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COMPUTE!

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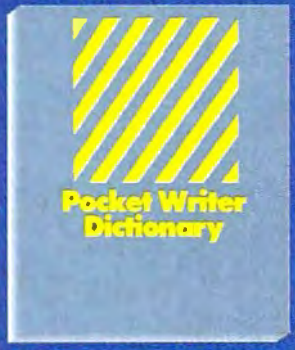

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COMPUTE!

FEBRUARY 1987
VOLUME 9
NUMBER 2
ISSUE 81

FEATURES

REVIEWS

COLUMNS AND DEPARTMENTS

THE JOURNAL

NOTE: See page 86 before typing in programs.

AP Apple, **Mac** Macintosh, **AT** Atari, **ST,** Atari ST, **64** Commodore 64, **128** Commodore 128, **P** PET/CBM, **PC** IBM PC, **PCjr** IBM PCjr, **AM** Amiga. *General interest.

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Editor's Notes

This is the 81st issue of COMPUTE!, an effort now in its ninth year. Writing the "Editor's Notes" for all of those years has been a fascinating challenge. When you add to this the 43 issues of COMPUTE!'s Gazette (through January 1987), and a few assorted odds and ends such as *Home and Educational Computing, COMPUTE!'s PC & PCjr Magazine, COMPUTE!'s Apple Applications Special,* and another special issue here and there, you discover a quiltwork of topics that extend back through much of the history of the home and consumer computing industry.

The topic for this issue is a highly personal one. This is my last set of notes as Editor in Chief of COMPUTE!. Beginning next issue, Richard Mansfield, presently Senior Editor and soon to become Vice President and Editorial Director, will take over the task of providing editorial leadership, and "Editor's Notes," for all of COMPUTE! Publications. Richard has been very much a part of COMPUTE! and its vision and voice since he joined us in 1981.

My own relationship with COMPUTE!, as founder, President, Chief Executive Officer, and finally Editor in Chief, has been in a state of beneficial evolution since we sold the company to the American Broadcasting Companies in 1983. As my relationship has evolved, so too has the industry, and our present marketplace is far stronger than it was even two years ago. I remain very much a part of the ABC Consumer Magazines/ COMPUTE! Publications effort, and will continue to lend my voice and experience to this company. At the same time, my diminishing involvement in the day-to-day activities of the company and its management will allow me the time to explore new horizons—a challenge I can only look forward to.

COMPUTE! and ABC Publishing share a long tradition of customer enthusiasm and loyalty. We are at the forefront of product introductions that continue to keep us and our readers at a pace with the evolution of our industry. We were among the first of the publishing houses to commit to the validity and future of the home computer market, and you have never let us down. While we have been occasionally sharp in print over the ebbs and flows of certain manufacturers and their products, we have enjoyed a long and pleasant vantage point on this industry. When I wrote my very first COMPUTE! editorial, a company called Atari, Inc. had just introduced its first computers. Single-board computers were big. And Ohio Scientific was threatening to become one of the biggest players in the industry. Commodore had introduced a computer with a "real" keyboard (the CBM) and a then-incredible 32K of memory. The top magazines in the industry had names like *Kilobaud, Micro, Creative, Recreational Computing,* and others. Only a few remain.

From the very first issue of this magazine, we've had a unique relationship with you, our readers. You've been supportive; you've encouraged; you've sometimes grown angry, but usually for the best of reasons: We were late delivering your issue, or we stepped on the toes of your particular computer manufacturer. In all candor, I cannot imagine an industry with a more vital and resourceful readership than an industry such as ours. We have readers/ authors from ages 8–80, from all over the world, who are shaping the face of this industry and our future, and opportunities like that simply don't happen very often. Personal computing is a highly individual revolution, and its publishing shape and practices have in many ways reflected that.

So, I guess that's it. With this last editorial (oh, perhaps I'll write a guest one or so next year) I'd like to send a very personal thank-you to each and every one of you, our readers.

Until next time, enjoy your COMPUTE!.

