GO WITH THE WINNER

If you wanted to bet on the horses, you'd get advice from somebody who'd been a success at betting on the horses.

So it's only reasonable to demand that the blackjack program you buy be one with a PROVEN system from a PROVEN winner at blackjack. Not from some anonymous programmer who can't change the filter in his coffee-maker. Not from some Sunday afternoon sports analyst, but from a man whose "Winningest System" earned him appearances on CBS Television's *60 Minutes* — and a penthouse in Las Vegas. Ken Uston.

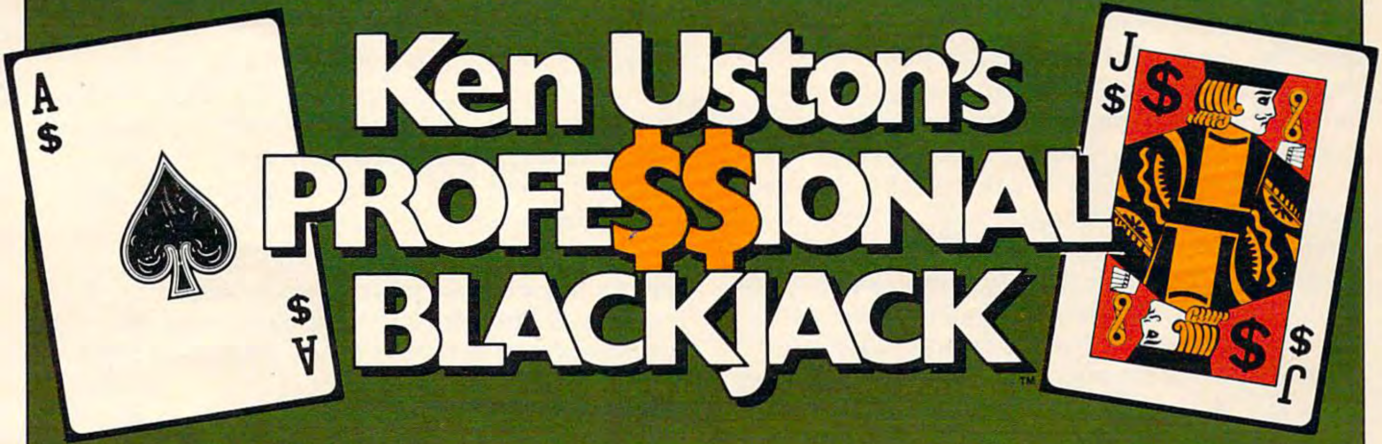
Now, Ken Uston and Intelligent Statements™ can help make you a winner three ways — three ways that add up to make *Ken Uston's Professional Blackjack* truly the winningest blackjack program ever!

WINNING FEATURE #1
An Unbelievable Program

Ken Uston's Professional Blackjack is a real winning program, with features unavailable on any other program at any other price. It's the most complete and realistic blackjack game money can buy. You'll meet the same playing opportunities that you'd face at a real blackjack table — at your choice of over 70 Nevada and Atlantic City casinos, each with its own set of rules and variations. Or you can create your own casino, manipulating sixteen different game variables to produce an unbelievable 39,813,120 different playing situations. Select the number of decks in the shoe, vary the dealing speed, and much, much more. And all your data is accurately displayed, so you can play the strategy you like and get the feedback you need to win.

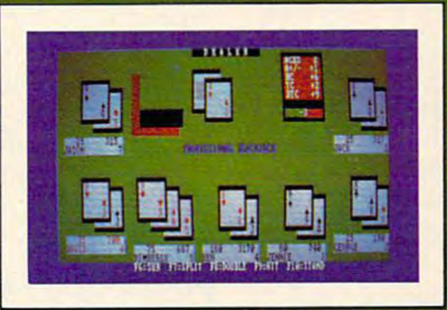
A Teaching System for Winners

Ken Uston's Professional Blackjack is the most thorough and authoritative teaching system you can buy. Now you can learn all of Ken Uston's computer-optimized card-counting strategies, from basic to advanced levels. Menu-driven interactive drills — augmented by superb documentation — lead you through each skill level. At any point you can choose to see accurate running counts, continuous statistical evaluations, discard deck totals and instructional prompts, complete with sound effects. So you develop and refine the skills you need to WIN BIG.



WINNING FEATURE #2
An Unbelievable Free Offer

In the package containing this winning program, we'll include, absolutely free, a coupon that entitles you to a free copy of *Million Dollar Blackjack*, Ken Uston's authoritative text on the game of blackjack — an $18.95 value! This book fully describes the blackjack system that won Ken Uston a reputation as the world's foremost blackjack player and rocketed him to nationwide fame in his apperances on *60 Minutes*. This is the system that made Uston such a threat to casinos that he's been barred from their playing tables — and it's implemented fully in this program and described in-depth in this book. If you want to investigate the reasoning behind the winningest blackjack system ever designed, this book is a must. If you want to LEARN the system, quickly and painlessly, this program is a must. We're offering you both — at a winning price.



IBM PC* REQUIREMENTS: 48K RAM, disk drive, PC-DOS*, 80-character display. Color and monochrome versions supplied with each package.
APPLE II** REQUIREMENTS: DOS 3.3, 48K RAM, disk drive, 40-character display.
OSBORNE 1™ REQUIREMENTS: Standard Osborne 1 package.
ATARI** 400/800/1200 REQUIREMENTS: 48K RAM and one disk drive.

*Display shows actual photograph of IBM PC version. Apple and Atari color graphics and Osborne monochrome graphics are similar. Versions for TRS-80** and other brands will be available shortly.*

WINNING FEATURE #3
An Unbelievably Low Price

The price for the winningest blackjack system ever is a winner, too. Including the software, the coupon and thorough documentation, *Ken Uston's Professional Blackjack* is an amazingly low $69.95. There are other programs that cost less and offer less. There are other programs that cost more and still offer less. This program is the winner, hands down.

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David D. Thornburg, Associate Editor

Computers Go To School

Since September is back-to-school month, I thought I would interrupt our discussion of languages to comment on the growing use of computers in the classroom.

Just as the number of computers in homes is rapidly increasing, the classroom computer is also becoming ever more common. During the last several months I have been speaking to thousands of teachers in California who are interested in this phenomenon. In my travels around the state, I have found that the effective use of this technology is equally of concern to parents, teachers, and administrators. Unlike the "visual aids" revolution that filled schools with underused overhead projectors and filmstrip machines, the classroom computer appears to be here to stay.

The major problem facing teachers today seems to center around which machine to buy, what software to get, and what to do with the computer once it is in the classroom. Some teachers are apprehensive about using computers because they don't see how the computer can be integrated with their existing curriculum. I tell teachers that if they are satisfied with their classroom activities and feel that the children are learning the things they should be learning, that the best computer for them might be no computer at all. It would be tragic if the computer were force-fed to these teachers and, as a result, disrupted their presently successful teaching style.

Judging by the attendance at conferences on the use of computers in the classroom, there are many thousands of teachers who do want to know more about computers and their effective use with children. Except for a few books on the topic, there is generally little in the way of formal training available for computer-using educators. California is particularly fortunate in that it has Teacher Education and Computer Centers (TECC) located all over the state as a result of Governor Brown's Investment in People program. Among other activities, these TECC centers sponsor computer classes for classroom teachers.

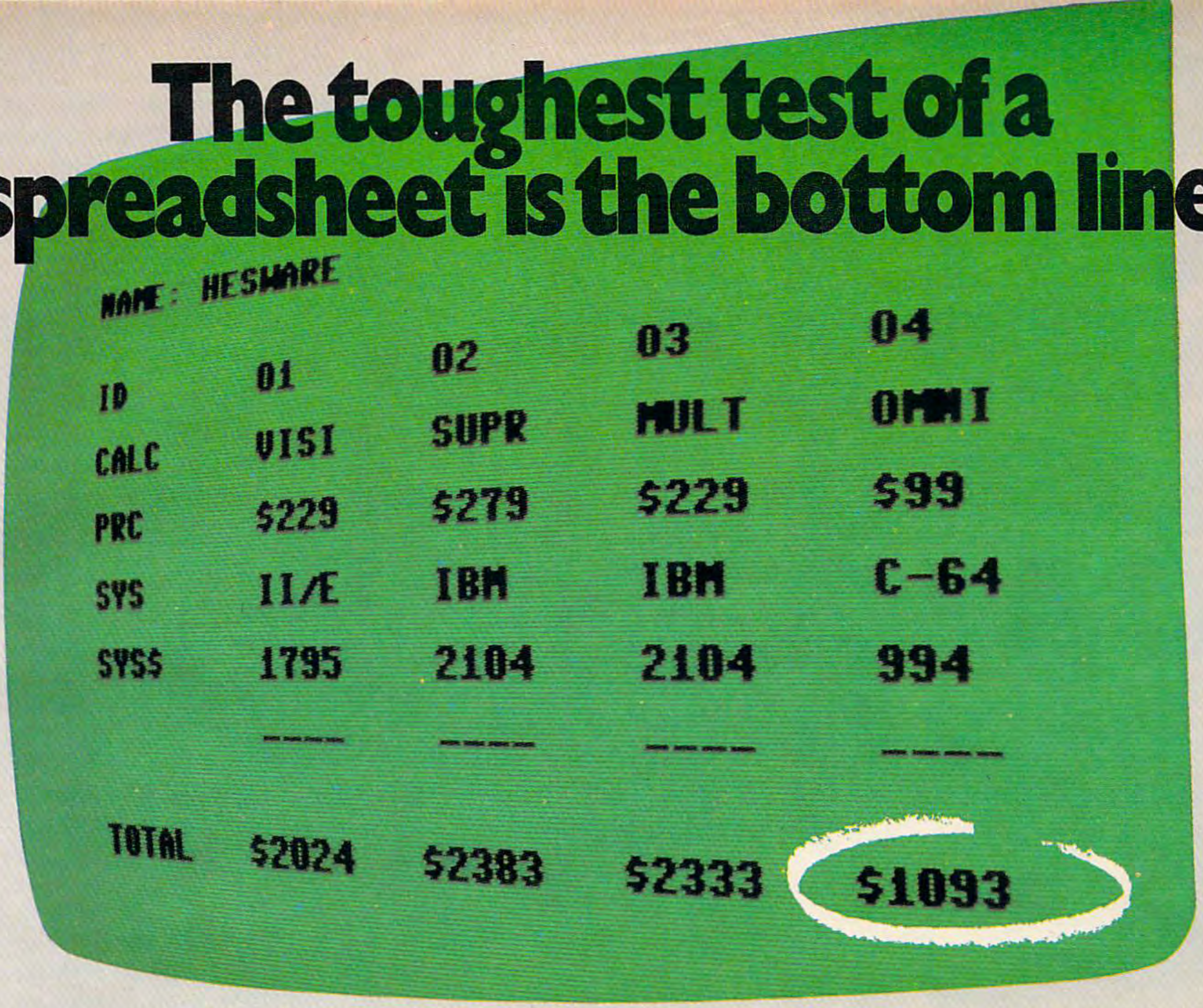
Some of the state and community colleges are offering courses in this area as well, affording teachers the opportunity to learn about computers from the vantage point of their profession. Other states, such as Minnesota, have been similarly helpful in providing teachers with the information they need. And yet the field is growing and changing so rapidly that it seems like a full-time job to stay on top of new developments. It is so sad, for example, to find a teacher who was given a computer that has only a text display when that teacher wants to teach computer graphics. The fact that all computers are not "created equal" is sometimes learned too late.

First Things First

The most important thing a teacher can do first is to figure out how the computer will be used, identify the software that will be needed to achieve this goal, and then buy the computer that runs this software. This approach to computer purchasing ignores the practical considerations of cost, but one must ask if a cheap computer is a bargain if all the software you want is available only for other machines.

Computer use in the classroom falls into several categories – it can be used to reinforce lessons through computer-assisted instruction (this includes drill and practice programs); it can be used as a tool for learning about computers per se – as

The toughest test of a spreadsheet is the bottom line.



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a "computer literacy" tool; and it can be used as a tool with which children can make discoveries and can explore topics on their own. The teacher can also use the computer for classroom management, lesson preparation, etc.

It takes some time for a teacher to become well-versed in the ways computers can be used – and this stage should be reached before the software selection process begins. Once teachers are ready to look at software, Pandora's box is opened. The sheer quantity of "educational" software is staggering. In the past, much of this software was garbage. Fortunately, times have changed. But teachers still have to learn how to evaluate software critically and how to interpret software reviews written by others.

Fortunately, teachers have some help in this area in the form of a new book, *Courseware in the Classroom* by Ann Lathrop and Bobby Goodson (Reading, Mass.: Addison-Wesley, $10). This fine book surveys the various uses of computers in the classroom, illustrates in detail the software selection and evaluation process, and lists many of the better software packages on the market today. Because the field is growing so rapidly, annual supplements will be published.

The Teacher's Job

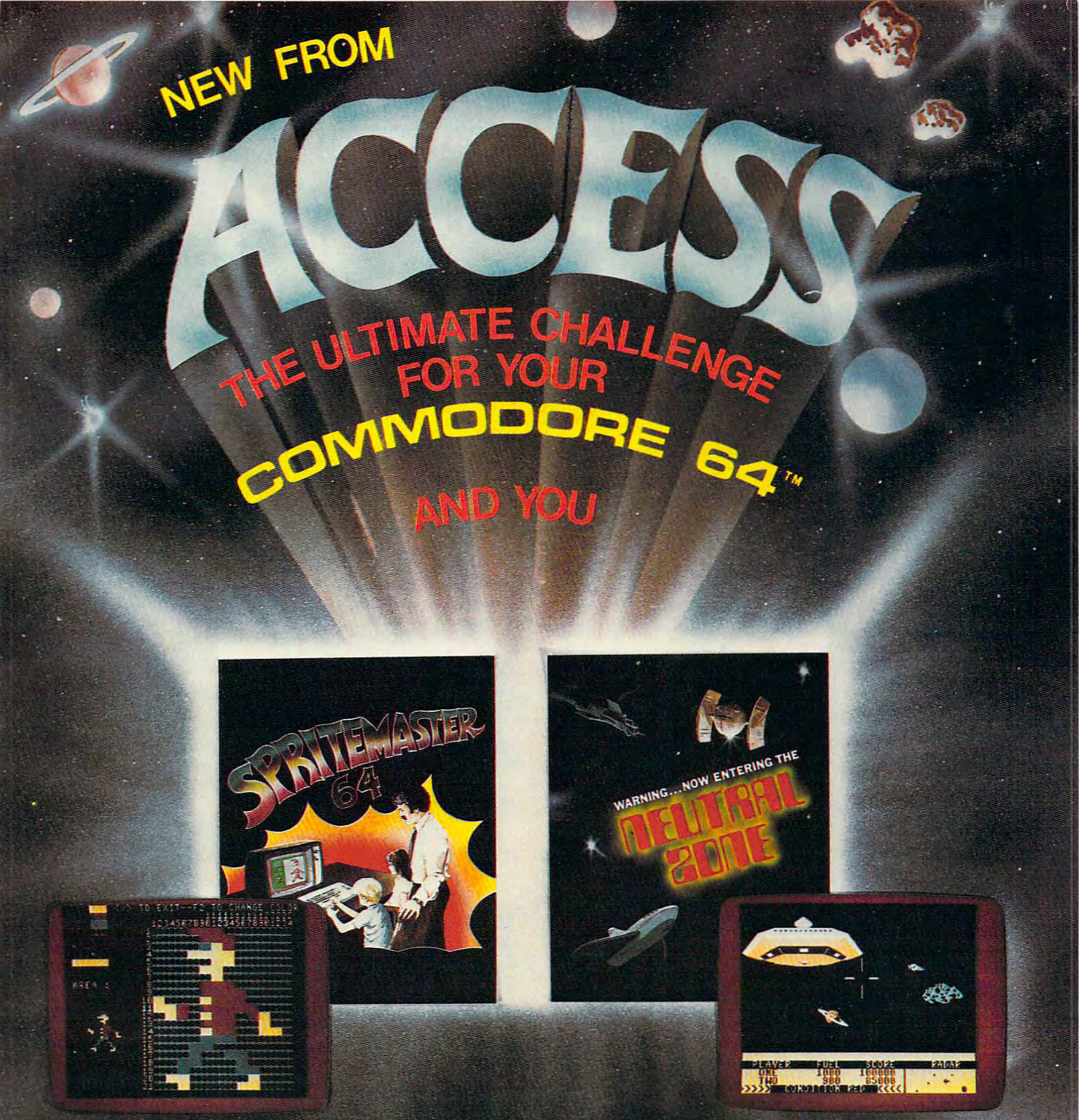
Once the computer gets into the classroom, the teacher has to keep up-to-date on new software, teaching techniques, and computer technology. All this takes time. Where does this time come from, and who pays for it?

It is interesting to see that thousands of teachers appear willing to give up weekends with their families to attend conferences on the use of computers in the classroom. I am appalled to find that some schools expect their teachers to attend such workshops on their own time and at their own expense, but are willing to send a school secretary to a class, during working hours, to learn how to use the school's word processor.

I was once asked if we can afford to have computers in the classroom. My response was that there were three costs involved. There is the cost of the computers and software; this is the cheapest part of the system. There is the cost of "release time" to allow teachers to become proficient at computer use without using up their weekends and vacations. And then there is the cost of increased teachers' salaries to keep these people in the profession once they have acquired all this skill.

At a time when the quality of education in this country is undergoing such careful scrutiny, the question is not if we can afford this expense, but how we are going to provide appropriate levels of support.

Our kids can't wait any longer. ©



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Questions Beginners Ask

Tom R. Halfhill, Features Editor

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

Q Why do some computers have numeric keypads and others don't? Is this something important I should check for when comparison shopping for a computer?

A Numeric keypads – those calculator-like groups of number keys found to the right of some computer keyboards – should be thought of as any other feature on personal computers. Whether or not they are a standard feature depends upon the reasoning of the computer's designers, and whether they are a desirable feature depends upon the needs of the user.

Numeric keypads are not built into most *home* computers – that is, the microcomputers primarily intended for home use. Keypads are usually found on computers designed for small-business use, or on higher-end personal computers that are suited to either purpose. This is because one of the most common applications for business computers is accounting, which calls for frequent entry of numbers. A numeric keypad is a great advantage for a skilled operator who is trained to touch-type on one. Entering numbers is much faster than with the usual number keys spread out along the top row of the typewriter keyboard.

Comparison shopping for a computer can be confusing to people just starting out because of the many combinations of features available. Our advice is not to lose sight of what you plan to use the computer for; that's how you'll know what features you need. This goes for numeric keypads or anything else. If you plan to be entering many numbers, and if you know (or will learn) how to touch-type on a keypad, then a keypad is a desirable feature. Otherwise, you'll probably never miss it. But even if you do, external plug-in keypads are available for most home computers, including the Apple, Atari, Commodore 64, and VIC-20. Also, part of the regular typewriter keyboard on most computers can be redefined to simulate a keypad via programming.

Incidentally, while we're on the subject, it's interesting to note that computer and calculator keypads are arranged exactly the opposite of touch-tone telephone keypads. Computers and calculators arrange the keys in descending numerical order, starting at the upper right and ending at the lower left, while telephone keys are just the opposite. This must be disorienting for people who have to switch back and forth – such as telephone receptionists or operators who also work with adding machines or computers. If any readers know the story behind this odd disparity we'd like to hear from you.

Q I've heard references to "80-column cards." What is a card? What does it look like? How does it work?

A A *card* is a circuit board which plugs into a computer and adds some sort of extra feature or capability. In microcomputing, "card" and "board" have come to be almost synonymous, except that "board" is also used to describe the larger main circuit boards already built into the computer.

Practically every personal computer has some kind of expansion slot or port designed to accept cards and boards. When a card is plugged in, it becomes part of the computer, almost as if it were built-in. The most common accessory card is a memory board, a circuit board with memory chips which adds extra Random Access Memory (RAM) to the computer. Game and other program cartridges that plug into computers are really cards with Read Only Memory (ROM) chips.

An "80-column card" is an accessory that expands the screen display to a width of 80 columns (80 characters fit on one screen line). This is generally preferred for such applications as word processing, because it allows the screen to simulate the full width of a standard sheet of typewriter paper. Home computers normally cannot display more than 40 characters per screen line because the ordinary TV sets they are designed to work with lack the necessary sharpness. A special computer monitor is required for widths greater than 40 columns. ©

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Records per file	to disk capacity
File structure	random access
Sorting on	any field
Nested sorts	to 5 deep
Nested subtotals	to 5 deep

Report Printout
- User defined format
- View or print selected information from your file
- Select by logical function, range, string, and other parameters

Compatible With Your Software
- Sequential files for use with MODEMS and to transfer data to and from spreadsheets, accounting programs, and custom programs

System Requirements
- C-64 Computer
- One or two Disk Drives
- TV or Monitor (color or monochrome)
- Printer — properly interfaced (program runs with limited applications without a printer)

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On The Road With Fred D'Ignazio

Do you have your track shoes on?

Do you have a pocketful of plane reservations?

Do you have your passport? And your international driver's license?

Are you in fantastic shape? Can you withstand a nonstop barrage of greasy airport Reubens, buttery croissants, chocolate éclairs, and warm ale? Can you keep your feet from going flat after walking through miles of computer and robot exhibits? Can you remain steady after transcontinental and transoceanic jet flights, cross-country train rides, car trips, and frantic wandering through the London subway?

You can? Good! Then you're ready to accompany me on a whirlwind replay of my spring "on the road."

Big Bird, Blue Jeans, And Blackboards

On March 17th, I joined the COMPUTE! staff and jetted out to San Francisco for the 1983 West Coast Computer Faire. On March 28th, I still hadn't recovered from the crowd, tumult, and heady new products introduced at the Faire. But I packed my bags and flew down to Tampa, Florida, to make a speech at the Florida Instructional Computing Conference. I remember asking the passenger sitting next to me, "Is Tampa on the east coast of Florida or the west coast?"

The week after I returned from Tampa, I hopped aboard another plane and flew up to New York to visit the people at the Children's Television Workshop and the Children's Computer Workshop. CCW and CTW were a treat. It was good to meet relaxed, smiling people dressed in blue jeans and T-shirts. And big fuzzy Cookie Monster, Kermit, and Big Bird dolls were perched on file cabinets and smiled down from colorful posters on the walls.

(You can read about what I learned on these trips in my July 1983 "On the Road" and "World Inside the Computer" columns in COMPUTE!, and in my August "Computing for Grown-Ups" column in COMPUTE!'s Gazette.)

During this phase of my travels I got to see a lot of educational software. My chief impressions were that the software is quickly improving and that its creators are beginning to deal with learning in a totally new manner.

Only a year ago, educational software on personal computers consisted almost entirely of old-fashioned "electronic textbook" programs and drill and practice programs.

Six months later we were besieged by educational game software, really *disguised drill and practice*.

Now we are beginning to see something new. We are seeing the first real microcomputer simulations, where the kid's computer "pretends" it is a world or environment and challenges the child to playact and build a face, conduct a chemistry experiment, pilot a starship, run a nuclear reactor, solve a crime, or map out a new world. Some of the forerunners in such simulation games include the Learning Company's *Gertrude's Puzzles*; Spinnaker's *Facemaker*, *Snooper Troops*, and *In Search of the Most Amazing Thing;* and Children's Computer Workshop's *Electronic Blackboard* game.

Electronic Blackboard suggests an even newer type of educational software for children: kids' workstations – where the computer becomes a general-purpose tool to enable children to use the computer to do *whatever they want* (just like adults!).

Electronic Blackboard creates an electronic "mailbox" for kids. Several blackboards are pictured on the computer's display screen. At first they are empty. Kids get to "borrow" a blackboard, associate their name with it (as a mail address), and use electronic *chalk* to write messages on the board for other kids to see.

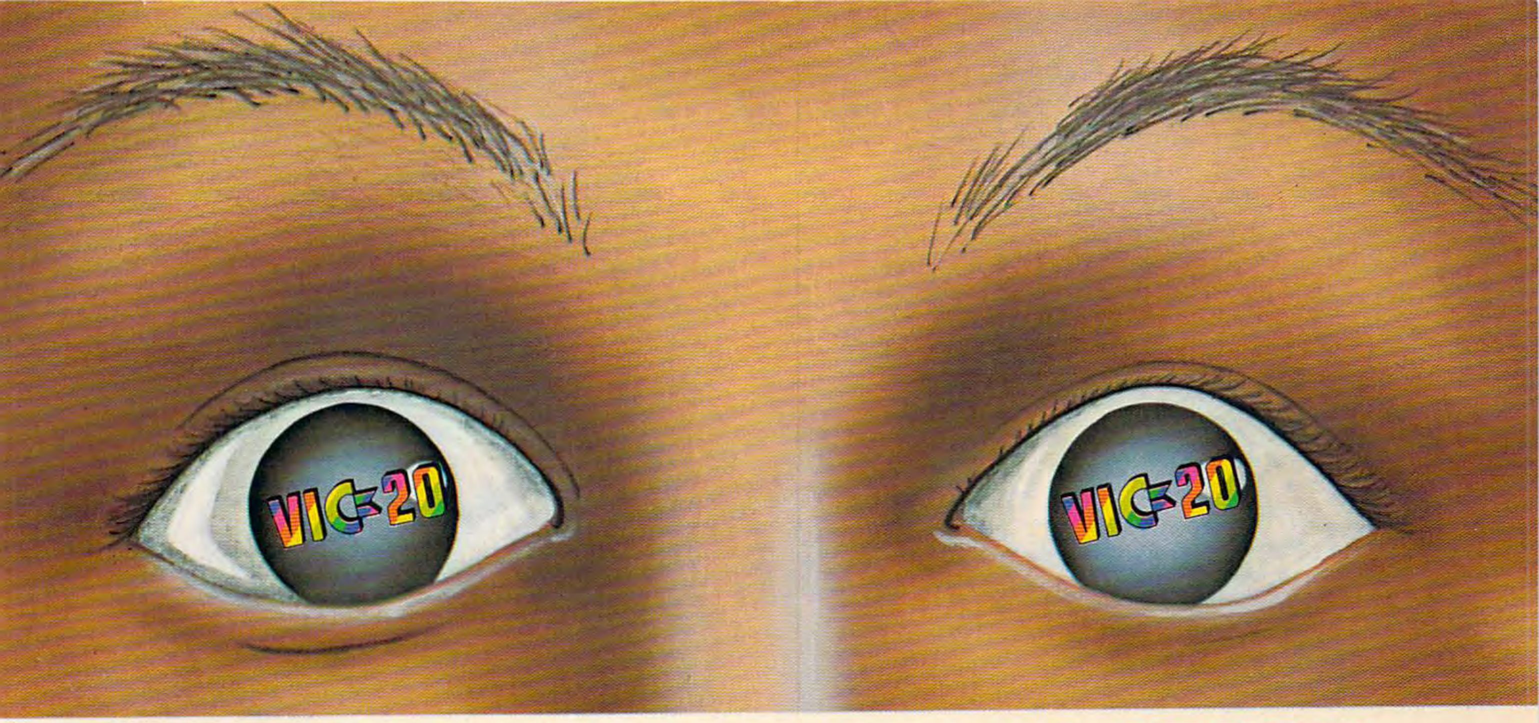
If a message isn't private, you get to see it just by calling up a particular blackboard. If, however, it *is* private, the child can hide it. You can access private messages "for your eyes only" by typing your name. It's not a foolproof security system, but it makes a great educational activity. Kids get to practice their reading and writing skills. And they are learning how to do word processing and send electronic mail.

All Alone With HERO

Not long after I visited CCW, I flew to Benton Harbor, Michigan, for a first encounter with HERO the robot, made by Heath. After *Star Wars'* C3PO and R2-D2, HERO is probably the third most famous robot in America.

And he is for real.

I noticed this immediately the first time I met



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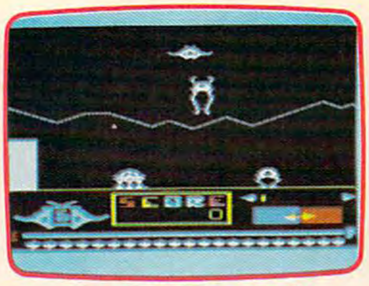

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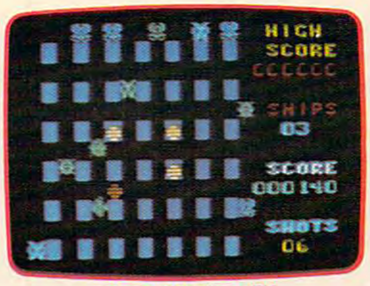

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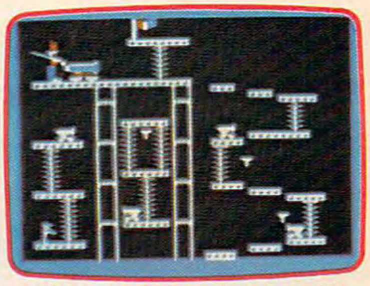

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him. Doug Bonham of Heath gave me some quick pointers about operating HERO, then he left the two of us alone.

There we were, in a tiny office deep inside Heath's giant manufacturing plant on the outskirts of Benton Harbor. HERO was on a worktable in the rear of the office, propped up at an angle so his drive wheel was slightly off the table (in case I told him to do something foolish).

And I was staring at HERO.

What do I do first? I am itching to get to know HERO – make him walk and talk and do other great things. But I am scared to death that I might get things mixed up and somehow hurt him.

I realize now that I was reliving those first anxious moments experienced by the first-time owner of a personal computer. You desperately want to touch the machine, play with it, make it perform. It doesn't even have to turn cartwheels or play Beethoven's *Fifth*. You would be thrilled if you could make the computer do *anything*.

Yet you are almost frozen by fear. What if you push the wrong button? What if you wipe out a program? What if you damage the machine? What if you do something foolish and silly?

I stood in the little room staring at the buttons on top of HERO's head and glancing at the "teaching pendant" (control box) sitting next to HERO on the table. What should I try first?

I decided that I'd try the safest thing first, something that was guaranteed not to get me into trouble. I would press the "3" button and the "1" button on HERO's keyboard. When HERO received a "31" command, he was supposed to move all his motorized limbs back to their "home" position. Surely this was a trivial and harmless thing to try first.

I pressed "31" and was startled when HERO came to life. His motors started buzzing, his arm rotated, his gripper hand pivoted, his wheels turned, and his head swung from side to side.

Then it happened.

I was just starting to breathe easier when HERO's wheels swiveled around and began banging into a metal plate. Bang! Bang! Bang! went the wheels. HERO's whole body began to rock.

I backed off in total dismay. I glanced fearfully at the door behind me. I was sure that Doug and his staff at Heath heard the racket and were about to rush in and accuse me of breaking their robot.

HERO's wheels kept banging. I leaned over and held onto HERO's shoulders, afraid that he would rock himself off the worktable.

Then he stopped.

"Ready," he said sweetly.

"Ready?" I thought. Then, with a flood of relief, I realized that HERO was okay. All that banging was okay. He was just returning his wheels to their "home" position. I hadn't broken anything. No one came into the room. They were used to HERO making noises like that.

My confidence quickly returned. I spent the next two hours joyfully punching buttons on Hero's head and flipping switches and turning the dial on HERO's teaching pendant. I taught him how to say "Hello, Fred," how to wave, and how to crash into the wall.

That last trick was not what I intended. I had hoped that my program would activate HERO's wheels and navigate him across the floor and out the door. I had planned for him to make a little trip down the hall to say hello to Doug's people.

But, somehow, the door was narrower than I figured. Or else HERO's front drive wheel was a little crooked. In any case, when I pressed the "A" and the "DO" buttons and gave the memory address of my little program, HERO said "Here I go," then marched right into the wall.

The Hall Of The Dinosaurs

The day after my first encounter with HERO, I rode with Doug Bonham in his car along the shoreline of Lake Michigan to Chicago. Doug was going to check up on Heath's exhibit at the ROBOTS VII conference in giant McCormick Place on the edge of the lake.

After spending several hours with HERO the day before, I thought he was the greatest. With his computer brain and his arm and wheels and motors and sensors, he was a complete, real robot. I expected him to hold his own with all the other robots in McCormick Place, since most of the robots there were not nearly as versatile or advanced. HERO could speak, move, and had an array of "senses," including the ability to detect motion, light, and sound. Most of the other robots were sightless, "dumb" industrial robots, anchored by lugs and rivets to the floor of the factory. How could they compare with a cute, walking, talking robot like HERO?

What a surprise!

When I walked into the mammoth exhibit hall at McCormick Place, I was stunned. I felt like I was in a giant, dreamlike Museum of Natural History, surrounded by prehistoric dinosaurs. Only the dinosaurs were not dead, old bones. Instead they were alive and they moved. And their skin wasn't a cement gray, but red, orange, black, and brilliant yellow – all the colors of the rainbow.

This all sounds melodramatic, but it's true. The robots in McCormick Place were *huge*. Their robotic arms were as long as the neck of a giraffe, or of a brontosaurus. They appeared even taller because they rested on top of six-foot-high metal pedestals.

And they didn't just sit there. They moved

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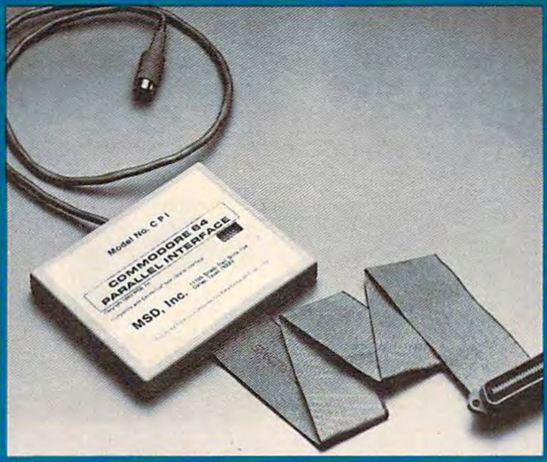

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The CPI is capable of twelve printing modes, specified by software or hardware switch settings. These twelve printing modes are combinations of three options as follows:

Line Feed,ASCII Conversion and Listing Legibility.

Line Feed: The CPI can generate a line feed if needed through software or hardware switches.

ASCII Conversion: The CPI converts Commodore ASCII into standard ASCII characters through software or hardware switches.

Listing Legibility: Since many printers do not support the codes/graphics that the VIC-20 and Commodore 64 produce, program listing can become illegible if not impossible (Printer may "hang-up"). The CPI provides three listing modes to address this problem — Normal, Extended Tag and Abbreviated Tag.

In the Normal mode the CPI passes all commands from the computer to the printer. The Normal code would be used for programs written by the user or programs with commands supported by the printer.

In the Extended Tag mode the CPI will generate "tags" (neumonics) for graphics, cursor control, print control and special characters. For any graphics characters that are not standard ASCII, the decimal value of the graphics symbol is printed. For instance, the "checker board" character (press the Commodore key and the plus sign) lists as [166].

The Abbreviated Tag mode is the same as Extended Tag mode, except all the tags are replaced by the "#" sign. This mode would be used if you wanted a program listing to be formatted as the original program. That is without the "tags" using several print spaces instead of one print space.

The CPI is equipped with a built-in self-test program that will check the RAM, ROM and I/O hardware of its microprocessor. This test can be helpful in determining if something is faulty or if the configuration you are using is valid. The self-test will print information to the printer.

CPI LISTING LEGIBILITY TAGS

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[CD]	Cursor Down	[DL]	Delete	[ORA]	Change to Orange	[F2]	Function Key 2
[CU]	Cursor Up	[BLK]	Change to Black	[BRN]	Change to Brown	[F3]	Function Key 3
[CL]	Cursor Left	[WHT]	Change to White	[LTR]	Change to Light Red	[F4]	Function Key 4
[CR]	Cursor Right	[RED]	Change to Red	[GY1]	Change to Grey 1	[F5]	Function Key 5
[HC]	Home Cursor	[CYN]	Change to Cyan	[GY2]	Change to Grey 2	[F6]	Function Key 6
[CS]	Clear Screen	[PUR]	Change to Purple	[LTG]	Change to Light Green	[F7]	Function Key 7
[RV]	Reverse On	[GRN]	Change to Green	[LTB]	Change to Light Blue	[F8]	Function Key 8
[RO]	Reverse Off	[BLU]	Change to Blue	[GY3]	Change to Gray 3	[PI]	Pi Symbol
[IN]	Insert	[YEL]	Change to Yellow	[F1]	Function Key 1		

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with frightening, snakelike swiftness and grace. Their movements made them seem alive, conscious, even intelligent. They twisted, gyrated, and whirled in a strange, mechanical dance.

As they moved they made soft noises. Some swished, others whooshed. Some buzzed, others wheezed. Many robots made no sound at all. They moved their enormous arms in great, sweeping arcs. They rotated, opened, and closed their leviathan grippers. Their arms telescoped abruptly to twice their size, or dived to the floor to pick up a cinder block or a paintbrush.

