFTed letter within quotes, you will get the normal graphics character or capital letter instead of a keyword. Typing SYS52557 turns 64Key on or off. So, if you want to deactivate it, type SYS52557 a second time. You can also deactivate it by pressing the RUN/STOP and RESTORE keys together. 64Key will remain in memory until you turn the computer off.

BASIC Keywords

A	ASC	N	NEXT
B	STEP	O	OPEN
C	CHR$	P	POKE
D	DIM	Q	PEEK
E	END	R	RIGHT$
F	FOR	S	STR$
G	GET	T	TAB(
H	STOP	U	USR
I	INPUT	V	VAL
J	GOTO	W	DATA
K	GOSUB	X	READ
L	LEFT$	Y	RESTORE
M	MID$	Z	SYS

Program 1: 64Key

```
10 PRINT"{CLR} 64-KEY"
20 FORI=52557TO52739
30 READA:X=X+A:POKEI,A
40 NEXTI
50 IFX<>24016THENPRINT"THERE IS AN ERROR
   {SPACE}IN YOUR DATA STATEMENTS":STOP
60 PRINT"SYS52557 TO ACTIVATE":END
80 DATA 120 , 173 , 20 , 3 , 72
90 DATA 173 , 21 , 3 , 72 , 173
100 DATA 116 , 205 , 208 , 2 , 169
110 DATA 118 , 141 , 20 , 3 , 173
120 DATA 117 , 205 , 208 , 2 , 169
130 DATA 205 , 141 , 21 , 3 , 104
140 DATA 141 , 117 , 205 , 104 , 141
150 DATA 116 , 205 , 88 , 96 , 0
160 DATA 0 , 72 , 138 , 72 , 152
170 DATA 72 , 165 , 215 , 72 , 165
180 DATA 212 , 240 , 4 , 104 , 76
190 DATA 221 , 205 , 104 , 201 , 193
200 DATA 144 , 82 , 201 , 219 , 176
210 DATA 78 , 56 , 233 , 193 , 170
220 DATA 189 , 229 , 205 , 162 , 0
230 DATA 134 , 198 , 170 , 160 , 158
240 DATA 132 , 34 , 160 , 160 , 132
250 DATA 35 , 160 , 0 , 10 , 240
260 DATA 16 , 202 , 16 , 12 , 230
```

```
270 DATA 34 , 208 , 2 , 230 , 35
280 DATA 177 , 34 , 16 , 246 , 48
290 DATA 241 , 200 , 177 , 34 , 48
300 DATA 17 , 8 , 142 , 255 , 205
310 DATA 230 , 198 , 166 , 198 , 157
320 DATA 119 , 2 , 174 , 255 , 205
330 DATA 40 , 208 , 234 , 230 , 198
340 DATA 166 , 198 , 41 , 127 , 157
350 DATA 119 , 2 , 169 , 20 , 141
360 DATA 119 , 2 , 230 , 198 , 104
370 DATA 168 , 104 , 170 , 104 , 76
380 DATA 49 , 234 , 198 , 169 , 199
390 DATA 134 , 128 , 129 , 161 , 144
400 DATA 133 , 137 , 141 , 200 , 202
410 DATA 130 , 159 , 151 , 194 , 201
420 DATA 196 , 163 , 183 , 197 , 131
430 DATA 135 , 140 , 158 , 127 , 0
440 DATA 0 , 0 , 255 , 255 , 255
```

Program 2: VICKey

```
100 POKE55,77:POKE56,29
110 PRINT "{CLR}VIC-KEY":PRINT:PRINT"WAIT
    ..."
120 FORI=7501TO7679
130 READA:X=X+A:POKEI,A
140 NEXT
150 IF X<>22351 THEN PRINT"THERE IS AN ER
    ROR ON YOUR DATA STATEMENTS":STOP
160 PRINT"SYS7501 TO ACTIVATE."
170 NEW
180 DATA 120,173,20,3,72,173,21,3
190 DATA 72,173,116,29,208,2,169,118
200 DATA 141,20,3,173,117,29,208,2
210 DATA 169,29,141,21,3,104,141,117
220 DATA 29,104,141,116,29,88,96,0
230 DATA 0,72,138,72,152,72,165,215
240 DATA 72,165,212,240,4,104,76,221
250 DATA 29,104,201,193,144,82,201,219
260 DATA 176,78,56,233,193,170,189,229
270 DATA 29,162,0,134,198,170,160,158
280 DATA 132,34,160,192,132,35,160,0
290 DATA 10,240,16,202,16,12,230,34
300 DATA 208,2,230,35,177,34,16,246
310 DATA 48,241,200,177,34,48,17,8
320 DATA 142,255,29,230,198,166,198,157
330 DATA 119,2,174,255,29,40,208,234
340 DATA 230,198,166,198,41,127,157,119
350 DATA 2,169,20,141,119,2,230,198
360 DATA 104,168,104,170,104,76,191,234
370 DATA 198,169,199,134,128,129,161,144
380 DATA 133,137,141,200,202,130,159,151
390 DATA 194,201,196,163,183,197,131,135
400 DATA 140,158,127
```

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INSIGHT: Atari

Bill Wilkinson

This month we'll begin to explore some of the techniques involved in creating a general-purpose formatted screen I/O routine in BASIC. "And just what is a general-purpose formatted screen I/O routine?" you quite rightfully ask.

A "New" Kind Of Screen Editor

Briefly, what I am trying to do is produce a method whereby the programmer may specify certain areas of the screen as "label" or "title" areas, which may not be modified by the user. Other parts of the screen then become the Input/Output (I/O) areas. The user will not be able to change any part of the screen except the designated I/O areas, but he or she will be able to "randomly" access any area and change it. When the screen is filled in properly, the user pushes a single key (I intend to use ESCape) and the screen is automatically read into data variables in memory, where the program may process them or write them to disk.

The concept is certainly nothing new. Mainframe installations such as airline reservation systems have been doing exactly this for years. And I am sure that programs already exist for the Atari computers which work in a like fashion. So why am I writing these routines? For practical use here at OSS. Believe it or not, we intend to have a sales order entry system, complete with accounts receivable and general ledger interface, up and running on an Atari computer.

Surprised? Didn't think the Atari was capable of such sophisticated work? Truthfully, as the machine is shipped from Atari, it is not. The big missing link is large amounts of disk storage. We intend to use at least two double-density, double-sided drives (or equivalents), and may find that we need three or four.

And why are we doing this on an Atari computer, instead of a CP/M or MS DOS machine? Quite frankly, because we have the equipment already paid for and because we have yet to see an adequate order entry system even for such "bigger" machines.

Anyway, so far I have written three of the workhorse subroutines of my formatted screen routines: (1) Display fixed information at fixed locations on the screen, (2) Display variable information (presumably obtained from a disk file) on the screen, (3) Edit the variable information (or enter new information).

Routine number three is both too big and too complicated to put in this month's column. Also, it runs fine in BASIC XL; but when I tried to translate it to Atari BASIC, it got bigger and slower and may not be too usable. If there is enough interest, I might be persuaded to write about it in a future column. Routines 1 and 2, though, are so surprisingly small, simple, and elegant when written in Atari BASIC that I felt you would enjoy seeing them. So let's look at them before explaining how they work.

Routine 1: Fixed Setup

```
30000 REM set up fixed screen areas
30010 TRAP 30020 : DIM DATA$(50)
30020 TRAP 40000 : RESTORE PTRDATA
30030 READ DATA$ : IF DATA$="*" THEN
      RETURN
30040 POSITION VAL(DATA$(1,2)),VAL(D
      ATA$(3,4))
30050 PRINT DATA$(5); : GOTO 30030
```

Routine 2: Variable Display

```
31000 REM display variable data area
      s
31010 TRAP 31020 : DIM DATA$(50)
31020 TRAP 40000 : RESTORE PTRDATA :
      QPTR=1
31030 READ DATA$ : IF DATA$="*" THEN
      RETURN
31040 POSITION VAL(DATA$(1,2)),VAL(D
      ATA$(3,4))
31050 PRINT SCREEN$(QPTR,QPTR-1+VAL(
      DATA$(5,6));
31060 QPTR=QPTR+VAL(DATA$(5,6)) : GO
      TO 31030
```

Listing 3: A Tester For The Routines

```
100 DIM SCREEN$(200)
110 SCREEN$="ZUCKERMAN 95099C"
```

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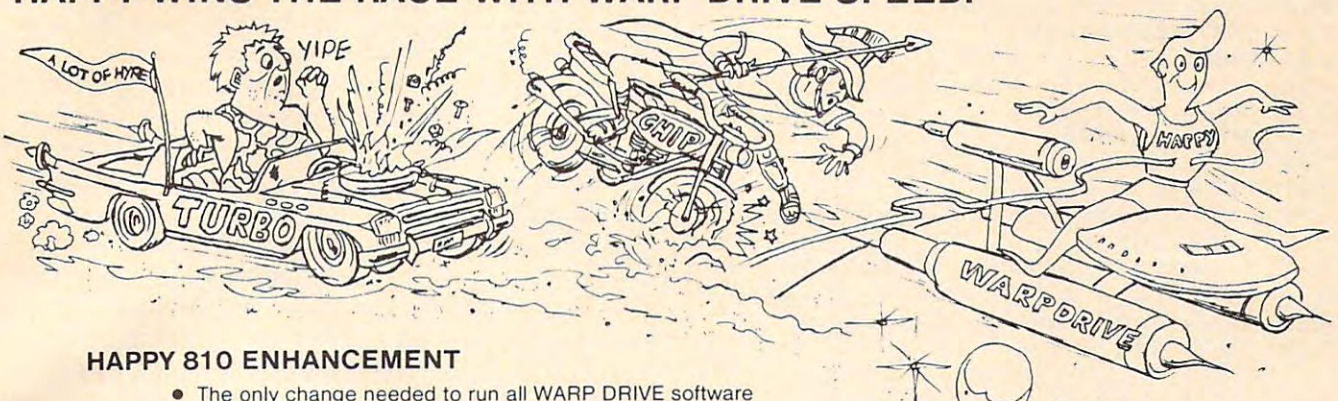