Robert C. Lock
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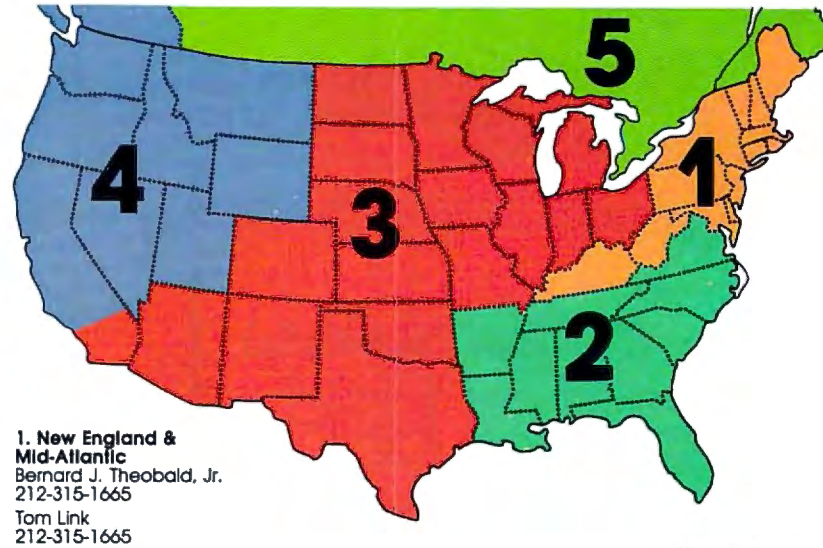

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Selby Bateman
Features Editor

New Frontiers For

Personal computer users dream of having machines with the power and speed of a mainframe, the print quality of a professional typesetter, and virtually unlimited disk storage. Now, a new generation of microprocessors, coupled with advances in laser-driven printers and optical disks, promise to make the dream a reality.

What single thing do computer users want? More.

More speed, more power, more flexibility, more storage capacity, more printing versatility, and more ease of use. During the past several years, computers have undergone explosive advances in each of those areas. But what's been occurring over the past year promises to move personal computing a quantum leap forward.

Before the end of the 1980s, personal computer systems may be available that will fulfill the wish list of even the most demanding power user. This is being accomplished by a combination of technological advances, ranging from refinements in low-power lasers to improvements in *very large scale integration* (VLSI) microchips.

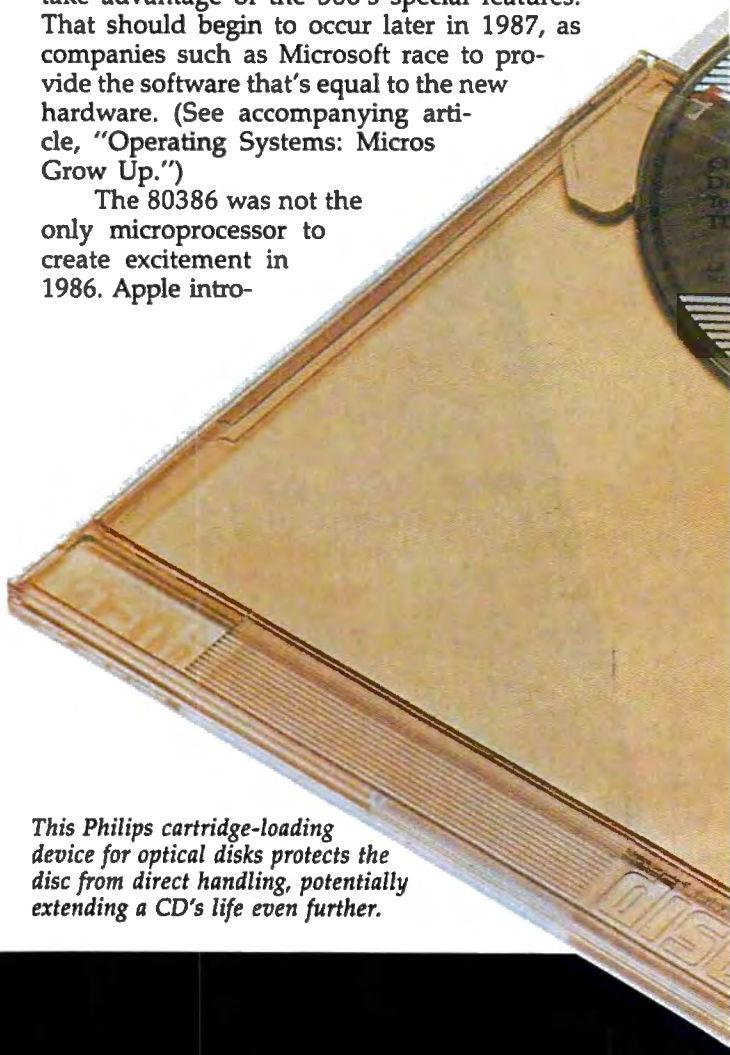
Processor Power

One of the biggest computer-industry news stories during the latter half of 1986 was the emergence of the new 80386 microprocessor from the Intel Corporation. (See accompanying article, "Microprocessors: Leapfrogging Ahead.")