And they made no sound at all.

In the midst of all these dinosaurs sat HERO – two HEROs, actually. He was the same robot as yesterday, but somehow, among all these hulking machines he seemed very different. He was obviously still "all robot," but now he also seemed sensitive, delicate, and fragile.

Whatever, HERO was a tremendous hit. I came back to the Heath booth several times during the day and always found huge crowds of people standing around the two HEROs, watching them perform, and listening to them tell jokes.

I left the ROBOTS VII conference late that afternoon and flew back to Roanoke. I carried with me one chief impression. Before the conference I had thought of robots as all belonging to the same tribe. Now I saw two tribes: the little guys, like HERO; and the big, hulking monster robots that are taking over our factories.

Eventually we'll have robots of all shapes and sizes in our society – not just big robots and little robots. But I think there will still be two different tribes. Then the *programming* will make the difference. Robots in the home will be programmed to be friendly, playful, helpful, and easygoing. Robots in the workplace will be cold, purposeful, and narrow-minded. They won't be programmed to carry on a chat with their human counterparts. Their only mission will be to get the job done. Both types of machines (home and work) will be robots. But they will be two different sorts of creatures entirely.

Next month Fred and HERO go to London, England, to teach a course on robotics literacy, and they visit a children's educational software company. Fred also meets a computer magician – a British teacher who creates kids' magic shows using computers. ©

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Mystery Spell

Doug Hapeman

This spelling game features lively graphics and sprites. It's also a clever teaching aid for parents, teachers, and students in which spelling lessons can be reviewed and then practiced. Originally written for the TI-99/4A with Extended BASIC, there are also versions for the VIC and 64.

If you've ever played Hangman, you won't have any trouble learning "Mystery Spell." Although it's similar in concept, there's a twist. Instead of a gallows, you'll see colorful balloons, flying blackbirds, cheerful music, and a happy face.

When the game begins, a happy face appears in a little hut surrounded by trees and landscape. The letters of the alphabet appear near the bottom of the screen, and blank spaces representing the secret word appear near the top. When you select a letter, the happy face moves to the selected letter and indicates whether it is an incorrect or correct choice. For each correct choice a colored balloon rises to the appropriate place in the secret word, and the letter is displayed. For each incorrect choice a blackbird descends and lands somewhere on the landscape. Too many blackbirds disallow any more guesses, and the word will be spelled correctly for you.

There are two levels of difficulty: easy, which permits six incorrect guesses, and difficult, allowing only four.

The program has 20 preselected words, or you can choose the "create your own word list" option (and, if you wish, save it to tape or disk). This option allows you to tailor the word difficulty to any learning level.

Many features of the TI-99/4A are used in the program: color, graphics, moving sprites, and music. Let's look at some program features and see how certain graphics results are accomplished in the TI version.

Screen Centered Printing

There are several locations in the program where variable length words or phrases are centered. Line 170 is an example. For centering text with the DISPLAY AT statement, a simple equation can determine the proper column position:

column = (14-LEN(L$)/2).

It's like using a typewriter. When you want to center your title, you find the center of the page and count back one-half the length of the title. Similarly, in TI BASIC you subtract one-half of the length of the string variable from one-half the screen width. Fourteen is one-half the screen width using DISPLAY AT, and 16 is one-half using CALL HCHAR. The length of the string variable is easily determined by the LEN function.

Moving Sprites

Moving sprites are a fascinating feature of TI Extended BASIC. Through a library of impressive subprograms, sprites can easily be called, defined, magnified, or set in motion, can acknowledge coincidence, change character definition, and so on. Because they are controlled by built-in subprograms, they are easily accessed by even a beginning programmer.

Regular characters are located on the screen in a 32 column by 24 row format, resulting in a total of 768 screen positions. Sprites, however, are located by dot-row and dot-column positions. Where normal characters are each made up of an eight-by-eight grid, sprites, on the other hand, can be located at any one of the 64 dots in the eight-by-eight grid. Therefore, there are 192 dot-rows and 256 dot-columns, for a total of 49,152 screen positions for sprites.

Mystery Spell uses moving sprites in several locations. The balloon and blackbird sprites are called with motion, but the happy face sprite is

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64 Version Notes

Eric Brandon, Programming Assistant

The most interesting feature of the 64 version of "Mystery Spell" (Program 2) is the animated bird. The bird flies around the top of the screen, swooping down to pick up letters and to sit on its perch, depending on whether your guesses are right or wrong.

As the bird moves around, it seems to flap its wings, creating an illusion of flight. This is achieved by rapidly displaying different "poses." In films, this is done by passing many frames through a projector every second. To achieve the illusion of flapping wings, we too must create a few "frames" of a bird in motion.

Using a sprite editor, we first drew the bird you see in Figure 1. Then, using that sprite, we designed two more birds, one with the wing up (Figure 2) and one with the wing down (Figure 3). Using those shapes, we designed three more birds identical to the first three, but without legs. This gave us three "frames" for the bird carrying a letter, and three "frames" for the bird flying freely. We then set up the DATA statements in the program as if we were going to display six different sprites.

Immediately after the screen RAM are eight memory locations that tell the 64 where in memory to find the shapes of the eight sprites. Usually these locations are at 2040 to 2047 ($07F8 to $07FF). By rapidly POKEing 2040 with the pointer to each "frame," the bird seems to flap its wings. To see how this is done, look at lines 2000-2060. This is the routine which flies the bird around the top of the screen until you press a key. Line 2050 steps through the "frame" numbers. The actual POKEing is done at the end of line 2000.

Another interesting feature of the game is that when you guess correctly, the bird swoops down to pick up a letter, and then carries it up to the word. How is that letter incorporated into the bird sprite?

In the character set ROM at 53248 ($D000), the shape of each character is contained in eight bytes. Each byte is one row, and each bit is a column within that row. Depending on whether the value of that bit is 0 or 1, the pixel will be clear or set inside the character. The sprite is 24 bits wide, which is as wide as three characters. This means that by putting character shape data into every third byte within a sprite, we can make character shapes inside sprites. This technique could be used in any program which moves letters or text around smoothly. To see how this is done, look at lines 2180 to 2260.

Lines 2180 and 2190 make the character ROM available to be PEEKed. They also turn off the keyboard. Lines 2200 to 2240 take the character data and put it in the sprites. Finally, lines 2250 and 2260 cover up the character ROM and re-enable the keyboard.

Figure 1: Sprite-Created Bird

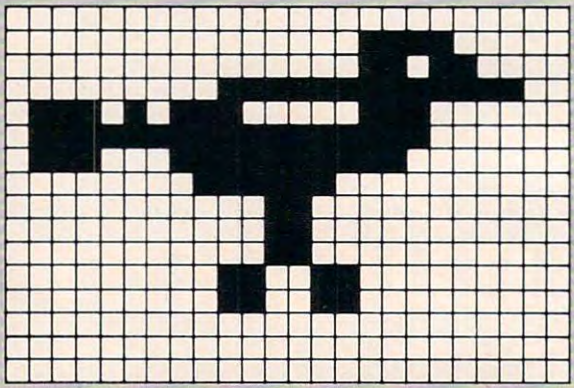


Figure 2: Bird With Wing Up

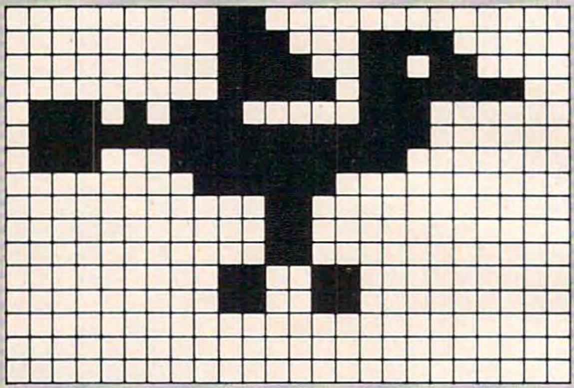
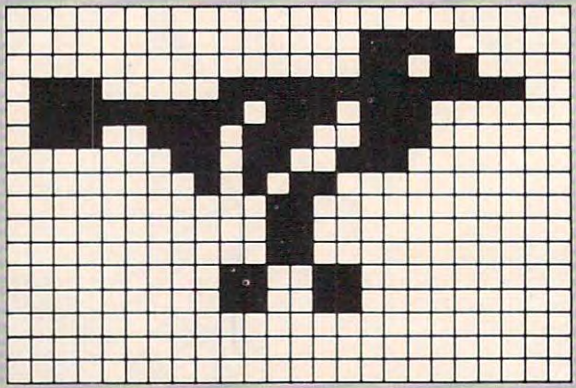


Figure 3: Bird With Wing Down



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initially stationary. Each time a letter is pressed, it moves to the location of the letter and then back to the hut.

Let's examine just how the happy face movement is achieved. The numeric variables used for determining direction and motion are: R=row, C=column, V=vertical motion, and H=horizontal motion.

The alphabet is displayed on the screen in two neat rows (A-M) and (N-Z). The ASCII (standard computer code) value of the alphabet is 65(A) to 90(Z). In response to the CALL KEY, any other key pressed is ignored. If the letter pressed is less than 78 (the letter N), then the row variable is set for the upper row; otherwise the row variable is set for the lower row (line 350). CALL GCHAR is used to determine whether the letter has previously been chosen (line 360). If not, then the vertical motion is set for downward movement until coincidence is achieved with the row variable – then motion stops (line 390 and subroutine at line 550).

Another Equation To The Rescue

Knowing which way to move horizontally is determined with another IF-THEN statement (line 400).

Knowing where to stop horizontally presented a more difficult problem. It could have been determined by the process of elimination through a long series of IF-THEN statements. But, once again, an equation can come to the rescue (line 410): C=(K-64)*16+4-208*INT ((K-64)/14).

(K-64) gives a number between 1 and 26, depending on which letter has been pressed. It is multiplied by 16, which is two times eight dot-column positions (one for the letter and one for the space). Four is added to center the sprite over the appropriate letter. The last part of the equation 208*INT((K-64)/14) yields either a 0 or 208, and ((K-64)/14) yields a 0 for (A-M) or 1 for (N-Z). The figure 208 represents 26 character positions (13 letters and 13 spaces in each row) times 8 dot positions per character position.

The best way to understand how the equation works is to experiment by placing different K values into it. For example, suppose the letter F was pressed. The ASCII value of F is 70, hence:

```
C=(70-64)+4-208*((70-64)/14)
C=6+4-208*6/14
C=96+4-208*0
C=100      (the dot-column position for F).
```

Balloon Motion

The balloon sprite moves from wherever the happy face sprite is located to the appropriate blank in the secret word at the top of the screen. See the "correct guess subroutine" (lines 570-600); you should be able to follow the program logic for balloon direction and motion.

Program 1:

Mystery Spell – TI-99 Extended BASIC

```
100 REM  MYSTERY SPELL
120 DIM A$(26),B$(20)
122 ON ERROR 140
125 CALL INIT :: CALL LOAD(-31878,1
    3)
130 REM **INITIALIZATION AND INTROD
    UCTION**
140 DISPLAY AT(12,5)ERASE ALL:"ONE
    MOMENT PLEASE..." :: GOTO 780
150 DISPLAY AT(7,1)ERASE ALL BEEP:"
    PRESS{3 SPACES}FOR": : :"  1  =
      INSTRUCTIONS": :"  2  =  MYST
    ERY SPELL": :"  3  =  FINISH MY
    STERY SPELL"
160 DISPLAY AT(23,3):"PLEASE ENGAGE
     ALPHA LOCK" :: CALL KEY(0,K,S)
    :: IF S=0 OR(K<49 OR K>51)THEN
    160 :: ON K-48 GOTO 980,190,170
170 DISPLAY AT(12,5)ERASE ALL BEEP:
    "THANKS FOR PLAYING," :: DISPLA
    Y AT(14,14-LEN(L$)/2):L$ :: STO
    P
190 DISPLAY AT(7,1)ERASE ALL BEEP:"
    CHOOSE A WORD LIST:": : :"  A
    =  PRESELECTED WORDS": :"  B  =
      CREATE YOUR OWN"
200 CALL KEY(0,K,S):: IF S=0 OR(K<6
    5 OR K>66)THEN 200 :: IF K=66 T
    HEN 220
210 PSW=1 :: GOTO 230
220 PSW=0 :: GOTO 1620
230 CALL CLEAR :: RESTORE 940 :: GO
    TO 930
240 CALL SPRITE(#2,120,2,78,121,0,0
    ):: CALL MAGNIFY(3):: CALL SPRI
    TE(#4,136,16,8,128,0,1):: CALL
    SPRITE(#3,140,2,8,128,0,-2)
250 DISPLAY AT(5,9):"MYSTERY SPELL"
     :: T=200 :: GOSUB 1050 :: IF P
    SW=1 THEN GOTO 1840
260 DISPLAY AT(19,1)BEEP:" WHAT IS
    YOUR NAME, PLEASE?" :: DISPLAY
    AT(23,1):"TYPE NAME, THEN PRESS
     ENTER"
270 ACCEPT AT(5,9)SIZE(14):L$ :: CA
    LL HCHAR(5,7,32,22)
280 REM **MAIN PROGRAM LOOP**
290 DISPLAY AT(19,1)BEEP:"  CHOOSE
    THE LEVEL OF PLAY"
300 DISPLAY AT(23,1):"{3 SPACES}1)
    EASY{3 SPACES}2) DIFFICULT" ::
    CALL KEY(0,K,S):: IF S=0 OR K>5
    0 OR K<49 THEN 300 :: IF K=49 T
    HEN ER=7 ELSE ER=5
310 FOR SP=5 TO 13 :: CALL DELSPRIT
    E(#SP):: NEXT SP
320 DISPLAY AT(19,1):" A B C D E F
    G H I J K L M" :: DISPLAY AT(23
    ,1)BEEP:" N O P Q R S T U V W X
     Y Z" :: RANDOMIZE
330 CALL HCHAR(5,3,32,28):: W$=B$(I
    NT(20*RND)+1):: F=LEN(W$):: FOR
     I=1 TO F :: DISPLAY AT(5,2*I+1
    4-F):"_" :: NEXT I :: Y=0 :: SP
    =13
340 CALL KEY(0,K,S):: IF S=0 OR(K<6
    5 OR K>90)THEN 340 ELSE C=121
```

```
350 IF K<78 THEN R=128 ELSE R=160
360 CC=((K-64)*16+16-208*INT((K-64)
    /14))/8 :: CALL GCHAR((R+24)/8,
    CC,X):: IF X=32 THEN 370 ELSE 3
    90
370 DISPLAY AT(16,14-(8+LEN(L$))/2)
    SIZE(8+LEN(L$))BEEP:" OOPS, ";L
    $;"," :: DISPLAY AT(17,1):" YOU
     TRIED THAT ONE ALREADY"
380 FOR D=1 TO 500 :: NEXT D :: CAL
    L HCHAR(16,1,33,64):: GOTO 340
390 V=12 :: H=0 :: GOSUB 550
400 IF K<72 OR(K>77 AND K<85)THEN H
    =-12 ELSE H=12
410 V=0 :: C=(K-64)*16+4-208*INT((K
    -64)/14):: GOSUB 550
420 X=0 :: CALL HCHAR((R+24)/8,(C+1
    2)/8,32):: FOR I=1 TO F :: IF A
    SC(SEG$(W$,I,1))<>K THEN 450
430 CALL PATTERN(#2,124):: GOSUB 58
    0
440 CALL PATTERN(#2,120):: DISPLAY
    AT(5,2*I+14-F)SIZE(-1):CHR$(K):
    : X=1 :: Y=Y+1
450 NEXT I :: IF X=1 THEN 470
460 CALL PATTERN(#2,128):: GOSUB 62
    0 :: CALL PATTERN(#2,120)
470 H=-H :: C=121 :: GOSUB 550
480 V=-12 :: H=0 :: R=78 :: GOSUB 5
    50
490 IF Y=LEN(W$)THEN GOSUB 740 ELSE
     500 :: GOTO 510
500 IF ER=1 THEN GOSUB 710 ELSE 340
510 DISPLAY AT(23,1)BEEP:"
    {5 SPACES}ANOTHER WORD? (Y/N)"
520 CALL KEY(0,K,S):: IF S=0 OR K<>
    89 AND K<>78 THEN 520 :: IF K=8
    9 THEN 290
530 CALL DELSPRITE(ALL):: GOTO 150
540 REM **SUB TO MOVE HAPPY FACE**
550 CALL MOTION(#2,V,H)
560 CALL COINC(#2,R,C,4,Z):: IF Z=0
     THEN 560 ELSE CALL MOTION(#2,0
    ,0):: CALL LOCATE(#2,R,C):: RET
    URN
570 REM **SUB FOR CORRECT GUESS**
580 B=8*(2*I+14-F):: CALL SPRITE(#1
    ,132,14,R,C,(32-R)/8,(B-C)/8)
590 J=2^(1/12):: FOR A=1 TO 25 :: C
    ALL SOUND(-40,220*J^A,1):: NEXT
     A
600 CALL COINC(#1,32,B,6,Z):: IF Z=
    0 THEN 600 ELSE CALL DELSPRITE(
    #1):: RETURN
610 REM **SUB FOR INCORRECT GUESS**
620 SP=SP-1 :: ER=ER-1 :: IF ER>4 T
    HEN RR=80 ELSE RR=50
630 IF ER=6 OR ER=4 THEN C=52
640 IF ER=5 OR ER=1 THEN C=188
650 IF ER=3 THEN C=110
660 IF ER=2 THEN C=132
670 CALL SPRITE(#SP,140,2,1,120,(RR
    -1)/8,(C-120)/8)
680 J=2^(1/12):: FOR A=25 TO 1 STEP
     -1 :: CALL SOUND(-40,440*J^A,1
    ):: NEXT A
690 CALL COINC(#SP,RR,C,6,Z):: IF Z
    =0 THEN 690 ELSE CALL MOTION(#S
    P,0,0):: CALL LOCATE(#SP,RR,C):
    : CALL PATTERN(#SP,100):: RETURN
700 REM **SUB FOR BLACKBIRDS WIN**
710 CALL HCHAR(19,3,32,28):: DISPLA
    Y AT(19,15-(8+LEN(L$))/2):"SORR
    Y, ";L$;","
720 DISPLAY AT(23,1)BEEP:"THE BLACK
    BIRDS WIN THIS TIME" :: GOSUB 7
    60 :: RETURN
730 REM **SUB FOR PLAYER WINS**
740 CALL HCHAR(19,3,32,28):: DISPLA
    Y AT(19,15-(8+LEN(L$))/2):"GREA
    T, ";L$;","
750 DISPLAY AT(23,1):"{3 SPACES}THA
    T'S THE SECRET WORD"
760 CALL HCHAR(5,3,32,28):: FOR I=1
     TO F :: DISPLAY AT(5,2*I+14-F)
    :SEG$(W$,I,1):: NEXT I :: T=180
     :: GOSUB 1050 :: RETURN
770 REM **ASSIGN COLORS AND DEFINE
    CHARACTERS**
780 FOR I=0 TO 9 :: CALL COLOR(I,2,
    8):: NEXT I :: CALL COLOR(10,3,
    8):: CALL COLOR(11,11,8):: CALL
     COLOR(1,13,8)
800 FOR I=1 TO 25 :: READ C,A$(I)::
     CALL CHAR(C,A$(I)):: NEXT I ::
     CALL SCREEN(15):: GOTO 150
810 DATA 112,C0C0C0C0C0C0C0C0,113,0
    303030303030303,114,FFFFFFFFFF
    FFFFF,115,C0C0C0FFFFC0C0C0,116,
    030303FFFF030303
820 DATA 105,183C3C7E7EFFFFFF,106,F
    FFFFFFFFFFFFFFF,107,FFFFFF7E7E3
    C3C18,108,071F7FFFFF7F1F07,109,
    C0F0FEFFFFFEF0C0
830 DATA 96,00000000030F3FFF,97,FFF
    FFFFFFFFFFFFF,98,FFFFEFC78383C7
    EF,99,7F3F1E3C78FCFEFF,33,FFFFF
    FFFFFFFFFFF
840 DATA 91,1F3F7FFFFFFFFFFF,92,F8F
    CFEFFFFFFFFFF,93,00000000C0F0FC
    FF
850 DATA 120,071820404C8880818088884
    4340201807E0180C0232110181011112
    1C202041 8E0
860 DATA 124,071820404C888081809F90
    4844231807E0180C023211018101F90
    91222C418E0
870 DATA 128,071820404C888081808384
    4840201807E0180C023211018101C12
    112020418E0
880 DATA 132,030F1F3F3F3F3F1F0F0703
    010102040880E0F0F8F8F8F8F0E0C08
    0
890 DATA 136,030F3F7F7F3FFFFFFFFF3F
    7F7F3707010 0C0CCFEFEFCFFFFFFFFF
    CFEFEECE080
900 DATA 140,0000000000183D478301
    000000000000000000000018BCE2C18
    0000000000
910 DATA 100,0001010100010303070707
    0301000101C0E0F0D0C0E0F0F0F8F8F
    8F0E0C02020
920 REM **PRINT SCREEN**
930 CALL HCHAR(16,1,33,288):: FOR I
    =1 TO 21 :: READ R,C,G$ :: DISP
    LAY AT(R,C)SIZE(-6):G$ :: NEXT
    I :: GOTO 240
940 DATA 9,12,`[aa\],10,12,qrrrrp,1
    1,12,qrrrrp,12,12,qrrrrp,13,14,
    st,14,14,st,15,14,st
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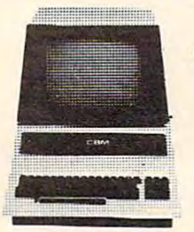

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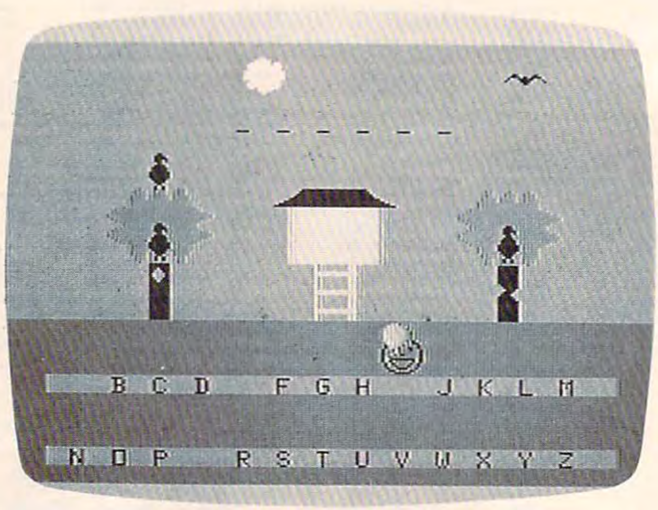
```
950 DATA 9,5,iii,1Ø,4,ljjjm,11,4,lj
     jjm,12,5,kjk,13,6,b,14,6,a,15,6
     ,a
960 DATA 9,22,iii,1Ø,21,ljjjm,11,21
     ,ljjjm,12,22,kjk,13,23,a,14,23,
     c,15,23,a
970 REM **INSTRUCTIONS**
980 DISPLAY AT(1,8)ERASE ALL:"MYSTE
     RY SPELL": :"{3 SPACES}THE OBJE
     CT OF MYSTERY":"SPELL IS TO GUE
     SS THE SECRET":"WORD."
990 DISPLAY AT(6,4):"WHEN YOU PRESS
      A LETTER,":"THE HAPPY FACE WIL
     L MOVE TO":"THE SELECTED LETTER
      AND LET":"YOU KNOW WHETHER YOU
      MADE A"
1ØØØ DISPLAY AT(1Ø,1):"RIGHT OR WRO
      NG CHOICE.":"{3 SPACES}A CORRE
      CT CHOICE LAUNCHES":"A BALLOON
      .  AN INCORRECT ONE":"CAUSES A
       BLACKBIRD TO LAND."
1Ø1Ø DISPLAY AT(14,1):"IF TOO MANY
      BLACKBIRDS LAND,":"YOU WILL LO
      SE THE GAME.": :"{3 SPACES}THE
      RE ARE TWO LEVELS:"
1Ø2Ø DISPLAY AT(19,1)BEEP:"EASY)  P
      ERMITS 6 INCORRECT":"
      {7 SPACES}GUESSES.": :"HARD)
      PERMITS ONLY 4."
1Ø3Ø DISPLAY AT(24,6):"**PRESS ANY
      KEY**" :: CALL KEY(Ø,K,S):: IF
       S=Ø THEN 1Ø3Ø ELSE 19Ø
1Ø4Ø REM **SUB FOR BLACKBIRD FLIGHT
       AND THEME MELODY**
1Ø5Ø R=8 :: FOR SP=5 TO 13 :: C=INT
      (RND*24Ø)+1 :: CALL SPRITE(#SP
      ,14Ø,2,R,C,Ø,12):: R=R+12 :: N
      EXT SP
1Ø6Ø CALL SOUND(T,175,Ø)
1Ø7Ø CALL SOUND(T,349,Ø,175,2)
1Ø8Ø CALL SOUND(T,587,Ø,175,2)
1Ø9Ø CALL SOUND(2*T,523,Ø,44Ø,1,175
      ,2)
11ØØ CALL SOUND(T,587,Ø,175,2)
111Ø CALL SOUND(2*T,523,Ø,44Ø,1,185
      ,2)
112Ø CALL SOUND(T,196,Ø)
113Ø CALL SOUND(T,33Ø,Ø,196,2)
114Ø CALL SOUND(T,587,Ø,196,2)
115Ø CALL SOUND(2*T,523,Ø,466,1,196
      ,2)
116Ø CALL SOUND(T,587,Ø,196,2)
117Ø CALL SOUND(2*T,523,Ø,466,1,2Ø8
      ,2)
118Ø CALL SOUND(T,22Ø,2)
119Ø CALL SOUND(T,523,Ø,44Ø,1,22Ø,2
      )
12ØØ CALL SOUND(T,311,2)
121Ø CALL SOUND(T,523,Ø,44Ø,1,311,2
      )
122Ø CALL SOUND(T,294,2)
123Ø CALL SOUND(T,494,Ø,415,1,294,2
      )
124Ø CALL SOUND(T,277,2)
125Ø CALL SOUND(T,466,Ø,392,1,277,2
      )
126Ø CALL SOUND(T,44Ø,Ø,262,2)
127Ø CALL SOUND(T,523,Ø,262,2)
128Ø CALL SOUND(T,587,Ø,247,2)
129Ø CALL SOUND(T,698,Ø,247,2)
13ØØ CALL SOUND(2*T,659,Ø,233,2)
131Ø CALL SOUND(2*T,784,Ø,659,1,131
      ,2)
132Ø CALL SOUND(T,88Ø,Ø,175,2)
133Ø CALL SOUND(T,831,Ø,175,2)
134Ø CALL SOUND(T,88Ø,Ø,262,2,349,2
      )
135Ø CALL SOUND(T,1Ø47,Ø,262,2,349,
      2)
136Ø CALL SOUND(T,1Ø47,Ø,22Ø,2)
137Ø CALL SOUND(T,88Ø,Ø,22Ø,2)
138Ø CALL SOUND(T,784,Ø,262,2,349,2
      )
139Ø CALL SOUND(T,698,Ø,262,2,349,2
      )
14ØØ CALL SOUND(T,784,Ø,233,2)
141Ø CALL SOUND(T,698,Ø,233,2)
142Ø CALL SOUND(T,587,Ø,294,2,349,2
      )
143Ø CALL SOUND(T,698,Ø,294,2,349,2
      )
144Ø CALL SOUND(T,698,Ø,22Ø,2)
145Ø CALL SOUND(T,587,Ø,22Ø,2)
146Ø CALL SOUND(T,523,Ø,262,2,349,2
      )
147Ø CALL SOUND(T,44Ø,Ø,262,2,349,2
      )
148Ø CALL SOUND(T,392,Ø,247,2)
149Ø CALL SOUND(T,784,Ø,247,2)
15ØØ CALL SOUND(T,698,Ø,294,2,349,2
      )
151Ø CALL SOUND(T,659,Ø,294,2,349,2
      )
152Ø CALL SOUND(T,587,Ø,196,2)
153Ø CALL SOUND(T,44Ø,Ø,196,2)
154Ø CALL SOUND(T,44Ø,Ø,233,2,349,2
      )
155Ø CALL SOUND(T,494,Ø,233,2,349,2
      )
156Ø CALL SOUND(T,523,Ø,175,2,22Ø,2
      )
157Ø CALL SOUND(T,587,Ø,175,2,22Ø,2
      )
158Ø CALL SOUND(2*T,659,Ø,262,2)
159Ø CALL SOUND(3*T,698,Ø,262,2,175
      ,Ø)
16ØØ FOR I=1 TO 3Ø STEP 2 :: CALL S
```



A letter is successfully chosen in the TI version of "Mystery Spell."

```
     OUND(-T,698,I,262,I,175,I):: N
     EXT I :: RETURN
1610 REM **CREATE A WORD LIST**
1620 DISPLAY AT(1,4)ERASE ALL:"WORD
      LIST INSTRUCTIONS": : :"  IN
     THIS SEGMENT YOU MAY":"EITHER
     CREATE A WORD LIST"
1630 DISPLAY AT(6,1):"OR LOAD AN EX
     ISTING ONE FROM":"A STORAGE DE
     VICE.": : :"  WHEN CREATING A
     WORD LIST,":"TYPE EACH WORD, T
     HEN PRESS"
1640 DISPLAY AT(12,1):"ENTER.  MAXI
     MUM WORD LENGTH":"IS 13 CHARAC
     TERS.  20 WORDS":"MUST BE ENTE
     RED FOR EACH OF":"THE WORD LIS
     TS CREATED."
1650 DISPLAY AT(18,3)BEEP:"AS YOU E
     NTER EACH LIST,":"YOU MAY SAVE
      IT TO A STORAGE":"DEVICE FOR
     FUTURE USE WITH":"MYSTERY SPEL
     L."
1660 DISPLAY AT(24,6):"**PRESS ANY
     KEY**" :: CALL KEY(Ø,K,S):: IF
      S=Ø THEN 1660
1670 DISPLAY AT(7,1)ERASE ALL BEEP:
     "PRESS{3 SPACES}TO": : :"  1
     =  CREATE A WORD LIST": :"  2
      =  LOAD A WORD LIST": :"  3
     =  EXIT"
1680 CALL KEY(Ø,K,S):: IF S=Ø OR(K<
     49 OR K>51)THEN 1680 :: J=Ø ::
      ON K-48 GOTO 1690,1795,190

1690 DISPLAY AT(1,5)ERASE ALL:"ENTE
     R THE WORD LIST:"
1700 I=1 :: C=1 :: FOR A=1 TO 2 ::
     R=3 :: FOR Z=1 TO 10
1710 ACCEPT AT(R,C)SIZE(-13)BEEP:B$
     (I):: R=R+2 :: I=I+1 :: NEXT Z
      :: C=15 :: NEXT A
1720 DISPLAY AT(24,1)BEEP:"CORRECT
     OR CHANGE ANY? (Y/N)"
1730 CALL KEY(Ø,K,S):: IF S=Ø OR K<
     >89 AND K<>78 THEN 1730 :: IF
     K=89 THEN 1700 :: J=1 :: GOTO
     1795
1740 FOR I=1 TO 20 :: PRINT #1:B$(I
     ):: NEXT I :: CLOSE #1 :: GOTO
      230
1750 FOR I=1 TO 20 :: INPUT #1:B$(I
     ):: NEXT I :: CLOSE #1
1760 DISPLAY AT(11,6)ERASE ALL BEEP
     :"DO YOU WISH TO SEE": :"
     {4 SPACES}THE WORD LIST? (Y/N)
     "
1770 CALL KEY(Ø,K,S):: IF S=Ø OR(K<
     >89 AND K<>78)THEN 1770 :: IF
     K=89 THEN 1780 ELSE 230
1780 DISPLAY AT(1,10)ERASE ALL BEEP
     :"WORD LIST" :: R=3 :: FOR I=1
      TO 20 STEP 2 :: DISPLAY AT(R,
     1):B$(I),B$(I+1):: R=R+2 :: NE
     XT I
1790 DISPLAY AT(24,1):"PRESS ANY KE
     Y WHEN FINISHED" :: CALL KEY(Ø
     ,K,S):: IF S=Ø THEN 1790 ELSE
     230
1795 ON ERROR 1795
1800 DISPLAY AT(5,6)ERASE ALL BEEP:
     "WHAT IS THE NAME": :"  OF YOU
     R STORAGE DEVICE?": :"(EXAMPLE
     : CS1 OR DSK1.WORDS)"
1810 DISPLAY AT(23,1):"PLACE TAPE O
     R DISK IN DEVICE" :: ACCEPT AT
     (11,3):F$ :: OPEN #1:F$,INTERN
     AL,UPDATE,FIXED 50
1820 IF J=Ø THEN 1750 ELSE 1740
1830 REM **PRESELECTED WORD LIST**
1840 FOR I=1 TO 20 :: READ B$(I)::
     NEXT I :: GOTO 260
1850 DATA BANANAS,CARROTS,RHUBARB,C
     ABBAGE,TURNIP,BEANS,CORN,CELER
     Y,WATERMELON,ORANGES,APPLES,PE
     ACHES
1860 DATA MUSHROOMS,ONIONS,POTATOES
     ,TOMATOES,GRAPES,PUMPKIN,SQUAS
     H,LEMONS
```

Program 2: Mystery Spell – 64 Version

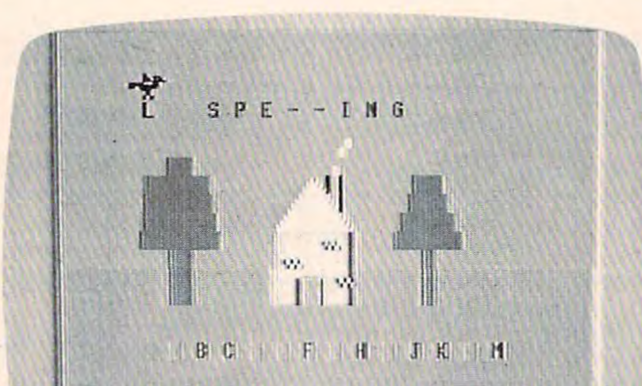
by Eric Brandon, Programming Assistant

```
100 GOSUB 2660
110 X=RND(-TI)
120 DIM W(20),W$(500)
130 GOSUB 1190 :REM DRAW HOUSE
140 PRINT"{HOME}{BLU}PLEASE WAIT...
150 GOSUB 1380 :REM POKE IN SPRITES
160 GOSUB 1970 :REM GET WORDS
170 GOSUB 690{2 SPACES}:REM SET UP SPRIT
    ES
180 PRINT"{HOME}{14 SPACES}"
190 W$=W$(RND(1)*N+1)
200 GOSUB 650
210 L$=" ABCDEFGHIJKLMNOPQRSTUVWXYZ"
220 PRINT"{HOME}{17 DOWN}{8 RIGHT}";
230 FOR I=2 TO 14
240 PRINTMID$(L$,I,1)"{RIGHT}";
250 NEXT
260 PRINT:PRINT"{DOWN}{8 RIGHT}";
270 FOR I=15TO 27
280 PRINTMID$(L$,I,1)"{RIGHT}";
290 NEXT
300 PRINT"{HOME}{4 DOWN}"SPC(18-LEN(G$))
    ;
310 FOR I=1TO LEN(G$)
320 PRINTMID$(G$,I,1)"{RIGHT}";
330 NEXT
340 IF COUNT<>LEN(W$) THEN420
350 POKE 198,Ø
360 FOR DL=1TO100:NEXTDL:CL=CL+1:IFCL=3T
    HENCL=1
370 PRINTMID$("{BLK}{CYN}",CL,1);
380 PRINT"{HOME}{14 SPACES}YOU WIN !!!!"
390 GETA$:IFA$=""THEN 360
400 GOTO 2610
410 GOSUB 2000
420 GETA$:IFA$<"A"ORA$>"Z"ANDA$<>"←"THE
    N410
430 IF A$="←"THEN 760
440 P=ASC(A$)-64
450 IF MID$(L$,P+1,1)<>" "THEN540
460 PRINT"{HOME}{4 DOWN}{8 SPACES}LETTER
     ALREADY CHOSEN{10 SPACES}"
470 FOR I=1 TO 800:NEXTI
480 PRINT"{HOME}{4 DOWN}{38 SPACES}"
490 PRINT"{HOME}{4 DOWN}"SPC(18-LEN(G$))
    ;
500 FOR I=1TO LEN(G$)
510 PRINTMID$(G$,I,1)"{RIGHT}";
```