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```
200 REM fixed data
210 DATA 0810Name:
220 DATA 0412Zip Code:
230 DATA 0816Code:
240 DATA *
300 REM variable data parameters
310 DATA 151010
320 DATA 151205
330 DATA 151601
340 DATA *
400 REM the actual test program
410 GRAPHICS 0
420 PTRDATA = 200 : GOSUB 30000
430 PTRDATA = 300 : GOSUB 31000
440 REM just loop here for now
450 GOTO 440
```

Even though I have presented this example as three separate listings, if you would like to see its effects, you should type all the lines into a single program.

Addressable DATA

So, what's the secret of this simple yet (according to me) elegant program? Surprisingly enough, I find myself returning to the concept I explored in my very first COMPUTE! column (September 1981, for you "regulars"): addressable DATA statements. Very few BASICs have addressable DATA statements, yet when I look at this program I cannot understand why they don't.

The lines to look at carefully are 30020 and 31020, where the program says "RESTORE PTRDATA". When either of these routines is called, it expects that the variable PTRDATA will contain the line number of the beginning of some DATA statements which it must begin processing. So let's look at those DATA statements first.

In lines 210 through 230, we define the fixed fields on the screen as starting at a particular horizontal (X) position (the first two digits) and a particular vertical (Y) position (the next two digits). Notice how line 30040 reflects this usage with the VAL functions it uses in conjunction with the POSITION statement.

Similarly, in lines 310 through 330, the definitions of the variable fields are expressed as horizontal position (first two digits), vertical position (next two digits), and field length (last two digits). Again, lines 31040 through 31060 reflect these usages via VAL functions.

If you are wondering why I am making such a fuss over these two little routines, especially when it takes so much programming to prepare to use them, you probably haven't typed in the program to see what it does. Or, to be fair, you haven't seen the best part of all, the onscreen editor that's too big for this month's column.

INPUT Weaknesses

And why am I going to this much trouble, when I could use PRINTs and INPUTs to do the same thing? Two reasons: (1) If I use PRINT and INPUT, I have to write the entire code each time in a form which makes my programs hard to read and understand. (2) The INPUT statement as implemented on most BASICs is a disaster, and Atari BASIC is no exception. There is no way, when using INPUT, to keep the user from hitting screen-editing keys or from entering too much or too little data.

Did I mention that the screen editing routine I have written allows the programmer to specify, via simple DATA statements, not only where and how big the variable data fields are on the screen but also what attributes they may have (for example, numeric, alphabetic, dollars and cents, etc.)? I didn't? Are you more interested now? Next month we'll continue our examination of screen I/O by making test runs of the example programs. ©

Commodore Files For Beginners
Part 4

Jim Butterfield, Associate Editor

In this concluding article of the series, we'll clean up a few small details on sequential files; then I'd like to open up the big picture on the use of sequential files.

Linefeed

With every PRINT#, we have scrupulously ended with the sequence ;CHR$(13); including the semicolon at the end. Is it overkill? Might we just say PRINT#1,X$ without harm?

On all machines produced since 1981, the answer is yes. The 4.0 BASIC that was introduced for PET/CBM at that time solved the problem, and when the VIC and Commodore 64 were produced, the solution stayed.

The problem was this: When we said PRINT #1,"X" the computer would send the X to the file, followed by a carriage return—so far, we're OK—followed by a linefeed character. The linefeed got mixed into our data and caused confusion. On Commodore products before the 4.0 was announced, we needed to eliminate that automatic linefeed by sending our own carriage return, which is CHR$(13).

From the 4.0 system onward (including VIC and 64), the linefeed won't go out unless you use a *logical* file number of 128 or greater. So on these machines, you can just say PRINT#1,"X" and have no problems.

Even if you have a newer machine, there's a question you should consider. Suppose you write a useful filing program. Is there a chance that someone might like to use your program on their computer—which might be an old PET/CBM? If so, use the CHR$(13). It won't hurt your system, and will save other users a lot of potential headaches.

GET#

Sometimes a file doesn't seem to behave. The information that comes in when you INPUT# is not what you expect. To look at the file in detail, you should switch to GET#, which will look at each individual character.

For a simple ASCII file, we can write a quick program to display everything:

```
100 OPEN 1,8,3,"FILENAME" (or tape equivalent)
110 GET#1,X$
120 PRINT X$;
130 IF ST=0 GOTO 110
140 CLOSE 1
```

Chances are, you'll be able to see the problem right away; it's often an unwanted character such as a comma or colon, or a line that is too long.

Sometimes a bug in your program will put into your file "strange" characters that won't print. In this case, you can usually investigate the problem by changing to the numeric ASCII representation: 120 PRINT ASC(X$); and if there's any chance that the file contains a binary zero character, you can catch it by coding 120 PRINT ASC(X$+CHR$(0)); to allow for the "null string" that results from reading this character.

A Longer Look

We've talked about the principles of writing and reading sequential files. I'd like to leave the mechanics to take a broader view of sequential files usage. We'll need to look at one extra touch: putting a file into some kind of order.

Unless we make a deliberate effort, a sequential file will end up with records in the order that they were created, or entered. But if we choose, we can set up the files with a distinctive sequence of records.

The Key Field(s)

We choose a certain field—say, student number or customer name—and decide that our file will be "sequenced" according to this field.

We may choose more than one field for our ordering. In this case, one of the fields is considered "major" and the other "minor." For example, suppose we choose to sort by two fields: surname and first name. This would work out as follows: If the surnames are different, put the records in order of surname; if they are the same, put them in order of first name. Thus Fred Jones would come before Pete Jones, but William Jolson would come before both of them.

It turns out that the terms "major key" and "minor key" apply not just to music. You can go even further, and have an intermediate key. But the key fields always have a distinct precedence.

No Sort

Beginners often think that files must be sorted in order to be in a given sequence. Not so. If the files are created in sequence, they will stay that way; there will be no need for a distinct sort operation. So long as new items are inserted into the proper spot, the records never get out of order.

If you change keys, however, you'll definitely need a sort; the new order will replace the old. And as we'll see later, sorting does play a role in the handling of sequenced files.

Why Ordered?

It's not obvious why a file will benefit from being placed in an ordered sequence. It's extra work, and with small files it may not seem to pay off.

Let's take a file of 100 records, and try some of the more common excuses.

- *It makes it easier to find a given record.* True, but often not important. We can usually search for a match in an array of 100 items in about a second; few users would find this an unworkable delay. With an ordered file, we could perform a binary search in one-tenth the time; but this may not matter.
- *It makes it easier to spot duplicates.* At the time that a new record is entered, finding a duplicate is the same job as finding a given record. Again, for 100 records or less, the difference may not be significant.
- *It makes it easier to add records.* Untrue: Adding to a keyed file may require "moving over" records so that the new one will fit. Adding to an unsequenced file involves tacking the new record onto the end of the file.
- *The file can be summarized faster.* Not usually true: 100 records take the same time to process regardless of their order.

As the number of records increases above 100, the first two reasons given above become more important; eventually, a sequenced file becomes quite desirable. But there's another major reason why a keyed file is useful.

The Major Reason

Here's the big one for commercial applications: In an ordered file, it's easy to group similar items together for processing. They are already together.

Suppose we have a file of credit sales. This might include customer number, date, and amount. Now, if the file is sorted by customer number, each customer's purchases are clustered together. We can summarize a customer's activity very simply.

Suppose we have the following sales:

Customer Number	Amount
123	40.20
123	6.15
241	50.00
244	5.75
244	6.00

It's obvious that these records are ordered by customer number. So here's how we handle calculating each customer's totals:

A. Read the first record.

B. Set Customer = the customer number, Total = the amount involved.

C. Read the next record. If the customer number is still the same, add the amount into the Total, and repeat.

D. If the customer number has changed, or when we reach end-of-file, print Customer, the previous customer number, and Total, the total customer purchases. If we're not at the end-of-file, go back to step B.

If you've followed the above logic, you can see that when the customer number in the record changes, say from 123 to 241, we must stop and summarize. This point is called a "control break."

More: Merging

If we have a file of customer transactions, and a file of customer names and addresses, and both files are sequenced by customer number, we can do something very powerful indeed. We can draw from both files simultaneously, and "mingle" the information together to produce a customer bill. We must be very careful to make sure that the customer numbers are synchronized.

This process—the streaming together of two ordered files—is called a "merge." It can happen only if both files are sequenced in the same way. And to be able to handle two files at the same time, we must have a disk system.

The merge is vital to most commercial data processing systems. It's worth describing how a typical commercial "merge/update" billing program works.

The Merge Update

The computer has a "Master Customer File" on disk. It contains the customer's name, address, previous balance, and the key field: customer number.

Over the past month, the computer has been gathering a "Transaction File." It contains a date, an amount, perhaps a transaction type and details, and the key field: customer number.

The program starts. Both the Master File and the Transaction File are opened and made ready for reading. A new file, the New Master File, is prepared for writing.

The computer grabs the first transaction, and then goes searching through the Master File for a matching customer number. Anything it finds on the Master File that doesn't match must be an inactive customer number (and a smaller number at that); and this is carefully copied over to the New Master File.

When we find a matching customer number on the Master File, we start to print out the customer bill. The name and address from the Master File are neatly printed. We move to the right place on the form and print the customer's previous balance. Now we print the first transaction.

We grab another transaction. If it's the same customer number, we print the transaction and keep going. But if it's a different customer number, we have a "control break." The previous customer's bill must be totaled, and a new statement moved into the right place on the printer. The New Master File will be written with the usual things: Name, Address ..., and a brand new balance.

This continues, the bills keep chugging out, and by the time we're finished we have created a brand new Master File that we'll use as an input next month.

Of course, there will be more things on the transaction file than purchases. Customer payments will also be shown there, and we might even include extra types of transactions such as corrections or changes of address.

And we'll produce extra output, usually directed to an "exception file." This includes transactions that have no matching customer number on the Master File, indications of customers with no activity but an outstanding balance, information on balances that exceed a certain amount, and whatever.

It's not my plan to give you a total outline of a billing system here. But I'd like you to get an appreciation of the mighty potential of the humble sequential file.

The Sort

We've previously deemphasized the role of sorting in the keyed sequential file. Perhaps we'd better bring it back into perspective.

In the Merge operation we described above, it's likely that the Master File will always be in sequence. No need for sorting there. But the transactions are probably logged in as they arrive. They will be sorted into customer number order just before the mighty merge. But there's more.

The control break—the method whereby we group related records together and then summarize them—is so important that it's given rise to a whole class of programs: the "report generator." These are program systems prewritten to pick up control breaks and do the desired totaling. To use the power of a report generator program, we must sort our records according to the keys involved.

An example: Suppose we have sales records listing customer, salesman, sales office, date, amount, and product. Now, if you wish to analyze sales by product, here's what to do. Sort by product, and then use a report generator to summarize the file based on control breaks in the product number. Or if you want a report on each salesman's achievements, sort the records by salesman. Or by office, or by date, or by whatever you want to analyze. Once you know how to handle sequential file processing, you can pick over the data any way you want.

We leapt from simple file handling to the extraordinary power of control breaks and report generators. And yet it's all handled by the humble sequential file. Just a few simple coding rules will get you going. But the sky's the limit. ©

C. Regena

Foreign Languages

As you may already know, Texas Instruments has disbanded its home computer division. It's unfortunate that the TI-99/4A will no longer be manufactured and sold, because it's such a good computer.

However, there are still a lot of people out there who own TIs. I will keep writing and programming for the TI as long as there is a demand for it. Also, several third-party software companies have announced that they will continue to publish software as long as there is a market for it. If you are looking for further support, I suggest that you get involved with a local user group. If you are not aware of any in your area, or would like to start one, you may contact:

Charles LaFara
International 99/4A User Group
P.O. Box 67
Bethany, OK 73008

I have had several requests for programs for teaching or translating foreign languages. Letters have come from Southern California specifically requesting help in using Spanish accents and the tilde plus the opening exclamation and interrogation symbols.

In my high school days, we used headphones with an audio system that taught us a dialogue as we repeated phrases. With the TI computer and the Speech Synthesizer, you can imitate this. However, the computer adds branching capabilities to learning processes. The computer can determine when you are ready to continue to the next learning unit—or you can repeat one unit as long as you wish.

To use the Speech Synthesizer, you will need a command module that has speech capabilities. The Terminal Emulator II command module allows "unlimited" speech—there is no set vocabulary of words—so it is an ideal module for foreign speech. With the command module in place, press 1 for TI BASIC as usual (not 2 for the particular module). Any words that you want spoken you can spell phonetically in your program. Warning: Allow plenty of time to experiment with different sounds and spellings. The Spanish program included here presents the option to use speech.

To The Screen

Now to print the language on the screen. You probably noticed that the TI-99/4A keyboard has a tilde on one of the keys (FCTN W). It's the little curvy mark that belongs above the N in many Spanish words. The tilde is important enough in the language to change the pronunciation and the meaning of words. In Spanish writing you cannot just ignore the tilde or you may convey the wrong meaning. For example, Segundo P. I. Acuña writes, "A MONO is a MONKEY whereas a MOÑO is variously a bun, a crest, a chignon, a tuft.... You would wear a bun in your hair, but never a monkey!"

The problem with the tilde alone on a key is that it really should be above an N. To print an N with the tilde on the screen you need to print the tilde on one line, then the N directly below it. The solution is to design our own characters with the N and the tilde together and the accents with the appropriate vowels.

For this example program, I am leaving all the lowercase letters as is. (They really are small capital letters, not true lowercase letters, but it would take too much memory to redefine all of them to look like the normal lowercase letters.) To be able to print the N with the tilde and the vowels with the accent marks, I have redefined several characters.

In your own programming, choose regular characters between 33 and 127 that you would not otherwise be printing in the program. I chose to use Characters 91, 92, 93, and 94 for a, e, i, and o. I redefined the underline, Character 95, to be the ñ. I also redefined Character 35 to be the upside-down exclamation point and Character 36 to be the upside-down question mark. Later when you PRINT "$" you won't see the dollar sign, but the upside-down question mark.

If you have the TI Extended BASIC command module, you can find out how the computer defines the characters by using the CHARPAT function. Rather than draw my own little letters, I used Extended BASIC and my printer to print a list of the definitions. If you have a printer and Extended BASIC, you can try the following

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*Reflects $100 Atari Rebate

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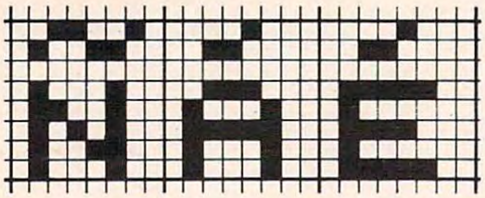
- Grave Robbers (C/D) ... $13
- Chomper Man (C/D) ... $18

program. Change line 100 for your own printer configuration.

```
100 OPEN #2:"RS232.BA=600"
110 PRINT #2:"CHARACTER","PATTERN CO
    DE": :
120 FOR N=33 TO 126
130 CALL CHARPAT(N,C$)
140 PRINT #2: :N;"    ";CHR$(N),C$
150 NEXT N
160 CLOSE #2
170 END
```

This program showed me that for the lowercase n, the character definition is 0000004464544C44. The next step was to get out the graph paper and draw a tilde above the given n:



The new character definition is 324C004464544C44. Similarly, you can draw the accents above the lowercase a, e, i, and o.

The redefined Spanish characters all have the accents going the same way. In French you will need the regular e plus é and è. In German you will need to define vowels with the umlaut marks above. (Sure, use the same idea for Chinese or Japanese characters—but I'll leave that up to you!)

The Special Characters

After you have redefined the characters in your program, you can print them on the screen—just remember which symbols correspond to which regular characters. For example, in the Spanish program, to print the word "niño", remember that the ñ is the underline (FCTN U) and use the command PRINT "ni_o". As you are programming, you will see the underline, but when the program is RUN, the underline will be redefined and you will see the ñ.

The main purpose of this Spanish program is to illustrate how to print the special characters. All of the Spanish is written with the lowercase letters—release the ALPHA LOCK key to type the lowercase letters. To type any symbols on the face of the keys, use FCTN and the key. Any phrase in a PRINT #1 statement is spoken with the Speech Synthesizer. You may want to experiment and change these pronunciations. If you do not have the Terminal Emulator II module or the Speech Synthesizer, make choice number 2 at the beginning of the program for no speech. The variable SP will then equal 2 and all commands involving speech will be by-passed.

The first part of the program draws pictures and shows the Spanish word or phrase. If you have speech, the computer will say the word or phrase and you may repeat it. If you want to hear the phrase again, press the space bar. To continue after each presentation, press the ENTER key. The last section of the program presents Spanish phrases with the English translation.

If you prefer to avoid the typing, you can receive a copy of "Spanish" by sending $3, a blank cassette or diskette, and a stamped, self-addressed mailer to:

C. Regena
P.O. Box 1502
Cedar City, Utah 84720

Program Explanation

110–200	Print title screen; define special Spanish characters.
210–250	Print option for speech and receive a 1 or 2. If "no speech" is chosen, SP will equal 2.
260–290	Print instructions.
300–310	If speech option is chosen, OPEN the device to allow speech. You must have the TI Speech Synthesizer and Terminal Emulator II to use speech.
320–370	Define graphics characters for characters numbered 128 to 137. Be sure to type all the commas as shown. If you RUN the program and get an error message for line 330 or 340, there is probably a typing error in lines 360–370.
380–390	Define colors for graphics.
400–420	Wait for user to press any key to begin.
430–570	Draw a boy on the screen and present the Spanish phrase for "I am a boy."
580–690	Draw a girl and say the phrase for a girl.
700–1470	Clear screen; draw face. CALL CHAR statements define graphics, and CALL HCHAR and CALL VCHAR statements draw on the screen. W$ contains the Spanish word to be printed. PRINT #1 statements use the speech synthesizer to say the word.
1480–1890	Present Spanish phrases with English translations.
1900–1950	Subroutine used for each word or phrase. If the space bar is pressed, R = 2 and the phrase is repeated. If ENTER is pressed, the program continues.
1960–1990	Subroutine to print the word on the screen without scrolling. W$ is the Spanish word, and X is the row for printing.
2000–2030	Clear screen; close speech device; end program.

Learning Spanish