This new central processing unit (CPU), compatible with all previous members of the 8086/8088 microprocessor family found in earlier IBM PCs and compatibles, first caused a stir when released in the Deskpro 386 computer from Compaq. Almost immediately, however, other manufacturers announced 80386 computers, add-on boards, and plans for future 386-compatible products. The Z-386 computer from Zenith Data Systems, Laser Digital's Pacer-386, Multitech's Model 1100, Gold Star's GS PC 386, and PC's Limited's 386-16 were among the first machines to jump into the 80386 future.

Because of the 80386's potential as a true 32-bit microprocessor, and its compatibility with earlier PCs, the new 386 computers promise an exciting new level of speed and power. However, much of the chip's powers will be hidden away until a new operating system is developed and marketed that can take advantage of the 386's special features. That should begin to occur later in 1987, as companies such as Microsoft race to provide the software that's equal to the new hardware. (See accompanying article, "Operating Systems: Micros Grow Up.")

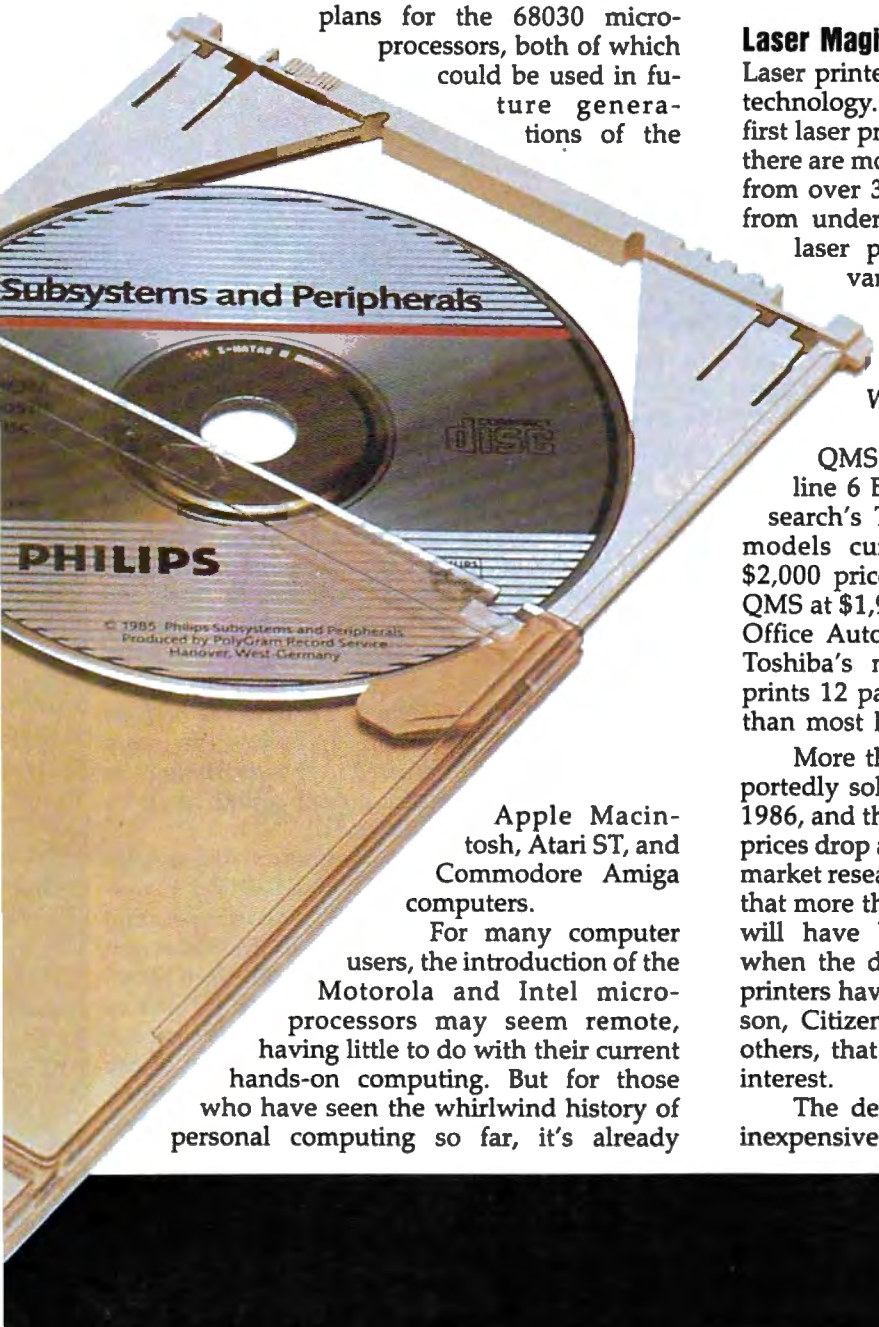
The 80386 was not the only microprocessor to create excitement in 1986. Apple intro-