```
520 NEXT
530 GOTO 420
540 L$=LEFT$(L$,P)+" "+MID$(L$,P+2)
550 RF=0 :REM FLAG FOR CORRECT GUESS
560 FOR I=1 TO LEN(W$)
570 IF MID$(W$,I,1)<>A$ THEN 610
580 G$=LEFT$(G$,I)+MID$(W$,I,1)+MID$(G$,
    I+2)
590 RF=RF+1
600 COUNT=COUNT+1
610 NEXT I
620 IF RF=0 THEN GOSUB 1030
630 IF RF THEN GOSUB 2070
640 GOTO 220
650 G$=" "
660 FOR I=1 TO LEN(W$):G$=G$+"-":W(I)=0:
    NEXT
670 RETURN
680 I=I+1:GOTO1980
690 REM SET UP SPRITES
700 V=53248
710 FOR I=0 TO 15:POKE V+I,0:NEXT
720 POKE V+21,255
730 FOR I=V+39 TO V+46:POKE I,0:NEXT
740 X=0:Y=60:S=251
750 RETURN
760 PRINT"{HOME}{BLU}ENTER YOUR GUESS: "
    ;
770 POKE V+21,PEEK(V+21)AND254
780 FOR I=1 TO LEN(W$):PRINT"{@}";:NEX
    T
790 PRINT"{HOME}{18 RIGHT}";GU$;
800 IF LEN(GU$)<LEN(W$)THENPRINT"{+}";
810 IF LEN(GU$)<LEN(W$)-1 THEN FOR I=2 T
    O LEN(W$)-LEN(GU$):PRINT"{@}";
820 GET K$:IF K$=""THEN 820
830 IF K$=CHR$(20) AND LEN(GU$)>0 THEN G
    U$=LEFT$(GU$,LEN(GU$)-1):GOTO790
840 IF K$=CHR$(13) AND LEN(GU$)=LEN(W$)
    THEN 870
850 IF K$>="A" AND K$<="Z" AND LEN(GU$)<
    LEN(W$) THEN GU$=GU$+K$
860 GOTO 790
870 IF GU$<>W$ THEN 930
880 PRINT"{HOME}{38 SPACES}"
890 PRINT"{HOME}{4 DOWN}"SPC(18-LEN(" "+
    W$));
900 FOR I=1TO LEN(" "+W$)
910 PRINTMID$(" "+W$,I,1)"{RIGHT}";
920 NEXT:GOTO350
930 PRINT"{HOME}{BLK}{13 SPACES}SORRY...
     YOU LOSE{5 SPACES}"
940 PRINT"{BLK}THE WORD WAS ..."
950 PRINT"{HOME}{4 DOWN}"SPC(18-LEN(" "+
    W$));
960 FOR I=1TO LEN(" "+W$)
970 PRINTMID$(" "+W$,I,1)"{RIGHT}";
980 FOR D=1 TO 200:NEXT
990 NEXT
1000 POKE 198,0
1010 GETA$:IFA$=""THEN1010
1020 GOTO 2610
1030 DB=DB+1:S=S-3
1040 DX=32*DB+16:DY=225
1050 IF DB=8 THEN DB=0
1060 POKEV,XAND255:POKEV+16,PEEK(V+16)AN
     D254OR-(X>255):POKE V+1,Y:POKE2040,
     S
1070 IF X=0 THEN POKE V+21,PEEK(V+21)OR1
1080 FLAG=0
1090 IFABS(X-DX)>1THENX=X+3:FLAG=1:IFX>3
     44THEN X=0:POKEV+21,PEEK(V+21)AND25
     4
1100 IF Y<DY THEN Y=Y+2:FLAG=1
1110 S=S+1:IFS=251THENS=248
1120 IF FLAG THEN 1060
1130 X=DX:Y=DY
1140 POKEV+2*DB,XAND255:POKEV+16,PEEK(V+
     16)OR(2↑DB)*(-(X>255))
1150 POKEV+2*DB+1,Y:POKE2040+DB,254
1160 IF DB<>0 THEN POKE V+21,PEEK(V+21)A
     ND254
1170 X=0:Y=60:IF DB=0 THEN 930
1180 RETURN
1190 POKE 53281,3:POKE 53280,4
1200 PRINT"{CYN}{CLR}
1210 PRINT"{4 DOWN}
1220 PRINT
1230 PRINT"{5 SPACES}{GRN}{3 SPACES}
     {RVS}{2 SPACES}{OFF}{10 SPACES}
     {WHT}{D}{UP}{RVS}{B}{OFF}{DOWN}
     {6 SPACES}{GRN}
1240 PRINT"{6 SPACES}{RVS}{K}
     {4 SPACES}{OFF}{J}{6 SPACES}{RVS}
     {YEL}{E}{*}{BLK}{OFF}{2 G}
     {3 SPACES}{GRN} {RVS}{J} {L}
     {OFF}
1250 PRINT"{6 SPACES}{RVS}{J}
     {4 SPACES}{L}{OFF}{5 SPACES}{RVS}
     {YEL}{E}{2 SPACES}{*}{OFF}{BLK}
     {G}{3 SPACES}{GRN} {RVS}
     {3 SPACES}{OFF}
1260 PRINT"{6 SPACES}{RVS}{G}
     {4 SPACES}{N}{OFF}{4 SPACES}{RVS}
     {YEL}{E}{4 SPACES}{*}{OFF}{GRN}
     {3 SPACES}{RVS}{J}{3 SPACES}{L}
     {OFF}
1270 PRINT"{6 SPACES}{RVS}{6 SPACES}
     {OFF}{4 SPACES}{RVS}{RED}{4 SPACES}
     {E} {OFF}{GRN}{3 SPACES}{RVS}
     {5 SPACES}{OFF}
1280 PRINT"{6 SPACES}{5}{2 SPACES}
     {RVS}{2 SPACES}{OFF}{6 SPACES}{RVS}
     {RED} {E}{4 SPACES}{OFF}
     {2 SPACES}{GRN}{3 SPACES}{RVS}{5}
     {OFF}
1290 PRINT"{RVS}{6}{8 SPACES}{5}
     {2 SPACES}{6}{6 SPACES}{RED}
     {2 SPACES}{I}{F} {E}{6}
     {5 SPACES}{5} {6}{12 SPACES}";
1300 PRINT"{8 SPACES}{5}{2 SPACES}
     {6}{6 SPACES}{RED}{2 SPACES}{OFF}
     {RVS}{K}{2 SPACES}{6}
     {5 SPACES}{5} {6}{12 SPACES}";
1310 PRINT"{6}{RVS}";
1320 FOR I=0 TO 8:PRINT"{40 SPACES}";:NE
     XT
1330 FOR I=1 TO 8 : L=1024+23*40+I*4 :PO
     KE L,114:POKEL+54272,0:NEXT
1340 FOR I=0 TO 39:POKE 1024+24*40+I,160
     :POKE 55296+24*40+I,13:NEXT
1350 PRINT"{HOME}
1360 PRINT"{BLK}
1370 RETURN
1380 I=15872:IFPEEK(I+1)=96THENFORI=1TO6
     4*6+2:READA:NEXT:RETURN
1390 READ A:IF A=256 THEN 1410
1400 POKE I,A:I=I+1:GOTO 1390
1410 FOR I=0 TO 63:POKE 254*64+I,PEEK(24
     9*64+I):NEXT:RETURN
```

```
1420 DATA Ø,96,Ø,Ø,113,224,Ø
1430 DATA 121,176,Ø,125,252,117,193
1440 DATA 192,127,255,192,113,255,128
1450 DATA Ø,252,Ø,Ø,24,Ø,Ø
1460 DATA 24,Ø,Ø,102,Ø,Ø,102
1470 DATA Ø,Ø,Ø,Ø,Ø,Ø,Ø
1480 DATA Ø,Ø,Ø,Ø,Ø,Ø,Ø
1490 DATA Ø,Ø,Ø,Ø,Ø,Ø,Ø
1500 DATA Ø,Ø,Ø,Ø,Ø,Ø,Ø
1510 DATA Ø,Ø,Ø,Ø,Ø,1,224
1520 DATA Ø,1,176,Ø,127,252,117
1530 DATA 193,192,127,255,192,113,255
1540 DATA 128,Ø,252,Ø,Ø,24,Ø
1550 DATA Ø,24,Ø,Ø,102,Ø,Ø
1560 DATA 102,Ø,Ø,Ø,Ø,Ø,Ø
1570 DATA Ø,Ø,Ø,Ø,Ø,Ø,Ø
1580 DATA Ø,Ø,Ø,Ø,Ø,Ø,Ø
1590 DATA Ø,Ø,Ø,Ø,Ø,Ø,Ø
1600 DATA Ø,Ø,Ø,Ø,Ø,Ø,1
1610 DATA 224,Ø,1,176,112,127,252
1620 DATA 127,221,192,115,185,192,1
1630 DATA 179,128,Ø,172,Ø,Ø,24
1640 DATA Ø,Ø,24,Ø,Ø,102,Ø
1650 DATA Ø,102,Ø,Ø,Ø,Ø,Ø
1660 DATA Ø,Ø,Ø,Ø,Ø,Ø,Ø
1670 DATA Ø,Ø,Ø,Ø,Ø,Ø,Ø
1680 DATA Ø,Ø,Ø,Ø,Ø,Ø,Ø
1690 DATA Ø,Ø,Ø,Ø,96,Ø,Ø
1700 DATA 113,224,Ø,121,176,Ø,125
1710 DATA 252,117,193,192,127,255,192
1720 DATA 113,255,128,Ø,252,Ø,Ø
1730 DATA Ø,Ø,Ø,Ø,Ø,Ø,Ø
1740 DATA Ø,Ø,Ø,Ø,Ø,Ø,Ø
1750 DATA Ø,Ø,Ø,Ø,Ø,Ø,Ø
1760 DATA Ø,Ø,Ø,Ø,Ø,Ø,Ø
1770 DATA Ø,Ø,Ø,Ø,Ø,Ø,Ø
1780 DATA Ø,Ø,Ø,Ø,Ø,Ø,Ø
1790 DATA Ø,1,224,Ø,1,176,Ø
1800 DATA 127,252,117,193,192,127,255
1810 DATA 192,113,255,128,Ø,252,Ø
1820 DATA Ø,Ø,Ø,Ø,Ø,Ø,Ø
1830 DATA Ø,Ø,Ø,Ø,Ø,Ø,Ø
1840 DATA Ø,Ø,Ø,Ø,Ø,Ø,Ø
1850 DATA Ø,Ø,Ø,Ø,Ø,Ø,Ø
1860 DATA Ø,Ø,Ø,Ø,Ø,Ø,Ø
1870 DATA Ø,Ø,Ø,Ø,Ø,Ø,Ø
1880 DATA Ø,Ø,1,224,Ø,1,176
1890 DATA 112,127,252,127,221,192,115
1900 DATA 185,192,1,179,128,Ø,172
1910 DATA Ø,Ø,112,Ø,Ø,Ø,Ø
1920 DATA Ø,Ø,Ø,Ø,Ø,Ø,Ø
1930 DATA Ø,Ø,Ø,Ø,Ø,Ø,Ø
1940 DATA Ø,Ø,Ø,Ø,Ø,Ø,Ø
1950 DATA Ø,Ø,Ø,Ø,Ø,Ø,Ø
1960 DATA Ø,Ø,Ø,Ø,Ø,Ø,Ø,256
1970 I=1
1980 READ W$(I):IFW$(I)="*"THENN=I-1:RET
     URN
1990 I=I+1:GOTO1980
2000 POKEV,XAND255:POKEV+16,PEEK(V+16)AN
     D254OR-(X>255):POKE V+1,Y:POKE2040,
     S
2010 IF X=Ø THEN POKE V+21,PEEK(V+21)OR1
2020 X=X+3:IFX>344 THEN X=Ø:POKEV+21,PEE
     K(V+21)AND254
2030 Y=Y-1+RND(1)*2:IFY>100THENY=99
2040 IF Y<50 THEN Y=50
2050 S=S+1:IFS=254THENS=251
2060 RETURN
2070 DX=INT(P+13*(P>13))*16+24+40
2080 DY=173+INT(P/14)*24:IF S>250 THEN S
     =S-3
2090 POKEV,XAND255:POKEV+16,PEEK(V+16)AN
     D254OR-(X>255):POKEV+1,Y:POKE2040,S
2100 IF X=Ø THEN POKE V+21,PEEK(V+21)OR1
2110 FLAG=Ø
2120 IFABS(X-DX)>2THENX=X+3:FLAG=1:IFX>3
     44THENX=Ø:POKEV+21,PEEK(V+21)AND254
2130 IF Y<DY THEN Y=Y+2:FLAG=1
2140 S=S+1:IFS=251THENS=248
2150 IF FLAG THEN 2090
2160 X=DX:Y=DY
2170 POKEV,XAND255:POKEV+16,PEEK(V+16)AN
     D254OR-(X>255):POKEV+1,Y:POKE2040,2
     49
2180 POKE 56334,PEEK(56334)AND254
2190 POKE 1,PEEK(1)AND251
2200 FOR I=Ø TO 7
2210 B=PEEK(53248+8*P+I)
2220 FOR J=248 TO 250
2230 POKE J*64+40+I*3,B
2240 NEXT J,I
2250 POKE 1,PEEK(1)OR4
2260 POKE 56334,PEEK(56334)OR1
2270 PRINT"{HOME}{17 DOWN}{8 RIGHT}";
2280 FOR I=2 TO 14
2290 PRINTMID$(L$,I,1)"{RIGHT}";
2300 NEXT
2310 PRINT:PRINT"{DOWN}{8 RIGHT}";
2320 FOR I=15TO 27
2330 PRINTMID$(L$,I,1)"{RIGHT}";
2340 NEXT
2350 DX=160-8*LEN(G$):DY=69
2360 POKEV,XAND255:POKEV+16,PEEK(V+16)AN
     D254OR-(X>255):POKEV+1,Y:POKE2040,S
2370 IF X=Ø THEN POKE V+21,PEEK(V+21)OR1
2380 FLAG=Ø
2390 IFABS(X-DX)>2THENX=X+3:FLAG=1:IFX>3
     44THEN X=Ø:POKEV+21,PEEK(V+21)AND25
     4
2400 IF Y>DY THEN Y=Y-2:FLAG=1
2410 S=S+1:IFS=251THENS=248
2420 IF FLAG THEN 2360
2430 X=DX:Y=DY
2440 POKEV,XAND255:POKEV+16,PEEK(V+16)AN
     D254OR-(X>255):POKEV+1,Y:POKE2040,2
     49
2450 PRINT"{HOME}{4 DOWN}"SPC(18-LEN(G$)
     );
2460 FOR I=1TO LEN(G$)
2470 IF MID$(G$,I,1)=A$ THEN PRINT A$;:R
     F=RF-1:IFRF=Ø THEN GOSUB 2560
2480 IF MID$(G$,I,1)<>A$ THEN PRINT"
     {RIGHT}";
2490 PRINT"{RIGHT}";
2500 IF RF=Ø THEN I=100:GOTO2540
2510 FOR J=Ø TO 15:X=X+1:S=S+1:IFS=251TH
     ENS=248
2520 POKEV,XAND255:POKEV+16,PEEK(V+16)AN
     D254OR-(X>255):POKE2040,S
2530 NEXT J
2540 NEXT I
2550 RETURN
2560 FOR K=Ø TO 7
2570 FOR J=248 TO 250
2580 POKE J*64+40+K*3,Ø
2590 NEXT J,K
2600 RETURN
2610 PRINT"{CLR}{7 DOWN}{BLK}DO YOU WISH
      TO PLAY AGAIN (Y/N) ?"
```

```
2615 POKE V+21,PEEK(V+21)AND254
2620 PRINT"{10 DOWN}YOU MISSED THIS MANY
     :"
2630 GETA$:IFA$<>"N"AND A$<>"Y"THEN2630
2640 IF A$="Y"THENPOKE V+21,0:RUN110
2650 END
2660 POKE 53281,0:POKE 53280,0
2670 PRINT"{CLR}{YEL}{13 SPACES}INSTRUCT
     IONS
2680 PRINT"{2 DOWN}{WHT}{4 SPACES}CHOOSE
      LETTERS TO GUESS THE WORD.
2690 PRINT"{DOWN}IF YOU CHOOSE A WRONG L
     ETTER, THE BIRD
2700 PRINT"{DOWN}WILL LAND ON ITS PERCH.
2710 PRINT"{DOWN}{4 SPACES}WHEN ALL THE
     PERCHES ARE FULL, OR
2720 PRINT"{DOWN}YOU GUESSED THE WORD, T
     HE GAME IS OVER
2730 PRINT"{2 DOWN}{4 SPACES}YOU CAN HIT
      THE "CHR$(34)"←"CHR$(34)" KEY ANY
     TIME TO
2740 PRINT"{DOWN}GUESS THE WORD. IF YOU
     GET IT WRONG,{DOWN}{4 SPACES}YOU LO
     SE.
2750 PRINT"{3 DOWN}{9 RIGHT}{YEL}HIT A K
     EY TO BEGIN"
2760 GETA$:IFA$=""THEN2760
2770 RETURN
2780 DATA HAPPY,BRIDGE,FAMILY,CHILDREN
2790 DATA WINDOW,TRAIN,DWARF,BIRDS
2800 DATA SUPERMAN,CONCERT,PEOPLE,MAGIC
2810 DATA SPACE,SCIENCE,PLANETS,GALAXY,S
     TARS
2820 DATA ROOMS,TEACHER,CHALK,BLACKBOARD
2830 DATA SCREEN,COMPUTER,KEYBOARD,PROGR
     AM
2840 DATA SPELLING,WORDS,COLORS,LETTERS
2850 DATA MARKET,STREETS,SQUARE,TRIANGLE
2860 DATA MOVIE,SPACESHIP,LASER,AIRPLANE
     ,BOAT
2870 DATA STICK,ROCK,PAPER,WIN,PLACE,SHO
     W
2880 DATA CHANNEL,EXECUTIVE,MONEY,SHIRT
2890 DATA QUIET,LOUD,BILLBOARD,YACHT,MOT
     ORCYCLE,*
```

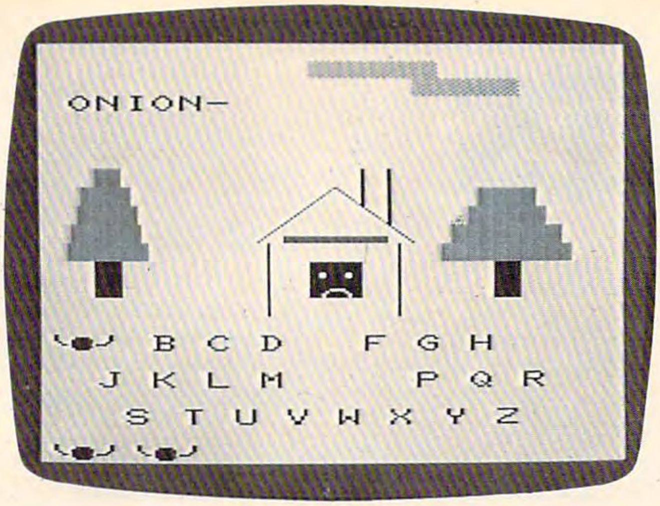


The bird carries an L to complete the spelling and end the game in "Mystery Spell." 64 version.

Program 3: Mystery Spell – VIC Version

by Gregg Peele, Editorial Programmer

```
100 DIMYA$(21):GOSUB1020:DIMW(20)
105 POKE36879,30
110 PRINT"{CYN}{CLR} {DOWN}{9 SPACES}
    {5 +}
120 PRINT"{14 SPACES}{4 +}
130 PRINT"{2 DOWN}
140 PRINT"
150 PRINT"{GRN}{2 SPACES}{RVS} {OFF}
    {8 SPACES}{BLK} {2 G}{2 SPACES}
    {GRN}
160 PRINT" {RVS}{K} {OFF}{J}
    {5 SPACES}{RED} NM{BLK}{2 G} {GRN}
     {RVS}{J} {L}{OFF}
170 PRINT" {RVS}{J} {L}{OFF}
    {4 SPACES}{RED} N{2 SPACES}M{BLK}
    {G} {GRN} {RVS}{3 SPACES}{OFF}
180 PRINT" {RVS}{G} {N}{OFF}
    {3 SPACES}{RED} N{4 O}M{GRN} {RVS}
    {J}{3 SPACES}{L}{OFF}
190 PRINT" {RVS}{3 SPACES}{OFF}
    {3 SPACES}{RED} B{4 SPACES}B{GRN}
    {RVS}{5 SPACES}{OFF}
200 PRINT" {BLK} {RVS} {OFF}{3 SPACES}
    {RED}{2 SPACES}B{4 SPACES}B{GRN}
    {3 SPACES}{RVS}{BLK} {OFF}
210 PRINT"{BLK}{2 SPACES}{RVS} {OFF}
    {3 SPACES}{RED}{2 SPACES}B{4 SPACES}
    B{2 SPACES}{BLK} {RVS} {OFF}
220 PRINT"{6 SPACES}{RED}{2 SPACES}B
    {4 SPACES}B
225 PRINT"{3 SPACES}{RVS}{BLK}MYSTERY
    {2 SPACES}SPELL{OFF}"
230 PRINT"{3 DOWN}";H$
240 T=7680:W=0
250 IFW<22THENT=T+1:IFT>7694ANDT<8000 TH
    ENT=T+21:IFT>7750THENT=T+1
260 W=W+1:IFW>44THENW=0:GOTO250
270 IFW>22THENT=T-20:IFT<7701THEN240
280 T0=PEEK(T):T1=PEEK(T+1):T2=PEEK(T+2)
290 C0=PEEK(T+30720):C1=PEEK(T+30721):C2
    =PEEK(T+30722)
300 POKET,74:POKET+1,81:POKET+2,75
310 POKET+30720,0:POKET+30721,0:POKET+30
    722,0
320 FORD=1TO100:NEXTD
330 POKET,67:POKET+2,67
340 FORD=1TO100:NEXTD
350 POKET,T0:POKET+1,T1:POKET+2,T2
360 POKET+30720,C0:POKET+30721,C1:POKET+
    30722,C2
1000 IFW=30THENGOSUB2000
1010 GOTO250
1020 PRINT"{CLR}ENTER YOUR OWN WORDS
     {2 SPACES}Y OR N"
1030 H$={2 SPACES}"{HOME}{BLK}{12 DOWN}
     {10 RIGHT}{RVS}..{DOWN}{2 LEFT}JK
     {OFF}"
1040 S$={2 SPACES}"{HOME}{BLK}{12 DOWN}
     {10 RIGHT}{RVS}..{DOWN}{2 LEFT}UI
     {OFF}"
1050 GETX$:IFX$<>"N"ANDX$<>"Y"THEN1050
1060 IFX$="N"THEN1080
1070 FORT=1TO20:PRINT"WORD#";T;:INPUTYA$
     (T):NEXT:GOTO1120
1080 FORT=1TO20:READA$:YA$(T)=A$:NEXT
1090 DATA GRAPES,ORANGES,POTATOES,ONIONS
     ,BROCCOLI
```



The bird swoops down to get the final letter for a correctly spelled word in the VIC version of "Mystery Spell."

```
1100 DATA BEANS,TOMATO,SPINACH,CUCUMBERS
     ,CARROT,LETTUCE,RADISHES
1110 DATA APPLE,CORN,PEAR,PEACH,GRAPEFRU
     IT,COCONUT,KUMQUAT,BANANA
1120 W$=YA$(RND(1)*20+1):RETURN
2000 FORT=1TO300:NEXT:FORT=8010TO8010+22
     :POKET,32:NEXT
2010 GOSUB 2210
2020 L$=" ABCDEFGHIJKLMNOPQRSTUVWXYZ"
2030 PRINT"{HOME}{16 DOWN}";:FORT=1TO10:
     PRINTMID$(L$,T,1);" ";:NEXT
2040 PRINT"{DOWN}{4 RIGHT}";:FORT=11TO19
     :PRINTMID$(L$,T,1);" ";:NEXT
2050 PRINT"{DOWN}{5 RIGHT}";:FORT=20TO27
     :PRINTMID$(L$,T,1);" ";:NEXT
2060 PRINT"{HOME}{3 DOWN}";G$;"{HOME}
     {22 DOWN}{5 LEFT}";
2062 IFWR>0THENFORY=0TOWR:PRINT"
     {3 RIGHT}";:NEXT:PRINT"{LEFT}JQK";
2065 IFWR=7THENGOTO 5000
2070 IF COUNT<>LEN(W$)THEN2080
2075 FORT=1TO20:PRINT"{HOME}YOU WIN
     {7 LEFT}";:FORO=1TO200
2078 NEXTO:PRINT"{9 SPACES}";:FORZ=1TO20
     0:NEXTZ:NEXTT:PRINTH$;:GOTO5000
2080 PRINT"{HOME}{4 DOWN}{25 SPACES}";:G
     ETA$:IFA$<"A"ORA$>"Z"THEN2030
2090 P=ASC(A$)-64
2100 IF MID$(L$,P+1,1)<>" "THEN2120
2110 PRINT"{HOME}{4 DOWN}LETTER ALREADY
     CHOSEN";:FORT=1TO600:NEXT:GOTO2080
2120 L$=LEFT$(L$,P)+" "+MID$(L$,P+2):PRI
     NTS$:FL=1:GOSUB3000
2130 FOR I=1 TO LEN(W$)
2140 IF MID$(W$,I,1)<> A$ THEN2180
2145 FLAG=0
2150 G$=LEFT$(G$,I)+MID$(W$,I,1)+MID$(G$
     ,I+2)
2160 COUNT=COUNT+1:PRINTHS:GOTO2180
2170 IF MID$(W$,I,1)<>" "ANDMID$(W$,I,1)
     =LEFRT$(A$,1)THENPRINTH$
2180 NEXT I
2185 WR=WR+FL
2190 GOTO 2060
2200 RETURN
2210 G$=" "
2220 FOR I=1 TO LEN(W$):G$=G$+"-":W(I)=0
     :NEXT
2230 RETURN
3000 FORG=7878TO8164STEP22
3010 Y0=PEEK(G):Y1=PEEK(G+1):Y2=PEEK(G+2
     )
3020 Z0=PEEK(G+30720):Z1=PEEK(G+30721):Z
     2=PEEK(G+30722)
3030 POKEG+30720,0{3 SPACES}:POKEG+30721
     ,0:POKEG+30722,0
3040 POKEG,74:POKEG+1,81:POKEG+2,75
3055 FORT=1TO100:NEXT
3060 POKEG,67:POKEG+2,67:FORT=1TO100:NEX
     T
3070 IFG>8160THENRETURN
3090 POKEG,Y0:POKEG+1,Y1:POKEG+2,Y2
3100 POKEG+30720,Z0:POKEG+30721,Z1:POKEG
     +30722,Z2
3115 FORR=GTOG+20
3116 IFPEEK(R)=PTHENM=R
3117 NEXTR
3120 IFM>G+1THENG=G-21:GOTO3126
3125 IFM=G+1THENG=G-22:J=J+1
3126 IFJ=5THENM=0:IFFL=0THENWR=WR+1:J=0:
     RETURN
3127 IFJ=5THENM=0:J=0:RETURN
3128 NEXT
3129 M=0:J=0
3130 NEXT:IFFL=0THENWR=WR+1
3140 RETURN
5000 PRINT"{HOME}THE WORD WAS{HOME}
     {3 DOWN}{RIGHT}";:FORT=1TOLEN(W$):P
     RINTMID$(W$,T,1);:FORU=1TO200:NEXT:
     NEXT
5010 PRINT"{HOME}{5 DOWN}PLAY AGAIN?Y OR
      N";
5011 GETM$:IFM$=""THEN5011
5012 IFM$="Y"THENRUN
5013 IFM$<>"N"THEN5011
5015 PRINT"{CLR}":END
```

©

DOTS

Eric K. Evans

Easy to play, but challenging, this game pits you against your computer. You can choose one of ten skill levels. Written for the VIC with versions for the 64, Color Computer, and Apple.

"Dots" is based on a strategy game that many people first come across while they are in elementary or junior high school. You remember it: you and a friend take a couple of pencils and a piece of paper and draw several rows of dots on the paper. Then you take turns drawing horizontal or vertical lines that would connect two dots. These lines form the sides of squares.

The object of the game is to maneuver your friend into drawing the third side of a square so that you can draw the fourth side and complete the square. Every time you finish a square you get one point and another turn. When all of the squares are finished, the game ends and the person with the most points wins.

With this program, your computer will be the friend you play against and it will also act as umpire. Its decisions will be final, but don't worry – it doesn't cheat.

How To Play

The first thing you need to do after typing in or loading the game is enter either a J if you plan to use a joystick for input or a K if you are going to use the keyboard cursor control keys and the RETURN key for input. Next you will be asked to enter a skill level between 0 and 10 (with 10 being the most difficult).

If you enter 0 as your skill level, the VIC will play randomly and you should win with little effort. At skill level 10, be prepared for a real strategic challenge. At level 0, the VIC will make its move immediately after yours. As the level of play increases, the VIC's response time increases, too. At level 10, it will usually take between 5 and 20 seconds to make its move.

When the game starts, a 100-dot (ten by ten) game board will be displayed with a scoring area at the bottom of the screen. You always move first. To move, position the yellow cursor where you want to draw a line, and then hit the joystick fire button or the RETURN key to enter your move. When the VIC makes a move, it will beep and flash the line it is going to draw to make sure you see where it is moving.

Whenever you complete a square, the square is colored in cyan and you get another turn. Whenever the VIC completes a square, the square is colored in red and the VIC moves again. These colors are used because they contrast well on black-and-white as well as color TVs. The game continues until all 81 squares have been formed and the winner is declared.

If you don't want to spend the time to type in this program, send me a cassette, a self-addressed, stamped mailer, and $3, and I will return your tape with two copies (just to be safe) of the game on it. *This is only for the VIC version.*

Eric K. Evans
P.O. Box 6287
New Haven, CT 06520

Color Computer And Apple Version Notes For Dots

The object of Dots on the Color Computer and the Apple is to form more squares than the computer by connecting dots with horizontal and vertical lines. On the Color Computer, the game is played on a 70-dot grid. Move the yellow cursor around the game board with the arrow keys. When it is in a position where you wish to draw a line, press the ENTER key. Squares that you complete will be colored orange; those the computer captures are colored red.

Dots on the Apple features a 100-dot game board and is played like the Color Computer version. A flashing asterisk, moved with the J,I,K, and M keys, indicates your position. Press the RETURN key to draw a connecting line. When a square is formed, an inverse Y or A is displayed, crediting either you or the Apple with the capture.

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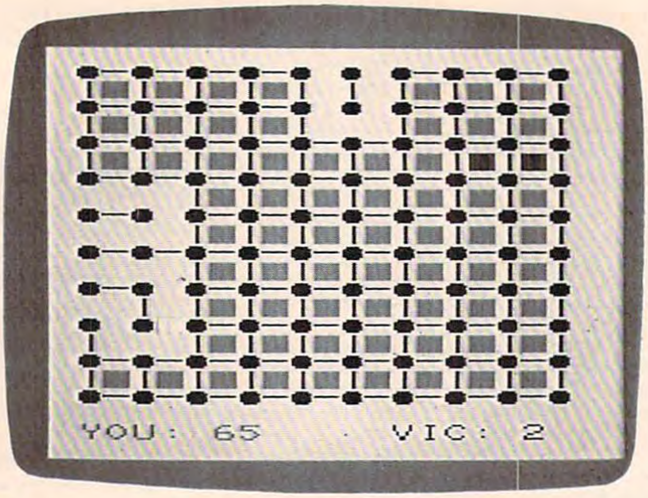

An almost completed game of "Dots," VIC version.

Program 1: Dots – VIC Version