```
100 REM  SPANISH
110 CALL CLEAR
120 PRINT TAB(10);"SPANISH"
130 CALL CHAR(95,"324C004464544C44"
    )
140 PRINT :TAB(10);"espa_ol"::::::
150 CALL CHAR(91,"08300038447C4444"
    )
160 CALL CHAR(92,"0830007C4078407C"
    )
170 CALL CHAR(93,"0830003810101038"
    )
180 CALL CHAR(94,"0830007C4444447C"
    )
190 CALL CHAR(35,"0010001010101010"
    )
200 CALL CHAR(36,"000800081020221C"
    )
```

```
210 PRINT "DO YOU HAVE THE SPEECH
    {6 SPACES}SYNTHESIZER AND":"TER
    MINAL EMULATOR II?"
220 PRINT :"  1 YES, INCLUDE SPEECH
    ":"  2 NO SPEECH"
230 CALL KEY(Ø,K,S)
240 IF (K<49)+(K>5Ø)THEN 23Ø
250 SP=K-48
260 CALL CLEAR
270 IF SP=2 THEN 29Ø
280 PRINT "PRESS THE SPACE BAR TO H
    EAR THE WORD OR PHRASE AGAIN.":
    ::
290 PRINT "PRESS <ENTER> TO CONTINU
    E":"AFTER EACH WORD OR PHRASE."
    :::
300 IF SP=2 THEN 32Ø
310 OPEN #1:"SPEECH",OUTPUT
320 FOR C=128 TO 137
330 READ C$
340 CALL CHAR(C,C$)
350 NEXT C
360 DATA 3C7EC3C3C3C37E3C,ØØØØØØFFF
    F,181818FFFF181818,181818181818
    3C3C,ØØØØØØØØØ1Ø1Ø3Ø2
370 DATA 6642C38181,ØØØØØØØØØ8Ø8ØCØ4
    ,Ø6Ø4ØC18387ØEØC,6Ø2Ø3Ø181CØEØ7
    Ø3,FFFFFFFFFFFFFFFF
380 CALL COLOR(13,5,1)
390 CALL COLOR(14,5,1)
400 PRINT "PRESS ANY KEY TO BEGIN."
410 CALL KEY(Ø,K,S)
420 IF S<1 THEN 41Ø
430 CALL CLEAR
440 CALL HCHAR(17,16,128)
450 CALL HCHAR(18,15,129,3)
460 CALL HCHAR(18,16,13Ø)
470 CALL HCHAR(19,16,131)
480 CALL HCHAR(2Ø,15,132)
490 CALL HCHAR(2Ø,16,133)
500 CALL HCHAR(2Ø,17,134)
510 CALL HCHAR(21,15,135)
520 CALL HCHAR(21,17,136)
530 PRINT TAB(9);"Soy un ni_o."
540 IF SP=2 THEN 56Ø
550 PRINT #1:"SOY UN ^NEEN YO."
560 GOSUB 19ØØ
570 IF R=2 THEN 54Ø
580 CALL COLOR(13,7,1)
590 CALL COLOR(14,7,1)
600 CALL CHAR(133,"7E7EFFFFFFFFFFFF
    ")
610 CALL CHAR(135,"Ø7Ø7ØF1F3F7FFFFF
    ")
620 CALL HCHAR(2Ø,16,137)
630 CALL CHAR(136,"EØEØFØF8FCFEFFFF
    ")
640 CALL HCHAR(23,11,32,12)
650 PRINT TAB(8);"Soy una ni_a."
660 IF SP=2 THEN 68Ø
670 PRINT #1:"SOY OONA ^NEEN YUH."
680 GOSUB 19ØØ
690 IF R=2 THEN 66Ø
700 CALL CLEAR
710 CALL CHAR(144,"EFDFFAA7FFEDFE7F
    ")
720 CALL CHAR(145,"8Ø4Ø2Ø1ØØ8Ø4Ø2Ø1
    ")
730 CALL CHAR(146,"Ø1Ø2Ø4Ø81Ø2Ø4Ø8"
    )
740 CALL CHAR(147,"FF")
750 CALL HCHAR(8,19,144,7)
760 CALL HCHAR(9,18,144)
770 CALL HCHAR(9,26,144)
780 CALL VCHAR(1Ø,17,144,8)
790 CALL VCHAR(1Ø,27,144,8)
800 CALL HCHAR(18,18,145)
810 CALL HCHAR(18,26,146)
820 CALL HCHAR(19,19,145)
830 CALL HCHAR(19,25,146)
840 CALL HCHAR(2Ø,2Ø,147,5)
850 PRINT TAB(17);"cabeza"
860 IF SP=2 THEN 88Ø
870 PRINT #1:"^CA BAY TSA."
880 GOSUB 19ØØ
890 IF R=2 THEN 86Ø
900 CALL CHAR(152,"ØF1Ø2Ø4Ø8Ø83878F
    ")
910 CALL CHAR(153,"FØØ8Ø4Ø2Ø1C1EØF1
    ")
920 CALL CHAR(154,"4F4F4F2F2F2F7Ø8"
    )
930 CALL CHAR(155,"F2F2F2F4F4F4Ø7Ø1
    ")
940 CALL COLOR(16,5,1)
950 FOR I=2Ø TO 23 STEP 3
960 CALL HCHAR(11,I,152)
970 CALL HCHAR(11,I+1,153)
980 CALL HCHAR(12,I,154)
990 CALL HCHAR(12,I+1,155)
1000 NEXT I
1010 W$="ojos"
1020 X=12
1030 GOSUB 196Ø
1040 IF SP=2 THEN 1Ø6Ø
1050 PRINT #1:"^O HOES."
1060 GOSUB 19ØØ
1070 IF R=2 THEN 1Ø4Ø
1080 CALL CHAR(136,"ØØØ4Ø4Ø8Ø81Ø1Ø2
     ")
1090 CALL CHAR(137,"2Ø4Ø4Ø8Ø8Ø8C936
     ")
1100 CALL COLOR(14,1Ø,1)
1110 CALL HCHAR(13,22,136)
1120 CALL HCHAR(14,22,137)
1130 W$="nariz"
1140 X=14
1150 GOSUB 196Ø
1160 IF SP=2 THEN 12ØØ
1170 PRINT #1:" NAR ^DHIZ."
1180 GOSUB 19ØØ
1190 IF R=2 THEN 116Ø
1200 CALL CHAR(128,"2Ø4ØAØ1ØØ8Ø6Ø1"
     )
1210 CALL CHAR(129,"ØØØØØØØØØØØØ817
     E")
1220 CALL CHAR(13Ø,"Ø4Ø2Ø5Ø81Ø6Ø8")
1230 CALL HCHAR(16,21,128)
1240 CALL HCHAR(16,22,129)
1250 CALL HCHAR(16,23,13Ø)
1260 W$="boca"
1270 X=16
1280 GOSUB 196Ø
1290 IF SP=2 THEN 131Ø
1300 PRINT #1:"^BO CA."
1310 GOSUB 19ØØ
1320 IF R=2 THEN 129Ø
1330 CALL CHAR(148,"ØØØØØØC4222222
     2")
1340 CALL CHAR(149,"ØØØØØØ6Ø1Ø1Ø1Ø2
     ")
```