This Philips cartridge-loading device for optical disks protects the disc from direct handling, potentially extending a CD's life even further.

Personal Computers

duced the new IIGS, which uses the Western Design Center's 65C816 chip, a 16/32-bit descendant of the earlier 6502 series used in the most popular 8-bit computers. And Motorola announced its 68020 and plans for the 68030 microprocessors, both of which could be used in future generations of the Apple Macintosh, Atari ST, and Commodore Amiga computers.



For many computer users, the introduction of the Motorola and Intel microprocessors may seem remote, having little to do with their current hands-on computing. But for those who have seen the whirlwind history of personal computing so far, it's already abundantly clear that the future has a way of arriving far faster than anticipated. And these new 32-bit microprocessors will be the engines at the core of the new supermicros taking us into the 1990s.

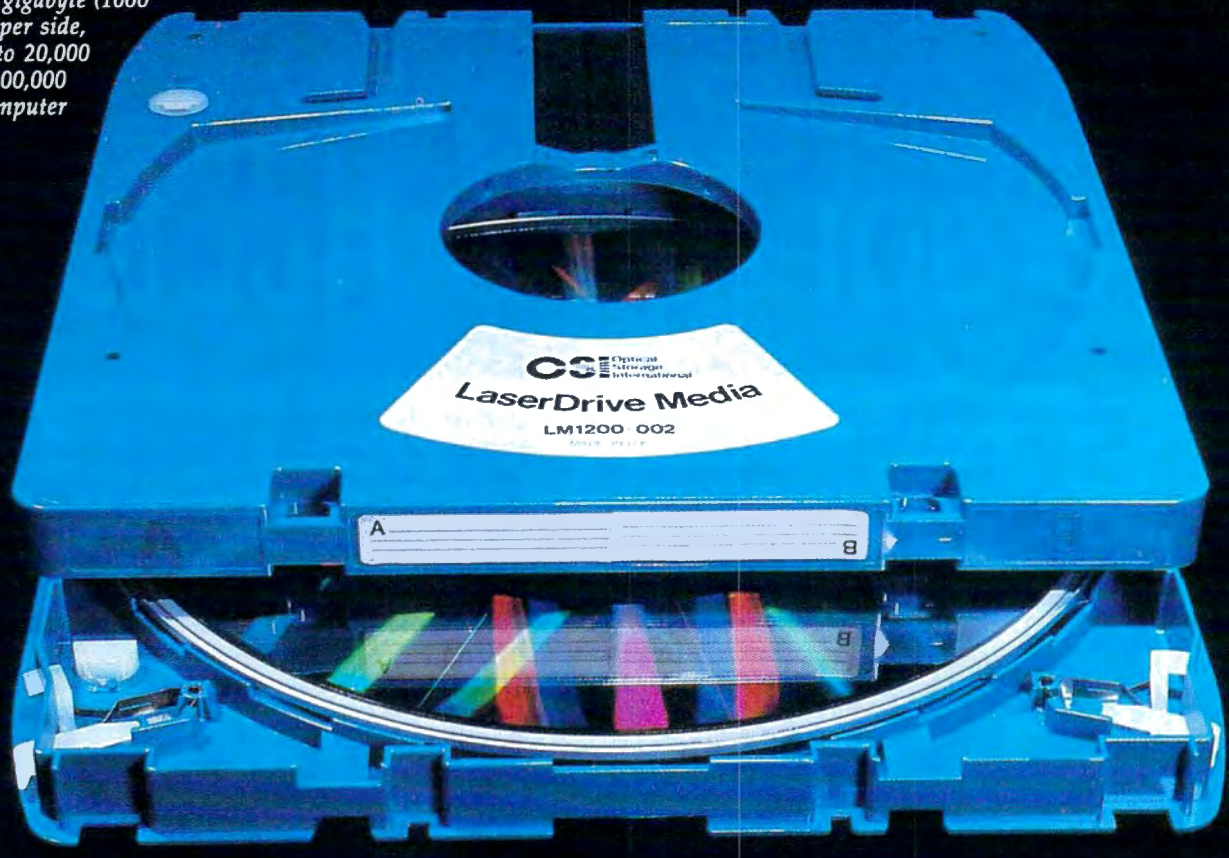
Laser Magic

Laser printers are also evidence of onrushing technology. Hewlett-Packard introduced the first laser printer, the LaserJet, in 1984. Today, there are more than 60 models of laser printers from over 30 companies, with prices ranging from under $2,000 for fairly slow text-only laser printers to about $8,000 for advanced graphics-and-text output that allows up to 300 dots per inch for graphic images. (See accompanying article, "Lasers That Read, Write, and Print.")

Apple's LaserWriter Plus; the QMS Kiss and Big Kiss; Okidata's Laserline 6 Basic and Advanced; and AST Research's Turbo Laser are but a few of the models currently available. Breaking the $2,000 price barrier are the QMS Kiss from QMS at $1,995 and the Laserpro Express from Office Automation Systems for $1,895. And Toshiba's new $3,499 PageLaser12, which prints 12 pages a minute, is 50-percent faster than most laser printers being used.

More than 46,000 laser printers were reportedly sold during the first nine months of 1986, and the demand is steadily increasing as prices drop and quality improves. Dataquest, a market research firm, has reportedly estimated that more than a quarter-million laser printers will have been shipped by manufacturers when the dust settles from 1986. New laser printers have recently been introduced by Epson, Citizen-America, Ricoh, Printronix, and others, that are helping to spur even greater interest.