```
10 PRINT"{CLR}{2 DOWN}"SPC(18)"DOTS
   {DOWN}"
20 INPUT"{6 SPACES}JOYSTICK{DOWN}
   {5 LEFT}OR{DOWN}{8 LEFT}KEYBOARD(J/K)
   ";A$
30 JK=-1:IFA$="K"THENJK=Ø
40 INPUT"{3 DOWN}{RIGHT}SKILL LEVEL(Ø-1Ø
   )";SK:IFSK<ØORSK>1ØTHEN4Ø
50 SK=(1Ø-SK)/1Ø:TS=2ØØ-2ØØ*SK:DT=TS+25:
   DD=37154:POKE37139,Ø:POKE36879,29
60 SC=4*(PEEK(36866)AND128)+64*(PEEK(368
   69)AND12Ø):CO=37888+4*(PEEK(36866)AND
   128)
70 PRINT"{CLR}":FORI=1TO1Ø:PRINT"{BLK} Q
   Q Q Q Q Q Q Q Q Q{DOWN}":NEXT
80 YS=Ø:VS=Ø:PRINT" {CYN}YOU:"YS"
   {4 SPACES}{RED}VIC:"VS
90 DEFFNBX(LC)=(PEEK(LC+22)<>32)+(PEEK(L
   C+1)<>32)+(PEEK(LC-22)<>32)+(PEEK(LC-
   1)<>32)
100 DEFFNVH(LC)=LC<>2*INT(LC/2)
110 SL=SC+23Ø:CL=CO+23Ø:X=1Ø:Y=1Ø:CC=PEE
    K(SL):CR=PEEK(CL)
120 POKESL,16Ø:POKECL,7:F=Ø
130 IFJKTHEN15Ø
140 GOSUB93Ø:GOTO16Ø
150 GOSUB86Ø:IFPC=ØTHEN15Ø
160 X=X+J:Y=Y+K:IFX<1ORX>19ORY<1ORY>19TH
    ENX=X-J:Y=Y-K:GOTO13Ø
170 IFPC=99THEN2ØØ
180 POKESL,CC:POKECL,CR:SL=SL+PC:CL=CL+P
    C:CC=PEEK(SL):POKESL,16Ø
190 CR=PEEK(CL):POKECL,7:GOTO13Ø
200 L=(PEEK(SL+1)=81)+(PEEK(SL-1)=81)+(P
    EEK(SL+22)=81)+(PEEK(SL-22)=81)
210 IFL+(CC=32)=-3THEN23Ø
220 I=128:GOSUB71Ø:GOTO13Ø
230 WH=1:ML=SL:GOSUB65Ø:IFNOTFNVH(SL)THE
    N28Ø
240 IFX>1ANDFNBX(SL-1)=-4THENBX=SL-1:GOS
    UB72Ø:F=-1
250 IFX<19ANDFNBX(SL+1)=-4THENBX=SL+1:GO
    SUB72Ø:GOTO11Ø
260 IFFTHEN11Ø
270 GOTO31Ø
280 IFY>1ANDFNBX(SL-22)=-4THENBX=SL-22:G
    OSUB72Ø:F=-1
290 IFY<19ANDFNBX(SL+22)=-4THENBX=SL+22:
    GOSUB72Ø:GOTO11Ø
300 IFFTHEN11Ø
310 WH=2:F=Ø:CN=Ø:IFRND(Ø)<SKTHEN39Ø
320 FORI=44TO396STEP44:FORJ=2TO18STEP2:K
    =SC+I+J
330 IFPEEK(K)=32ANDFNBX(K)=-3THEN35Ø
340 NEXTJ,I:GOTO39Ø
350 I=K:IFPEEK(I-22)=32THENI=I-22:GOTO54
    Ø
360 IFPEEK(I+22)=32THENI=I+22:GOTO54Ø
370 IFPEEK(I-1)<>32THENI=I+1:GOTO6ØØ
380 IFPEEK(I+1)<>32THENI=I-1:GOTO6ØØ
390 I=INT(RND(Ø)*415+SC+23):CN=CN+1:IFPE
    EK(I)<>32THEN39Ø
400 IFNOT((PEEK(I+1)=81ANDPEEK(I-1)=81)O
    R(PEEK(I+22)=81ANDPEEK(I-22)=81))THE
    N39Ø
410 IFSK>.6ORCN>TSTHEN47Ø
420 IFFNVH(I)THEN45Ø
430 IFFNBX(I-22)=-2ORFNBX(I+22)=-2THEN39
    Ø
440 GOTO54Ø
450 IFFNBX(I-1)=-2ORFNBX(I+1)=-2THEN39Ø
460 GOTO6ØØ
470 IFFNVH(I)THEN51Ø
480 IFSK>.6ORCN>DTTHEN54Ø
490 IFFNBX(I+22)=-2ANDFNBX(I-22)=-2THEN3
    9Ø
500 GOTO54Ø
510 IFSK>.6ORCN>DTTHEN6ØØ
520 IFFNBX(I+1)=-2ANDFNBX(I-1)=-2THEN39Ø
530 GOTO6ØØ
540 ML=I:GOSUB65Ø
550 IFFNBX(ML-22)=-4THENBX=ML-22:GOSUB72
    Ø:F=-1
560 IFFNBX(ML+2?2)=-4THENBX=ML+22:GOSUB72
    Ø:GOTO31Ø
570 IFFTHEN31Ø
580 GOTO11Ø
590 IFNOT(PEEK(I-22)=81ANDPEEK(I+22)=81)
    THEN39Ø
600 ML=I:GOSUB65Ø
610 IFFNBX(ML-1)=-4THENBX=ML-1:GOSUB72Ø:
    F=-1
620 IFFNBX(ML+1)=-4THENBX=ML+1:GOSUB72Ø:
    GOTO31Ø
630 IFFTHEN31Ø
640 GOTO11Ø
650 CL=CO+ML-SC
660 POKEML,67
670 IFFNVH(ML)THENPOKEML,93
680 I=185:IFWH=2THENI=15Ø
690 FORJ=1TOWH:POKECL,Ø:GOSUB71Ø:POKECL,
    1
700 FORL=1TO2ØØ:NEXT:POKECL,Ø:NEXT
710 POKE36878,15:POKE36876,I:FORK=1TO2ØØ
    :NEXT:POKE36878,Ø:POKE36876,Ø:RETURN
720 YS=YS+1:J=3:I=2ØØ:CL=CO+BX-SC:IFWH=2
    THENJ=2:I=15Ø:YS=YS-1:VS=VS+1
730 POKEBX,16Ø:POKECL,1
740 FORL=1TO3:POKECL,J:GOSUB71Ø:POKECL,1
    :FORK=1TO2ØØ:NEXT:I=I+18:POKECL,J:NE
    XT
750 PRINT"{HOME}{21 DOWN} {CYN}YOU:"YS"
    {4 SPACES}{RED}VIC:"VS
760 IFYS+VS<81THENRETURN
```

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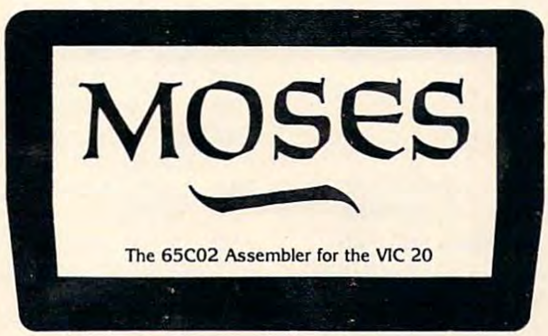

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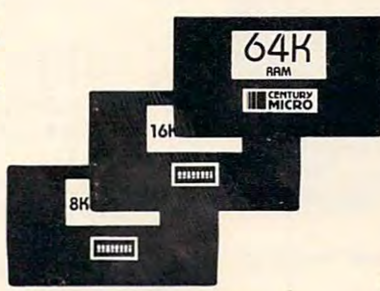

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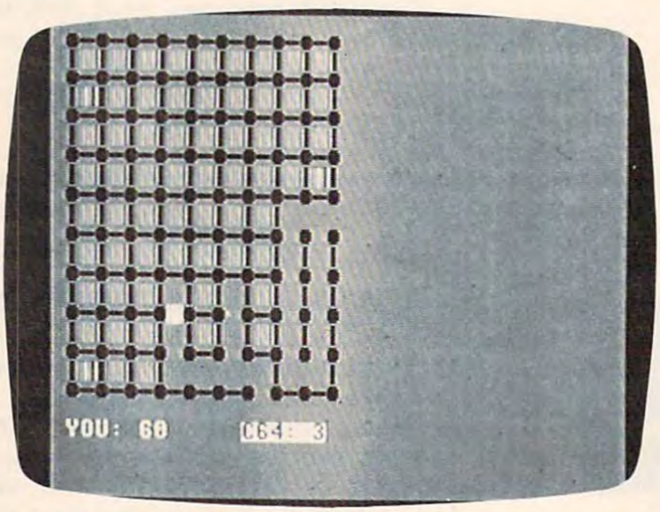
```
770 PRINT"{HOME}{19 DOWN}":IFYS>VSTHEN80
    Ø
780 PRINT"{BLK}{7 SPACES}YOU LOSE"
790 POKE36878,15:POKE36877,128:FORI=1TO1
    5ØØ:NEXT:GOTO85Ø
8ØØ PRINT"{DOWN}":FORJ=1TO3
81Ø PRINT"{2 UP}{RVS}{BLU}!{RED}**{BLU}!
    {PUR}{3 SPACES}YOU{2 SPACES}WIN
    {3 SPACES}{BLU}!{RED}**{BLU}!"
82Ø POKE36878,15:FORL=128TO255:POKE36876
    ,L:NEXT:POKE36874,Ø:POKE36878,Ø
83Ø PRINT"{2 UP}{22 SPACES}":FORL=1TO3ØØ
    :NEXT
84Ø PRINT"{2 UP}{RVS}{BLU}!{RED}**{BLU}!
    {PUR}{3 SPACES}YOU{2 SPACES}WIN
    {3 SPACES}{BLU}!{RED}**{BLU}!":NEXT
85Ø POKE36878,Ø:POKE36877,Ø:END
86Ø J=Ø:K=Ø:PC=Ø:POKEDD,127:IFPEEK(37152
    )=119THENPC=1:J=1:POKEDD,255:RETURN
87Ø POKEDD,255:I=PEEK(37137)
88Ø IF(IAND4)=ØTHENPC=-22:K=-1:RETURN
89Ø IF(IAND8)=ØTHENPC=22:K=1:RETURN
9ØØ IF(IAND16)=ØTHENPC=-1:J=-1:RETURN
91Ø IF(IAND32)=ØTHENPC=99
92Ø RETURN
93Ø J=Ø:K=Ø:PC=Ø
94Ø GETA$:IFA$=""THEN94Ø
95Ø IFA$="{UP}"THENPC=-22:K=-1:RETURN
96Ø IFA$="{RIGHT}"THENJ=1:PC=1:RETURN
97Ø IFA$="{DOWN}"THENK=1:PC=22:RETURN
98Ø IFA$="{LEFT}"THENJ=-1:PC=-1:RETURN
99Ø IFASC(A$)=13THENPC=99
1ØØØ RETURN
```



"Dots," 64 version. The computer has almost lost the game.

Program 2: Dots – 64 Version

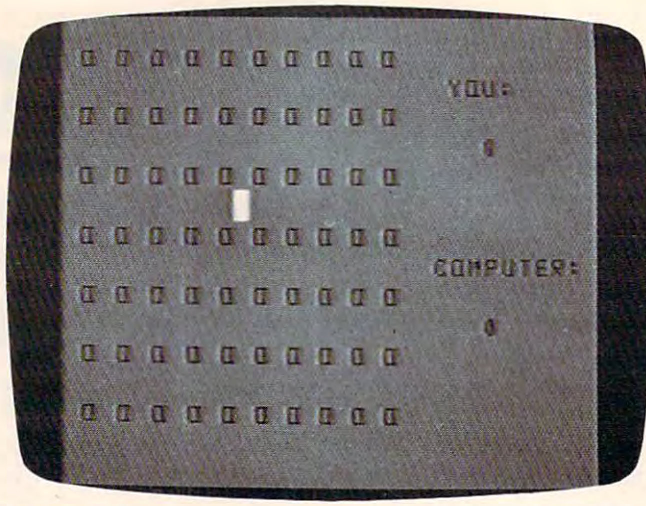
```
5 POKE 53281,12:POKE53280,Ø
1Ø PRINT"{BLK}{RVS}{CLR}{2 DOWN}"SPC(17)
   "DOTS
2Ø PRINT"{2 DOWN}{15 SPACES}{WHT}JOYSTIC
   K{DOWN}{5 LEFT}OR{DOWN}{7 LEFT}KEYBOA
   RD(J/K){SHIFT-SPACE}?";
25 GETA$:IFA$<>"J"ANDA$<>"K"THEN25
26 PRINTA$
3Ø JK=-1:IFA$="K"THENJK=Ø
4Ø INPUT"{3 DOWN}{RIGHT}SKILL LEVEL(Ø-1Ø
   )";SK:IFSK<ØORSK>1ØTHEN4Ø
5Ø SK=(1Ø-SK)/1Ø:TS=2ØØ-2ØØ*SK:DT=TS+25
6Ø SC=1Ø24 : CO = 13*4Ø96+8*256
7Ø PRINT"{CLR}":FORI=1TO1Ø:PRINT"{BLK} Q
   Q Q Q Q Q Q Q Q Q{DOWN}":NEXT
8Ø YS=Ø:VS=Ø:PRINT" {WHT}YOU:"YS"
   {4 SPACES}{RVS}C64:"VS
9Ø DEFFNBX(LC)=(PEEK(LC+4Ø)<>32)+(PEEK(L
   C+1)<>32)+(PEEK(LC-4Ø)<>32)+(PEEK(LC-
   1)<>32)
1ØØ DEFFNVH(LC)=LC<>2*INT(LC/2)
11Ø SL=SC+45Ø:CL=CO+45Ø:X=1Ø:Y=11:CC=PEE
    K(SL):CR=PEEK(CL)
12Ø POKESL,16Ø:POKECL,7:F=Ø
13Ø IFJKTHEN15Ø
14Ø GOSUB93Ø:GOTO16Ø
15Ø GOSUB86Ø:IFPC=ØTHEN15Ø
16Ø X=X+J:Y=Y+K:IFX<1ORX>19ORY<1ORY>19TH
    ENX=X-J:Y=Y-K:GOTO13Ø
17Ø IFPC=99THEN2ØØ
18Ø POKESL,CC:POKECL,CR:SL=SL+PC:CL=CL+P
    C:CC=PEEK(SL):POKESL,16Ø
19Ø CR=PEEK(CL):POKECL,7:GOTO13Ø
2ØØ L=(PEEK(SL+1)=81)+(PEEK(SL-1)=81)+(P
    EEK(SL+4Ø)=81)+(PEEK(SL-4Ø)=81)
21Ø IFL+(CC=32)=-3THEN23Ø
22Ø I=128:GOSUB71Ø:GOTO13Ø
23Ø WH=1:ML=SL:GOSUB65Ø:IFNOTFNVH(SL)THE
    N28Ø
24Ø IFX>1ANDFNBX(SL-1)=-4THENBX=SL-1:GOS
    UB72Ø:F=-1
25Ø IFX<19ANDFNBX(SL+1)=-4THENBX=SL+1:GO
    SUB72Ø:GOTO11Ø
26Ø IFFTHEN11Ø
27Ø GOTO31Ø
28Ø IFY>1ANDFNBX(SL-4Ø)=-4THENBX=SL-4Ø:G
    OSUB72Ø:F=-1
29Ø IFY<19ANDFNBX(SL+4Ø)=-4THENBX=SL+4Ø:
    GOSUB72Ø:GOTO11Ø
3ØØ IFFTHEN11Ø
31Ø WH=2:F=Ø:CN=Ø:IFRND(Ø)<SKTHEN39Ø
32Ø FORI=8ØTO72ØSTEP8Ø:FORJ=2TO18STEP2:K
    =SC+I+J
33Ø IFPEEK(K)=32ANDFNBX(K)=-3THEN35Ø
34Ø NEXTJ,I:GOTO39Ø
35Ø I=K:IFPEEK(I-4Ø)=32THENI=I-4Ø:GOTO54
    Ø
36Ø IFPEEK(I+4Ø)=32THENI=I+4Ø:GOTO54Ø
37Ø IFPEEK(I-1)<>32THENI=I+1:GOTO6ØØ
38Ø IFPEEK(I+1)<>32THENI=I-1:GOTO6ØØ
39Ø I=INT(INT(RND(Ø)*2Ø)*4Ø+21*RND(Ø)+SC
    +41):CN=CN+1:IFPEEK(I)<>32THEN39Ø
4ØØ IFNOT((PEEK(I+1)=81ANDPEEK(I-1)=81)O
    R(PEEK(I+4Ø)=81ANDPEEK(I-4Ø)=81))THE
    N39Ø
41Ø IFSK>.6ORCN>TSTHEN47Ø
42Ø IFFNVH(I)THEN45Ø
43Ø IFFNBX(I-4Ø)=-2ORFNBX(I+4Ø)=-2THEN39
    Ø
44Ø GOTO54Ø
45Ø IFFNBX(I-1)=-2ORFNBX(I+1)=-2THEN39Ø
46Ø GOTO6ØØ
47Ø IFFNVH(I)THEN51Ø
48Ø IFSK>.6ORCN>DTTHEN54Ø
49Ø IFFNBX(I+4Ø)=-2ANDFNBX(I-4Ø)=-2THEN3
    9Ø
5ØØ GOTO54Ø
51Ø IFSK>.6ORCN>DTTHEN6ØØ
52Ø IFFNBX(I+1)=-2ANDFNBX(I-1)=-2THEN39Ø
53Ø GOTO6ØØ
54Ø ML=I:GOSUB65Ø
```

```
550 IFFNBX(ML-40)=-4THENBX=ML-40:GOSUB72
    Ø:F=-1
560 IFFNBX(ML+40)=-4THENBX=ML+40:GOSUB72
    Ø:GOTO31Ø
570 IFFTHEN31Ø
580 GOTO110
590 IFNOT(PEEK(I-40)=81ANDPEEK(I+40)=81)
    THEN39Ø
600 ML=I:GOSUB65Ø
610 IFFNBX(ML-1)=-4THENBX=ML-1:GOSUB720:
    F=-1
620 IFFNBX(ML+1)=-4THENBX=ML+1:GOSUB720:
    GOTO31Ø
630 IFFTHEN31Ø
640 GOTO110
650 CL=CO+ML-SC
660 POKEML,67
670 IFFNVH(ML)THENPOKEML,93
680 I=185:IFWH=2THENI=15Ø
690 FORJ=1TOWH:POKECL,Ø:GOSUB71Ø:POKECL,
    1
700 FORL=1TO200:NEXT:POKECL,Ø:NEXT
710 FORK=1TO200:NEXT:RETURN
720 YS=YS+1:J=3:I=200:CL=CO+BX-SC:IFWH=2
    THENJ=2:I=150:YS=YS-1:VS=VS+1
730 POKEBX,160:POKECL,1
740 FORL=1TO3:POKECL,J:GOSUB71Ø:POKECL,1
    :FORK=1TO200:NEXT:I=I+18:POKECL,J:NE
    XT
750 PRINT"{HOME}{21 DOWN} {WHT}YOU:"YS"
    {4 SPACES}{RVS}C64:"VS
760 IFYS+VS<81THENRETURN
770 PRINT"{HOME}{19 DOWN}":IFYS>VSTHEN80
    Ø
780 PRINT"{BLK}{7 SPACES}YOU LOSE
    {7 SPACES}"
790 GOTO850
800 PRINT"{DOWN}YOU WIN !!!"
850 END
860 J=Ø:K=Ø:PC=Ø
870 I=PEEK(56321)
880 IF(IAND1)=ØTHENPC=-40:K=-1:RETURN
885 IF(IAND8)=ØTHENJ=1:PC=1:RETURN
890 IF(IAND2)=ØTHENPC=40:K=1:RETURN
900 IF(IAND4)=ØTHENPC=-1:J=-1:RETURN
910 IF(IAND16)=ØTHENPC=99
920 RETURN
930 J=Ø:K=Ø:PC=Ø
940 GETA$:IFA$=""THEN94Ø
950 IFA$="{UP}"THENPC=-40:K=-1:RETURN
960 IFA$="{RIGHT}"THENJ=1:PC=1:RETURN
970 IFA$="{DOWN}"THENK=1:PC=40:RETURN
980 IFA$="{LEFT}"THENJ=-1:PC=-1:RETURN
990 IFASC(A$)=13THENPC=99
1000 RETURN
```

Program 3: Dots – Color Computer Version

Translation by Patrick Parrish, Editorial Programmer

```
100 CLS 7:PRINT@236,"D O T S";
110 PRINT@357,"SKILL LEVEL (Ø-1Ø)";
     :INPUT SK:IF SK<Ø OR SK>1Ø THEN
      11Ø
120 CLS:SK=(1Ø-SK)/1Ø:TS=2ØØ-2ØØ*SK
     :DT=TS+25:SC=1024
130 PRINT:FOR I=1 TO 7:PRINT" O O O
     O O O O O O O":PRINT:NEXT I
140 YS=Ø:CS=Ø:PRINT@87,"YOU:":PRINT
     @278,"COMPUTER:"
150 PRINT@152,YS:PRINT@344,CS
```



No moves have been made in this Color Computer version of "Dots."

```
160 DEF FNBX(LC)=(PEEK(LC+32)<>96)+
    (PEEK(LC+1)<>96)+(PEEK(LC-32)<>
    96)+(PEEK(LC-1)<>96)
170 DEF FNVH(LC)=(LC<>2*INT(LC/2))
180 SL=SC+202:X=1Ø:Y=7:CC=PEEK(SL)
190 POKE SL,128+16*(2-1)+15:F=Ø
200 GOSUB 91Ø
210 X=X+J:Y=Y+K:IFX<1ORX>19ORY<2ORY
    >14THEN X=X-J:Y=Y-K:GOTO 2ØØ
220 IF PC=99 THEN 25Ø
230 POKE SL,CC:SL=SL+PC:CC=PEEK(SL)
    :POKE SL,128+16*(2-1)+15
240 GOTO 2ØØ
250 L=(PEEK(SL+1)=79)+(PEEK(SL-1)=7
    9)+(PEEK(SL+32)=79)+(PEEK(SL-32
    )=79)
260 IF L+(CC=96)=-3 THEN 28Ø
270 I=62:GOSUB 76Ø:GOTO 2ØØ
280 WH=1:ML=SL:GOSUB 7ØØ:IF NOT FNV
    H(SL)THEN 33Ø
290 IF X>1 AND FNBX(SL-1)=-4 THEN B
    X=SL-1:GOSUB 77Ø:F=-1
300 IF X<19 AND FNBX(SL+1)=-4 THEN
    BX=SL+1:GOSUB 77Ø:GOTO 18Ø
310 IF F THEN 18Ø
320 GOTO 36Ø
330 IF Y>1 AND FNBX(SL-32)=-4 THEN
    BX=SL-32:GOSUB 77Ø:F=-1
340 IF Y<13 AND FNBX(SL+32)=-4 THEN
     BX=SL+32:GOSUB 77Ø:GOTO 18Ø
350 IF F THEN 18Ø
360 WH=2:F=Ø:CN=Ø:IF RND(Ø)<SK THEN
     44Ø
370 FOR I=64 TO 384 STEP 64:FOR J=2
     TO 12 STEP 2:K=SC+I+J
380 IFPEEK(K)=96ANDFNBX(K)=-3 THEN
    4ØØ
390 NEXTJ,I:GOTO 44Ø
400 I=K:IF PEEK(I-32)=96 THEN I=I-3
    2:GOTO 59Ø
410 IF PEEK(I+32)=96 THEN I=I+32:GO
    TO 59Ø
420 IF PEEK(I-1)<>96 THEN I=I+1:GOT
    O 65Ø
430 IF PEEK(I+1)<>96 THEN I=I-1:GOT
    O 65Ø
440 I=RND(19)+RND(13)*32+33+SC:CN=C
    N+1:IF PEEK(I)<>96THEN 44Ø
```

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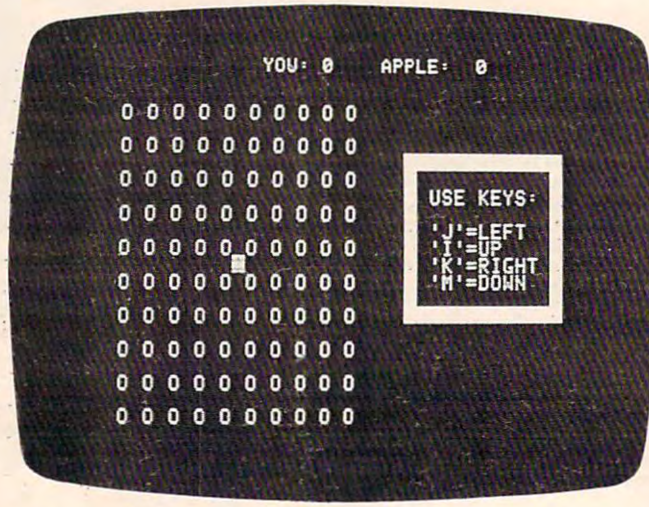
```
450 IFNOT((PEEK(I+1)=79ANDPEEK(I-1)
    =79)OR(PEEK(I+32)=79ANDPEEK(I-3
    2)=79))THEN 440
460 IF SK>.6 OR CN>TS THEN 520
470 IF FNVH(I) THEN 500
480 IF FNBX(I-32)=-2 OR FNBX(I+32)=
    -2 THEN 440
490 GOTO 590
500 IF FNBX(I-1)=-2 OR FNBX(I+1)=-2
     THEN 440
510 GOTO 650
520 IF FNVH(I) THEN 560
530 IF SK>.6 OR CN>DT THEN 590
540 IF FNBX(I+32)=-2 AND FNBX(I-32)
    =-2 THEN 440
550 GOTO 590
560 IF SK>.6 OR CN>DT THEN 650
570 IF FNBX(I+1)=-2 AND FNBX(I-1)=-
    2 THEN 440
580 GOTO 650
590 ML=I:GOSUB 700
600 IF FNBX(ML-32)=-4 THEN BX=ML-32
    :GOSUB 770:F=-1
610 IF FNBX(ML+32)=-4 THEN BX=ML+32
    :GOSUB 770:GOTO 360
620 IF F THEN 360
630 GOTO 180
640 IF NOT (PEEK(I-32)=79 AND PEEK(
    I+32)=79) THEN 440
650 ML=I:GOSUB 700
660 IF FNBX(ML-1)=-4 THEN BX=ML-1:G
    OSUB 770:F=-1
670 IF FNBX(ML+1)=-4 THEN BX=ML+1:G
    OSUB 770:GOTO 360
680 IF F THEN 360
690 GOTO 180
700 REM
710 POKE ML,109
720 IF FNVH(ML) THEN POKE ML,73
730 I=185:IF WH=2 THEN I=150
740 FOR J=1 TO WH:GOSUB 760
750 FOR L=1 TO 200:NEXT:NEXT
760 SOUND I,2:RETURN:REM NOISE
770 YS=YS+1:J=8:I=200:IF WH=2 THEN
    J=4:I=150:YS=YS-1:CS=CS+1
780 POKE BX,128+16*(5-1)+15
790 FOR L=1 TO 3:POKE BX,128+16*(J-
    1)+15:GOSUB 760:POKE BX,128+16*
    (5-1)+15:FOR I=1 TO 200:NEXT:I=
    I+18:POKE BX,128+16*(J-1)+15:NE
    XT
800 PRINT@152,YS:PRINT@344,CS
810 IF YS+CS<54 THEN RETURN
820 IF YS>CS THEN 850
830 PRINT@487,"SORRY, YOU LOST.";
840 SOUND 128,10:FORI=1 TO 1500:NEX
    T I:GOTO 870
850 PRINT@490,"YOU WIN!!!!!";
860 FOR I=128 TO 255:SOUND I,1:NEXT
870 PRINT@487,"PLAY AGAIN (Y/N) ?";
880 A$=INKEY$:IF A$="" THEN 880
890 IF LEFT$(A$,1)="Y" THEN 100
900 END
910 J=0:K=0:PC=0
920 A$=INKEY$:IF A$="" THEN 920
930 IF A$=CHR$(94) THEN PC=-32:K=-1
    :RETURN
940 IF A$=CHR$(9) THEN J=1:PC=1:RET
    URN
950 IF A$=CHR$(10) THEN K=1:PC=32:R
    ETURN
960 IF A$=CHR$(8) THEN J=-1:PC=-1:R
    ETURN
970 IF ASC(A$)=13 THEN PC=99
980 RETURN
```



This game is just beginning in the Apple version of "Dots."

Program 4: Dots – Apple Version

Translation by Patrick Parrish, Editorial Programmer

```
100  DIM XL%(23): FOR I = 0 TO 7:XL%(I)
      = 1024 + 128 * I:XL%(I + 8) = 106
     4 + 128 * I:XL%(I + 16) = 1104 + 1
     28 * I: NEXT I
110  FOR I = 770 TO 795: READ M: POKE I
     ,M: NEXT
120  TEXT : HOME : VTAB 11: HTAB 19: INVERSE
     : PRINT "D O T S": FOR J = 1 TO 10
     00: NEXT J: NORMAL
130  VTAB 15: HTAB 11: INPUT "SKILL LEV
     EL (0-10) ?";SK: IF SK < 0 OR SK >
     10 THEN 130
140 SK = (10 - SK) / 10:TS = 200 - 200 *
     SK:DT = TS + 25
150  HOME : PRINT : PRINT : FOR I = 1 TO
     10: PRINT : PRINT " O O O O O O O
     O O O": NEXT
160  VTAB 9: HTAB 27: PRINT "USE KEYS:"
     : VTAB 11: HTAB 27: PRINT "'J'=LEF
     T": HTAB 27: PRINT "'I'=UP": HTAB
     27: PRINT "'K'=RIGHT": HTAB 27: PRINT
     "'M'=DOWN"
170  VTAB 7: HTAB 25: INVERSE : PRINT "
                 ": VTAB 16: HTAB 25: PRINT
     "            "
180  FOR ROW = 7 TO 14: FOR COL = 24 TO
     36 STEP 12: POKE XL%(ROW) + COL,32
     : NEXT : NEXT : NORMAL
190 YS = 0:AS = 0: VTAB 1: HTAB 13: PRINT
     "YOU: "YS"    APPLE:  "AS;
200  DEF  FN BX(COL) =  - ( PEEK (XL%(R
     OW + 1) + COL) <  > 160) - ( PEEK
     (XL%(ROW) + COL + 1) <  > 160) - (
      PEEK (XL%(ROW - 1) + COL) <  > 16
     0) - ( PEEK (XL%(ROW) + COL - 1) <
      > 160)
210  DEF  FN BY(ROW) =  - ( PEEK (XL%(R
     OW + 1) + COL) <  > 160) - ( PEEK
```

```
    (XL%(ROW) + COL + 1) <  > 160) - (
     PEEK (XL%(ROW - 1) + COL) <  > 16
    0) - ( PEEK (XL%(ROW) + COL - 1) <
     > 160)
220  DEF  FN VH(ROW) =  - ((XL%(ROW) +
    COL) <  > 2 *  INT ((XL%(ROW) + CO
    L) / 2))
230 X = 10:Y = 10:ROW = 12:COL = 10:CC =
     PEEK (XL%(ROW) + COL)
240  POKE XL%(ROW) + COL,106:F = 0
250 OLDROW = ROW:OCOL = COL: GOSUB 900
260 X = X + J:Y = Y + K: IF X < 1 OR X >
     19 OR Y < 1 OR Y > 19 THEN X = X -
     J:Y = Y - K: GOTO 250
270  IF PC = 99 THEN 300
280  POKE XL%(OLDROW) + OCOL,CC:CC =  PEEK
     (XL%(ROW) + COL): POKE XL%(ROW) +
     COL,42
290  GOTO 250
300 L =  - ( PEEK (XL%(ROW) + COL + 1) =
     207) - ( PEEK (XL%(ROW) + COL - 1)
      = 207) - ( PEEK (XL%(ROW + 1) + C
     OL) = 207) - ( PEEK (XL%(ROW - 1) +
     COL) = 207)
310  IF L - (CC = 160) =  - 3 THEN 330
320  POKE 768,250: POKE 769,1: CALL 770
     : GOTO 250
330 WH = 1:MROW = ROW:MCOL = COL: GOSUB
     750: IF  NOT  FN VH(ROW) THEN 380
340 BY = ROW: IF X > 1 AND  FN BX(COL -
     1) =  - 4 THEN BX = COL - 1: GOSUB
     790:F =  - 1
350  IF X < 19 AND  FN BX(COL + 1) =  -
     4 THEN BX = COL + 1: GOSUB 790: GOTO
     230
360  IF F =  - 1 THEN 230
370  GOTO 410
380 BX = COL: IF Y > 1 AND  FN BY(ROW -
     1) =  - 4 THEN BY = ROW - 1: GOSUB
     790:F =  - 1
390  IF Y < 19 AND  FN BY(ROW + 1) =  -
     4 THEN BY = ROW + 1: GOSUB 790: GOTO
     230
400  IF F =  - 1 THEN 230
410 WH = 2:F = 0:CN = 0: IF  RND (1) <
     SK THEN 490
420  FOR ROW = 4 TO 22 STEP 2: FOR COL =
     2 TO 18 STEP 2:K = XL%(ROW) + COL
430  IF  PEEK (K) = 160 AND  FN BX(COL)
      =  - 3 THEN 450
440  NEXT : NEXT : GOTO 490
450 I = K: IF  PEEK (XL%(ROW - 1) + COL
     ) = 160 THEN ROW = ROW - 1: GOTO 6
     40
460  IF  PEEK (XL%(ROW + 1) + COL) = 16
     0 THEN ROW = ROW + 1: GOTO 640
470  IF  PEEK (XL%(ROW) + COL - 1) <  >
     160 THEN COL = COL + 1: GOTO 700
480  IF  PEEK (XL%(ROW) + COL + 1) <  >
     160 THEN COL = COL - 1: GOTO 700
490 ROW =  INT ( RND (1) * 19) + 3:COL =
      INT ( RND (1) * 19) + 1:CN = CN +
     1: IF  PEEK (XL%(ROW) + COL) <  >
     160 THEN 490
500  IF  NOT (( PEEK (XL%(ROW) + COL +
     1) = 207 AND  PEEK (XL%(ROW) + COL
      - 1) = 207) OR ( PEEK (XL%(ROW +
     1) + COL) = 207 AND  PEEK (XL%(ROW
      - 1) + COL) = 207)) THEN 490
510  IF SK > .6 OR CN > TS THEN 570
520  IF  FN VH(ROW) =  - 1 THEN 550
530  IF  FN BY(ROW - 1) =  - 2 OR  FN B
     Y(ROW + 1) =  - 2 THEN 490
540  GOTO 640
550  IF  FN BX(COL - 1) =  - 2 OR  FN B
     X(COL + 1) =  - 2 THEN 490
560  GOTO 700
570  IF  FN VH(ROW) =  - 1 THEN 610
580  IF SK > .6 OR CN > DT THEN 640
590  IF  FN BY(ROW + 1) =  - 2 AND  FN
     BY(ROW - 1) =  - 2 THEN 490
600  GOTO 640
610  IF SK > .6 OR CN > DT THEN 700
620  IF  FN BX(COL + 1) =  - 2 AND  FN
     BX(COL - 1) =  - 2 THEN 490
630  GOTO 700
640 MROW = ROW:MCOL = COL: GOSUB 750
650 BX = COL: IF  FN BY(ROW - 1) =  - 4
     THEN BY = ROW - 1: GOSUB 790:F =
     - 1
660  IF  FN BY(ROW + 1) =  - 4 THEN BY =
     ROW + 1: GOSUB 790: GOTO 410
670  IF F =  - 1 THEN 410
680  GOTO 230
690  IF ( PEEK (XL%(ROW - 1) + COL) <  >
     207 OR  PEEK (XL%(ROW + 1) + COL) <
      > 207) THEN 490
700 MROW = ROW:MCOL = COL: GOSUB 750
710 BY = ROW: IF  FN BX(MCOL - 1) =  -
     4 THEN BX = MCOL - 1: GOSUB 790:F =
      - 1
720  IF  FN BX(MCOL + 1) =  - 4 THEN BX
      = MCOL + 1: GOSUB 790: GOTO 410
730  IF F =  - 1 THEN 410
740  GOTO 230
750  POKE 768,1: POKE 769,175: CALL 770
     : IF WH = 2 THEN  FOR I = 1 TO 500
     : NEXT I
760  POKE XL%(MROW) + MCOL,173: POKE XL
     %(MROW) + MCOL,45: FOR H = 1 TO 50
     : NEXT H: POKE XL%(MROW) + MCOL,17
     3
770  IF  FN VH(MROW) =  - 1 THEN  POKE
     XL%(MROW) + MCOL,201: POKE XL%(MRO
     W) + MCOL,137: POKE XL%(MROW) + MC
     OL,201
780  RETURN
790 YS = YS + 1:J = 25:I = 200: IF WH =
     2 THEN J = 1:I = 150:YS = YS - 1:A
     S = AS + 1
800  POKE 768,1: POKE 769,175: CALL 770
810  POKE XL%(BY) + BX,J: VTAB 1: HTAB
     13: PRINT "YOU: "YS"    APPLE:  "A
     S;
820  IF YS + AS < 81 THEN  RETURN
830  IF YS > AS THEN 860
840  VTAB 24: HTAB 14: PRINT "SORRY, YO
     U LOSE."
850  POKE 768,250: POKE 769,2: CALL 770
     : FOR I = 1 TO 500: NEXT I: GOTO 8
     80
860  VTAB 24: HTAB 15: PRINT "!! YOU WI
     N !!"
870  FOR I = 1 TO 5: POKE 768,1: POKE 7
     69,200 - I * 30: CALL 770: NEXT I:
      FOR I = 1 TO 10: POKE 768,1: POKE
     769,40 + I * 20: CALL 770: NEXT I
880  VTAB 24: HTAB 14: PRINT "TRY AGAIN
     (Y/N) ?";: GET B$: IF  LEFT$ (B$,
     1) = "Y" THEN 120
```

```
890  HOME : HTAB 5: VTAB 8: PRINT "...S
     EE YA...": END
900 PC = 0:J = 0:K = 0:A =  PEEK ( - 16
     384): IF A < 128 THEN 900
910  POKE  - 16368,0:A$ =  CHR$ (A - 12
     8)
920  IF A$ = "I" THEN ROW = ROW -  SGN
     (ROW - 3):K =  - 1: RETURN
930  IF A$ = "K" THEN COL = COL +  SGN
     (19 - COL):J = 1: RETURN
940  IF A$ = "M" THEN ROW = ROW +  SGN
     (21 - ROW):K = 1: RETURN
950  IF A$ = "J" THEN COL = COL -  SGN
     (COL - 1):J =  - 1: RETURN
960  IF A$ =  CHR$ (13) THEN PC = 99:
     RETURN
970  RETURN
980  REM  MUSIC ML DATA
990  DATA  172,1,3,174,1,3,169,4,32,168
     ,252,173,48,192,232,208,253,136,20
     8,239,206,0,3,208,231,96
```

©

TI Towers

Raymond J. Herold

Here's a game that's not only fun to play, but is also a demonstration of the potential of TI BASIC. The author also discusses how ordinary TI BASIC can perform some of the functions available with Extended BASIC.

Programming in TI Extended BASIC – with its powerful screen formatting commands, multiple statement lines, subprogram capability, and sprite graphics – offers something for everyone. However, not everyone is willing to shell out the extra purchase price right away.

This is especially true for the many first-time computer owners. They are content to "get along" using TI BASIC, which comes with the TI-99/4A. Anyone who thinks that these programmers are struggling along in the stone age should take a closer look. Careful examination will reveal that TI BASIC is a powerful language which outperforms many of the "standard" BASICs offered on other machines.

"TI Towers" is written in TI BASIC and demonstrates how some of its capabilities may be utilized. The game itself is a version of the ancient game Towers of Hanoi. There are three adjacent spindles, one of which has seven rings on it – the smallest ring on top, the next ring is the second smallest, and so on in pyramid fashion, with the largest ring on the bottom. The object of the game is to get all of the rings onto one of the other two spindles in the same order. You may move only one ring at a time, and you may not move a larger ring on top of a smaller one. It might sound easy, but it's not.

Problem Solving In The Program

To provide instructions at the beginning of the game, the screen is set to black at line 905, then the instructions are PRINTed (lines 910 - 986). The screen is immediately set to medium red at line 991. This causes a momentary "blackout" of the screen before the instructions are displayed, but is preferable to the slow scroll produced by individually entering numerous PRINT statements.

The base of the playing board is drawn using the CALL HCHAR at line 7050, which uses the CHARPAT defined in line 7031. The spindles are drawn using the CALL HCHAR statement at lines 7090 - 7094 and the CHARPAT defined in line 7030. The execution time for these commands is quite fast.

Creating the rings presents something of a problem. Seven rings are required, each larger than the one before. If the first ring consists of a single character position, the second must use three characters; the third, five characters, and so on. The seventh ring requires 15 character positions. Since a ring can be on one of three spindles, the only way to avoid overlapping rings is to have a screen with at least 45 columns per line. With the TI-99/4A, limited to 32, the problem is obvious.

The solution is to use "half characters." Line 6300 defines a character with all bits on: a "full" character. Line 6320 defines a character with only the leftmost bits on: a "half character" for the right side of a ring. Line 6340 defines a "half character" for the left side. The seven rings required are built in lines 6350 - 6380 by concatenating the character patterns. Figure 1 illustrates this process. Lines 8040 - 8060 load the rings to the screen for the initial game setup.

Once the game begins, the program has to provide prompts and error messages to the player. Since the PRINT statement causes scrolling, and since the game uses a "fixed" game screen, the PRINT command is not acceptable for displaying messages. An alternative to this is using the TI BASIC command CALL HCHAR, which simulates the PRINT AT command that is so useful in Extended BASIC.

The message to be printed is moved to the variable MESSAGE$. The desired location for the message is loaded into the variables ROW and COLUMN. The routine starting at line 5001 actually writes the message. The loop initiated at line 5005 is performed the number of times indicated by the length of the message. Line 5010 converts each successive character in the string into its ASCII equivalent. Line 5020 then prints the string, one character at a time, at the position determined by ROW and COLUMN + I. This same procedure is used to position the rings when they are moved.

Getting information from the player presents a similar problem: the INPUT statement also causes a scroll. To avoid this, we must use the CALL KEY. This command detects a key being pressed and places the ASCII code of the key pressed into a specified variable. Lines 428-434 illustrate how this procedure can be used. Although TI BASIC doesn't have Extended BASIC's BEEP facility, the CALL SOUND command can be used just as effectively to notify the player that a response is necessary.

Manipulating The Rings

The location of the rings is stored in the variable ARRAY. ARRAY is dimensioned by the number of spindles (3) and the number of allowable rings plus one. The additional element permits checking the spindles when no rings are present. The rings are initially assigned the numbers 1 through 7 and placed on the center spindle in lines 6250 - 6260. Ring 1 is the smallest; ring 7 the largest. Figure 2 shows the contents of ARRAY at the beginning of the game. Figure 3 shows what the contents of ARRAY would be if the two smallest rings were on the first spindle, the third smallest ring on the third spindle, and the rest on the middle spindle. Lines 1005 and 1008 find the "top" of the array for the corresponding sending and receiving spindles. For example, using Figure 3, RINGS(1) would contain 2 (number of rings). Subtracting this from 8 would give the sixth position of the first spindle, the top ring.

Lines 1020 and 1025 check to make sure that a large ring is not placed on top of a smaller one. When a valid move is made, the location of the rings is updated in lines 1100 - 1130. The variable RINGS keeps track of how many rings are on each spindle. The rings are moved by placing the appropriate RINGPAT$ in the new location. The ring at the old location is erased by moving BAND$ to it (lines 1530 - 1535). BAND$ defines only the spindle character (line 6390). When one of the two side spindles gets all seven rings, the game is over. Lines 482 and 484 determine this condition by checking the first and third spindle counters for 7.

TI BASIC can be quite effective when used to its potential. This article and game have perhaps given you some ideas for your own programs.

TI Towers