```
1350 CALL CHAR(150,"0000000060808080
     4")
1360 CALL CHAR(151,"0000000304244444
     4")
1370 CALL HCHAR(10,20,148)
1380 CALL HCHAR(10,21,149)
1390 CALL HCHAR(10,23,150)
1400 CALL HCHAR(10,24,151)
1410 W$="pestu_a"
1420 X=10
1430 GOSUB 1960
1440 IF SP=2 THEN 1460
1450 PRINT #1:"PES ^TUNE YA."
1460 GOSUB 1900
1470 IF R=2 THEN 1440
1480 CALL CLEAR
1490 PRINT "Buenos dJas, se_or."::"
     Good day, Sir."
1500 IF SP=2 THEN 1520
1510 PRINT #1:"^BWAY NOSE THEE AS,
     _SEEN YOR."
1520 GOSUB 1900
1530 IF R=2 THEN 1500
1540 PRINT ::"Buenas tardes, se_ora
     ."::"Good afternoon, Madam."
1550 IF SP=2 THEN 1570
1560 PRINT #1:"^BWAY NAS. TAR DES,
     ^SEEN _YO RA."
1570 GOSUB 1900
1580 IF R=2 THEN 1550
1590 PRINT ::"Buenas noches, se_ori
     ta."::"Good evening, Miss."
1600 IF SP=2 THEN 1620
1610 PRINT #1:"^BWAY NAS NO CHES, _
     SEEN YO _REE TA."
1620 GOSUB 1900
1630 IF R=2 THEN 1600
1640 PRINT :::"$Habla usted espa_ol
     ?"::" Do you speak Spanish?"
1650 IF SP=2 THEN 1670
1660 PRINT #1:"^ABLA OO _STED _S PA
     N YOLE?"
1670 GOSUB 1900
1680 IF R=2 THEN 1650
1690 PRINT :::"#Yo hablo espa_ol!":
     :" I speak Spanish!"
1700 IF SP=2 THEN 1720
1710 PRINT #1:"^YO ABLO _S PAN YOLE
     !"
1720 GOSUB 1900
1730 IF R=2 THEN 1700
1740 PRINT ::::"$C^mo est[ usted?":
     :" How are you?"
1750 IF SP=2 THEN 1770
1760 PRINT #1:"^COE MOE  _S TAW  _U
     _STED?"
1770 GOSUB 1900
1780 IF R=2 THEN 1750
1790 PRINT :::"No s\."::"I do not k
     now."
1800 IF SP=2 THEN 1820
1810 PRINT #1:"^NO SAY."
1820 GOSUB 1900
1830 IF R=2 THEN 1800
1840 PRINT ::::"#Adi^s!"::"Good bye
     !":::
1850 IF SP=2 THEN 1870
1860 PRINT #1:"^AWDHEE OSE!"
1870 GOSUB 1900
1880 IF R=2 THEN 1850
1890 GOTO 2000
1900 R=1
1910 CALL KEY(0,K,S)
1920 IF K=13 THEN 1950
1930 IF K<>32 THEN 1910
1940 R=2
1950 RETURN
1960 FOR I=1 TO LEN(W$)
1970 CALL HCHAR(X,4+I,ASC(SEG$(W$,I
     ,1)))
1980 NEXT I
1990 RETURN
2000 CALL CLEAR
2010 IF SP=2 THEN 2030
2020 CLOSE #1
2030 END
```
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64 EXPLORER

Larry Isaacs

First let's finish up the topic of last month's column: how to take advantage of the graphics features found in most dot-matrix printers. We offered a BASIC program which output a graphics image copy of the 64's character generator ROM to my NEC-8023, but that output was quite slow. As promised, here's a faster version which makes use of machine language.

Subroutine Changes

There are a few changes in operation. First, the subroutine beginning at line 200 now copies the entire character ROM contents to a buffer at 36608 ($8F00). The old version copied only eight bytes and stored them in an array called SA.

Another change is that the subroutine beginning at line 300 now uses the USR function to call a machine language graphics output routine. It accepts a pointer to an eight-byte character cell and outputs the appropriate graphics bytes over logical channel 4. Last month's version output the bytes contained in the SA array.

The machine language routine rearranges the bits in the same way as the old version, but much faster, however. Errors that occur within the machine language routine are handled by returning the error code as the value of the USR function. A value of zero is returned if the eight-byte cell is output successfully. With some simple changes, the routine could be modified to rearrange the bits appropriately for other printers. This would be a good exercise for someone just learning machine language.

The program now takes approximately one minute to run, with half the time spent copying the character generator ROM to memory, and the other half printing it.

Checksum Routine

When entering the program, use the following procedure to insure the DATA statements are correct. Type in lines 10–90, except for line 40. Next, enter the DATA statements at the end of the program (lines 10000–10100). Now add the following lines and save a copy of the test program to play it safe:

```
100 TL=0:FOR I=0 TO 81
110 TL=TL+PEEK(40704+I)
120 T=INT((I+1)/8)*8-1
130 IF T=I THEN PRINT TL,:TL=0
140 NEXT I:PRINT TL
```

When you RUN the test program, the following numbers should be printed:

468	962	1117	1086
699	1041	1270	1241
905	165	0	

These are checksums of the numbers in each DATA statement, printed left to right. If one of your printed checksum numbers is different from those above, check the associated DATA statement for incorrectly entered numbers. Once these numbers check out, you can type the rest of the program.

Creating Useful Graphics

In my example program, I print out the character ROM for demonstration purposes. This is because creating a useful graphics screen image in BASIC is a complex task that would warrant a separate article (or two) and I want to keep the example programs simple.

However, being able to create your own graphics is prerequisite to putting the graphics features of your printer to best use. This means you need routines to set up and draw onto a graphics screen. BASIC is inefficient for this task, especially in terms of speed. Using machine language routines is better. An even better alternative would be to use one of the BASIC enhancement programs which adds a set of graphics commands. This allows you to access machine language drawing routines without resorting to SYS and USR. Instead, you use commands like MOVE and DRAW, making the programs much more readable.

The following is a review of one such BASIC enhancement program. There are others, so be sure to shop around to see what is available.

Ultrabasic-64

Written by Roy Wainwright, *Ultrabasic-64* is available from Abacus Software. It comes on tape for $39.95, or on disk for $42.95. *Ultrabasic-64* offers enhanced BASIC commands for controlling sound as well as graphics.

The program supports both the standard and multicolor bitmapped graphics modes provided by the 64 video chip. To set up a graphics display, you first initialize the graphics screen with either a HIRES or a MULTI command. The HIRES command sets up a standard bitmapped screen, and MULTI sets up a multicolor bitmapped screen.

Once you set up a graphics screen, you can switch between the graphics screen and normal program text display with the GRAPH and NORM commands. If you are in the direct command mode, you can switch to the graphics screen with the f5 function key, and back to the normal screen with the f7 function key.

Drawing Commands

To manipulate the graphics screen, you have three sets of commands at your disposal. There is a set of commands which performs normal line and dot plotting. This set includes DOT, DRAW, BOX, CIRCLE, CHAR, BLOCK, FILL, TIC, MODE, and PIXEL. Another set of commands provides for doing turtle graphics. These commands include TURTLE, TCOLOR, TUP, TDOWN, TURN, TURNTO, MOVE, BYE, and TPOS. The third set of commands performs sprite manipulation. The commands are COPY, SPRITE, OFF, PLACE, and ROTATE. Associated with the sprite commands are some special commands like DATA statements which provide a choice of methods to specify the sprite data. These special commands are BIT, HEX, SDATA, and COLORS.

Sounds And Games

In addition to the graphics commands, there is a set of commands for controlling the SID sound chip on the 64. These commands include SOUND, GET, VOL, SET, and TUNE. The GEN and VOL commands are used to set up the hardware, with SOUND and TUNE making the sounds. The SOUND command plays a single note or sound of a specified pitch and duration. The TUNE command plays a tune selected by the SET command. The tune itself is specified by the data string in a TDATA statement.

Ultrabasic-64 also has commands to help with game applications. These include JOY, PADDLE, and PEN to access the joystick, paddle, and light pen. (Note: The PEN command simply reads the light pen registers. It makes no assumption or mention of what hardware is required to make it functional.) There are two commands, SCOLL and BCOLL, for detecting collisions between sprites and other sprites or with the background. Also implemented are ten countdown timers. These are initially set with an SCTR command. The current count of the timer can be read with a CTR( ) function. The first four of these timers count in jiffies (1/60 second); the others count in seconds.

There are a few other miscellaneous utility commands provided to fill out the set. The [N...] command implements a repeat loop, and the EXIT command provides forced exit from the loop. Essentially, all commands (including normal BASIC commands) found between the [N and the] will be executed N times, provided an EXIT isn't encountered at some earlier point. The N may be any expression specifying how many times to repeat the loop. These two commands are primarily intended to enhance the turtle graphics commands.

There are DUMP and GREAD commands for writing and reading back the graphics screen. There is also a HARD command which prints the graphics image to your graphics printer. My review copy supports only the Commodore 1515 or 1525 and the Epson MX-80 or FX-80 printers. I would imagine that by the time you read this, others will be supported as well.

Documentation And Examples

Accompanying *Ultrabasic-64* on the disk or tape are a demo program and a tutorial program in two parts. These programs are intended to supply you with plenty of examples. The reference manual is fairly complete. I had no trouble understanding how to use the various commands.

Ultrabasic-64 adds quite a lot to BASIC. This, of course, does not come without penalty. With *Ultrabasic-64* running, you are left with a maximum of 21245 bytes free. This is a rather substantial reduction from the usual 38909 bytes free. About half of the memory taken is used by machine language added to the BASIC interpreter. The other half is taken up by various RAM storage areas for sprites, screen memory, etc. With only 21245 bytes available, *Ultrabasic-64* is not appropriate for applications which require a large program or a large amount of data storage.

Compatibility Questions

While on the topic of enhancement programs, I might as well say a few words about compatibility. There are essentially two ways for an enhancement program to attach its machine language onto the BASIC interpreter. One way is for the enhancement to actually make its machine language a part of the interpreter. This is what *Ultrabasic-64* does. Once operational, the new commands are as much a part of BASIC as the standard commands.

The second way for an enhancement program to attach to BASIC is to modify the CHRGET routine which BASIC uses to fetch the bytes of the program. By linking into the CHRGET routine, the enhancement can preexamine what BASIC is trying to execute, and steal any of the enhancement commands. These enhancement commands are executed and the command characters in the program are skipped over, so that BASIC never realizes they were in the program. The DOS Wedge uses this method.

As you might expect, *Ultrabasic-64* and the DOS Wedge will work together without a hitch. However, with other combinations of enhance-

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ment programs you may not be that lucky. Essentially, only one enhancement program will be able to use the first method at one time. More than one program can use the second method at a time, provided they don't make the modification at the same place, or can handle the situation in which a modification is already present in a desired location.

In addition to conflicts in attaching to BASIC, there may be conflicts in RAM usage as well. If documentation permits, you should try to determine if there is any memory usage conflict. Of course, the best way to determine if two enhancements are compatible is to try them out together.

Next Month

Sales figures show that a high percentage of you with 64s have also purchased at least one disk drive. In light of this, and the requests I've received for more information about the 1541 disk drive, I will try to cover this topic in the next column.

Graphics Demonstration Program