The development of versatile, relatively inexpensive laser printers is fueling the recent



LMS international's double-sided LaserDrive Media disc is typical of advances in laser technology, storing one gigabyte (1000 megabytes) per side, equivalent to 20,000 images or 500,000 pages of computer text.

upsurge of interest in desktop publishing, an industry that barely existed much more than a year ago. At recent computer industry trade shows, such as COMDEX, the show floors have been awash with new laser printers and desktop publishing software, often running at lightning speed on new 80386-based personal computers. Companies like Apple Computer are selling computer and laser printer system combinations, often bundled with page definition and layout software, that offer a complete solution to virtually any kind of publishing effort—from a newsletter to a book.

The CDs Are Coming

No other area of computer development is more potentially important than that of compact discs (CDs). The CD audio market has taken the music world by storm. For example, CD versions of the recent Bruce Springsteen five-album set, which is becoming one of the bestselling albums of all time, has been outselling the LP record version by a margin of almost 2 to 1. And similar results are beginning to occur on many new music releases. The combination of high-quality digital sound and near indestructibility makes CDs a very attractive purchase. And prices for audio CDs are expected to continue to drop, soon reaching the same price points now found on record albums.

For many of the same reasons, the CD data market—either CD-ROM data storage and retrieval or the new CD-I interactive media—is showing signs of becoming a multibillion-dollar market within the next few years. (See accompanying article, "Lasers That Read, Write, and Print.")

In early March, Microsoft Corporation, a leading developer of software, will sponsor the second International Conference on CD-ROM, to be held in Seattle, Washington. Last year's conference, which attracted over a thousand participants, included information on one of the most exciting developments in CD technology, CD-I, developed jointly by Sony and Philips, giants in the consumer electronics field. This year's conference will extend the boundaries of proposed applications and allow the many different companies interested in this technology to gauge the best directions for growth and to catch up on the latest technical advances.