```
100 DIM ARRAY(3,8)
110 DIM RINGS(3)
120 DIM RINGPAT$(7)
130 REM
140 REM INTRODUCTION
150 REM
160 CALL CLEAR
170 CALL SCREEN(9)
180 GOSUB 1930
190 MESSAGE$=M1$
200 ROW=5
210 COLUMN=11
220 GOSUB 1850
230 MESSAGE$=M2$
240 ROW=18
250 COLUMN=3
```

Figure 1: Building The Rings

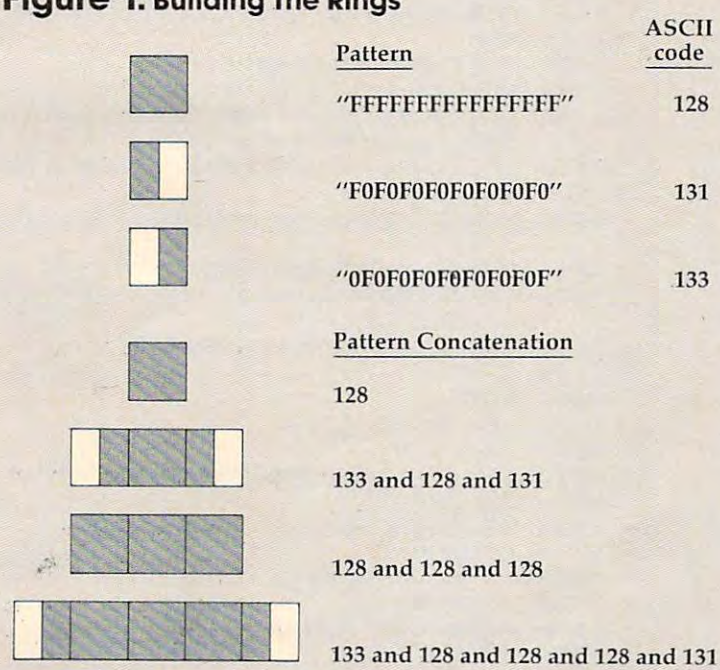


Figure 2: Contents Of ARRAY

----Spindles---			
0	1	0	
0	2	0	R
0	3	0	I
0	4	0	N
0	5	0	G
0	6	0	S
0	7	0	

Figure 3: Contents Of ARRAY

	----Spindles---			
	0	0	0	
	0	0	0	R
	0	0	0	I
	0	4	0	N
	0	5	0	G
top ----	1	6	0	S
	2	7	3	

```
260 GOSUB 1850
270 MESSAGE$=M3$
280 ROW=20
290 COLUMN=9
300 GOSUB 1850
310 CALL SOUND(200,1000,4)
320 CALL KEY(3,KEY,STATUS)
330 IF STATUS=0 THEN 320
340 IF KEY=89 THEN 1070
350 IF KEY<>78 THEN 270
360 REM
370 REM BEGIN GAME
380 REM
390 IF MOVES>HIGHSCORE THEN 410
400 HIGHSCORE=MOVES
410 GOSUB 2260
420 IF HIGHSCORE<>0 THEN 440
430 HIGHSCORE=99999
440 MOVES=0
450 REM
460 REM PLAY GAME LOOP
470 REM
480 ROW=1
490 COLUMN=28
500 MESSAGE$=STR$(MOVES)
510 GOSUB 1850
520 ROW=23
530 COLUMN=1
540 MESSAGE$=M6$
550 GOSUB 1850
560 CALL SOUND(250,1000,4)
570 CALL KEY(3,KEY,STATUS)
580 IF STATUS=0 THEN 570
590 IF KEY<49 THEN 1700
600 IF KEY>51 THEN 1700
610 CALL HCHAR(23,13,KEY)
620 MOVEFROM=VAL(CHR$(KEY))
630 COLUMN=16
640 MESSAGE$=M7$
650 GOSUB 1850
660 CALL SOUND(250,1000,4)
670 CALL KEY(3,KEY,STATUS)
680 IF STATUS=0 THEN 670
690 IF KEY<49 THEN 1700
700 IF KEY>51 THEN 1700
710 CALL HCHAR(23,26,KEY)
720 MOVETO=VAL(CHR$(KEY))
730 IF MOVEFROM=MOVETO THEN 1700
740 GOSUB 1350
750 MOVES=MOVES+1
760 CALL HCHAR(23,1,32,30)
770 IF RINGS(1)=7 THEN 800
780 IF RINGS(3)=7 THEN 800
790 GOTO 450
800 REM
810 REM GAME COMPLETED
820 REM
830 FOR X=1 TO 20
840 CALL HCHAR(23,1,42,31)
850 CALL SOUND(150,X*400,21-X)
860 CALL HCHAR(23,1,32,31)
870 NEXT X
880 ROW=23
890 COLUMN=2
900 MESSAGE$=M8$
910 GOSUB 1850
920 FOR DELAY=1 TO 1500
930 NEXT DELAY
940 ROW=24
950 MESSAGE$=M9$
960 GOSUB 1850
970 CALL SOUND(300,1000,4)
980 CALL KEY(3,KEY,STATUS)
990 IF STATUS=0 THEN 980
1000 IF KEY=89 THEN 1050
1010 IF KEY<>78 THEN 970
1020 CALL CLEAR
1030 PRINT "GAME OVER"
1040 STOP
1050 GOSUB 1930
1060 GOTO 360
1070 REM
1080 REM INSTRUCTIONS
1090 REM
1100 CALL SCREEN(1)
1110 PRINT "TI TOWERS IS A VERSION OF"
1120 PRINT
1130 PRINT "THE GAME TOWERS OF HANOI."
1140 PRINT
1150 PRINT "THE OBJECT OF THE GAME IS TO"
1160 PRINT
1170 PRINT "MOVE THE RINGS ON THE CENTER"
1180 PRINT
1190 PRINT "SPINDLE TO ONE OF THE TWO"
1200 PRINT
1210 PRINT "SIDE SPINDLES.  YOU MAY ONLY"
1220 PRINT
1230 PRINT "MOVE ONE RING AT A TIME, AND"
1240 PRINT
1250 PRINT "YOU MAY NOT PLACE A LARGE"
1260 PRINT
1270 PRINT "RING ON TOP OF A SMALL ONE."
1280 PRINT
1290 PRINT
1300 PRINT "PRESS ANY KEY TO BEGIN"
1310 CALL SCREEN(9)
1320 CALL KEY(3,KEY,STATUS)
1330 IF STATUS=0 THEN 1320
1340 GOTO 360
1350 REM
1360 REM ANALYZE MOVE
1370 REM
1380 SUB1=8-RINGS(MOVEFROM)
1390 SUB2=8-RINGS(MOVETO)
1400 IF ARRAY(MOVEFROM,SUB1)>ARRAY(MOVETO,SUB2)THEN 1700
1410 IF RINGS(MOVEFROM)=0 THEN 1700
1420 GOSUB 1480
1430 RINGS(MOVEFROM)=RINGS(MOVEFROM)-1
1440 RINGS(MOVETO)=RINGS(MOVETO)+1
1450 ARRAY(MOVETO,SUB2-1)=ARRAY(MOVEFROM,SUB1)
1460 ARRAY(MOVEFROM,SUB1)=0
1470 RETURN
1480 REM
1490 REM MOVE RING
1500 REM
1510 ROW=7+(2*(7-RINGS(MOVEFROM)))
1520 COLUMN=19
1530 IF MOVEFROM<>1 THEN 1550
1540 COLUMN=3
1550 IF MOVEFROM<>2 THEN 1570
1560 COLUMN=11
1570 MESSAGE$=BAND$
1580 GOSUB 1850
1590 ROW=19-(2*(RINGS(MOVETO)))
```

```
1600 COLUMN=22
1610 IF MOVETO<>1 THEN 1630
1620 COLUMN=6
1630 IF MOVETO<>2 THEN 1650
1640 COLUMN=14
1650 XX=ARRAY(MOVEFROM,SUB1)
1660 COLUMN=COLUMN-(INT(LEN(RINGPAT
     $(XX)))/2)
1670 MESSAGE$=RINGPAT$(XX)
1680 GOSUB 1850
1690 RETURN
1700 REM
1710 REM ERROR IN MOVE
1720 REM
1730 ROW=24
1740 COLUMN=1
1750 MESSAGE$=E1$
1760 CALL SOUND(900,200,1)
1770 GOSUB 1850
1780 FOR DELAY=1 TO 200
1790 NEXT DELAY
1800 CALL HCHAR(23,1,32,32)
1810 CALL HCHAR(24,1,32,32)
1820 MOVEFROM=0
1830 MOVETO=0
1840 GOTO 520
1850 REM
1860 REM WRITE MESSAGES
1870 REM
1880 FOR I=1 TO LEN(MESSAGE$)
1890 CHAR=ASC(SEG$(MESSAGE$,I,1))
1900 CALL HCHAR(ROW,COLUMN+I,CHAR)
1910 NEXT I
1920 RETURN
1930 REM
1940 REM INITIALIZE AREAS
     {5 SPACES}
1950 REM
1960 M1$="TI TOWERS"
1970 M2$="DO YOU NEED INSTRUCTIONS?
     "
1980 M3$="REPLY Y OR N"
1990 M4$="BEST SCORE:"
2000 M5$="MOVES:"
2010 M6$="MOVE FROM?"
2020 M7$="MOVE TO?"
2030 M8$="{3 SPACES}*** YOU DID IT
     ***{6 SPACES}"
2040 M9$="PLAY AGAIN - Y OR N"
2050 E1$="** INVALID MOVE - TRY AGA
     IN"
2060 RINGS(1)=0
2070 RINGS(2)=7
2080 RINGS(3)=0
2090 FOR I=1 TO 8
2100 ARRAY(2,I)=I
2110 NEXT I
2120 ARRAY(1,8)=8
2130 ARRAY(3,8)=8
2140 CALL CHAR(128,"FFFFFFFFFFFFFF
     F")
2150 CALL CHAR(131,"F0F0F0F0F0F0F
     0")
2160 CALL CHAR(133,"0F0F0F0F0F0F0
     F")
2170 RINGPAT$(1)=CHR$(128)
2180 RINGPAT$(2)=CHR$(133)&CHR$(128
     )&CHR$(131)
2190 RINGPAT$(3)=CHR$(128)&CHR$(128
     )&CHR$(128)
2200 RINGPAT$(4)=CHR$(133)&CHR$(128
     )&CHR$(128)&CHR$(128)&CHR$(131
     )
2210 RINGPAT$(5)=CHR$(128)&CHR$(128
     )&CHR$(128)&CHR$(128)&CHR$(128
     )
2220 RINGPAT$(6)=CHR$(133)&CHR$(128
     )&CHR$(128)&CHR$(128)&CHR$(128
     )&CHR$(128)&CHR$(131)
2230 RINGPAT$(7)=CHR$(128)&CHR$(128
     )&CHR$(128)&CHR$(128)&CHR$(128
     )&CHR$(128)&CHR$(128)
2240 BAND$=CHR$(32)&CHR$(32)&CHR$(3
     2)&CHR$(36)&CHR$(32)&CHR$(32)&
     CHR$(32)
2250 RETURN
2260 REM
2270 REM SET UP GAME BOARD
2280 REM
2290 CALL CLEAR
2300 CALL SCREEN(8)
2310 CALL CHAR(36,"1818181818181818
     ")
2320 CALL CHAR(37,"FFFFFFFFFFFFFFF
     ")
2330 CALL COLOR(1,13,1)
2340 CALL COLOR(13,7,1)
2350 CALL HCHAR(20,2,37,30)
2360 GOSUB 2510
2370 ROW=1
2380 COLUMN=1
2390 MESSAGE$=M4$
2400 GOSUB 1850
2410 COLUMN=21
2420 MESSAGE$=M5$
2430 GOSUB 1850
2440 CALL HCHAR(21,7,49)
2450 CALL HCHAR(21,15,50)
2460 CALL HCHAR(21,23,51)
2470 COLUMN=13
2480 MESSAGE$=STR$(HIGHSCORE)
2490 GOSUB 1850
2500 RETURN
2510 REM
2520 REM INITIAL RING SETUP
2530 REM
2540 CALL VCHAR(6,7,36,14)
2550 CALL VCHAR(6,15,36,14)
2560 CALL VCHAR(6,23,36,14)
2570 FOR X=1 TO 7
2580 ROW=5+(X*2)
2590 COLUMN=14-(INT(LEN(RINGPAT$(X)
     ))/2)
2600 MESSAGE$=RINGPAT$(X)
2610 GOSUB 1850
2620 NEXT X
2630 RETURN
```

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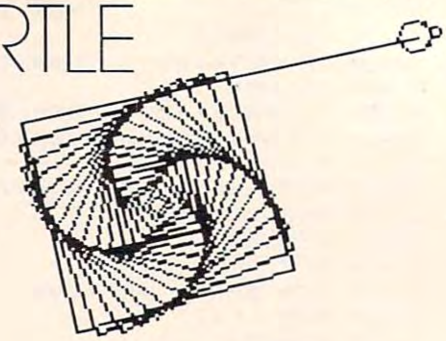
FRIENDS OF THE TURTLE



David D Thornburg, Associate Editor

The Logo Kaleidoscope

One of the first programming projects for many BASIC programmers is the construction of a screen kaleidoscope that generates pretty, symmetrical patterns on the display screen. For these programs, people usually pick a screen location at random and then place a colored dot at that location and at three other "mirror" locations to produce four symmetrically placed dots. While the resulting image is often quite attractive, the result is not that of a true kaleidoscope.

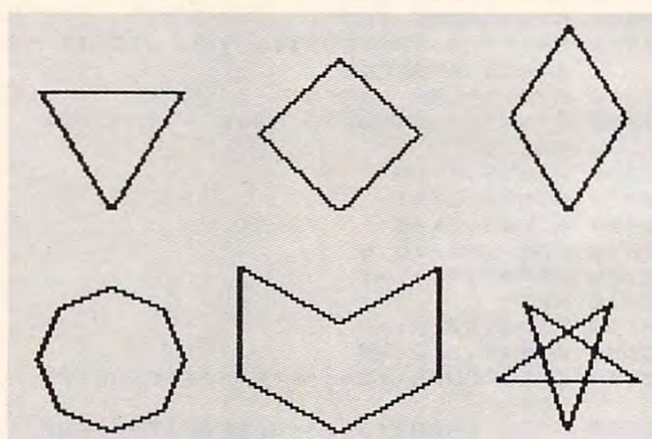
If you have ever taken a kaleidoscope apart, you must have wondered how such a simple apparatus could generate such beautiful images. Most kaleidoscopes consist of a set of mirrors and some small pieces of colored plastic that can be shaken to take random positions on a flat surface. When you look through the eyepiece, the mirrors generate multiple images of the arrangement of plastic pieces to produce beautifully symmetric pictures. Because Logo's turtle graphics allows you to easily create images that imitate the pieces of plastic, it is possible to create quite attractive kaleidoscopic images on your computer screen with a simple set of procedures.

The Logo kaleidoscope operates in the following manner. The system contains a set of graphic procedures to draw the fundamental picture elements (squares, triangles, stars, etc.). There can be as many of these elements as you desire (subject to the memory limitations of your system, of course). Each of these elements can be drawn as large as you desire. This gives the effect of having even more patterns to choose from.

Next, we use Logo's random number generator to select a shape, a size for the shape, the shape's color, and a distance from the center of the screen at which the shape will be drawn. Finally, this data is used by another procedure that places a copy of the chosen shape at several equally spaced angles around the center of the screen. Once one shape has been drawn, the process can be repeated for other shapes until the final image meets with your approval.

The kaleidoscope we will demonstrate in this article is written in the MIT version of Logo for the Apple II and should work with most Logo systems with very few modifications.

The kaleidoscope was started out with six shapes.



The procedures for these shapes are:

```
TO TRI :SIZE
  LT 30
  REPEAT 3 [FD :SIZE RT 120]
  RT 30
END

TO DIAMOND :SIZE
  LT 45
  REPEAT 4 [FD :SIZE RT 90]
```

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```
  RT 45
 END
 TO PATT1 :SIZE
  LT 30
  REPEAT 2 [FD :SIZE RT 60 FD :SIZE RT 120]
  RT 30
 END
 TO OCT :SIZE
  LT 67.5
  REPEAT 8 [FD :SIZE / 2 RT 45]
  RT 67.5
 END
 TO PATT2 :SIZE
  LT 60
  FD :SIZE RT 60 FD :SIZE RT 120
  FD :SIZE LT 60 FD :SIZE RT 120
  FD :SIZE RT 60 FD :SIZE RT 120
 END
 TO STAR :SIZE
  LT 18
  REPEAT 5 [FD :SIZE RT 144]
  RT 18
 END
```

Each of these figures has been defined to have mirror symmetry on the vertical axis. This is not a requirement, and you may wish to experiment with other orientations. The octagon was drawn at half the specified size to keep it in balance with the other figures.

Constructing The Pattern

To make the kaleidoscopic image, we need a procedure that creates a list of basic patterns, chooses a pattern at random from this list, and selects an appropriate size (say between 20 and 50 units). Next, it should pick a random distance from the center (less than 60 units, to keep the images on the screen). Once these steps have been completed, copies of the chosen image should be stamped symmetrically around the screen. Then the procedure should wait for you to tell it if you want another element added to the image. When you press the RETURN key, the process will be repeated. The following procedure performs these tasks for us:

```
 TO IMAGE
  MAKE "LIST [STAR DIAMOND OCT PATT1
    PATT2 TRI]
  MAKE "NAME SENTENCE PICKRANDOM :LIST
    ( 20 + RANDOM 30 )
  MAKE "DIST RANDOM 60
  PENCOLOR ( 1 + RANDOM 5 )
  PENUP
  WINDMILL :DIST :NAME
  MAKE "NAME REQUEST
  IMAGE
 END
```

This procedure uses two other procedures that have to be defined: PICKRANDOM and WINDMILL. The function of PICKRANDOM is to choose an element of a list randomly. The following procedure does this for us:

```
 TO PICKRANDOM :LIST
  OUTPUT PICK ( 1 + RANDOM (LENGTH :LIST ) )
    :LIST
 END
```

The procedure PICK selects a given element from a list, and LENGTH measures the number of elements in a list:

```
 TO PICK :NUM :LIST
  IF :NUM = 1 OUTPUT FIRST :LIST
  OUTPUT PICK ( :NUM - 1 ) ( BUTFIRST :LIST )
 END
 TO LENGTH :LIST
  IF :LIST = [] THEN OUTPUT 0
  OUTPUT 1 + LENGTH BUTFIRST :LIST
 END
```

These two procedures operate "recursively." If you have a hard time understanding how they work, you may want to read about them in *Logo for the Apple II*, by H. Abelson, or read the chapter on recursion in my book *Discovering Apple Logo*. Also, we published some columns on recursion in "Friends of the Turtle" (COMPUTE!, November and December 1982).

Defining Windmill

The only procedure we have left to define is WINDMILL. The function of this procedure is to draw a chosen pattern at equally spaced angular increments around the center of the screen. You may want to experiment with different numbers of images. I have tried using six images spaced at 60-degree increments and eight images spaced at 45-degree increments. These both work fine, but other angles are worth exploring as well. The number of copies of a pattern times the angle increment must be 360 in order for the pattern to be symmetric. That is why we turn 60 degrees for 6 copies (6 x 60 = 360) and 45 degrees for 8 copies (8 x 45 = 360).

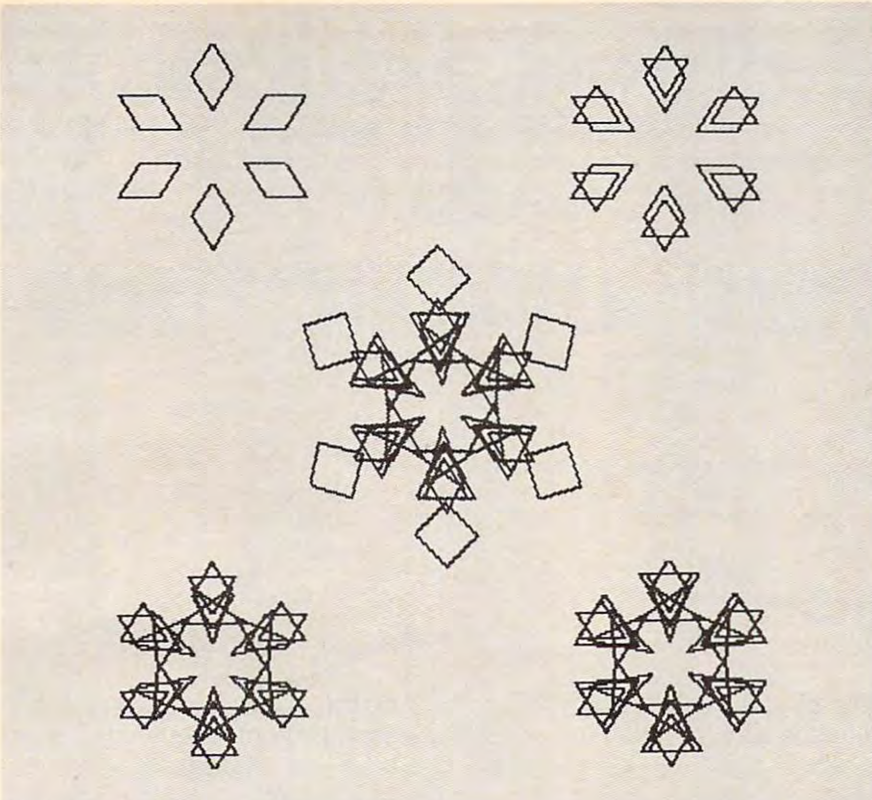
```
 TO WINDMILL :DIST :LIST
  REPEAT 6 [FD :DIST PENDOWN RUN :LIST
    PENUP BACK :DIST RT 60]
 END
```

To generate a kaleidoscopic pattern, hide the turtle and enter:

```
IMAGE
```

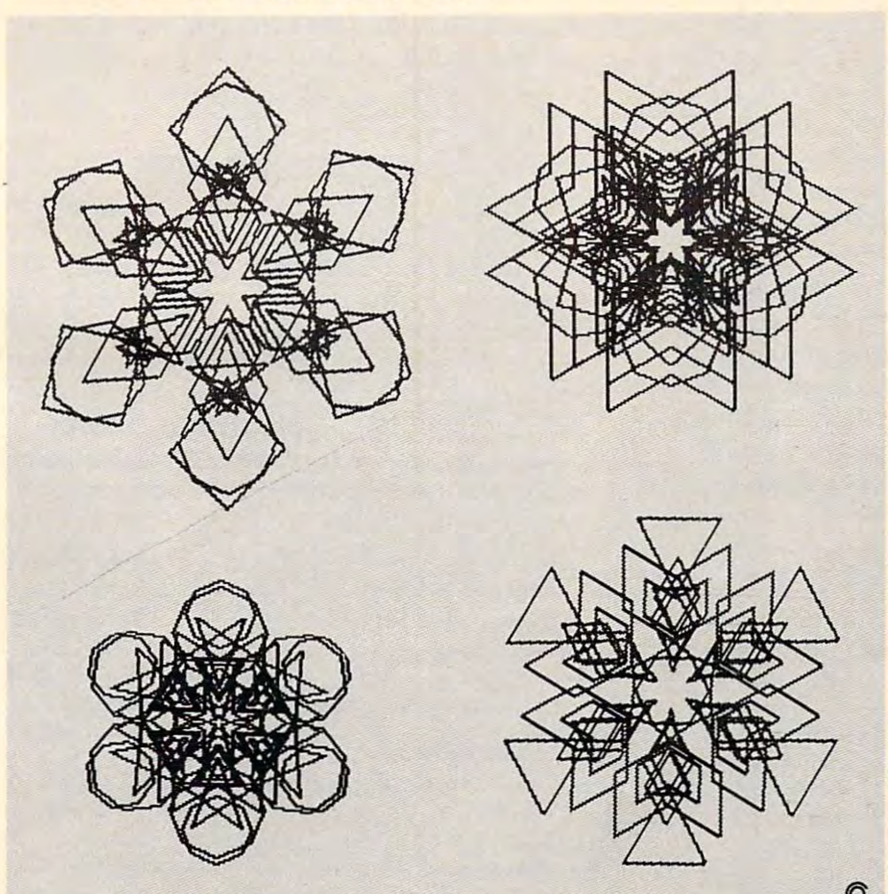
After the first pattern is drawn, press RETURN to get the next one. When the complexity of the pattern is satisfactory, you may want to print a copy of it or save it on your disk (with SAVEPICT, for example). If you are ambitious, you might want to write a Logo procedure that will keep track of all the randomly chosen values and generate its own Logo procedures for each pattern. Abelson's book (mentioned above) shows how to do this sort of thing.

The following five pictures show the successive development of one pattern:



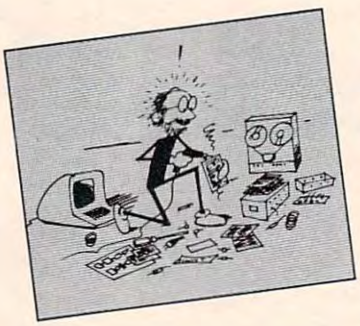
The remaining figures illustrate some other kaleidoscopic patterns that were generated with this set of procedures.

I think you will agree that these patterns are more interesting than those created with colored dots.



Beyond Computer Literacy

Fred D'Ignazio, Associate Editor



A recent national "computers in the schools" survey conducted by the Center for the Social Organization of Schools at Johns Hopkins University found that most secondary schools are using computers to teach programming. (For a copy of the survey, write to Dr. Henry Becker, Center for the Social Organization of Schools, The Johns Hopkins University, Baltimore, MD 21218.) According to the survey, the second most popular use of computers was for drill and practice, primarily for math and language arts. In addition, the majority of the teachers who responded to the survey said that they looked at the computer as a "resource" rather than as a "tool."

I think this concentration on programming, drill, and practice and the image of computers as a "resource" is temporary. I believe that it is time for teachers and parents to start thinking beyond computer programming, beyond drill and practice, and beyond computer literacy.

The Computer Steam Engine

Two factors have caused teachers and parents to concentrate on the computer as a resource and to stress computer literacy. First, most computer courseware turns the computer into an "electronic textbook." This kind of courseware is the most popular with teachers because it is the most familiar and the least threatening. The courseware (like a good textbook) introduces a new subject to a student, then drills the student on that subject.

Second, personal computers are still very primitive machines (compared to what they soon will be). They are a young, immature technology. Compared to what they'll be, the personal computers of today are like chugging steam engines, crude wooden plows, or fussy, cranky Model T's.

Despite manufacturers' claims, you *cannot* buy a personal computer and turn it on the way you would turn on a TV, then immediately begin to use it. Some computer literacy is still essential, or you quickly become lost in a nightmarish maze pursued by horrible creatures like bytes, RAMs, ROMs, K's, RS-232s, modems, interfaces, bauds, "Escapes," "Breaks," and "Resets."

The Age Of Computer Literacy

Another recent survey (conducted by the University of Maryland) echoes the Johns Hopkins survey. It found that most schools introduce computers into the curriculum to help students become literate in computer technology.

But what does this literacy entail?

Is "computer literacy" programming? Is it the fundamentals of computer operation? Is it a quick course on using a computer keyboard? Is it drill and practice or the daily use of the computer as an electronic textbook?

Because of the pervasive spread of computers throughout our society, we have all become convinced that computers are important. From what we read and hear, when our kids grow up almost everyone will have to use computers in some aspect of their lives. This makes computers, as a subject, not only important, but also *relevant*.

An important, relevant subject like computers should be part of a school's curriculum. The question is how "Computers" ought to be taught.

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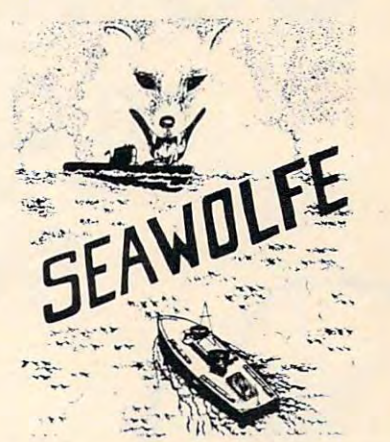

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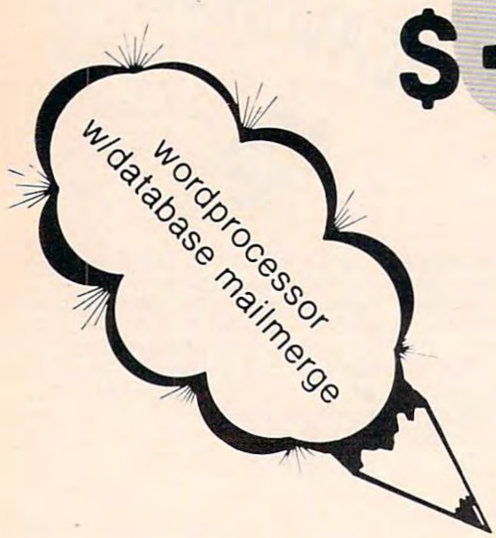

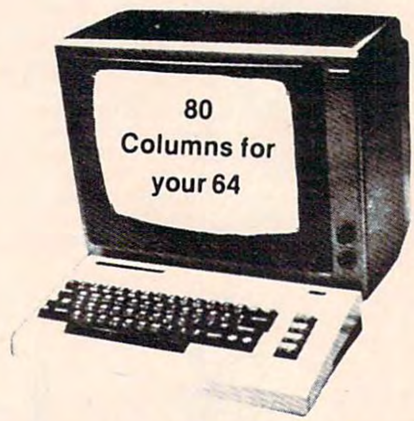

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relevant subjects (like math, social studies, geography, and language arts) – *with books*. However, since desktop computers are now relatively cheap, schools are buying computers so the students can get a look at the machines themselves. Special computer classes are being set up so that students can play with computers, tinker with them, and learn some basic programming. Thus, on a practical level, computer literacy turns out to be mere computer *exposure*.

But exposure to what? Kids who are now enrolled in elementary and secondary schools are exposed to four aspects of computers. They learn that computers are programmable machines. They learn that computers are being used in all areas of society. They learn that computers make good electronic textbooks. And (something they already knew), they learn that computers are terrific game machines.

The Results

This exposure is worthwhile. It alone justifies a school's purchase of computers for its students. According to the surveys, real educational results have been realized at schools which concentrate on exposing kids to computers. First, students develop a familiarity with computer keyboards, computer operation, and computer concepts.

Second, students in these schools develop a realistic, positive image about computers. Past generations saw computers as electronic brains – abstract, all-powerful, and mysterious. Now kids get to see computers as they really are. Kids get to touch computers, play with them, push their buttons, order them about, and cope with computers' incredible dumbness, their awful pickiness, their exasperating bugs, and their ridiculous quirks.

Third, the surveys show that computers have played a big part in improving kids' (*and* teachers') attitudes toward school. Kids who use computers during their school day come early and stay late – just to have time on the computers. The whole school day goes better for everyone because it has a rosy glow caused by the computers. There are countless stories of learning disabled kids, handicapped kids, and near dropouts who got turned on to computers and became model students. Kids with problems warm up to computers and, on their own, use them to improve their academic performance. Bright kids turn to computers as intellectual companions and resources and learn in a more personal, accelerated fashion.

Computers touch a kid's life. And the effect is cumulative. When enough young people are affected by computers, it changes the atmosphere of the entire school. The impact of computers on a school can be psychological. Computers can improve school spirit.

Last, computers make the students less fiercely competitive. Instead, they begin helping each other. Striving for academic excellence is a good thing. But in certain contexts, it can put kids under a great deal of pressure to succeed – with almost no help or support from their friends.

Here, too, the effect of computers on the "social organization of learning" has been significant. Computer classes have an atmosphere which is different from that found in many other classes. In computer class, teachers don't just teach, and students don't just give answers, write down notes, and take tests. In computer class, *everybody* learns, everybody shares, and everybody learns to be helpful. Teachers tell stories about how big, smart-aleck teenagers in their classes have put their arms around their shoulders, and with great patience and sincerity have explained how to boot a disk, load a program from tape, or master a new piece of software. Roles become reversed, fluid, and fuzzy. But often everyone benefits. And learning occurs at a rapid pace.

Computers Of The Future

Computers in schools have already had a substantial, positive effect.

But I'm still worried.

I think that schools are unintentionally locking their students into the present – the fleeting, short-lived Age of Computer Literacy. This is an age from which computers will emerge very soon. Computer literacy will become irrelevant and unimportant long before most students enter the job market.

Also, in many schools, computers are being taught in separate "computer courses." This divorces them from the rest of the school, from the rest of the curriculum, and most importantly, from the other teachers.

Computers in our economy and in our society don't exist as islands of technology. Instead, they have become part of the fabric of everything we do. They are intimately involved with the way we live, move about, play, and do business. Just telling the students that this is so and teaching them BASIC or Logo is not adequate. We need to give them working experience with computers *as they are used in the real world*.

What's more, schools are using their newly acquired computers as an object of curiosity; as a hands-on device to learn the arcane arts of programming and computer operation; and as a teaching aid to learn math and language arts. But in the very near future, computers will be as common as TV sets, computer operation will be simple, and relatively few people will be employed as programmers. In the near future, the most popular, important, and powerful use of computers will be as a *general-purpose tool*.

The Computer-Literacy Deep Freeze

Computers are at a crude, nasty, awkward stage in their development. But they are evolving at an incredible pace. Hardware advances occur almost daily. And software, long the bumbling, dim-witted half brother of computer hardware, has at last entered into its own revolution. In 1976 there was almost no software, yet last year 200 companies sold more than a billion dollars of software. By 1990, experts predict that people will be buying $12 billion in software, about as much as they now spend on home appliances. We will soon see more software than ever before, and if we weed through all the junk, we will find much software that is good and quickly getting better.

The twin revolutions in computer hardware and (especially) in computer software will insure that computers of today will be transient, short-lived creatures. Trendy, high-income schools that buy up dozens of these computers and inaugurate intensive courses in the art and science of their programming and operation are handicapping their students. They are guaranteeing that these young people will be victims of technology.

In ten years, how important will it be for a student to know how to program in BASIC, or know machine language, or know how many K bytes are available in RAM storage? Or how to format a floppy? Or how to position a tape cassette to a particular program?