```
10 REM PROGRAM TO PRINT CHAR ROM IMAGE
20 REM RESERVE SOME MEMORY
30 POKE 55,0:POKE 56,143:CLR
40 OPEN 4,4,5
50 REM INSTALL MACHINE CODE
60 FOR I=0 TO 81
70 READ BY:POKE 40704+I,BY:NEXT
80 REM SET USR VECTOR
90 POKE 785,0:POKE 786,159:GOTO 1000
100 REM ENABLE GR. MODE FOR N CHARS
110 N$=STR$(N):N$=RIGHT$(N$,LEN(N$)-1)
120 N$=LEFT$("0000",4-LEN(N$))+N$
130 PRINT#4,CHR$(27);"S";N$;
140 RETURN
200 REM COPY CHAR. ROM TO MEMORY AT BF
210 PRINT "COPYING CHAR. ROM TO MEMORY"
220 POKE 56334,PEEK(56334) AND 254
230 POKE 1,PEEK(1) AND 251
240 FOR I=0 TO 4095
250 POKE BF+I,PEEK(CP+I):NEXT
260 POKE 1,PEEK(1) OR 4
270 POKE 56334,PEEK(56334) OR 1
280 RETURN
300 REM PRINT 8 BYTE CELL AT CP
310 T=CP+(CP>=32768)*65536
320 IF USR(T)=0 THEN RETURN
330 PRINT "ERROR OUTPUTTING TO PRINTER"
340 CLOSE 4:STOP
1000 REM THE MAIN ROUTINE
1010 PRINT#4,CHR$(27);"T16";
1020 N=16*8:CP=53248
1030 BF=36608:GOSUB 200:REM COPY ROM
1040 CP=BF:REM SET CP
1050 PRINT "PRINTING THE ROM CONTENTS"
1060 FOR L=1 TO 32:REM PRINT 32 LINES
1070 GOSUB 100
1080 FOR G=1 TO 16:REM 16 GROUPS/LINE
1090 GOSUB 300:CP=CP+8:NEXT G
1100 PRINT#4:NEXT L
1110 PRINT#4,CHR$(27);"A";
1120 CLOSE 4
1130 END
10000 DATA 76,9,159,108,3,0,108,5
10010 DATA 0,32,3,159,132,251,133,252
10020 DATA 160,7,177,251,153,74,159,136
10030 DATA 16,248,162,4,32,201,255,168
10040 DATA 176,32,169,0,160,0,162,0
10050 DATA 30,74,159,106,232,224,8,208
10060 DATA 247,32,210,255,165,144,208,9
10070 DATA 200,192,8,208,233,160,0,240
10080 DATA 1,168,32,204,255,169,0,76
10090 DATA 6,159,0,0,0,0,0,0
10100 DATA 0,0
```

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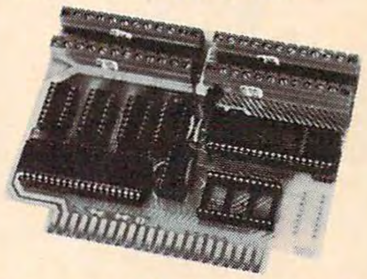

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Dr. Video 64

David W. Martin

The cursor control keys on your 64 already give you some of the most powerful screen editing capabilities of any home computer, but this utility adds even more: clear screen below the cursor, clear screen above the cursor, and "home" the cursor to the bottom left of the screen, all at machine language speed.

While revising long programs or doing repeated numerical calculations in immediate mode, it is often useful to be able to clear a portion of the screen display while leaving the rest intact. It is also useful at times to be able to "home" the cursor to the lower left of the screen instead of the usual upper-left position.

Although Commodore built excellent screen editing features into the 64, "Dr. Video 64" adds even more flexibility by giving you three additional cursor control keys. A special technique allows Dr. Video to function even while you are typing or running another program. Since the program is written entirely in machine language, it doesn't take up any of the memory normally used for BASIC programming.

The new cursor control features are assigned to three of the 64's special function keys. The assignments are as follows:

- **f1** Clear display to the top of the screen starting with the line containing the cursor.
- **f3** Clear display to the bottom of the screen starting with the line containing the cursor.
- **f5** Move the cursor to the lower-left corner of the screen.

How The Doctor Operates

Every 1/60 second your 64 stops whatever it is doing and takes some time out to read the keyboard and perform other housekeeping tasks. These breaks are called *interrupts,* and the machine language program which runs during this interrupt period is called the interrupt service routine. When the microprocessor receives the interrupt request (IRQ) signal, it looks at a pair of memory locations to find the starting address (called the IRQ vector) of the interrupt service routine to be executed. On the 64, the IRQ vector is contained in locations 788 and 789, which normally point to address 59953, the beginning of the standard IRQ SERVICE ROUTINE IN ROM (unchanging memory). However, since the IRQ vector is stored in RAM, changeable memory, we can substitute the address of our own machine language subroutine and add it to the normal interrupt service routine.

Like all interrupt-driven routines, Dr. Video 64 continues to run until you reset the computer (by hitting the RUN/STOP and RESTORE combination, for example). It is not disabled by hitting just the STOP key. After a reset, you can reactivate the new screen editing keys by typing SYS 49152.

Typing In The Program

Dr. Video is a machine language program which uses a BASIC loader to POKE the data into memory and issue the SYS to start it running. A checksum is calculated to assist in detecting typing errors in the DATA statements, but since the loader program NEWs itself out of the BASIC memory area, you should be careful to SAVE a copy before RUNning for the first time.

Dr. Video 64