Microsoft also recently announced the availability of the Microsoft MS-DOS CD-ROM Extensions, extensions to the MS-DOS standard operating system that support the use of CD-ROM disc drives with personal computers. Following the High Sierra CD-ROM file format that's been adopted by leaders in the CD-ROM field, the new Microsoft extensions mean that a way is now available for many of the already installed IBM PCs and compatibles (running MS-DOS 3.1 or 3.2) to use new CD-ROM products. That opens the door to a huge new market for CD-ROM companies.

The High Sierra file format was developed by a

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The new Compaq Deskpro 386 is among the first personal computers to take advantage of Intel's 80386 32-bit microprocessor, a powerhouse ushering in a new level of personal computing.

group of industry companies that wanted a standard format for all CD-ROM development. This means that different computers with different operating systems can still use the same format for CD-ROM even with different brands of CD-ROM disc drives.

At the same time that CD-ROM is being standardized, many companies are lining up to promote future CD-I applications. One of the newest companies in the burgeoning CD-I field is American International Media (AIM), created by compact disc pioneers Philips International and Polygram B.V. International. Following the Sony/Philips CD-I standard, AIM's mission is to spearhead the development of software for CD-I. Philips, with Control Data, has also formed another company involved in the mass-storage arena, Laser Magnetic Storage (LMS) International, which will be involved in the design, manufacture, and marketing of optical disc and magnetic tape storage systems.

The formation of these companies is indicative of the confidence that major players in the computer and optical disk markets have in CD-ROM or CD-I technology. They want to be on the ground floor of whatever CD market is built. And they're betting that the CD-I market in the long run could be every bit as big as the CD audio market is becoming today.

More support for the CD-ROM market has come from Reference Technology, a Colorado company that has announced support for major CD-ROM drives in conjunction with Microsoft's MS-DOS CD-ROM Extensions. Reference Technology is providing the necessary device-driver software to operate with Hitachi, Sony, and Philips CD-ROM drives.

Another company, computer-disk giant Maxell, has introduced a new 5¼-inch optical WORM (Write Once, Read Many) disc that's capable of storing 13,000 letter-size pages on its two sides. The Model OC-101 is housed in a protective cartridge designed to work with the Hitachi OD-101-1 optical disc drive. Designed to be used with a personal computer or office automation applications, the new WORM disc allows the user to write to the laser disc one time, storing huge amounts of data for archival use. Thereafter, the information can be accessed but not changed.

New CD media are emerging virtually every week as competing companies jockey for position in this potentially explosive market. While many computer owners may not directly use laser printers and optical discs for several years, it's clear that the technology is advancing much faster than anyone had expected. With powerful new microprocessors, versatile operating systems, and laser-driven products growing more practical for business *and* home users, the personal computer system of 1990 is likely to be as different from today's as our present machines are from those used in the late 1970s.

Toshiba's new $3,499 PageLaser12 laser printer costs less than half the price of the first generation of laser printers in 1984–85, and prints at double their speed—up to 12 pages per minute.

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Selby Bateman, Features Editor

Microprocessors: Leapfrogging Ahead

The history of the personal computer is really based on the evolution of the microprocessor, a tiny central processing unit (CPU) that can perform arithmetic and logical operations to execute ordered sets of instructions—in other words, to run programs.

A microprocessor is the brains of a computer, little more than a fingernail-sized chip of silicon with an intricate grid of microscopic transistorized circuits. As its name implies, a microprocessor *processes* information within the computer by organizing the flow of electrical signals. The computer uses a binary code of ones and zeros that match the *on* and *off* states of electricity. Each on or off position is defined as a *binary digit*, or *bit*, of information.

Examples of microprocessors are the 6502-family chips found in the Apple II series and most Commodore and Atari computers; the 8088/8086 chips found in the IBM PC series and compatibles; the Z80 chips found in computers which run the CP/M operating system; the 68000 chips found in the Macintosh, Atari ST, and Amiga; and the 80286 chips found in IBM ATs and compatibles.

Each of these families of chips has, in its own way, contributed to the continuing development of personal computers. Now, however, new microprocessors have been announced that will give the next generation of computers the speed and power of today's mainframe computers.