BASIC Will Be A Dead Language

In five years computers will be completely different. In ten years they will be black boxes. They will still be programmable, but nobody except the experts will do the programming. The final custom-fitting of all commercial programs will be done by the user, but in English, not in BASIC, Logo, or Pascal. These will be archaic languages, like Greek or Latin, important historically, but of little relevance to students who are entering the job market of the early 1990s.

High schools, vocational-technical schools, and colleges are turning out huge numbers of computer scientists and technicians. But, surprisingly, computer jobs are beginning to dry up, especially at the entry level. High-paying computer jobs are still there, but they are reserved for those who have several years of experience or who have combined skills in computers and in some other field such as business, medicine, law, chemistry, or engineering.

Computer classes in schools today are busy turning out the computer "mechanics" and "repair persons" of the future. Persons trained in these areas will find that there are very few jobs awaiting them, and the competition will be incredible. With the huge supply of bodies and the slackening demand, salaries will plummet and so will prestige. By the time young people enter the market as computer specialists, most of the romantic aura about computers will have rubbed off. The glamour will have faded.

It all boils down to how we see computers. Do we see them as finicky appliances that have to be twiddled, scrutinized, and understood? Do we see them as "exer-cycles" and mental jogging machines that stimulate our problem-solving abilities and encourage algorithmic (that is, step-by-step, logical, goal-oriented) thinking? Or are they mechanical chameleons and quick-change artists?

In the near future I think most of us will see computers as Super Tools – like the handy-dandy Swiss pocketknives you can buy that have all those scissors, bottle openers, screwdrivers and twelve different blades stuffed inside. They will do everything. And we won't care how. We'll just pull out a new tool and run it!

For example, we will pop in a cartridge and our computer will become an electronic typewriter, dictionary, or secretary. We'll pop in another cartridge, and the computer will become our personal accountant, tax advisor, or a gourmet chef.

Computers of the near future will be like vaudeville performers who can change their costumes in a flash. One minute they will be patient math tutors for our children. The next moment, they will be our electronic windows to the outside world. We will use them to bring us the latest stock prices, make a plane reservation, or mass mail our Christmas cards.

Or a moment later the computer will become an interactive (videodisc and graphics) TV. We will get to track down a roller-coaster bomber, solve the mystery of a collapsing bridge, or go on a big game hunt in darkest Africa.

We will not care how the computer changes its clothes. We will not be interested in a tour behind the stage, or what the performer's clothes look like from the inside out. Instead, we will want (maybe demand) to learn, to be informed, to be entertained, and to get on with our work. The computer will slip into its rightful position. It will become a marvelous tool that is almost ignored. It will be an almost invisible means to accomplish the *essential* things in life: survival, work, education, and fun.

Computers As Islands

The approach in many schools is to teach about computers in a special "computer science" or "computer lab" or "computer literacy" course. This reminds me of the touch typing course and the metalworking and other "shop" courses I took when I was in high school.

In all these "technical skill" courses, kids are introduced to machines and instructed in how to

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develop a certain level of proficiency and familiarity with these machines. *But they aren't told why.*

At some level, students who take these courses must be asking themselves: Why is a computer important? What good does it do me to know how to program a computer, or load a program, or learn about FOR-NEXT loops?

The computer is not an end in itself. It is a means to an end. It is a resource or a tool that can be used to do something else. Computer skills are meaningless to a child unless the child can use them to do something that he or she wants or needs to do. To make computers meaningful, they must be integrated, on a daily basis, into the rest of the curriculum and into a child's life. The child must need or want to do something important that can only be done on a computer.

Computers As Moon Rocks

In many schools, desktop computers are introduced as oddities and curiosities, like moon rocks.

This is a marvelous approach. It encourages children to see computers as wondrous devices (which they are) and to approach computers with curiosity and fascination.

Since computers are objects of wonder and curiosity, many schools have put them in a special room – a computer *museum*. Everyone can come in and gawk at them, reverently press their buttons, and say ooh and aah.

But after having a computer about six months, a school usually moves beyond this approach. The awe and magic about computers quickly wears off – especially for the kids. Teachers begin teaching kids how to program – how to master computers, boss them around, and tame them.

The Latest Audiovisual Device

Today, many schools are leapfrogging right over these first two steps. When schools acquire a computer today, they don't automatically send it off to a tiny lab or unused classroom. Instead, they regard the computer as a new kind of audiovisual device – a godsend for the frazzled, overworked but forward-thinking teacher of the 1980s.

This approach is being given a big boost by the educational courseware flooding into the market. Dozens of companies are producing hundreds of software packages. A year ago, there was an acute shortage of reputable software. Now, already, there is a glut. There are hundreds of programs out that introduce kids to the alphabet. Dozens more teach them how to add two numbers or spell simple words.

I walked down the exhibitors' (read *vendors'*) aisle at a recent educational computing conference, and I was overwhelmed by the number of glossy, smart-looking packages I saw. It was a kaleidoscopic, mind-numbing experience.

Given this vast amount of courseware, it won't be long before computers move out of their "computer museums" and isolated labs and into the curricular mainstream. Thousands of math and language arts teachers already use computers as audiovisual aids. Soon history, science, music, and art teachers will use them too.

The Computer As A General-Purpose Tool

The computer will soon become a valuable resource for teachers, no matter what subject they teach. But the computer can be more than a special-purpose resource to help a teacher teach a particular subject. It is also a tool – a magnificent, general-purpose tool that a child can apply to any subject.

If children learn only how to program, decipher bits from bytes, and learn geography on a computer, they are going to be poorly equipped to use computers – in the future, in a job, in the outside world.

To be prepared for the future, youngsters must learn how to use computers as tools. That's the way most computers in our society are used. And that's the way they will be used in the future.

Discovering A Tool

The problem has been that most classroom computers are regarded more as *toys* than as tools. They don't have the speed, memory capacity, or software to make them serious devices. They are also isolated, one from the next, instead of tied into information and programming resources (by phone or direct-wired access to a central, high-speed computer).

But all this is changing.

One of the most popular and well-attended sessions at the National Educational Computing Conference (NECC), held this past June in Baltimore, was on using computers in studying literature and English composition. Teachers presented papers on how they taught word processing in the classroom, how they used a computer in writing class, and how they and their students used a computer to study and analyze literature.

Kids in the first two classes used the computer as a tool – as a *word processor*. They found it was easier to write stories, develop ideas, and explore new subjects by using a computer.

Kids in the third class learned programming skills for a purpose: they turned the computer into a tool to help them analyze a book, article, or short story. They used the computer to complete a class assignment.

Right now, word processing is a very popular computer application in schools. But it is just the tip of the "computer tool" iceberg. Computers can become powerful word-handling tools for kids. But they can also become all sorts of other kid tools.

With software already available or under development, computers can become kids' powerful database managers, priority sorters, homework organizers, and calendar schedulers. They can simulate chemistry labs, physics labs, and math labs. They can be used to map out a complicated dance routine for a musical, compose a song, or take the student on a journey inside a volcano, to the center of an atom, or to the outer reaches of the solar system.

New software packages are also needed that are patterned after the "second generation" software now running on expensive IBM, Apple, and Xerox business computers. These *kid workstations* should be general-purpose tools that help a student process words, perform complicated calculations, create graphs, functions and diagrams, and organize, classify, and summarize huge amounts of data. They should enable students to link their computers and thereby communicate with each other. They should encourage teachers to assign more *team projects* for students in which students and their computers work together to solve problems, do homework, or complete class assignments.

The more students get to use a computer as a *tool* to enable them to do something necessary or desirable, the more meaningful and useful computers will become. Also, this is precisely the type of training that young people will need to prepare them for their future careers. Very few students will find jobs as computer specialists. But a vast majority of today's students will need to use computers as tools in their jobs. They will use computers to help them solve problems, make decisions, analyze information, have fun, create and disseminate new knowledge, and communicate with their fellow human beings. ©

Glenn M. Kleiman

Playful Exercises For The Mind

One premise underlies all I have to say in this month's column: the mind, like the body, is strengthened by exercise. I believe any activity is worthwhile if it leads people to exercise their creativity, thinking, problem-solving, memory, perception, concentration, math, or language skills.

Many toys, games, and puzzles provide opportunities for mental exercise. For example, building toys, such as blocks, Erector Sets, Tinker Toys, and Legos, provide opportunities for children to design, build, test, and modify various objects. Clay, crayons, and paint sets provide other means for creative play.

Also, crossword puzzles, and word games such as Scrabble, exercise vocabulary and spelling skills. Jigsaw puzzles exercise perceptual and imagery skills, while puzzles such as Rubik's Cube exercise problem-solving skills. Games such as chess and checkers involve problem-solving and planning skills. Many board games provide varied learning experiences. Monopoly, for example, simulates aspects of a real estate market in which players experience negotiating, buying, and selling. The game involves rents, taxes, utility bills, and banking. It also requires a fair amount of reading and math, particularly for the "banker."

Computers can be programmed to provide many types of playful exercise for the mind. In some cases, the exercises are similar to those which can be done without a computer, but the computer makes some things easier. Computers can be programmed to set up game boards on the screen, keep score, monitor time limits, save the "state" of games so they can be continued later, and make sure the rules are followed. But computers should not be limited to these mundane chores.

Making Real Use Of Computer Power

The flexible and interactive nature of personal computers, combined with their graphics, animation and sound capabilities, offers exciting new possibilities for mental exercises. For example, computers can be programmed to automatically adjust the level of challenge to be suitable for each player. Depending upon the nature of the game, the computer can adjust the speed of movement, the complexity of the materials, the size of the board, or the level at which it plays.

Computers can also provide hints, second chances, and other on-line aids. The graphics and animation make it possible to represent many things pictorially, as well as provide displays which hold players' interest. The sound and, on some systems, speech capabilities, also add to the attention-holding and information exchange possibilities. The continuous control players can have, and the speed at which the computer can respond, are additional important advantages.

Various types of mental exercise programs have been developed to take advantage of computer features. There are computer versions of paint sets, chess, checkers, Othello, crossword puzzles, Rubik's Cube, Scrabble, Concentration, and many more. Simulations provide another type of playful mental exercise. Adventure games and other interactive stories – stories in which readers direct and contribute to the flow of events as they read – also belong in this category.

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I have reviewed some paint set and simulation programs in previous columns (October and November 1982), and I will discuss interactive stories, computer word games, and other types of playful exercises in the future. For the rest of this column, I will describe one program which is perhaps the best example now available of how computers offer new opportunities for play and creativity.

Pinball Construction Set

Suppose you were designing and creating a pinball game. You would have to figure out the shape of the playing area and barricades, where to put flippers, bumpers, spinners, lanes, gates, targets, and the other apparatus of these games. You would have to assign point values for when the ball hits each one, and add the essential sound effects.

Of course, good pinball games are not random arrangements. They are designed so there is a good amount of bounce, ample opportunity to use the flippers, and an appropriate amount of risk of losing the ball. There should be no places where a ball can get stuck or be caught in an endlessly repetitive pattern of bounces. The number of points scored in various ways should reflect the difficulty and likelihood of striking the various targets. Hitting all of a set of targets should yield bonus points.

And, of course, the overall design should be visually balanced and pleasing. Building such a game would require a great deal of thinking and experimenting. Certainly, a pinball construction kit would offer opportunities for creative, exploratory play comparable to those provided by other building toys.

Pinball Construction Set program, created by Bill Budge, offers all of the above possibilities and more. Once you have created a game, you can play it like any of the available video pinball games. You control the ball with the joystick. The play action feels like a real pinball game, and the movement of the ball is an excellent simulation of the real thing.

When you boot *Pinball Construction Set*, you see the screen with three types of elements. At the left is a box in the basic shape of a pinball game. At the right are pictorial representations (called *icons*) of the tools you have available – a hand, arrow, scissors, hammer, paintbrush, and others. In between are the pieces for the pinball game – flippers, bumpers, and all the rest. You construct your game, test playing it as you go. When finished, you can make a separate disk with your game, so that anyone can play it. The figure shows the screen after a game has been constructed.

You begin constructing a game by using a joystick to control the hand icon on the screen. You can move the hand to any pinball piece, press the joystick button to pick up the piece, and then move it anywhere on the game board. In the figure, the hand is shown in the middle of the board, having just placed the round bumper that is next to it.

There are a variety of pinball components available: two sizes of flippers; polygons which the ball just bounces off; bumpers which kick the ball away when they are hit; launchers which are like the spring-operated device that puts the ball into play; a ball hopper which captures balls until it holds three and then releases them all; a ball eater which makes the ball vanish; spinners; lanes; gates; rollovers; and targets – everything you need for a real pinball game.

Each time you pick up a piece, it is replaced with an identical one, so you can, if you choose, create a game with 30 pairs of flippers and 50 bumpers. The only limit is that a maximum of 128 pieces can be placed on the board. It's very unlikely you would ever want more.

Beyond Pinball

What I have described so far would make a very impressive pinball construction program, but Bill Budge has provided much more. You can change the shape of the board, and the shapes and sizes of the barricades. To do so, you simply move to the arrow tool and press the button to select it. When you select the arrow tool, knobs appear at the corners of each shape. Using the joystick, you can move the arrow tool to a knob and pull that corner out or push it in. The scissors and hammer are for removing and adding knobs so you can, for example, change a rectangle to a triangle or to a pentagon.

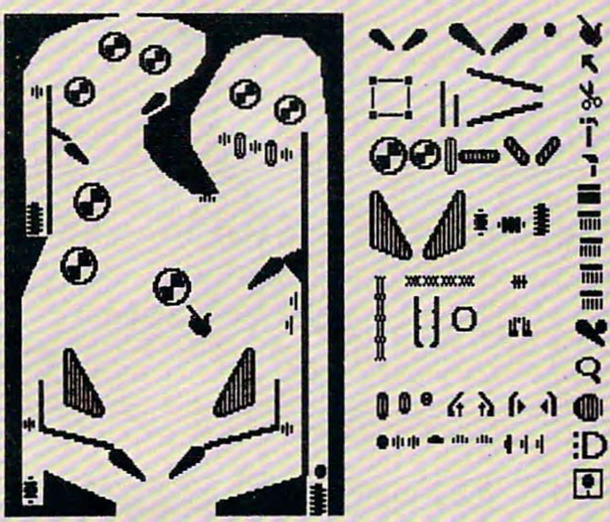
Another tool is the paintbrush. Pick it up, move it to the paint pot with your choice of color, and paint the board or any barricade. There is even a magnifying glass tool for very detailed painting.

Each pinball piece has an associated number of points and a sound that plays when the ball hits it. You can reset these. You can also use AND gates to link parts together for bonus points. That is, you can create effects such as: "If you hit all three of these targets, you get 10,000 bonus points."

Now for the most amazing part, which could be done only with computer pinball. You control the physics of the world in which the game is played! You can set gravity anywhere along a scale from very high to very low. Set gravity to be low, and the ball moves as if it's very light, almost like a Ping-Pong ball. Set gravity to be high, and the ball moves as if it's made of lead – it will even be difficult to shoot it into play with the launcher.

You can also change how much the ball

Pinball Construction Set



bounces and how much the bumpers kick. You can play with a lively ball and dead bumpers, a dead ball and lively bumpers, or anything in between. By experimenting with these two controls, you get a good sense of how different factors interact in a physical system.

Finally, you can set the speed. This lets you put the whole game into slow motion. The ball moves the same distance as it would otherwise, but it goes very slowly. Or you can set the game to high speed and really test your reflexes.

Pinball Construction Set is remarkably simple to use. Everything is done with the joystick, and almost everything you need to know is represented pictorially. In fact, although it runs on much less expensive machines, the program has aspects of the Lisa and other new, more powerful machines.

With its encouragement of creativity, its visual appeal, its ease of use, the complete control it provides over the world of a pinball game, its inherent physics lessons, and its great fun, *Pinball Construction Set* is a truly remarkable program. If I had to select one program to demonstrate the potential of personal computers to provide playful exercises for the mind, *Pinball Construction Set* would be the one.

I have reviewed the Apple II version of this program, and, by the time this column appears, versions for Atari, Commodore 64, and IBM PC computers will be available. The Apple II version is available from BudgeCo, 428 Pala Ave., Piedmont, CA 94611. All the versions will be available from Electronic Arts, 2755 Campus Drive, San Mateo, CA 94403. ©

VIC PILOT

Mark Haugan

Just type in this program and you've got a completely new language you can use with your VIC: Turtle PILOT. For many applications, this language is superior to the BASIC that comes with the computer. If you're interested in a new, easy way to produce startling graphics; or in fractals and recursion; or in introducing Turtle graphics to a youngster – it's all possible with this PILOT and its high-resolution graphics capabilities. You'll need at least an 8K RAM memory expander. The Super Expander is optional.

It is difficult to exaggerate the interest and excitement being generated by Turtle Graphics and the languages, Logo and PILOT, that support it. Home-computer users, educators, mathematicians, and, of course, kids are all fascinated with "The Turtle." You need look no further than David Thornburg's "Friends of the Turtle" column in each month's COMPUTE! to see evidence of this.

However, if you are a VIC user, you may be feeling left out. Although the VIC has excellent graphics capabilities, no package of Turtle Graphics commands that fully exploit these capabilities seems to be available. The programs included with this article will provide VIC users with a PILOT interpreter and high-resolution Turtle Graphics. You must have at least 8K RAM expansion. If you also have a Super Expander, there is an extra program that will really speed things up.

The PILOT Interpreter

The PILOT interpreter included here is an extension of the core PILOT interpreter written in BASIC by Michael Tinglof (COMPUTE!, December 1982). His PILOT provides commands for displaying written information on the screen and for accepting and testing responses from the keyboard. To this core I've added a set of Turtle Graphics commands which control the location, heading, and motion of an imaginary turtle that inhabits the graphic screen.

The turtle can leave a trail as it moves around the screen. The trail forms the graphic design. The interpreter understands commands which control whether a trail is left along any particular portion of the turtle's path; its color, assuming a trail is left; and the colors of VIC's screen and border. Most people find the "Turtle" approach to graphics simpler than the "Cartesian" approach (turn on the pixel, or dot, at screen coordinate x,y) because they can imagine themselves in the place of the turtle and "walk through" a desired design as an aid to programming it.

Two versions of the interpreter are provided. Program 1 will run on a VIC with 8K or more expansion RAM added. It provides a 160x176 pixel high-resolution graphics screen and roughly 2K bytes for PILOT programs. You can, of course, add memory as you like. This version of the interpreter plots the path of the turtle point-by-point in a fashion that will be familiar to anyone who has worked with VIC's high-resolution screen. The result is a nice, sharp graphic display, but the procedure is slow – it provides *turtle* graphics in every sense of the word.

If you have the Super Expander cartridge in addition to at least 8K of expansion RAM, type in Program 1, but make the substitutions shown in Program 2. The machine language graphics routines of the Super Expander are used to overcome the speed problem of the other PILOT version. Typical Turtle Graphics programs now run in tens of seconds. Even when the turtle's path consists of an immense number of tiny steps and plotting may take a few minutes, the Super Expander version runs about twice as fast as the first. If you are planning to work with a young child with a short attention span, this extra speed

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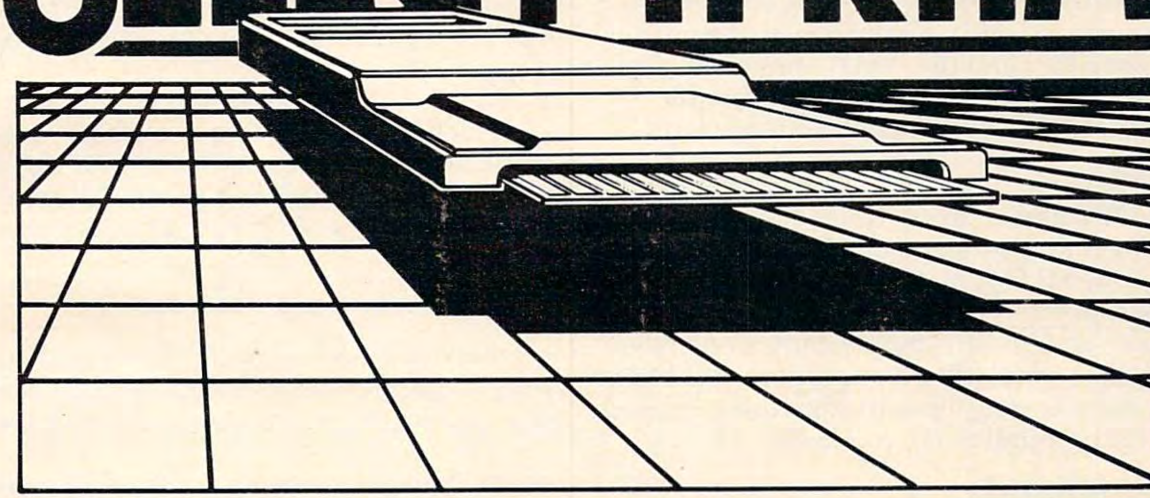

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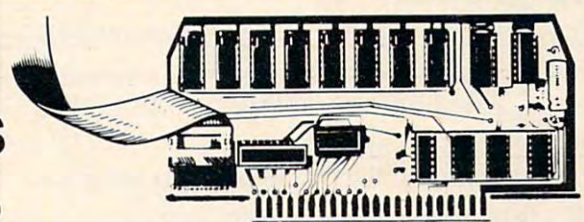

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could be very important. For that matter, anyone wanting to experiment extensively with Turtle Graphics would probably prefer a faster turtle.

The Super Expander version provides a 160x160 pixel high-resolution graphics screen and with an 8K RAM cartridge you have, once again, roughly 2K bytes for PILOT programs.

Toward the end of this article we'll discuss a few PILOT programs to demonstrate some of the capabilities of this interpreter. But first, let's talk about the turtle commands that the interpreter understands and, also, briefly review the operation of the editor and the PILOT commands, instructions, and variable conventions that are inherited from Michael Tinglof's interpreter.

The Editor

The PILOT editor is precisely like the BASIC editor. To enter a program line, type the line number, the PILOT statement, and hit RETURN. To correct an error, move the cursor to it, type the correction, and hit RETURN. Alternatively, you may simply reenter the entire program line. As in BASIC, the editor assumes that anything entered without a line number is a command.

The Commands

The editor understands the following commands:

- **LIST xx-yy** – Lists the program lines between the specified line numbers. Either or both of the line numbers may be absent.
- **RUN** – Executes the PILOT program in memory.
- **SAVE name** – Saves the program in memory on cassette.
- **LOAD name** – Loads the program from cassette.
- **NEW** – Clears program memory.
- **BASIC** – Exits the interpreter and returns to BASIC.
- **PLIST xx-yy** – Same as the list command except that output is sent to the printer, device 4.

Note that command names may be shortened, even to a single letter. For example,

L 10-25 for **LIST 10-25**
R for **RUN.**

PILOT Instructions

PILOT statements, with the exception of labels, consist of an instruction name, an optional conditioner, a colon, and an object. The object is simply everything that follows the colon and is optional with some instructions.

The interpreter understands the following PILOT instructions:

T: The TYPE instruction prints everything in the object on the screen. This may be text or variables. For example,

```
10 T:ANGLE=#A
```

prints "ANGLE=xx" where xx is the value for the numerical variable #A. Note that no carriage return will be printed if a T: instruction is ended with a ";".

A: The ACCEPT instruction inputs a response from the user. The user must hit RETURN to complete a response. The object of an A: instruction may be a numerical or string variable, but no object is necessary. The user's response will be assigned as the variable's value if an object is given. It will be assigned to a buffer that can be used by the MATCH instruction when no object is present.

```
15 A:
20 A:$V
```

M: The MATCH instruction checks to see if certain strings are present in the contents of the Accept buffer or in a string variable. If so, the Y-conditioner flag is set. If not, the N flag is set. For example,

```
15 M:12,TWELVE,XII,1100,$OC
```

sets the Y flag if any of these representations of twelve is present in the Accept buffer, while

```
20 M:$L,SUPERIOR,MICHIGAN,HURON,ERIE,ONTA
   RIO
```

sets the Y flag if the string variable $L contains any one of these Great Lakes names.

I: The IF instruction is a nonstandard instruction implemented by Michael Tinglof to allow mathematical testing to set the Y and N flags. It can check to see if a given variable is greater than, less than, or equal to a given value or a second variable. The Y flag is set if the expression in the object of the instruction is true. Otherwise, the N flag is set. Only =, ‹, and › can be used in expressions. Sample instructions are

```
30 I:#N=9
35 I:#N<#L
```

J: and **U:** The JUMP and USE instructions are the analogues of BASIC's GOTO and GOSUB statements. However, either labels or line numbers may be used in PILOT to specify where in a program these instructions are to transfer control.

```
35 J:5
20 U:*SHIFT
```

E: The END instruction is the analogue of BASIC's RETURN statement. It transfers control to the program line following the last U: instruction executed by PILOT.

C: The COMPUTE instruction performs simple four-function calculations in linear order (no parentheses). The object of this instruction must be an equation specifying the value of a numerical variable. The expression on the right-hand side of the equation is evaluated and the value of the variable is set to the result.

```
15 C:#N=#G*10/#T+15
```

Note that if #R is encountered in the expression,

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its value will be set to a random number between 0 and 1.

R: The REMARK instruction is not executed. Its object may be any desired program documentation.

H: The HOME instruction clears the text screen and returns the cursor to home.

G: The GRAPHICS instruction takes as its object any of the turtle commands discussed below. For example,

```
12 G:DRAW 50
```

END This instruction stops execution of a PILOT program and returns control to the editor. It may not be abbreviated and is the only instruction that cannot be modified by a Y or N conditioner.

```
100 END
```

Conditioners: PILOT instructions can be modified by the addition of a Y or N conditioner. For example,

```
50 TY:VERY GOOD $N.
60 JN:*START
```

Y-conditioned instructions will be executed only if the Y flag is set. Similarly, N-conditioned instructions will be executed only if the N flag is set. Remember that these flags are set by MATCH and IF instructions.

Labels: These are designated by beginning a line with *. For example,

```
.
.
10 *LOOP START
.
.
25 JY:*LOOP START
.
.
```

PILOT Variables

The interpreter recognizes both string and numerical variables. String variable names consist of a $ followed by a single letter. Numerical variables are integer variables. Their names consist of a # followed by a single letter.

Turtle Commands

Each of the commands described here must be preceded by a G: instruction. Command names may be abbreviated, even to a single letter, although, as we'll see, other parts of commands such as color names may not be shortened.

CLEAR – This command sets and clears the VIC's high-resolution screen. It initializes the color of the screen to white, the border to blue, and the color of the turtle's trail to black. The CLEAR command also initializes the turtle's heading to zero degrees, north, and its location to center screen, X and Y coordinates (0,0). The CLEAR command must be the first in any graphics routine.

```
G:CLEAR
GY:C
```

TURN – The TURN command is followed by a number or a numeric variable. The number or the value of the variable is the number of degrees added to the turtle's current heading. A positive value turns the turtle clockwise.

```
G:TURN -270
G:T #A
```

TURNTO – This command sets the turtle's heading to the specified angle. The word TURN in TURNTO may be abbreviated, but TO must be included at the end of any abbreviation of TURNTO. For example,

```
G:TURNTO 90
G:TTO #A
```

DRAW – The DRAW command moves the turtle the specified distance along its current heading. The turtle will leave a trail if its pen is down (see the PEN command below). When using the Super Expander version, program execution will cease and you will receive a warning message if you attempt to DRAW off screen. With the other version, the turtle will proceed off screen. You will receive a message informing you that the turtle left the screen at some point during program execution when you return to text mode.

```
G:DRAW 50
G:D #L
```

GO – The GO command moves the turtle the specified distance along its current heading without leaving a trail. The command is equivalent to DRAW with PEN UP.

```
GN:GO 45
G:G #D
```

GOTO – This command moves the turtle to the specified screen coordinates without changing its heading. The X and Y coordinates are separated by a comma in the GOTO statement. The range of X coordinates on the screen is -106.65 to 108, and the range of Y coordinates is -87 to 88. When using the Super Expander interpreter, the Y coordinates are -79 to 80.

```
G:GOTO #X,#Y
G:GTO -15,35
```

PEN – The PEN command controls the color of the turtle's trail on the screen. With the VIC, it is possible to use several pen colors on a single graphics display. Allowed color names are BLACK, WHITE, RED, CYAN, PURPLE, GREEN, BLUE, and YELLOW. If the PEN command is followed by the word ERASE, the pen color is set to the screen's current color. The PEN command may also be followed by the words UP and DOWN. PEN UP causes DRAW commands to move the turtle without leaving a trail. PEN DOWN returns the pen to normal. Note that color names and the other pen control words may not be abbreviated.

```
G:PEN GREEN
G:P DOWN
```

SCREEN – This command changes the color of the graphics screen without clearing it. The same colors are available as for the PEN command.

```
G:SCREEN RED
G:S CYAN
```

BORDER – This command controls the color of VIC's screen border. Once again, the colors already mentioned are available.

```
G:BORDER YELLOW
G:B RED
```

QUIT – The QUIT command returns the text screen. When this command is encountered, the graphics screen will be held until you enter Q from the keyboard. This lets you control the amount of time you spend admiring your turtle handiwork.

In general, QUIT *must* be the final command of a graphics routine. The only exception occurs when the turtle is sent along an infinite path (it may loop back on itself). In this case a QUIT command would never be reached, and you exit graphics mode by hitting @.

```
G:QUIT
GY:Q
```

One structure that occurs frequently in Turtle Graphics programs is a sequence of DRAW and TURN commands. This is done to draw polygons of various types. The interpreter understands one compound command that performs this task easily.

```
G:xx(DRAW yy;TURN zz)
```

xx must be an integer. yy and zz may be integers or integer variables as for single DRAW and TURN commands. For example,

```
G:9(D 5Ø;T 16Ø)
G:5(DRAW #L;TURN 72)
```

Program Operation

All of VIC's internal memory is required to produce the high-resolution screen for Turtle Graphics. For this reason, the start of BASIC must be moved to location 8192, the beginning of BLK1 of expansion RAM, before loading and running either version of the interpreter. This is accomplished by typing in this direct statement before doing anything else:

```
POKE 44,32:POKE 642,32:POKE 8192,Ø:NEW
```

The interpreter takes up about 5K of RAM memory, and 1K is required for system initialization. So, with 4K allocated to screen and programmable character memory, you can see why there is only 2K left for PILOT programs on an 8K-expanded VIC. Note that the maximum allowable number of PILOT program lines is contained in the variable M in line 6 of the interpreter. This number may be changed.

To stop any PILOT program you simply hit the @ key. If you are in graphics mode, the text screen will automatically return. Note that the @ is accepted only when execution of the current PILOT program line has been completed. If this line should be, for example, a long turtle loop like

```
G:18Ø(D 1;T 2)
```

there will be a noticeable delay before the program halts.

If for any reason the program returns to BASIC, you may reenter the interpreter without losing the current PILOT program by typing GOTO 11 and hitting RETURN. This means that you may hit RUN/STOP and RESTORE to regain control if the interpreter "locks up" (if, for example, you forget a G:QUIT statement and get stuck with the graphics display on screen). You then type GOTO 11 and hit RETURN to resume work on your program.

When loading PILOT programs (if the NEW command has not been given) the current program and the new one are merged. If you wish to operate the interpreter with disk rather than cassette storage, the following program changes are required:

```
41 OPEN1,8,2,R$+",S,W":PRINT"SAVING "R$
45 OPEN1,8,2,R$+",S,R":PRINT"LOADING "R$
```

In addition, to save a program on drive 0 the syntax of the SAVE command must be altered to

SAVE 0:name

The following error codes may be generated when a PILOT program is run:

1. Illegal variable name
2. Unknown label
3. Stack overflow (too many USES)
4. Stack empty (an E: without a USE)
5. Bad format
6. Division by zero
7. Numerical variable out of range (magnitude greater than 32767)
8. CLEAR not the first graphic command

Finally, it should be remarked that the PILOT interpreter is not as indifferent about spaces scattered through program lines as the BASIC interpreter is. The PILOT interpreter will remove spaces before a line number or a command and will remove extra spaces between line numbers and instruction names. However, extra spaces elsewhere in a program line may confuse the interpreter. Also, spaces as shown in the sample commands are *necessary*. For example, there must be a space between DRAW and #L in

```
5Ø G:DRAW #L
```

Sample Turtle Graphics Programs

The three sample programs here serve to demonstrate the graphics capabilities of this PILOT interpreter. There's a little something for everyone: a typical turtle pattern made of shifted and rotated squares, a picture for the kids, and a recursive binary tree program for the mathematically minded. Although no abbreviations are used in Program 3 (to make it easy to follow), they are included in the other two programs to demonstrate their use.

"Pretty Pattern" (Program 3) draws a picture that is typical of turtle designs made up of simple polygons. In this case the polygons are squares, and they are shifted and rotated relative to each other to form the design. A star is formed by the overlapping squares at the center of the pattern. After drawing six squares, the turtle returns to its initial location and heading. The program is written so that the turtle loops around its six-square path again and again, forever. As a result, no G:QUIT and END statements are needed. Exit the program by hitting the @ key. It only takes about 20 seconds for the "fast" (Super Expander) turtle to make its way around the design.

Program 4, "Teddy Bear," is fun for children. Fairly rough circles are used in the design to reduce the time for drawing to 90 seconds with the "fast" turtle. When the program reaches the G:QUIT statement in line 29, execution will halt until you hit the "Q" key. Note that it is quite easy to turn this bear into a rabbit by designing ears made using two quarter circles for each ear.

Finally, for those of you who are interested in recursion, Program 5, "Recursive Tree," draws a simple binary tree. The way in which the tree is drawn by the procedure *BRANCH is of particular interest. This procedure calls itself repeatedly. To understand how this is done using only global variables, it is helpful to study the listing and to run the program. When you run it, select final branch level 1, then level 2, and so on to see the order in which the branches are drawn. The VIC's screen resolution produces nice pictures of the tree up to level 5 and even level 6.

Further Suggestions

My goal while developing this PILOT interpreter was to make Turtle Graphics available on a VIC with only 8K bytes of expansion RAM added. I have "crunched" the program to achieve this goal (the few REMs scattered through the listings are to keep the line numbers of the two versions of the interpreter aligned), but there are a few features I simply could not squeeze in. If you have more memory and the inclination, you might want to extend the program.

I regret not being able to include the capability for mixing text and graphics on the high-resolution screen. This means that you really cannot run a program like VISITURT ("Friends of the Turtle," COMPUTE!, April 1982) which makes the turtle interactive. The necessary prompts cannot be written onto the graphics screen.

This is unfortunate because an interactive turtle would be very nice for children to work with. It would, however, be fairly simple to add a mixed text-graphics mode, if you have access to the Super Expander command CHAR. Other possible additional features include adding a SOUND command like the one in Atari PILOT or the ability to use VIC's multicolor mode.