```
200 FORI=0TO148
210 READJ:POKE49152+I,J:X=X+J:NEXTI
230 IFX<>17524THENPRINT"ERROR IN DATA":ST
    OP
240 SYS49152:NEW
300 DATA120,169,13,141,20,3,169,192,141,2
    1,3,88,96,165,197,41
310 DATA127,201,4,208,27,169,0,133,25,169
    ,4,133,26,216,24,165
320 DATA209,105,40,133,27,165,210,133,28,
    144,2,230,28,24,144,46
330 DATA165,197,41,127,201,5,208,19,165,2
    09,133,25,165,210,133,26
340 DATA169,231,133,27,169,7,133,28,24,14
    4,19,201,6,208,67,169
350 DATA192,133,209,169,7,133,210,169,24,
    133,214,24,144,44,216,56
360 DATA165,27,229,25,133,29,165,28,229,2
    6,133,30,169,32,166,30
370 DATA240,12,160,0,145,25,200,208,251,2
    30,26,202,208,246,166,29
380 DATA240,8,160,0,145,25,200,202,208,25
    0,169,0,133,211,169,32
390 DATA133,197,76,49,234
```

©

A Beginner's Guide To Typing In Programs

What Is A Program?

A computer cannot perform any task by itself. Like a car without gas, a computer has *potential*, but without a program, it isn't going anywhere. Most of the programs published in **COMPUTE!** are written in a computer language called BASIC. BASIC is easy to learn and is built into most computers (on some computers, you have to purchase an optional BASIC cartridge).

BASIC Programs

Each month, **COMPUTE!** publishes programs for many machines. To start out, type in only programs written for your machine, e.g., "TI Version" if you have a TI-99/4. Later, when you gain experience with your computer's BASIC, you can try typing in and converting certain programs from one computer to yours.

Computers can be picky. Unlike the English language, which is full of ambiguities, BASIC usually has only one "right way" of stating something. Every letter, character, or number is significant. A common mistake is substituting a letter such as "O" for the numeral "0", a lowercase "l" for the numeral "1", or an uppercase "B" for the numeral "8". Also, you must enter all punctuation such as colons and commas just as they appear in the magazine. Spacing can be important. To be safe, type in the listings *exactly* as they appear.

Brackets And Special Characters

The exception to this typing rule is when you see the curved bracket, such as "{DOWN}". Anything within a set of brackets is a special character or characters that cannot easily be listed on a printer. When you come across such a special statement, refer to the appropriate key for your computer. For example, if you have an Atari, refer to the "Atari" section in "How to Type COMPUTE!'s Programs "

About DATA Statements

Some programs contain a section or sections of DATA statements. These lines provide information needed by the program. Some DATA statements contain actual programs (called machine language); others contain graphics codes. These lines are especially sensitive to errors.

If a single number in any one DATA statement is mistyped, your machine could "lock up," or "crash." The keyboard, break key, and RESET (or STOP) keys may all seem "dead," and the screen may go blank. Don't panic – no damage is done. To regain control, you have to turn off your computer, then turn it back on. This will erase whatever program was in memory, so always SAVE a copy of your program before you RUN it. If your computer crashes, you can LOAD the program and look for your mistake.

Sometimes a mistyped DATA statement will cause an error message when the program is RUN. The error message may refer to the program line that READs the data. *The error is still in the DATA statements, though.*

Get To Know Your Machine

You should familiarize yourself with your computer before attempting to type in a program. Learn the statements you use to store and retrieve programs from tape or disk. You'll want to save a copy of your program, so that you won't have to type it in every time you want to use it. Learn to use your machine's editing functions. How do you change a line if you made a mistake? You can always retype the line, but you at least need to know how to backspace. Do you know how to enter inverse video, lowercase, and control characters? It's all explained in your computer's manuals.

A Quick Review

1) Type in the program a line at a time, in order. Press RETURN or ENTER at the end of each line. Use backspace or the back arrow to correct mistakes.

2) Check the line you've typed against the line in the magazine. You can check the entire program again if you get an error when you RUN the program.

3) Make sure you've entered statements in brackets as the appropriate control key (see "How To Type COMPUTE!'s Programs" elsewhere in the magazine.)

We regret that we are no longer able to respond to individual inquiries about programs, products, or services appearing in **COMPUTE!** *due to increasing publication activity. On those infrequent occasions when a published program contains a typo, the correction will appear on the CAPUTE! page, usually within eight weeks. If you have specific questions about items or programs which you've seen in* **COMPUTE!**, *please send them to Readers Feedback, P.O. Box 5406, Greensboro, NC 27403.* ©

How To Type COMPUTE!'s Programs

Many of the programs which are listed in **COMPUTE!** contain special control characters (cursor control, color keys, inverse video, etc.). To make it easy to tell exactly what to type when entering one of these programs into your computer, we have established the following listing conventions. There is a separate key for each computer. Refer to the appropriate tables when you come across an unusual symbol in a program listing. If you are unsure how to actually enter a control character, consult your computer's manuals.

Atari 400/800

Characters in inverse video will appear like: INVERSE VIDEO
Enter these characters with the Atari logo key, {⅄}.

When you see	Type	See	
{CLEAR}	ESC SHIFT <	↖	Clear Screen
{UP}	ESC CTRL -	↑	Cursor Up
{DOWN}	ESC CTRL =	↓	Cursor Down
{LEFT}	ESC CTRL +	←	Cursor Left
{RIGHT}	ESC CTRL *	→	Cursor Right
{BACK S}	ESC DELETE		Backspace
{DELETE}	ESC CTRL DELETE		Delete character
{INSERT}	ESC CTRL INSERT		Insert character
{DEL LINE}	ESC SHIFT DELETE		Delete line
{INS LINE}	ESC SHIFT INSERT		Insert line
{TAB}	ESC TAB		TAB key
{CLR TAB}	ESC CTRL TAB		Clear tab
{SET TAB}	ESC SHIFT TAB		Set tab stop
{BELL}	ESC CTRL 2		Ring buzzer
{ESC}	ESC ESC		ESCape key

Graphics characters, such as CTRL-T, the ball character ● will appear as the "normal" letter enclosed in braces, e.g. {T}.

A series of identical control characters, such as 10 spaces, three cursor-lefts, or 20 CTRL-R's, will appear as {10 SPACES}, {3 LEFT}, {20 R}, etc. If the character in braces is in inverse video, that character or characters should be entered with the Atari logo key. For example, {♥} means to enter a reverse-field heart with CTRL-comma, {5U} means to enter five inverse-video CTRL-U's.

Commodore PET/CBM/VIC/64

Generally, any PET/CBM/VIC/64 program listings will contain words within braces which spell out any special characters: {DOWN} would mean to press the cursor down key. {5 SPACES} would mean to press the space bar five times.

To indicate that a key should be *shifted* (hold down the SHIFT key while pressing the other key), the key would be underlined in our listings. For example, S would mean to type the S key while holding the shift key. If you find an underlined key enclosed in braces (e.g., {10 N}), you should type the key as many times as indicated (in our example, you would enter ten shifted N's). Some graphics characters are inaccessible from the keyboard on CBM Business models (32N, 8032).

For the VIC and 64, if a key is enclosed in special brackets, ⌊ ⌋, you should hold down the *Commodore key* while pressing the key inside the special brackets. (The Commodore key is the key in the lower left corner of the keyboard.) Again, if the key is preceded by a number, you should press the key as many times as indicated.

Rarely, you'll see in a Commodore 64 program a solitary letter of the alphabet enclosed in braces. These characters can be entered by holding down the CTRL key while typing the letter in the braces. For example, {A} would indicate that you should press CTRL-A.

About the *quote mode*: you know that you can move the cursor around the screen with the CRSR keys. Sometimes a programmer will want to move the cursor under program control. That's why you see all the {LEFT}'s, {HOME}'s, and {BLU}'s in our programs. The only way the computer can tell the difference between direct and programmed cursor control is the quote mode.

Once you press the quote (the double quote, SHIFT-2), you are in the quote mode. If you type something and then try to change it by moving the cursor left, you'll only get a bunch of reverse-video lines. These are the symbols for cursor left. The only editing key that isn't programmable is the DEL key; you can still use DEL to back up and edit the line. Once you type another quote, you are out of quote mode.

You also go into quote mode when you INSerT spaces into a line. In any case, the easiest way to get out of quote mode is to just press RETURN. You'll then be out of quote mode and you can cursor up to the mistyped line and fix it.

Use the following tables when entering special characters:

When You Read:	Press:		See:	When You Read:	Press:		See:
{CLEAR}	SHIFT	CLR/HOME		{GRN}	CTRL	6	
{HOME}		CLR/HOME		{BLU}	CTRL	7	
{UP}	SHIFT	↑CRSR↓		{YEL}	CTRL	8	
{DOWN}		↑CRSR↓		{F1}	f1		
{LEFT}	SHIFT	←CRSR→		{F2}	f2		
{RIGHT}		←CRSR→		{F3}	f3		
{RVS}	CTRL	9		{F4}	f4		
{OFF}	CTRL	0		{F5}	f5		
{BLK}	CTRL	1		{F6}	f6		
{WHT}	CTRL	2		{F7}	f7		
{RED}	CTRL	3		{F8}	f8		
{CYN}	CTRL	4		←	←		
{PUR}	CTRL	5		↑	SHIFT	↑	

All Commodore Machines

Clear Screen	{CLR}	Cursor Left	{LEFT}
Home Cursor	{HOME}	Insert Character	{INST}
Cursor Up	{UP}	Delete Character	{DEL}
Cursor Down	{DOWN}	Reverse Field On	{RVS}
Cursor Right	{RIGHT}	Reverse Field Off	{OFF}

Apple II / Apple II Plus

All programs are in Applesoft BASIC, unless otherwise stated. Control characters are printed as the "normal" character enclosed in brackets, such as {D} for CTRL-D. Hold down CTRL while pressing the control key. You will not see the special character on the screen.

Texas Instruments 99/4

The only special characters used are in PRINT statements to indicate where two or more spaces should be left between words. For example, ENERGY {10 SPACES} MANAGEMENT means that ten spaces should be left between the words ENERGY and MANAGEMENT. Do not type in the braces or the words 10 SPACES. Enter all programs with the ALPHA LOCK on (in the down position). Release the ALPHA LOCK to enter lowercase text.

CAPUTE!

Modifications Or Corrections To Previous Articles

Chopperoids

Here's how to produce a working version of the "Chopperoids" game described in the December 1983 issue (p. 122):

1. Load the MLX program shown on p. 216 of the December issue.
2. Add or change the following lines in the MLX program. (Note: These changes are for fixing Chopperoids only; they do *not* alter the MLX program. Be sure not to make any permanent changes to MLX.)

For tape users:

```
940 CLOSE #2:TRAP 32767:? "Finished.":?
950 IF NOT READ THEN END
955 BUFFER$(FIN-BEG+24)=CHR$(0):BUFFER$(
    25)=BUFFER$(55):LET READ=0:GOTO 360
```

For disk users:

```
1185 BUFFER$(31)=BUFFER$(61)
```

3. RUN MLX using the starting, ending, and run/init addresses specified in the Chopperoids article. Disk users should again choose to make a boot disk. Use the MLX Load function (CTRL-L) to load the Chopperoids data from the December issue. If you use the Display command (CTRL-D), you will see that all the data has been moved up five lines. That is, the data in lines 3584-3608 has been eliminated, so the data formerly at line 3614 is now at line 3584, and so forth.
4. Use the MLX New Address command (CTRL-N) to begin typing at line 6092. Add the following lines:

```
6092:197,020,208,252,169,000,026
6098:133,148,076,146,023,160,128
6104:005,166,142,169,000,157,087
6110:130,025,232,136,208,249,178
6116:141,005,208,141,006,208,169
6122:096,000,000,000,000,000,074
```

5. After you type the last line, MLX should create a boot tape or disk which is a working version of Chopperoids.

Atari Gas Mileage

In the Atari version of this utility from the December 1983 issue (p. 86), delete lines 280, 290, and 450 and change the following lines:

```
270 ? "{CLEAR}"
440 A=130-MG*2
```

TI Get The Gold

To load Program 2 of this two-part game from the December issue (p. 132), type in NEW, then OLD CS1. Reader Mark Leair suggests these improvements, which allow Program 1 to load Program 2:

For console BASIC:

```
790 PRINT "loading":"After load type RUN
    then Enter"
800 OPEN #1:"CS1",INTERNAL,OUTPUT,FIXED
810 CLOSE #1
```

For Extended BASIC:

```
790 PRINT "Loading"
800 RUN "CS1"
810 REM
```

Goodbye Charlie For 64 And VIC

In both these versions of this game from the November 1983 issue (p. 68), change the S=CS+10 in line 515 to SC=SC+10.

64 Crazy Climber

The logical AND in line 1440 of this game from the November 1983 issue (p. 80) should be replaced with an OR.

64 Sound Tester

The final Release stage of the ADSR envelopes generated in this program (November 1983, p. 187) is not realized because the program ends each note by POKEing the frequency to zero rather than by turning off the gate bit. To correct this, change the POKE W, in lines 250–280 to X= and change the following lines:

```
310 FORI=1TO15STEP2: POKEW,X: POKEHF,SO((
    I,A(2)): POKELF,SO(I+1,A(2))
311 O=O+1: FORN=1TOD(0): NEXT: POKEW,X-1:
    NEXT: FORI=1TO10000: NEXT
```

Then eliminate the NEXT in line 315. The new FOR-NEXT loop in 311 allows time for the Release to be heard at the end of the tune. Our thanks to Arthur Hunkins for this correction.

Stock Market Analyzer For VIC/64 And Atari

In both versions of this utility from the November 1983 issue (p. 54), the following line must be changed to plot stock prices higher than $10 per share:

```
620 FORT=1TOINT(15/HI*TP(X)):PRINT"{UP}";
    :NEXTT
```

In line 652 of the VIC/64 version, insert a colon after the first semicolon.

Timex/Sinclair Making Change

A typographical error in the machine language loader (Program 1) for this article from the September 1983 issue (p. 252) causes the program to crash. The twentieth character in A$ in line 20 should be 8 rather than 6. ©

COMPUTE! Back Issues

Here are some of the applications, tutorials, and games from available back issues of COMPUTE!. Each issue contains much, much more than there's space here to list, but here are some highlights:

Home and Educational COMPUTING! (Fall 1981 and Summer 1981 — count as one back issue): Exploring The Rainbow Machine, VIC As Super Calculator, Custom Characters On The VIC, Alternative Screens, Automatic VIC Line Numbers, Using The Joystick (Spacewar Game), Fast VIC Tape Locater, Window, VIC Memory Map.

May 1981: Named GOSUB/GOTO in Applesoft, Generating Lower Case Text on Apple II, Copy Atari Screens to the Printer, Disk Directory Printer for Atari, Realtime Clock on Atari, PET BASIC Delete Utility, PET Calculated Bar Graphs, Running 40 Column Programs on a CBM 8032, A Fast Visible Memory Dump, Cassette Filing System, Getting To A Machine Language Program, Epidemic Simulation.

June 1981: Computer Using Educators (CUE) on Software Pricing, Apple II Hires Character Generator, Ever Expanding Apple Power, Color Burst for Atari, Mixing Atari Graphics Modes 0 and 8, Relocating PET BASIC Programs, An Assembler In BASIC for PET, Quadra PET: Multitasking?, Mapping Unknown Machine Language, RAM/ROM Memory, Keeping TABs on a Printer.

July 1981: Home Heating and Cooling, Animating Integer BASIC Lores Graphics, The Apple Hires Shape Writer, Adding a Voice Track to Atari Programs, Machine Language Atari Joystick Driver, Four Screen Utilities for the PET, Saving Machine Language Programs on PET Tape Headers, Commodore ROM Systems, Using TAB, SPC, And LEN.

August 1981: Minimize Code and Maximize Speed, Apple Disk Motor Control, A Cassette Tape Monitor for the Apple, Easy Reading of the Atari Joystick, Blockade Game for the Atari, Atari Sound Utility, The CBM "Fat 40," Keyword for PET, CBM/PET Loading, Chaining, and Overlaying, Adding A Programmable Sound Generator, Converting PET BASIC Programs To ASCII Files.

October 1981: Automatic DATA Statements for CBM and Atari, VIC News, Undeletable Lines on Apple, PET, and VIC; Budgeting on the Apple, Atari Cassette Boot-tapes, Atari Variable Name Utility, Atari Program Library, Train Your PET to Run VIC Programs, Interface a BSR Remote Control System to PET, A General Purpose BCD to Binary Routine, Converting to Fat-40 PET.

December 1981: Saving Fuel $$ (multiple computers), Unscramble Game (multiple computers), Maze Generator (multiple computers), Animating Applesoft Graphics, A Simple Atari Word Processor, Adding High Speed Vertical Positioning to Atari P/M Graphics, OSI Supercursor, A Look At SuperPET, Supermon for PET/CBM, PET Mine Maze Game, Replacing The INPUT# Command, Foreign Language Text on The Commodore Printer, File Recovery.

January 1982: Invest (multiple computers), Developing a Business Algorithm (multiple computers), Apple Addresses, Lowercase with Unmodified Apple, Cryptogram Game for Atari, Superfont: Design Special Character Sets on Atari, PET Repairs for the Amateur, Micromon for PET, Self-modifying Programs in PET BASIC, Tinymon: a VIC Monitor, VIC Color Tips, VIC Memory Map, ZAP: A VIC Game.

May 1982: VIC Meteor Maze Game, Atari Disk Drive Speed Check, Modifying Apple's Floating Point BASIC, Fast Sort For PET/CBM, Extra Atari Colors Through Artifacting, Life Insurance Estimator (multiple computers), PET Screen Input, Getting The Most Out Of VIC's 5000 Bytes.

August 1982: The New Wave Of Personal Computers, Household Budget Manager (multiple computers), Word Games (multiple computers), Color Computer Home Energy Monitor, A VIC Light Pen For Under $10, Guess That Animal (multiple computers), PET/CBM Inner BASIC, VIC Communications, Keyprint Compendium, Animation With Atari, VIC Curiosities, Atari Substring Search, PET and VIC Electric Eraser.

September 1982: Apple and Atari and the Sounds of TRON, Commodore Automatic Disk Boot, VIC Joysticks, Three Atari GTIA Articles, Commodore Disk Fixes, The Apple Pilot Language, Sprites and Sound on the Commodore 64, Peripheral Vision Exerciser (multiple computers), Banish INPUT Statements (multiple computers),

COMPUTE! Back Issues

Charades (multiple computers), PET Pointer Sort, VIC Pause, Mapping Machine Language, Commodore User-defined Functions Defined, A VIC Bug.

January 1983: Sound Synthesis And The Personal Computer, Juggler And Thunderbird Games (multiple computers), Music And Sound Programs (multiple computers), Writing Transportable BASIC, Home Energy Calculator (multiple computers), All About Commodore WAIT, Supermon 64, Perfect Commodore INPUTs, VIC Sound Generator, Copy VIC Disk Files, Commodore 64 Architecture.

March 1983: An Introduction To Data Storage (multiple computers), Mass Memory Now And In The Future, Games: Closeout, Boggler, Fighter Aces, Letter And Number Play (all for multiple computers), VIC Music, Direct Atari Disk Access, Automatic Commodore Program Selector, PET Quickplot, A Commodore Gotcha, VIC and Atari Memory Management, Friendly VIC INPUTs.

April 1983: Selecting The Right Word Processor, Air Defense (multiple computers), Commodore Structure BASIC, Retirement Planner (multiple computers), Dr. Video For Commodore, Atari Filefixer, Video 80:80 Columns For The Atari, VICword, Magic Commodore BASIC, A BASIC Hex Editor For VIC, VIC Music Theory.

May 1983: The New Low Cost Printer/Plotters, Jumping Jack (multiple computers), Deflector (multiple computers), VIC Kaleidoscope, Graphics on the Sinclair/Timex, Bootmaker For VIC, PET and 64, VICSTATION: A "Paperless Office," The Atari Musician, Puzzle Generator (multiple computers), Instant 64 Art, 64 Odds And Ends, Versatile VIC Data Acquisition, POP For Commodore.

June 1983: How To Buy The Right Printer, The New, Low-cost Printers, Astrostorm (multiple computers), The Hawkmen Of Dindrin (multiple computers), MusicMaster For The Commodore 64, Commodore Data Searcher, Atari Player/Missile Graphics Simplified, VIC Power Spirals, Un NEW For The VIC and 64, Atari Fast Shuffle, VIC Contractor, Commodore Supermon Q & A.

July 1983: Constructing The Ideal Computer Game, Techniques For Writing Your Own Adventure Game, SpeedSki And Time Bomb (VIC), Castle Quest And Roadblock (Atari), RATS! And Goblin (64), How To Create A Data Filing System (multiple computers), How To Back Up Disks For VIC And 64, Atari Artifacting, All About The Commodore USR Command, TI Mailing List.

August 1983: Weather Forecaster (multiple computers), First Math And Clues (multiple computers), Converting VIC And 64 Programs To PET, Atari Verify, Apple Bytechanger, VIC And 64 Escape Key, Banish Atari INPUT Statements, Mixing Graphics Modes On The 64, VICplot, VIC/64 Translations: Reading The Keyboard, Musical Atari Keyboard, VIC Display Messages.

September 1983: Games That Teach, Caves Of Ice, Diamond Drop, Mystery Spell, and Dots (multiple computers), VIC Pilot, Ultrasort (VIC, 64, PET), Easy Atari Page Flipping, Computer Aided Design On The TI, Relative Files On the VIC/64, Atari Fontbyter, TI Sprite Editor, All About Interrupts (multiple computers), Cracking The 64 Kernal, Making Change On The Timex/Sinclair, Build Your Own Random File Manager (multiple computers).

October 1983: Computer Games By Phone, Coupon File (multiple computers), Dragon Master And Moving Maze (multiple computers), Merging Programs From Commodore Disks, Atari Master Disk Directory, Sprites In TI Extended BASIC, Commodore EXEC, Multicolor Atari Character Editor, High Speed Commodore Mazer, Apple Sounds, Extra Instructions (multiple computers), Commodore DOS Wedges, Invisible Disk Directory For VIC And 64.

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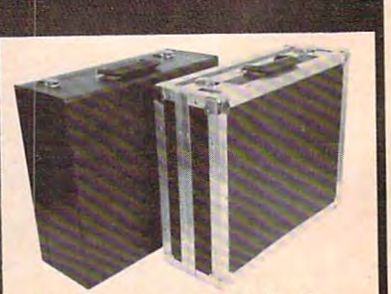

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