Program 1: PILOT Interpreter

```
Ø GOTO4
1 I$=""
2 SYS82Ø:IFPEEK(Ø)=13THENRETURN
3 I$=I$+CHR$(PEEK(Ø)):GOTO2
4 POKE36866,15Ø:POKE36869,24Ø:POKE648,3Ø
5 FORJ=217TO228:POKEJ,158:NEXT:FORJ=229T
  O25Ø:POKEJ,159:NEXT
6 CLR:M=2ØØ:DIMS%(9),N%(26),S$(26),L$(M)
  ,C$(17),G$(7),B$(1Ø)
7 PRINT"{CLR}{BLK} **** PILOT V2.1 ****"
  :FORX=82ØTO825:READZ:POKEX,Z:NEXT:FORX
  =ØTO17
8 READC$(X):NEXT:FORX=ØTO7:READG$(X):NEX
  T:FORX=ØTO1Ø:READB$(X):NEXT:DATA32,2Ø7
  ,255,133
9 DATAØ,96,LIST,RUN,SAVE,LOAD,NEW,BASIC,
  PLIST,T,J,E,U,M,C,A,I,H,R,G,CLEAR,QUIT
  ,TURN
1Ø DATADRAW,GO,PEN,SCREEN,BORDER,BLACK,W
   HITE,RED,CYAN,PURPLE,GREEN,BLUE,YELLO
   W,ERASE,UP
11 PRINT"{DOWN}PILOT.":DATADOWN
12 GOSUB1:PRINT:IFASC(I$)=32ANDLEN(I$)=1
   THEN12
13 IFLEFT$(I$,1)=" "THENI$=MID$(I$,2):GO
   TO13
14 L=VAL(I$):IFL<>ØTHEN23
15 L=1:H=M:R$="":FORX=1TOLEN(I$):IFMID$(
   I$,X,1)<>" "THENNEXT:GOTO21
16 R$=MID$(I$,X+1):I$=LEFT$(I$,X-1)
17 L=VAL(R$):H=L:FORX=1TOLEN(R$):IFMID$(
   R$,X,1)<>"-"THENNEXT:GOTO19
18 L=VAL(LEFT$(R$,X-1)):H=VAL(MID$(R$,X+
   1))
19 IFL=ØTHENL=1
2Ø IFH=ØTHENH=M
21 FORX=ØTO6:IFI$<>LEFT$(C$(X),LEN(I$))T
   HENNEXT:PRINT"UNKNOWN COMMAND.":GOTO1
   1
22 ONX+1GOTO32,51,41,45,49,5Ø,31
23 IFL>MTHENPRINT"LINE NUMBER OUT OF RAN
   GE.":GOTO11
24 X=LEN(STR$(L)):X$=MID$(I$,X):IFX$=""T
   HENL$(L)="":GOTO12
25 IFLEFT$(X$,1)=" "THENX$=MID$(X$,2):GO
   TO25
26 X=3:IFMID$(X$,2,1)<>":"THENX=4:IFMID$
   (X$,3,1)<>":"THENL$(L)=X$:GOTO12
27 FORZ=7TO17:IFLEFT$(X$,1)<>C$(Z)THENNE
   XT:PRINT"ILLEGAL COMMAND.":GOTO11
28 IFMID$(X$,2,1)="Y"THENZ=Z+13
29 IFMID$(X$,2,1)="N"THENZ=Z+26
```

```
30 L$(L)=CHR$(Z-6)+MID$(X$,X):GOTO12
31 OPEN1,4:GOTO33
32 OPEN1,3
33 FORX=LTOH:IFL$(X)=""THEN39
34 X$=":":Z=ASC(L$(X)):IFZ>40THENX$=LEFT
   $(L$(X),1):GOTO38
35 IFZ>26THENZ=Z-26:X$="N"+X$
36 IFZ>13THENZ=Z-13:X$="Y"+X$
37 X$=C$(Z+6)+X$
38 PRINT#1,X;X$;MID$(L$(X),2)
39 GETX$:IFX$<>""THENCLOSE1:GOTO11
40 NEXT:CLOSE1:GOTO11
41 OPEN1,1,1,R$:PRINT"SAVING "R$
42 FORX=1TOM:IFL$(X)=""THEN44
43 PRINT#1,X;CHR$(13)CHR$(34)L$(X)CHR$(3
   4)CHR$(13);
44 NEXTX:CLOSE1:GOTO11
45 OPEN1,1,0,R$:PRINT"LOADING "R$
46 INPUT#1,X:IFSTTHEN48
47 INPUT#1,L$(X):IFST=0THEN46
48 CLOSE1:GOTO11
49 GOTO6
50 PRINT"{DOWN}EXITING TO BASIC....":END
51 L=0:FORX=1TO26:N%(X)=0:S$(X)="":NEXT:
   P=0:F%=0
52 L=L+1:IFL=>MORL$(L)="END"THEN11
53 GETX$:IFX$="@"ANDCQ%=0THEN11
54 IFX$="@"ANDCQ%=1THENGOSUB127:GOTO11
55 IFL$(L)=""THEN52
56 X=ASC(L$(L)):IFX>40THEN52
57 IFX>26THENX=X-26:IFF%=1THEN52
58 IFX>13THENX=X-13:IFF%=0THEN52
59 C$=MID$(L$(L),2)
60 ONXGOTO62,73,76,71,78,85,101,106,115,
   52,116
61 PRINT"ERROR #"E"IN LINE"L:GOTO11
62 Z=0:IFRIGHT$(C$,1)=";"THENZ=1:C$=LEFT
   $(C$,LEN(C$)-1)
63 FORX=1TOLEN(C$):X$=MID$(C$,X,1):IFX$=
   "#"THEN67
64 IFX$="$"THEN68
65 PRINTX$;:NEXT:IFZ=0THENPRINT
66 GOTO52
67 GOSUB69:X$=STR$(N%(Y)):GOTO65
68 GOSUB69:X$=S$(Y):GOTO65
69 X=X+1:Y=ASC(MID$(C$,X,1))-64:IFY<1ORY
   >26THENE=1:GOTO61
70 RETURN
71 IFP>8THENE=3:GOTO61
72 P=P+1:S%(P)=L
73 IFVAL(C$)<>0THENL=VAL(C$)-1:GOTO52
74 FORX=1TOM:IFC$<>L$(X)THENNEXT:E=2:GOT
   O61
75 L=X:GOTO52
76 IFP=0THENE=4:GOTO61
77 L=S%(P):P=P-1:GOTO52
78 X=1:C$=C$+",":X$=AC$:IFLEFT$(C$,1)="$
   "THENGOSUB83
79 FORZ=XTOLEN(C$):IFMID$(C$,Z,1)<>","TH
   ENNEXT
80 Z$=MID$(C$,X,Z-X):FORY=1TOLEN(X$):IFM
   ID$(X$,Y,LEN(Z$))=Z$THENF%=1:GOTO52
81 NEXT:IFZ<LEN(C$)THENX=Z+1:GOTO79
82 F%=0:GOTO52
83 Y=ASC(MID$(C$,2))-64:IFY<1ORY>26THENE
   =1:GOTO61
84 X$=S$(Y):X=4:RETURN
85 A=3:Z=0:X$="":IFLEFT$(C$,1)<>"#"ORMID
   $(C$,3,1)<>"="THENE=5:GOTO61
86 Y=1:X$=MID$(C$,A,1):A=A+1:IFMID$(C$,A
   ,1)="-"THENA=A+1:Y=-1
87 IFMID$(C$,A,1)<>"#"THENY=Y*VAL(MID$(C
   $,A)):A=A+LEN(STR$(Y))-1:GOTO91
88 X=ASC(MID$(C$,A+1))-64:IFX<1ORX>26THE
   NE=1:GOTO61
89 IFX=18THENY=Y*RND(1):GOTO91
90 Y=Y*N%(X):A=A+2
91 IFX$="="THENZ=Y
92 IFX$="-"THENZ=Z-Y
93 IFX$="+"THENZ=Z+Y
94 IFX$="/"ANDY=0THENE=6:GOTO61
95 IFX$="*"THENZ=Z*Y
96 IFX$="/"THENZ=Z/Y
97 IFA<=LEN(C$)THEN86
98 X=ASC(MID$(C$,2))-64:IFX<1ORX>26THENE
   =1:GOTO61
99 IFZ>32767ORZ<-32767THENE=7:GOTO61
100 N%(X)=Z:GOTO52
101 IFC$=""THENGOSUB1:AC$=I$:PRINT:GOTO5
    2
102 X=ASC(MID$(C$,2))-64:IFX<1ORX>26THEN
    E=1:GOTO61
103 GOSUB1:Z=VAL(I$):PRINT:IFLEFT$(C$,1)
    ="#"THENN%(X)=Z
104 IFLEFT$(C$,1)="$"THENS$(X)=I$
105 GOTO52
106 IFLEFT$(C$,1)<>"#"THENE=5:GOTO61
107 X=ASC(MID$(C$,2))-64:IFX<1ORX>26THEN
    E=1:GOTO61
108 A=N%(X):X$=MID$(C$,3,1):IFMID$(C$,4,
    1)<>"#"THENX=VAL(MID$(C$,4)):GOTO111
109 X=ASC(MID$(C$,5))-64:IFX<1ORX>26THEN
    E=1:GOTO61
110 X=N%(X)
111 F%=0:IFX$="<"ANDA<XTHENF%=1
112 IFX$=">"ANDA>XTHENF%=1
113 IFX$="="ANDA=XTHENF%=1
114 GOTO52
115 PRINT"{CLR}";:GOTO52
116 Y=0:FORZ=1TOLEN(C$):IFMID$(C$,Z,1)<>
    " "THENNEXT:GOTO121
117 R$=MID$(C$,Z+1):C$=LEFT$(C$,Z-1):IFR
    IGHT$(C$,2)="TO"THENY=1:C$=LEFT$(C$,
    LEN(C$)-2)
118 FORZ=1TOLEN(R$):X$=MID$(R$,Z,1):IFX$
    <>","ANDX$<>";"THENNEXT:GOTO121
119 IFX$=";"THEN130
120 X$=LEFT$(R$,Z-1):R$=MID$(R$,Z+1)
121 FORZ=0TO7:IFC$<>LEFT$(G$(Z),LEN(C$))
    THENNEXT:GOTO126
122 IFCQ%=0ANDZ<>0THENE=8:GOTO61
123 IFZ=2ANDY=1THEN167
124 IFZ=4ANDY=1THEN168
125 ONZ+1GOTO139,142,145,147,157,158,163
    ,165
126 GOSUB127:PRINT"UNKNOWN GRAPHICS":PRI
    NT"COMMAND IN LINE ";L:GOTO11
127 CQ%=0:POKE36864,5:POKE36866,150:POKE
    36867,46:POKE36869,240:POKE36879,27
128 IFOS%=1THENPRINT"*PLOT WENT OFF SCRE
    EN"
129 PRINT"{CLR}{BLK}";:RETURN
130 D=VAL(C$):Y=LEN(STR$(D)):C$=MID$(C$,
    Y+1):IFD<=0THEN126
131 IFC$<>LEFT$(G$(3),LEN(C$))THEN126
132 FORZ=1TOLEN(R$):IFMID$(R$,Z,1)<>";"T
    HENNEXT:GOTO126
133 C$=LEFT$(R$,Z-1):X$=MID$(R$,Z+1)
```

```
134 FORZ=1TOLEN(X$):IFMID$(X$,Z,1)<>" "T
    HENNEXT:GOTO126
135 R$=MID$(X$,Z+1):X$=LEFT$(X$,Z-1):IFX
    $<>LEFT$(G$(2),LEN(X$))THEN126
136 X$=R$
137 R$=C$:GOTO147
138 R$=X$:GOTO145
139 CQ%=1:UD%=Ø:OS%=Ø:POKE36864,7:POKE36
    866,148:POKE36867,23
14Ø POKE36869,252:POKE36879,3Ø:CO=Ø:SC=2
    :BC=6:AN=Ø:XØ=Ø:YØ=Ø
141 FORI=ØTO219:POKE768Ø+I,I:NEXT:FORI=4
    Ø96TO7615:POKEI,Ø:NEXT:GOTO52
142 GETX$:IFX$<>"Q"THEN142
143 REM
144 GOSUB127:GOTO52
145 GOSUB169:AN=AN+Z:D=D-1:IFD>ØTHEN137
146 D=Ø:GOTO52
147 GOSUB169:IFZ<ØTHEN126
148 TH=(9Ø-AN)*3.1415926/18Ø
149 FORY=ØTOZ:XG=XØ+Y*COS(TH):YG=YØ+Y*SI
    N(TH):IFUD%=ØTHENGOSUB152
15Ø NEXT:XØ=XG:YØ=YG:IFD>ØTHEN138
151 GOTO52
152 U=INT((XG+1Ø6.65)/1.35+.5):V=88-INT(
    YG+.5)
153 CH=INT(V/16)*2Ø+INT(U/8):RO=(V/16-IN
    T(V/16))*16
154 IFCH<ØORCH>22ØORXG<-1Ø6.65ORXG>1Ø8TH
    ENOS%=1:RETURN
155 BY=4Ø96+16*CH+RO:BI=7-(U-INT(U/8)*8)
156 POKE384ØØ+CH,CO:POKEBY,PEEK(BY)OR(2↑
    BI):RETURN
157 GOSUB169:TH=(9Ø-AN)*3.14159265/18Ø:X
    Ø=XØ+Z*COS(TH):YØ=YØ+Z*SIN(TH):GOTO5
    2
158 FORZ=ØTO1Ø:IFR$<>B$(Z)THENNEXT:GOTO1
    26
159 IFZ<8THENCO=Z:GOTO52
16Ø IFZ=8THENCO=SC-1:GOTO52
161 IFZ=9THENUD%=1:GOTO52
162 IFZ=1ØTHENUD%=Ø:GOTO52
163 FORZ=ØTO7:IFR$<>B$(Z)THENNEXT:GOTO12
    6
164 SC=Z+1:POKE36879,SC*16+BC-8:GOTO52
165 FORZ=ØTO7:IFR$<>B$(Z)THENNEXT:GOTO12
    6
166 BC=Z:POKE36879,SC*16+BC-8:GOTO52
167 GOSUB169:AN=Z:GOTO52
168 GOSUB169:YØ=Z:R$=X$:GOSUB169:XØ=Z:GO
    TO52
169 Z=VAL(R$):IFZ<>ØORR$="Ø"THEN173
17Ø IFLEN(R$)<>2ORLEFT$(R$,1)<>"#"THENE=
    1:GOSUB127:GOTO61
171 Y=ASC(RIGHT$(R$,1))-64:IFY<ØORY>26TH
    ENE=1:GOSUB127:GOTO61
172 Z=N%(Y)
173 RETURN
```

Program 2: Changes For Super Expander

```
4 GRAPHICØ:COLOR1,3,Ø,Ø
5 REM
127 CQ%=Ø:GRAPHIC4:COLOR1,3,Ø,Ø:SCNCLR:RE
    TURN
128 REM
129 REM
139 CQ%=1:UD%=Ø:OS%=Ø:GRAPHIC2:COLOR1,6,Ø
    ,Ø:SCNCLR:CO=Ø:SC=1:BC=6:AN=Ø:XØ=Ø:Y
    Ø=Ø:GOTO52
14Ø REM
141 REM
143 GOSUB127:IFOS%=1THEN11
144 GOTO52
147 GOSUB169
148 REM
149 REM
15Ø TH=(9Ø-AN)*3.1415926/18Ø:XG=XØ+Z*COS(
    TH):YG=YØ+Z*SIN(TH):IFUD%=ØTHENGOSUB
    154
151 IFOS%=1THEN:CHAR18,Ø,"OFF SCREEN AT L
    INE{2 SPACES}"+STR$(L)+" : HIT Q":GO
    TO142
152 XØ=XG:YØ=YG:IFD>ØTHEN138
153 GOTO52
154 IFYØ<-79ORYG<-79ORYØ>8ØORYG>8ØORXØ<-1
    Ø6ORXG<-1Ø6ORXØ>1Ø8ORXG>1Ø8THENOS%=1
    :RETURN
155 UØ=1Ø23*(XØ+1Ø6.65)/(1.35*159):VØ=1Ø2
    3*(8Ø-YØ)/159:U=1Ø23*(XG+1Ø6.65)/(1.
    35*159)
156 V=1Ø23*(8Ø-YG)/159:DRAW1,UØ,VØTOU,V:R
    ETURN
159 IFZ<8THENCO=Z:REGIONZ:GOTO52
16Ø IFZ=8THENCO=SC:REGIONCO:GOTO52
164 SC=Z:COLORZ,BC,CO,Ø:GOTO52
166 BC=Z:COLORSC,Z,CO,Ø:GOTO52
```

Program 3: Pretty Pattern

```
1 *PRETTY PATTERN
2 G:CLEAR
3 G:SCREEN RED
4 G:GO 13
5 G:TURN 6Ø
6 G:GO -17
7 U:*SHIFT SQUARE
8 J:7
1Ø *SHIFT SQUARE
11 G:GO 17
12 G:TURN 6Ø
13 G:4(DRAW 6Ø;TURN 9Ø)
14 E:
```

Program 4: Teddy Bear

```
1 *TEDDY BEAR
2 G:C
3 G:TTO -9Ø
4 I:#C=2
5 JY:*FACE
6 U:*1/3 BIG CIRCLE
7 U:*LOCATE FOOT/EAR
8 U:*FOOT/EAR
9 U:*LOCATE FOOT/EAR
1Ø U:*1/3 BIG CIRCLE
11 U:*LOCATE FOOT/EAR
12 U:*FOOT/EAR
13 U:*LOCATE FOOT/EAR
14 U:*1/3 BIG CIRCLE
15 G:T 18Ø
16 C:#C=#C+1
17 J:4
18 *FACE
19 G:GTO 7,3Ø
2Ø G:TTO Ø
21 U:*EYE
22 G:GTO -7,3Ø
23 G:T 18Ø
24 U:*EYE
```

```
25 G:GTO Ø,22
26 G:4(D 1;T 9Ø)
27 G:GTO 12,2Ø
28 G:1Ø(D 4;T 18)
29 G:Q
3Ø END
35 *1/3 BIG CIRCLE
36 G:15(D 4;T 8)
37 E:
4Ø *FOOT/EAR
41 G:2Ø(D 4;T 18)
42 E:
45 *EYE
46 G:15(D 2;T 24)
47 E:
5Ø *LOCATE FOOT/EAR
51 G:T 9Ø
52 G:G 6
53 G:T 9Ø
54 E:
```

Program 5: Recursive Tree

```
1 *RECURSIVE TREE
2 H:
3 T:FINAL BRANCH LEVEL ?
4 A:#L
5 G:C
6 C:#B=64
7 G:G -64
8 U:*BRANCH
9 G:Q
1Ø END
15 *BRANCH
16 I:#L=Ø
17 JY:3Ø
18 G:D #B
19 C:#B=#B/2
2Ø C:#L=#L-1
21 G:T -45
22 U:*BRANCH
23 G:T 9Ø
24 U:*BRANCH
25 G:T -45
26 C:#B=#B*2
27 C:#L=#L+1
28 C:#A=-#B
29 G:G #A
3Ø E:
```

©

Telengard

Tony Roberts
Assistant Managing Editor

Telengard is a fantasy, role-playing game that requires a good memory, the ability to think quickly, and hours and hours to play.

Telengard is a dungeon, 50 levels deep. It is littered with treasures and crawling with monsters. Your purpose is to enter the dungeon, gather treasures, gold, and experience, and come out alive. You encounter monsters and traps, fall into pits, and wander into teleportation chambers that send you who knows where. You have your strength, your magic, and your wits to help you survive.

This Dungeon-and-Dragons-like game, which is both complicated and intriguing, is available from Avalon Hill for the Atari, Apple, PET, and Commodore 64 computers. It plays the same on any computer, but the 64 version, with its graphic representation of the monsters and dungeon hazards, has the most flair.

Telengard's complexity is indicated by the 24-page instruction manual, most of which is spent explaining what you'll encounter in the dungeon and how to cope with it. Learning the features of the dungeon, the characteristics of the creatures that inhabit it, and the weapons and magic at your disposal is crucial to the game.

Another complicating factor is time. On each of your moves, you have a limited amount of time (about five seconds) to decide how to proceed. The world of Telengard does not stop if you are indecisive. If you fail to initiate action, the forces of the dungeon will choose a path for you.

The Characters

You are the adventurer in *Telengard*, and every time you play, you are endowed with different characteristics, each of which affects your performance in the dungeon.

These characteristics are: strength, which determines your success during combat; intelligence, which has a bearing on how well you cast magical spells; wisdom, which governs your ability to cast healing spells and to successfully use spells on "undead" creatures; constitution, a factor directly related to how much injury you can sustain in battle; dexterity, a measure of your ability to run when necessary; and charisma, which affects the way some creatures react to you.

When you begin your descent into the dungeon, you are a Level 1 adventurer. As you accumulate experience, gained by successfully fighting monsters and collecting gold, you advance to higher levels, giving you the stamina needed to carry you further into the maze of tunnels, as well as a larger array of spells to help you out of tight spots.

Monsters And Spells

There are 20 monsters in *Telengard*, each dangerous in its own way. Some are living monsters, fighters, elves, and dragons, for example, and others are undead. These undead creatures – mummies, wraiths, and specters, among others – require an entirely different approach in battle.

Each monster has its quirks, and, like each character, monsters have levels. A Level 1 Kobold may not be much to fear, but for a Level 1 adventurer, a Level 23 Kobold can be a handful. The outcome of your encounters with the monsters depends on the combination of the monster's level, its characteristics, your character's attributes, and how you choose to fight the monster.

There are 36 spells available to *Telengard* adventurers. At the start of a game, a character can use the first six. Access to the others is reserved for more experienced characters. Among the spells are Magic Missiles, Invisibility, Continual Light, Finger of Death, and Wall of Fire. Some spells can be used only in battle; others are "duration spells" that give an adventurer extra power for several turns.

The Dungeon

Once the game begins, you find yourself deposited in the dungeon, directly below an inn, a place you'll return to often – if you can remember where it is. On the right side of the screen is a report showing your character's attributes, your collection of treasures, your gold, and your experience points.

You play this adventure in a series of two-part turns. Part one is the action phase in which you decide whether to move or stay put. If you move, the dungeon's maze is redrawn around you, and you're thrown into the

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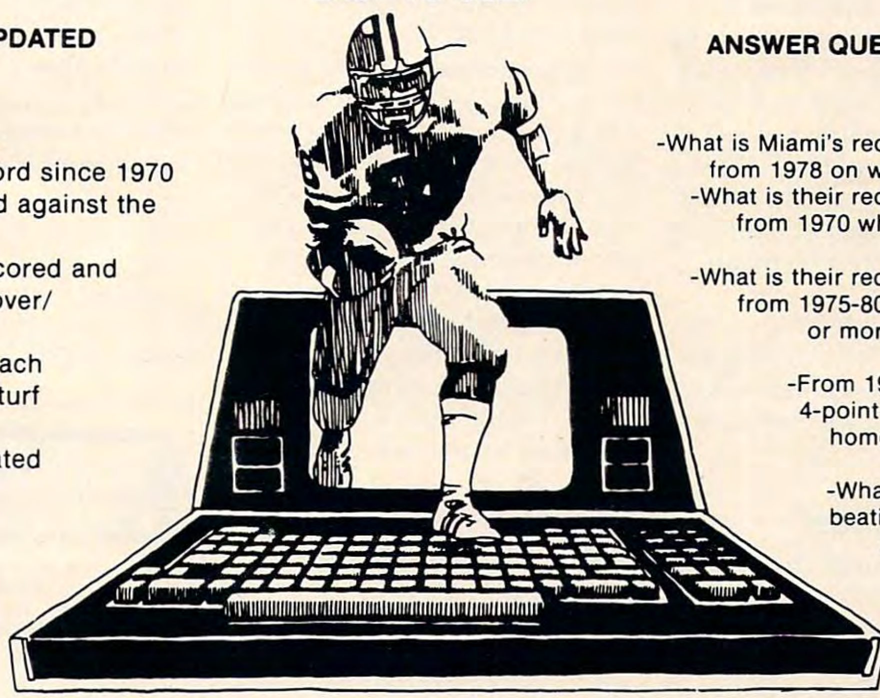

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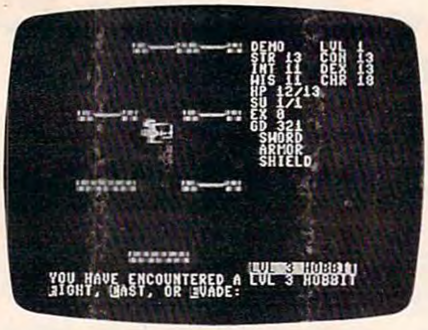

The player has encountered a Hobbit, skill level 3. 64 version.

encounter phase if you've moved into an occupied space.

If you've encountered a monster, you'll be told (in the 64 version, shown) which monster it is and how strong it is. Based on that information, you have a few seconds to decide whether to fight, evade, or cast a spell. If you hesitate, the monster is likely to attack, and your adventure may well be over.

If you fight and survive, you're probably injured and not likely to survive another battle. It's time to find one of the inns and recuperate.

Gray Misty Cube

As you wander through the dungeon in the darkness, you have more to fear than unsavory creatures. There are many inanimate objects to worry about as well. You may step into a Gray Misty Cube, which can take you to any dungeon level – but if you go, can you find your way back? There are teleportals, pits, fountains, altars, and a mysterious "small box with buttons."

Each of these features offers its own set of problems, and who knows, if you press the right combination of buttons on the small box, something good may come of it. There's more strewn about *Telengard*. Treasure chests, silver, armor and weapons, and even a Ring of Regeneration, something that makes those long trips back to the inn easier to survive.

But beware, that treasure chest may contain 10,000 gold pieces. Or it may house a poisonous spider. Do you dare open it?

Playing The Game

Playing *Telengard* takes time. First it takes time to learn the game, and then playing could take forever. The game goes on until you meet your match. While learning, pay attention to the helpful hints in the instruction manual. It also helps to play a few games with the time element disabled. That will give you time to leaf through the instructions to bone up on monsters or spells.

Once you're playing a real game, there is no way to stop to check the mail or make a cup of coffee. If you stop playing, you'll be attacked and defeated in no time. Whenever you return to one of the inns, however, the game is stopped until you give the command to reenter Telengard. You may find yourself heading back to an inn just so you can walk away from the computer for a few minutes to relieve the tension.

Though the dungeon is 50 levels deep, with a different maze on each level, you're wise to wander no farther than two or three moves from an inn until you've advanced to Level 3 or 4. The farther into Telengard you venture, the more troublesome your opposition will be.

The most frustrating part of the game comes after working your character up to Level 4 or 5 only to stumble across a Level 32 dragon and lose in an instant. The early game must be played painstakingly, with frequent visits to an inn. Each time you visit an inn, you have the option of saving your character to tape or disk. Once a character has been saved, it can be revived, even after a disastrous encounter with a demon. When saving to tape, have everything ready to go before giving the command, because the program will begin writing immediately.

A feature of *Telengard* that produces some unexpected results is the program's keyboard buffer. It holds two or three characters, so if you get excited and begin pushing keys without thinking, you'll blindly affect your future. Sometimes it's to your advantage to preprogram your steps, but usually you'll regret it.

Telengard is an exciting game, one that can tie you up in knots and rob you of your sleep. Learning to play is simultaneously frustrating and fascinating. And once you know the ropes, there's plenty of satisfaction in knowing you've assessed your character correctly and directed him appropriately.

Telengard
The Avalon Hill Game Company
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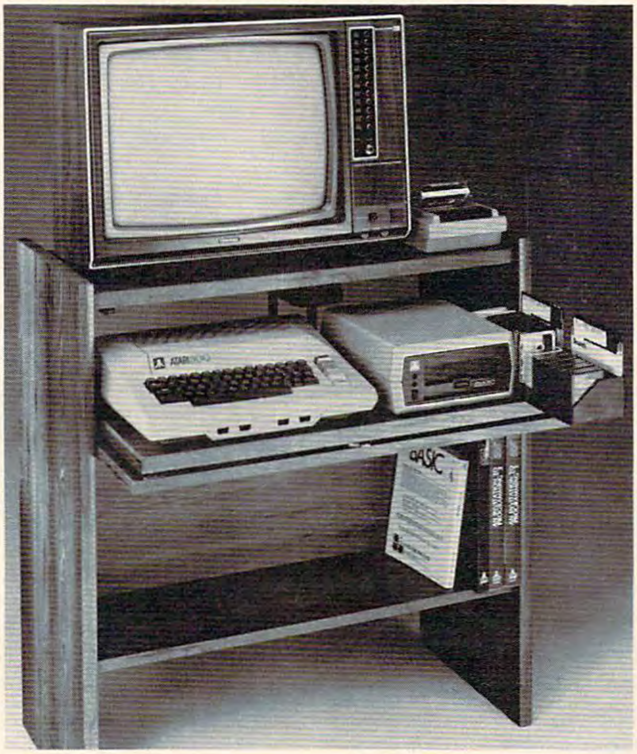

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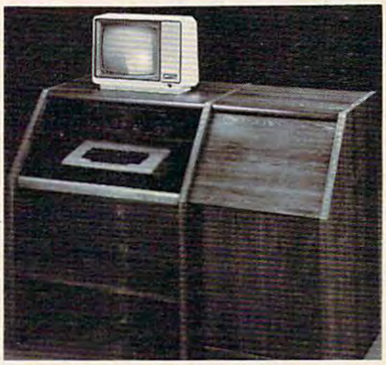

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Getaway! For The Atari

Stephen Levy, Assistant Editor

Getaway!, by Mark Reid, is an arcade-style game which takes advantage of the Atari's graphics capabilities. Since the game board – a town map – is approximately 35 screens, the player sees only part of the town at any one time. The player uses a joystick to view other areas of town.

The object of the game is to race all over, stealing as much loot as possible, and then return to your hideout before the police catch you. The game progresses through several levels, but, in the end, justice prevails when the thief is caught. Your score is based on the amount of loot you are able to stash in your hideout.

Smart Police

There are a number of ways to collect loot. But the greatest rewards come from catching the white armored van. The police don't seem to bother you much until you make the big heist, then their chase is relentless. The more loot you gather or the higher the level, the more energetic their pursuit.

The graphics in *Getaway!* are detailed and appealing. Smooth scrolling is provided by easy joystick control. The sound is realistic; the challenge is exciting and the game becomes more difficult the more effectively you play. And the instruction manual is complete and easy to understand.

Touring The Town

The first time I played *Getaway!* I was impressed by the detail of the graphics. In fact, I was so intrigued that I put off actually playing until I'd toured the town. Using the black and white map of the town supplied in the user's manual, I was able to "drive" to see all the sights. The town has high-rise buildings, a river, trees, schools, bridges, factories, and three very important gas stations. Each feature is impressive by itself, but taken together, the effect is delightful.

The sound, too, is impressive. When a police car nears, you are aware of it before you see it, because its siren warns you. With experience, you will be able to estimate the distance by the siren's volume.

Fine graphics and sound are always important to a good game, but the game must also play well. You can think of *Getaway!* as a variation of a maze game in the same sense that *Pac-Man* is. The difference is that in *Getaway!* there is much more variety and detail to deal with. The ever-present police are only the beginning. As in any town, stop signs seem to appear whenever you are in a rush. And just when you are about to reach the hideout, you notice that you are running out of gas. If you are new at the game or haven't kept your bearings, those three gas stations can be hard to find.

Time also becomes a factor: additional stop signs will appear, and the police begin setting up roadblocks as the game progresses. The police also seem to become more aware of your whereabouts in the night scenario.

For Any Age

The game's beginning levels are easy enough for a child to enjoy. Adults and more experienced game players will also find the challenge satisfactory. If you manage to get to the fifth level – no easy task – the bonus is an extra getaway car. It comes with a price, though; the game becomes truly challenging at this point.

If you like chase-type, fast-action games; if you are looking for an Atari game the whole family will enjoy; or if you are willing to take the time to become skilled at a game (it takes time to learn the map and all the techniques needed to get to the upper levels), *Getaway!* will surely satisfy you.

Getaway!
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Three Game Modules For The TI

Steve Davis

Last year, a young man named Michael Brouthers left his job at Texas Instruments in Dallas and boldly began a venture to develop game software for the TI home computer, a market that he felt was ready to blossom. When TI announced the $100 rebate on the 99/4A, the market for the machine did indeed grow rapidly.

Until now, Texas Instruments has been the only source of software packaged in the convenient Command Module, which TI invented for the 99/4. The module can contain ROM or GROM chips which contain a program (usually written in Assembler or GPL), and, in the case of TI's Mini-Memory Module, the cartridge can be used to add RAM to the console.

The main advantages to using program modules are:

- Ease of use. A person needs no peripheral devices or programming knowledge; just plug in the module and turn on the computer.
- Security. Programs cannot be copied or pirated easily since they reside in GROM or ROM chips. This also prevents accidental erasure of the program.
- Memory. An application program in a module takes up little or no console memory (RAM), so the computer's memory is available for data storage.

Using most third-party game software for the TI requires either Extended BASIC, Memory Expansion, Mini-Memory, Editor/Assembler, cassette or disk.

Now, Funware has introduced a line of game modules, *Henhouse, Rabbit Trail,* and *Video Vegas,* for the 99/4A. All use the sprite graphics capability of the TI.

Henhouse

In *Henhouse*, you have five prolific chickens that lay eggs which roll down into five chutes. Each time a chute fills with eggs, you must take them to your truck without dropping them, all the while watching for wolves and poachers.

You get points for each poacher you shoot. Birds fly overhead, and you get points for shooting them, too. You play, using joysticks or the keyboard, until a wolf gets in the henhouse or you break six eggs.

The game may not seem as fast as some of the space or maze games in the arcades, but there are enough distractions that it requires concentration and the ability to do several things at once. It is simple enough to be enjoyed by users of all ages. The retail price is $39.95.

Rabbit Trail

This game is a cross between the *Donkey Kong* and *Frogger* type games. You are a hungry bunny who must hop along the trails and burrow through tunnels in search of carrots. You must not be eaten by a weasel or a hawk, be run over by a speeding car, or get caught in a trap.

Eating all the carrots without being caught advances you to the next level. You receive bonus points based on how fast you complete the level. If you are quick (as a rabbit should be), you may earn "bonus bunnies."

Each of the seven levels presents a more challenging screen. If you complete all seven screens, the game repeats from the first screen but with increased difficulty. Funware says that so far no one has been able to get higher than 24 screens, but to make it even that far would be an accomplishment.

Because of the graduated levels of difficulty, this game is suitable for both beginners and experienced game players. The keyboard may be used, but joysticks are recommended. The retail price for the module is $42.95.

Video Vegas

Anyone who has been to Las Vegas recently knows that some of the slot machines have been replaced by video versions. These operate like the mechanical ones except that the figures (bells, bars, cherries, lemons, etc.) are displayed on a video screen that simulates the rotating cylinders on a conventional slot machine.

Such is *Video Vegas*, a slot machine game that allows you to place $1, $2, or $3 bets by merely pressing keys on the computer console. This is not nearly as tiring as pulling those big levers in Vegas.

The color graphics of the figures are excellent; in fact, they look better than the graphics on some of the machines in Vegas and are a good example of the high-resolution pictures that can be drawn on the 99/4A.

There is nothing challenging about the module, which sells for $29.95, but people who like to play the slots will enjoy it.

Funware prefers that its modules be purchased from software dealers, rather than by mail order from the company.

Henhouse
Rabbit Trail
Video Vegas
Funware
405 N. Bowser
Building A
Richardson, TX 75081

©

The *VicTree* Programming Module For VIC And 64

Eric Brandon, Programming Assistant

The *VicTree*, a cartridge for the VIC-20 or the Commodore 64, makes programming more efficient.

Available for $89.95 from Skyles Electric Works (the originators of the PET "Toolkit"), the *VicTree* adds 42 commands to BASIC.

All the commands of PET BASIC 4.0 are supported, which make disk use much easier, especially when trying to program relative files. The BASIC 4.0 commands are not tokenized (converted from what you type into a more memory-efficient form) in the same way as in a "true" BASIC 4.0 machine. Fortunately, the manual contains a program that converts "true" BASIC 4.0 to *VicTree* format.

One requirement for using BASIC programs with the *VicTree* is that you must use a colon between a "THEN" (as in an IF...THEN statement) and a BASIC 4.0 disk command. The *VicTree* does not speed up "garbage collection" (the process of removing unwanted or discarded strings from memory) as BASIC 4.0 does, nor will machine language programs written for BASIC 4.0 now run on your VIC or 64.

Added Commands

Several disk commands not present in BASIC 4.0 have been added, including EXECUTE, which LOADs and RUNs a program all in one step, and CHAIN# which allows an "executive" program to have several BASIC subroutines on disk and load them in only as needed to preserve memory. With this utility, programs can essentially be of unlimited length.

Another set of commands has been added to assist in program editing. As well as all the standard commands we would expect from any BASIC enhancement package, such as renumbering program lines, finding and changing text, and deleting line ranges, *VicTree* adds many new and useful commands never before seen in this type of product.

Among these are the very useful LCOPY and LMOVE commands which let you rearrange the order of the lines in your program. *VicTree* does not "scroll" through your program like other aids, but supplies a PAGE command that LISTs your program one screen at a time.

There are also several commands designed to aid in debugging. These are DUMP, which displays the value of all non-array variables; HELP, which shows where an error has occurred; and TRACE, which LISTs out your program lines as they run.

There are also commands intended for use with any "Centronics" type printer (with no extra hardware needed besides a cable to connect the printer to the parallel user port of your computer). Skyles will supply you with this cable for $29.95, or the *VicTree* and a cable as a package for $109.95.

Multiple-Computer Communication

Skyles is planning to come out with a device called the Cee-Net which will allow up to 64 VICs or Commodore 64s to communicate with each other and to share disk drives and printers. The *VicTree* is designed to work with Cee-Net when it arrives and has a command to ATTACH itself to the network.

On the 64, the *VicTree* "covers up" memory from 32768 to 40959. This means you have about 30,000 bytes left for your BASIC program. The *VicTree* also uses up memory from 49152 to 53247, so it cannot be used in conjunction with other software which uses these locations such as the Wedge or Micromon. When used with software that does not require that area of memory, however, it seems to work fine. I have had no trouble using the *VicTree* with Supermon, and with the PAL assembler.

On the VIC-20, the *VicTree* uses locations 24576 to 32767 and 45056 to 49151, leaving 21,000 bytes free if you have enough expansion RAM. If you have an unexpanded VIC, the *VicTree* will not use up any of your memory.

The *VicTree* also allows the machine language programmer to add his own commands to BASIC, with descriptions in the manual of how to do it.

The manual contains over 100 pages of clearly written information about the 42 commands. Each command is given its own page (or more) with examples, explanations, and special notes. Also included is a very complete technical description about the machine language applications of the *VicTree*. This is one of the most convenient and useful manuals I have ever seen.

VicTree
Skyles Electric Works
Mountain View, CA 94041
(415) 965-1735
$89.95

©

Crisis Mountain For Apple And Atari

Patrick Parrish, Editorial Programmer

Crisis Mountain, programmed in machine language by Ron Aldrich and David Schroeder, is an excellent, exciting game, requiring an Apple II or Apple II Plus with 48K RAM (also available for the Atari 400/800 with 48K) and a disk drive. This one-player contest from Synergistic Software can be played with either a joystick or the game paddles.

The scenario of the game is that a group of terrorists was hiding out in the caverns of a dormant volcano in the Pacific Northwest. The volcano erupted unexpectedly, forcing the terrorists to abandon their hideout. As they fled, they left behind their loot and supplies – and several nuclear bombs. To save the West Coast from impending disaster, *you* must venture into Crisis Mountain, dig up and defuse the bombs while avoiding numerous hazards.

Nine Skill Levels

Crisis Mountain alternates between two cavern scenes as you progress through nine skill levels. In the beginning of the game, you are given three lives. And if you're skillful enough you can earn a life at 10,000, 30,000, and 50,000 points. On each level you are presented with a labyrinth of passageways, precipices, and fiery lava pits which sporadically spew rocks and debris.

Scattered about the cavern, in addition to innocuous objects left by the terrorists, are active bombs positioned randomly in one of five locations. Each displays a time, also randomly chosen, before detonation. As you advance from one skill level to another, you are challenged with more bombs and less time to defuse them. Thus, picking the appropriate route through the maze of passageways becomes more and more critical.

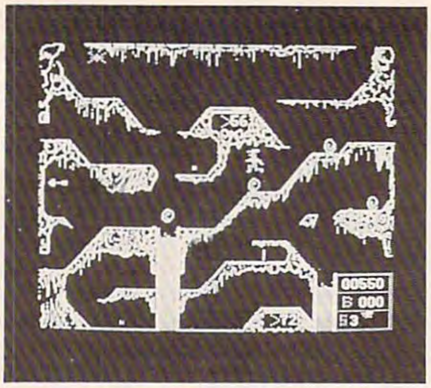
Scoring Points

Points are awarded for the completion of several tasks. Nominal scores are given for gathering the loot, gun caches, and boxes left by the terrorists. Once you've collected all items, certain bonus forms appear in random positions about the cave.

Another way to score points is to leap boulders. The larger the boulder, the more points you receive. Being struck by a boulder, on the other hand, diminishes your strength. The strength level is indicated with a number from one (weakest) to three (strongest). When you are weakened, your point scoring abilities are significantly impaired. In fact, at strength level one, scoring becomes secondary to mere survival since you can rarely manage to leap boulders in this weakened condition. Fortunately, there are several safe nooks around the cavern where you can recover.

Treacherous Caverns

There are other ways you can be



Your running figure (center) leaps a tumbling boulder in Crisis Mountain.

destroyed in the game. You can fall or be knocked into a lava pit by a boulder, a bomb can detonate, or you can be bitten by the deadly bat, Bertrum.

It is obvious that tremendous effort went into designing this game's high-resolution graphics. Each form is drawn in intricate detail. The frothing lava pits and tumbling boulders are remarkably realistic.

The Deadly Bat

But the most remarkable graphic element of the game (and the most confounding to any player) is Bertrum, the bat. Bertrum flits about the cavern in a way that resembles a real bat. If a boulder is blasted from a nearby lava pit, Bertrum will dart toward it for a quick inspection, determine the rock is not prey, and fly off to another part of the cave.

But Bertrum is more than just a visual success. His presence adds a degree of chance to the game which makes it faster and more challenging. This dreaded bat has a knack for determining where your player is at any moment in the game. Sometimes, you can avoid Bertrum with a last minute duck or leap. At other times, escape is simply impossible. I've yet to discover a foolproof way to evade this creature, though there may be a tactic.

There are several other excellent features of this game. For one, the ESC key allows you to halt or resume a game at any time during play. With *Crisis Mountain*, a game can sometimes last an hour or more. A break during such a prolonged period of play, beyond being a convenience, is often essential for maintaining your concentration. (No "save game" option is offered.)

Although the sound effects are very good, you may want to turn them off occasionally. If so, you can cancel output to the Apple speaker with CTRL-S. On the other hand, if you want an engulfing, environmental audio effect, output can be sent to external speakers via the cassette port. You can also store on disk, and subsequently display, the high score to date.

Overall, *Crisis Mountain* is a superior programming achievement and a thoroughly entertaining game.

Crisis Mountain
Synergistic Software
830 N. Riverside Drive
Suite 201, Renton, WA 98055
$34.95

©

Magic Storybook: Three Little Pigs For Atari

Orson Scott Card
Editor, COMPUTE! Books

Five-year-old Geoffrey sat down at the computer, and a woman introduced a wolf named Wasco. "Move him to the magic door," she said. He pushed his joystick and the wolf walked over to the door, waving his arms and moving his legs. When he reached the door, the wolf flashed different colors and disappeared.

Then the picture on the screen changed, as if it were a camera panning from left to right. Geoffrey saw a straw house, with a nervous pig inside, wiggling its ears and tail. The straw salesman walked by as the woman told how the house came to be built. Then Wasco came back.

"Little pig, little pig, let me in," said the wolf, in a voice that echoed strangely.

"Not by the hair of my chinny-chin-chin," said the squeaky-voiced pig.

Geoffrey laughed aloud. The woman told him to move Wasco to Door Number One. Geoffrey did it – pausing on the way to let the wolf have a chance to take a few bites of the pig through the window. The pig was apparently safe inside, so Geoffrey moved the wolf the rest of the way to the door.

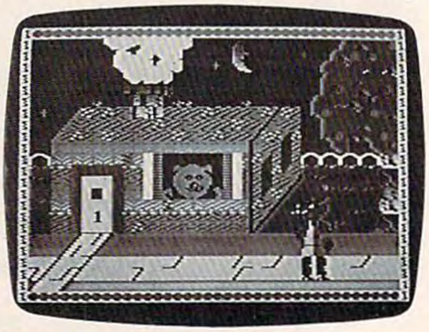
Huffing And Puffing

The wolf started dancing around while he huffed and puffed. Sure enough, the sky flashed, the "camera" panned to the right again, and the house was now a wreck. The same thing happened with the wood house, and then the wolf failed in two tries at the brick house.

The woman told Geoffrey to move Wasco to the chimney. When Geoffrey got him there, the wolf climbed up and jumped down. But there was a pot waiting down in the fireplace, and the wolf dropped neatly inside.

"I want another story now!" said Geoffrey.

But there was no other story.



The wolf lurks outside the first pig's house in The Magic Storybook: Three Little Pigs.

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So Geoffrey happily repeated "The Three Little Pigs" about six times before his parents sent him to bed with a promise that he could play it again tomorrow.

By the fairest standard of judgment I know, that makes *Magic Storybook*'s animated, interactive computer story a success. It is meant for children, and my very picky son Geoffrey thought it was great.

And it was, in many ways. The pictures of the houses were beautifully done, with display list interrupts allowing eight colors and many different shades on the screen at a time. The wolf and the salesman were each made up of four player/missiles combined, and despite the limitation of the 16-bit-wide format (they were tall and thin), the animation was well-done.

Artistic Screen Display

There were thoughtful extras, too. Stars twinkled. The pigs' eyes, ears, and tails were in constant motion. The artistry of the screen display was delightful. The horizontal scrolling was beautifully done – it even trembled like an earthquake when the wolf blew and blew at the brick house. The cassette loaded correctly the first time, every time, and when we wanted to repeat the story, the other side of the tape had the storytelling soundtrack only, so we didn't have to wait for a load. There was even a line-drawing replica of the cover picture, for a kid to color.

There were trade-offs, of course. That can't be helped. To create fluid, lifelike cartoon movements requires a new picture for every different body position of an onscreen character. That kind of quality takes a lot of artists a lot of time and money. That's why cheaply made cartoons have stiff, unnatural movements, faces that show no expressions, and dull backgrounds that repeat endlessly.

The same limitations apply to computer animation, only in addition to time and money, a third limitation is memory. Smooth, lifelike movement requires that every single picture be in RAM, where it can be accessed instantly. Player/missile graphics compensates a lot, because figures can be moved smoothly. But as soon as you want arms and legs to move naturally, or faces to change expressions, you run into the same old problems – every shape has to be in memory.

Limited Interaction

But that doesn't excuse all the flaws. For one thing, the interaction was *very* limited. All the child can ever do is move the wolf from right to left. There's a little bit of freedom: the wolf can go up and down about an inch. But if the child plays around with the wolf too long, the program takes over and moves the wolf against the child's will.

That seems like an unnecessary precaution. Why shouldn't children be free to move the wolf all around the house, if they feel like it, and take as long as they want doing it, too? It would have taken only a few dozen machine language commands to allow the wolf to go behind the house in the effort to get inside – a lot of drama would have been added to the story, and nothing is gained by making children hurry through the tale.

The sound was another problem. The background music was tolerable but unexciting. The funny voices for the wolf and the pigs were great – Geoffrey and his three-year-old sister, Emily, laughed out loud the first time through the story. But the narrator! She read in a monotone, as if she were hopelessly bored, repeating an elocution lesson, carefully pronouncing every vowel and consonant.

I couldn't help but compare *Magic Storybook* with PDI's interactive story *Sammy the Sea Serpent*. The graphics and programming in *Magic Storybook* are light-years beyond *Sammy*. But *Sammy*'s narrator is an excellent, excited storyteller, and the child is given meaningful tasks to perform and games to play. The six high-resolution screens and player/missile graphics in *Magic Storybook* cost the children the chance to really become part of the story.

The glow on my son's face when the narrator of *Sammy the Sea Serpent* tells him, "Sammy is home now. He couldn't have done it without you," just wasn't there at the end of "The Three Little Pigs." Some things count even more than graphics.

Magic Storybook:

The Three Little Pigs
Amulet Enterprises, Inc.
P.O. Box 25612
Garfield Heights, OH 44125
(216)475-7766
$29.95

©

Type Attack

J. David Keller

Type Attack, a program from Sirius Software, is a basic course in touch typing enlivened by the challenge and addictive qualities of an arcade game. The program is available in disk versions for the Apple, Atari, and Commodore 64, and on cartridge for the VIC-20.

The Game

Each lesson in *Type Attack* has two modes. In the first – Character Attack – characters march down the screen in *Space Invaders* fashion. By pressing the proper key on the keyboard, you wipe out the bottom character. If the wrong key is pressed, reserve energy is reduced.

There are three waves of characters. In the first two waves, the characters are in a set pattern; in the third, the characters appear in a random pattern.

In the second mode – Word Attack – words travel across the screen. One vulnerable word is indicated by a flashing marker. When you correctly type the entire word and press the space bar, the word is wiped out and you gain energy units.

If a word goes off the left side of the screen, it reappears at the right side at the cost of energy units. If all the words are correctly typed on the first pass, a set of bonus words come marching by in double time. If you complete *Word Attack* without losing all your energy, you advance to the next lesson.

Scoring is based on the number of characters and words destroyed. Points are lost for pressing the wrong keys. Bonus points are computed at the end of each lesson by multiplying the average words per minute by the speed level at which you played.

The Lessons

Type Attack has 39 planned lessons that follow typical keyboard manuals. Lesson 1 uses the home Keys A S D F. Lesson 2 uses J K L ;. Subsequent lessons build skills by using additional keys, usually two at a time. After the alphabet and basic punctuation marks are studied, numbers are added, and eventually, the symbols that utilize the shift key are introduced.

In Word Attack, early lessons have two to four characters per word. Later, up to 12-character words are presented. Many of the words in Word Attack are computer commands, such as GOTO and 5 HOME.

After the 39 planned lessons, you can add programs to practice specific skills. For example, a lesson which uses only two keys could be designed for very young typists. Or, advanced lessons could utilize a series of programming commands.

You can set the speed at which the letters and words move. The variety of the settings is sufficient to make a beginner feel confident and the pro feel inadequate. Higher score values are given for higher speeds. However, I found I made my highest scores with lower speed settings.

At the left edge of the screen, a bar graph shows the speed at which you are typing the lesson.

The manual is well written and the directions are clear, but more information on typing skill development and the content of each lesson would have been helpful.

Type Attack is a well-balanced game and learning program. The challenge is certainly there and as a result, players will surely develop better typing skills.

Type Attack
Sirius Software, Inc.
10364 Rockingham Drive
Sacramento, CA 95827
(916)366-1195
$39.95

©

Mutant Herd For The VIC

Tony Roberts, Assistant Managing Editor

If your fire-button finger is worn out from trying to shoot down everything that moves, *Mutant Herd* from Thorn EMI Video may be the prescription. In this VIC-20 cartridge game, the fire button does come into play, but only occasionally. There's much more than dodging and shooting here.

Your assignment is to protect a powerhouse, which pulsates at the center of your screen, from an invasion of mutants, who crawl from burrows located at each corner of the display.

Your weapon is a pair of laser beams – one horizontal and one vertical – that are controlled by joystick or the keyboard.

At the game's start, everything is quiet, the beams intersect at center screen, no mutants are in sight. Move one of the beams – even slightly – and the burrows erupt. Red, green, purple, and yellow mutants stream from the burrows and pour toward the power station.

If They Form A Ring

Use the beams to stop the wave of attackers and push them toward the edges of the screen. Don't push them too far, though, for as you push the attackers to one side, the inhabitants of the other burrows creep in from the other side. If the mutants manage to form a ring around the perimeter of the powerhouse, one of your three lives is lost, and you start again.

As you defend the rumbling powerhouse, you'll soon hear the high-pitched sound of the Mutant Slayers as they begin to appear on the screen. The Mutant Slayers, though not unlike the mutants in appearance, are the key to eliminating these power production pests.

Use the laser beams to guide a slayer into one of the four burrows. By pressing the fire button, you allow the slayers to pass through the beams. If you push one of the slayers – you get ten – off the screen or into the powerhouse, color it gone.

Once you guide a slayer into one of the burrows, the scene changes. You find yourself in the shoes of a Mutant Slayer near the top of the burrow you just entered. You see a ladder leading down past abandoned caverns to the bottom of the screen where the Mutant Queen protects 15 of her precious eggs.

You're working against time, so don't spend too long admiring the sights. Get down the ladder into the Queen's cavern and put down an explosive charge. Dart back up the ladder and touch the detonator to destroy five of the eggs and seal the burrow.

It's not as easy as it sounds. The mutants, though they are admirable burrowers, know little about engineering. The abandoned caverns are deathtraps. Rocks continually fall from the walls and ceilings and bound down the ladderway. Step quickly into the gaps to the left of the ladder to avoid the falling rocks. You can't survive a direct hit.

While you're dodging rocks on your way to the top of the burrow, the Mutant Queen attempts to move your explosive away from her eggs. If she succeeds, you must go back and replace it. Be forewarned: the Mutant Queen considers Mutant Slayers a delicacy and will not hesitate to eat one if it ventures too close.

If you successfully plant the charge, dodge the rocks, and return to the detonator before the explosive has been moved, you will destroy five eggs and seal the burrow. Congratulations. But you've only just begun.

When you return to the powerhouse, things will have changed. Only three burrows remain, but your laser beams have been weakened. They're filled with gaps where mutants can slip through. Despite the difficulties, you must press on; you must seal the remaining burrows.

Guide a slayer into another burrow, and the scene shifts as before. This time, however, the Queen guards only ten eggs. You'll have to get closer to the Queen to plant the charge (risking ending up as a light lunch), and the Queen needn't go as far to move the explosive away from the eggs.

Use The Patrol Schedule

Though the Mutant Queen is vicious and certainly voracious, she does have a weakness: her pacing is predictable. She ambles back and forth through her narrow cavern almost like clockwork. Use her patrol schedule to your advantage.

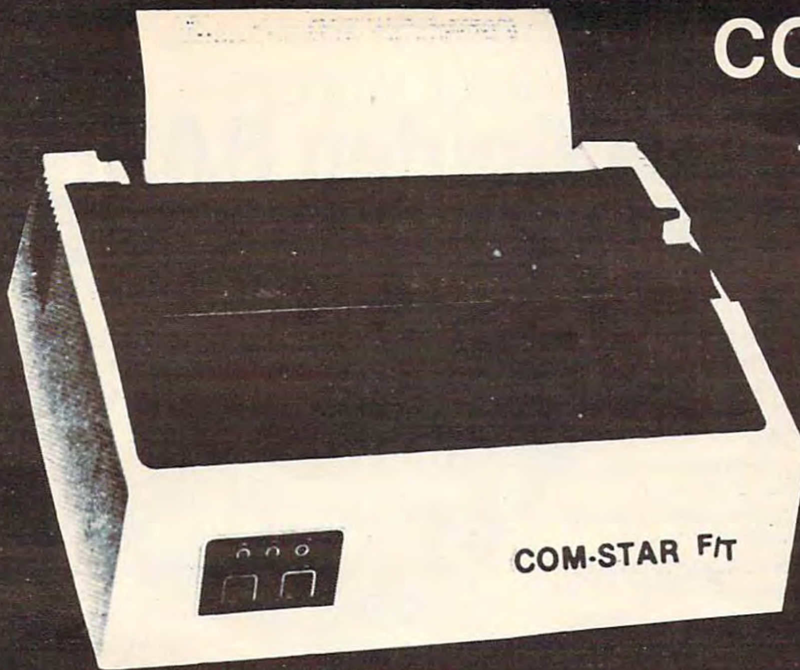
If you manage to seal the second burrow, you'll return to the powerhouse, your beams weaker still. Send a slayer into one of the remaining burrows, plant the charge, dodge the rocks and the Mutant Queen, and detonate the explosive to destroy the final five eggs.

Once the eggs are destroyed, you can turn your full attention to the Queen herself. Back at the powerhouse, you have only one burrow of mutants to contend with, but your laser beams look like Swiss cheese.

Guide a slayer into the final burrow. Plant your explosive in the Queen's cavern and crawl for cover. When the Queen is directly above the charge, press the fire button to trigger the explosion and complete the round.

Once the Queen has been destroyed, you move on to new rounds, and new hazards.

Mutant Herd includes options for one or two players. No pause option is available, but



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each time you return to the powerhouse, either by losing a life or sealing a burrow, the game waits until you initiate action by moving the laser beams.

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ULTRASORT
For Commodore

John W. Ross

This is probably the fastest sorting program ever published for any home computer. It will alphabetize 1000 items in less than eight seconds.

There are versions here for the 64, VIC, and 4.0 PET. You might want to change the amount sorted in the test program to reflect the available memory in your computer. If so, change N in line 110 of Program 4. The test generates random "words" so you can see how the program works.

This article is a sequel to my earlier article "Super Shell Sort for PET/CBM" (February 1983). In that article, I described a shell sort program for the CBM 8032 written entirely in machine language. It performed as expected and was, overall, very fast; however, it had a couple of shortcomings. First of all, it had a rather clumsy interface with BASIC; that is, the calling sequence was not very neat; and second, sorting was performed by the shell sort algorithm. This method of sorting is actually quite efficient, certainly far better than a bubble sort, for instance. Nevertheless, there are better sorts.

C.A.R. Hoare's Quicksort algorithm is possibly the fastest yet developed for most applications. So, I rewrote my machine language sort program based on the Quicksort algorithm.

Speed Improvements

How much better is it? In order to test the program, I wrote a small sort test program (Program 4), similar to the one in my original article. This program generates a character array containing N items (line 110).

Different items are generated depending on the value of the random number seed, SD in line 140; SD must be a negative number.

I generated six 1000 element arrays and sorted them using both the shell sort and Ultrasort. Super Shell Sort required an average of 29.60 seconds to sort all 1000 elements, while Ultrasort required an average of only 8.32 seconds. The sorting time has increased 72%. I don't believe you will find a faster sort for an eight-bit machine anywhere.

The way you start the sort (see Program 4) has also been refined. To RUN the sort on the PET, you simply type:

```
SYS 31744,N,AA$(K)
```

For the 64, use:

```
SYS 49152,N,AA$(K)
```

The format is the same for the VIC, but the loader for the VIC version (Program 2) is designed to relocate itself to the top of available memory, which will vary according to the amount of expansion memory added to your VIC. (Ultrasort is too long for the unexpanded VIC.) The loader program will tell you the proper SYS address to use on your VIC.

RUNning The Program

Ultrasort can be used either from within a program or in immediate mode. RUNning Ultrasort causes N elements from array AA$, starting with element K, to be sorted into ascending order. The sort occurs in place; there is no additional memory overhead. N and K can be constants or variables, and any character array name can be substituted for AA$.

Before RUNning the sort, though, it must be LOADed by BASIC. The appropriate loader is supplied in Programs 1-3. The tradeoff for the increased speed of Ultrasort is increased complexity, especially in machine language. The sort program runs from $7C00 to $7F8B (908 bytes) on the PET. The increased size, of course, creates a greater possibility of errors when you enter the numbers. In order to minimize this, the PET loader

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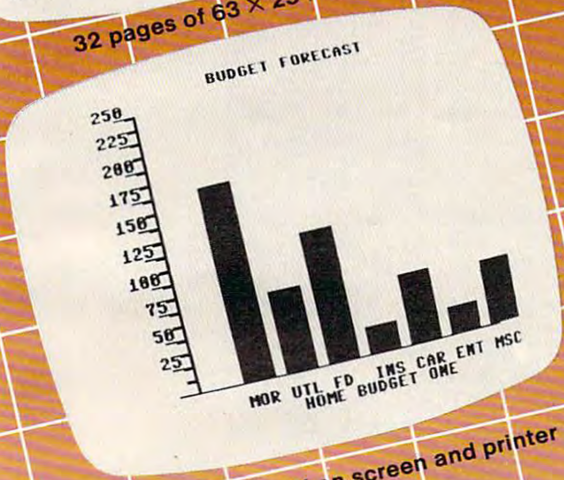

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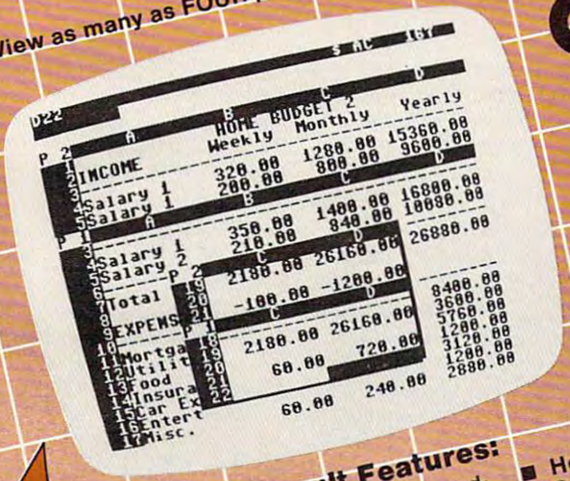

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(Program 1) is written to be self-checking to a degree. The DATA statements are grouped in blocks of 20 lines or 140 numbers (except for the first and last blocks), each of which is supplied with a checksum. If all the numbers in a block do not add up to the checksum, an error message is printed, giving you an indication of which block is in error. VIC and 64 owners should check their typing carefully, as there is no checksum.

Notice that the first thing the loader programs do is reset the top of memory pointer. This is very important – you must use the BASIC loader before RUNning the sort program.

Once Program 1 is loaded into upper memory of the PET, you should save it to disk by entering the monitor (SYS 4) and typing:

S"0:ULTRASORT",08,7C00,7F8C

VIC and 64 owners should use a monitor program or cartridge (e.g., VICMON, Supermon 64) or a routine such as "Machine Language Saver" (COMPUTE!, June 1983, p. 216) to save a copy of the Ultrasort machine language.

To load your copy of Ultrasort from the PET monitor, reset the top of memory and type:

L"0:ULTRASORT",08

From PET, VIC, or 64 BASIC type:

LOAD"ULTRASORT",8,1 for disk, or
LOAD"ULTRASORT",1,1 for tape.

You can use Program 4 to watch the action with the PET, VIC, or 64 versions of Ultrasort.

Program 1: Ultrasort For PET

```
1 REM ULTRASORT-LOADER
1Ø POKE 52,Ø : POKE 53,124 : CLR
2Ø FOR IB=1 TO 7
3Ø READ N,NL,CC:CS=Ø : IF NL<>Ø THEN L=NL
4Ø FORI=1 TO N : READ X : CS=CS+X : POKE
   L,X
5Ø L=L+1 : NEXT I
6Ø IF CS<>CC THEN PRINT"ERROR IN BLOCK"IB
   : END
7Ø PRINT"BLOCK"IB"OK"
8Ø NEXT IB
9Ø END
199 REM ... BLOCK 1 ...
2ØØ DATA 3,31744,3ØØ
2Ø5 DATA 76,1ØØ,124
2Ø6 REM ... BLOCK 2 ...
2Ø7 DATA 14Ø,31844,148Ø8
21Ø DATA 32,245,19Ø,32,152,189,32
215 DATA 45,2Ø1,165,17,141,12,124
22Ø DATA 165,18,141,13,124,32,245
225 DATA 19Ø,32,152,189,56,165,68
23Ø DATA 233,3,133,84,165,69,233
235 DATA Ø,133,85,162,1,173,12
24Ø DATA 124,157,2Ø,124,173,13,124
245 DATA 157,4Ø,124,169,1,157,6Ø
25Ø DATA 124,169,Ø,157,8Ø,124,189
255 DATA 6Ø,124,141,16,124,189,8Ø
26Ø DATA 124,141,17,124,189,2Ø,124
265 DATA 141,18,124,189,4Ø,124,141
27Ø DATA 19,124,32,47,127,173,11
275 DATA 124,48,4,2Ø2,2Ø8,221,96
28Ø DATA 189,6Ø,124,141,16,124,189
285 DATA 8Ø,124,141,17,124,169,1
29Ø DATA 141,18,124,169,Ø,141,19
295 DATA 124,32,1Ø1,127,189,2Ø,124
3ØØ DATA 141,18,124,141,14,124,189
3Ø5 DATA 4Ø,124,141,19,124,141,15
3Ø6 REM ... BLOCK 3 ...
3Ø7 DATA 14Ø,Ø,13385
31Ø DATA 124,32,47,127,173,11,124
315 DATA 48,3,76,167,125,32,131
32Ø DATA 127,173,16,124,141,3,124
325 DATA 173,17,124,141,4,124,173
33Ø DATA 14,124,141,5,124,173,15
335 DATA 124,141,6,124,32,132,126
34Ø DATA 32,18Ø,126,173,11,124,48
345 DATA 218,173,16,124,141,3,124
35Ø DATA 173,17,124,141,4,124,173
355 DATA 18,124,141,16,124,173,19
36Ø DATA 124,141,17,124,169,1,141
365 DATA 18,124,169,Ø,141,19,124
37Ø DATA 32,1Ø1,127,173,16,124,141
375 DATA 18,124,173,17,124,141,19
38Ø DATA 124,173,3,124,141,16,124
385 DATA 173,4,124,141,17,124,32
39Ø DATA 47,127,173,11,124,16,35
395 DATA 173,14,124,141,3,124,173
4ØØ DATA 15,124,141,4,124,173,18
4Ø5 DATA 124,141,5,124,173,19,124
4Ø6 REM ... BLOCK 4 ...
4Ø7 DATA 14Ø,Ø,13499
41Ø DATA 141,6,124,32,132,126,32
415 DATA 18Ø,126,173,11,124,48,152
42Ø DATA 32,47,127,173,11,124,16
425 DATA 18,173,16,124,141,3,124
43Ø DATA 173,17,124,141,4,124,32
435 DATA 132,126,32,31,127,76,241
44Ø DATA 124,234,189,2Ø,124,141,3
445 DATA 124,189,4Ø,124,141,4,124
45Ø DATA 173,16,124,141,5,124,173
455 DATA 17,124,141,6,124,32,132
46Ø DATA 126,32,31,127,173,16,124
465 DATA 141,18,124,141,3,124,173
47Ø DATA 17,124,141,19,124,141,4
475 DATA 124,32,81,127,189,2Ø,124
48Ø DATA 141,18,124,189,4Ø,124,141
485 DATA 19,124,32,1Ø1,127,173,11
49Ø DATA 124,48,15,189,6Ø,124,141
495 DATA 18,124,189,8Ø,124,141,19
5ØØ DATA 124,32,1Ø1,127,169,1,141
5Ø5 DATA 18,124,169,Ø,141,19,124
5Ø6 REM ... BLOCK 5 ...
5Ø7 DATA 14Ø,Ø,15957
51Ø DATA 173,3,124,141,16,124,173
515 DATA 4,124,141,17,124,173,11
52Ø DATA 124,16,52,189,6Ø,124,232
525 DATA 157,6Ø,124,2Ø2,189,8Ø,124
53Ø DATA 232,157,8Ø,124,32,1Ø1,127
535 DATA 173,16,124,157,2Ø,124,173
54Ø DATA 17,124,157,4Ø,124,32,131
545 DATA 127,32,131,127,2Ø2,173,16
55Ø DATA 124,157,6Ø,124,173,17,124
555 DATA 157,8Ø,124,76,128,126,32
56Ø DATA 131,127,232,173,16,124,157
565 DATA 6Ø,124,173,17,124,157,8Ø
57Ø DATA 124,2Ø2,189,2Ø,124,232,157
575 DATA 2Ø,124,2Ø2,189,4Ø,124,232
58Ø DATA 157,4Ø,124,2Ø2,32,1Ø1,127
585 DATA 32,1Ø1,127,173,16,124,157
59Ø DATA 2Ø,124,173,17,124,157,4Ø
```

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```
595 DATA 124,232,76,162,124,160,3
600 DATA 165,84,133,88,133,90,165
605 DATA 85,133,89,133,91,24,165
606 REM ... BLOCK 6 ...
607 DATA 140,0,15683
610 DATA 88,109,3,124,133,88,165
615 DATA 89,109,4,124,133,89,24
620 DATA 165,90,109,5,124,133,90
625 DATA 165,91,109,6,124,133,91
630 DATA 136,208,223,96,160,0,140
635 DATA 11,124,177,88,141,7,124
640 DATA 177,90,141,8,124,200,152
645 DATA 205,7,124,240,2,176,13
650 DATA 205,8,124,240,21,144,19
655 DATA 238,11,124,76,30,127,205
660 DATA 8,124,240,2,176,62,206
665 DATA 11,124,76,30,127,140,9
670 DATA 124,160,1,177,88,133,86
675 DATA 200,177,88,133,87,172,9
680 DATA 124,136,177,86,141,10,124
685 DATA 140,9,124,160,1,177,90
690 DATA 133,86,200,177,90,133,87
695 DATA 172,9,124,177,86,200,205
700 DATA 10,124,208,3,76,195,126
705 DATA 144,184,76,224,126,96,160
706 REM ... BLOCK 7 ...
707 DATA 108,0,11613
710 DATA 2,177,88,72,177,90,145
715 DATA 88,104,145,90,136,16,243
720 DATA 96,169,0,141,11,124,173
725 DATA 17,124,205,19,124,144,6
730 DATA 240,8,238,11,124,96,206
735 DATA 11,124,96,173,16,124,205
740 DATA 18,124,144,244,208,238,96
745 DATA 173,16,124,24,109,18,124
750 DATA 141,16,124,173,17,124,109
755 DATA 19,124,141,17,124,96,169
760 DATA 0,141,11,124,56,173,16
765 DATA 124,237,18,124,141,16,124
770 DATA 173,17,124,237,19,124,141
775 DATA 17,124,176,3,206,11,124
780 DATA 96,238,16,124,208,3,238
785 DATA 17,124,96
```

Program 2: Ultrasort For VIC

```
5 I1=PEEK(56)*256-1024
6 POKE 55,0:HI=INT(I1/256):POKE 56,HI:CL
  R
7 I1=PEEK(55)+PEEK(56)*256
8 HI=INT(I1/256)
10 I=I1
20 READ A:IF A=256 THEN PRINT"TO RUN SOR
   T, USE: SYS"I1:END
22 IF A<0 THEN A=ABS(A)-26+HI
25 IF A=257 THEN I=I1+100:GOTO 20
30 POKE I,A:I=I+1:GOTO 20
6656 DATA 76,100,-26,257
6768 DATA 32,253,206,32,158
6776 DATA 205,32,247,215,165,20,141
6784 DATA 12,-26,165,21,141,13,-26
6792 DATA 32,253,206,32,158,205,56
6800 DATA 165,71,233,3,133,75,165
6808 DATA 72,233,0,133,76,162,1
6816 DATA 173,12,-26,157,20,-26,173
6824 DATA 13,-26,157,40,-26,169,1
6832 DATA 157,60,-26,169,0,157,80
6840 DATA -26,189,60,-26,141,16,-26
6848 DATA 189,80,-26,141,17,-26,189
6856 DATA 20,-26,141,18,-26,189,40
6864 DATA -26,141,19,-26,32,47,-29
6872 DATA 173,11,-26,48,4,202,208
6880 DATA 221,96,189,60,-26,141,16
6888 DATA -26,189,80,-26,141,17,-26
6896 DATA 169,1,141,18,-26,169,0
6904 DATA 141,19,-26,32,101,-29,189
6912 DATA 20,-26,141,18,-26,141,14
6920 DATA -26,189,40,-26,141,19,-26
6928 DATA 141,15,-26,32,47,-29,173
6936 DATA 11,-26,48,3,76,167,-27
6944 DATA 32,131,-29,173,16,-26,141
6952 DATA 3,-26,173,17,-26,141,4
6960 DATA -26,173,14,-26,141,5,-26
6968 DATA 173,15,-26,141,6,-26,32
6976 DATA 132,-28,32,180,-28,173,11
6984 DATA -26,48,218,173,16,-26,141
6992 DATA 3,-26,173,17,-26,141,4
7000 DATA -26,173,18,-26,141,16,-26
7008 DATA 173,19,-26,141,17,-26,169
7016 DATA 1,141,18,-26,169,0,141
7024 DATA 19,-26,32,101,-29,173,16
7032 DATA -26,141,18,-26,173,17,-26
7040 DATA 141,19,-26,173,3,-26,141
7048 DATA 16,-26,173,4,-26,141,17
7056 DATA -26,32,47,-29,173,11,-26
7064 DATA 16,35,173,14,-26,141,3
7072 DATA -26,173,15,-26,141,4,-26
7080 DATA 173,18,-26,141,5,-26,173
7088 DATA 19,-26,141,6,-26,32,132
7096 DATA -28,32,180,-28,173,11,-26
7104 DATA 48,152,32,47,-29,173,11
7112 DATA -26,16,18,173,16,-26,141
7120 DATA 3,-26,173,17,-26,141,4
7128 DATA -26,32,132,-28,32,31,-29
7136 DATA 76,241,-26,234,189,20,-26
7144 DATA 141,3,-26,189,40,-26,141
7152 DATA 4,-26,173,16,-26,141,5
7160 DATA -26,173,17,-26,141,6,-26
7168 DATA 32,132,-28,32,31,-29,173
7176 DATA 16,-26,141,18,-26,141,3
7184 DATA -26,173,17,-26,141,19,-26
7192 DATA 141,4,-26,32,81,-29,189
7200 DATA 20,-26,141,18,-26,189,40
7208 DATA -26,141,19,-26,32,101,-29
7216 DATA 173,11,-26,48,15,189,60
7224 DATA -26,141,18,-26,189,80,-26
7232 DATA 141,19,-26,32,101,-29,169
7240 DATA 1,141,18,-26,169,0,141
7248 DATA 19,-26,173,3,-26,141,16
7256 DATA -26,173,4,-26,141,17,-26
7264 DATA 173,11,-26,16,52,189,60
7272 DATA -26,232,157,60,-26,202,189
7280 DATA 80,-26,232,157,80,-26,32
7288 DATA 101,-29,173,16,-26,157,20
7296 DATA -26,173,17,-26,157,40,-26
7304 DATA 32,131,-29,32,131,-29,202
7312 DATA 173,16,-26,157,60,-26,173
7320 DATA 17,-26,157,80,-26,76,128
7328 DATA -28,32,131,-29,232,173,16
7336 DATA -26,157,60,-26,173,17,-26
7344 DATA 157,80,-26,202,189,20,-26
7352 DATA 232,157,20,-26,202,189,40
7360 DATA -26,232,157,40,-26,202,32
7368 DATA 101,-29,32,101,-29,173,16
7376 DATA -26,157,20,-26,173,17,-26
7384 DATA 157,40,-26,232,76,162,-26
7392 DATA 160,3,165,75,133,79,133
7400 DATA 81,165,76,133,80,133,82
7408 DATA 24,165,79,109,3,-26,133
7416 DATA 79,165,80,109,4,-26,133
```