A Burst Of Growth

The Intel Corporation brought out its successor to the 80286, the powerful 80386, causing a phenomenal amount of publicity within the microcomputer industry. Next, Motorola announced the successor to its 68020 chip, the 68030. Why all the interest over announcements in the continuing battle between Intel and Motorola? To understand the furor over these chips, and the promise that they both offer, it's helpful to first understand how each new generation of microchips has meant an exponential growth in power and speed.

In 1972, Intel developed the first functioning microprocessor, the 4004, which was widely used in a generation of multifunction handheld calculators. The 4004 was a four-bit microprocessor, which simply means that the chip was capable of handling four bits of information at a time. Shortly after that, Intel introduced the first eight-bit microprocessor, the 8008, followed by the 8080. That chip was used in the first hobbyist computer, the MITS Altair, which was distributed in a do-it-yourself kit.

Soon, other companies were involved in creating 8-bit microprocessors. For example, Zilog introduced the 8-bit Z80 chip which was used in a variety of personal computers. And MOS Technology brought forward its 6502 chip, the basis for many of the most popular 8-bit computers. These 8-bit microprocessors function in much the same way. All of them fetch, execute, and store data 8 bits at a time within pathways that are called *buses*. The width of these pathways determines whether a microprocessor is called a 4-bit, 8-bit, 16-bit, or a mixture of these.

When IBM introduced its PC computer in 1981, the company used Intel's 8088 chip (a descendant of the 8008), which is a *hybrid* microprocessor. That is, internal bus communications are handled 16 bits at a time while external bus communications are only handled 8 bits at a time. An 8/16 microprocessor, like the 8088, can access, or *address*, up to a megabyte of memory (1024K, or 1,048,576 bytes). By comparison, 8-bit computers address only 64K (64,536 bytes) of memory.

When Apple Computer introduced the Macintosh computer in 1983, that system was based on Motorola's 68000 microprocessor, a 16/32–bit hybrid chip capable of addressing up to 16 megabytes of memory (16,384K, or 16,777,220 bytes) at one time. Obviously, such exponential growth can mean a staggering improvement in the speed and power of a computer system. Today, the Atari ST and the Commodore Amiga also each use the 68000 chip.

Motorola announced in 1984 the creation of the next step in the 68000 family, the 68020 microprocessor, a true 32-bit supermicro chip that's been called "the mainframe on a chip." The chip has the equivalent of 200,000 transistors crowded onto its surface. It can address up to four *gigabytes* of memory (4,194,304K, or 4,294,967,296 bytes.) And, importantly, it is upwardly compatible with the earlier 68000 chips. So, future Macintosh, Amiga, and ST computers will be able to use the 68020.

Not to be outdone, Intel's 80286 appeared in the new-generation IBM PC-AT computers in 1985, and this past year the 80386 was created. This true 32-bit microprocessor is upwardly compatible with the earlier 8088- and 80286-based IBM and compatible computers. To keep the microprocessor race alive, Motorola has announced its next-generation candidate, the

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68030 chip, which should be ready for use this year.

The addressing capabilities of these new microprocessors are only one part of the story. The clock speed, or how fast a chip can run, has also continued to grow. For example, the 68030 can run up to 20 megahertz (MHz) clock speed. By comparison, the Commodore 64 runs at 1 MHz, the Atari ST runs at 8 MHz, and the 68020 chip can run at about 14 MHz. Intel's 80386 is capable of running more than ten times faster than today's computers.

Despite these amazing leaps forward, there are some roadblocks that will have to be overcome before these new microprocessors are capable of reaching their potential. The chief problem now is that the industry-standard MS-DOS operating system wasn't built to handle such super-fast hardware. It will take time for the operating system software to catch up to the Intel 80286 and 80386 chips. And then it will take time for applications software to really take advantage of the operating system and the hardware.

But in spite of the inevitable delays, the advances in microprocessor speed and power are driving personal computers to previously unheard-of levels of performance. And as hardware and software manufacturers race to the edge of technology, computer users will reap the benefits.

Tom R. Halfhill, Staff Editor

Operating Systems: Micros Grow Up

When talk turns to the latest trends in computing, new and exciting hardware usually gets most of the attention. But more people are beginning to recognize the importance of another part of the equation: the operating system. Without a suitable operating system, the most state-of-the-art hardware can seem to be ensnared in a strait jacket. This has become a particular concern in the IBM PC community, where hardware advances have outgrown the dominant operating system.

To begin with, exactly what *is* an operating system? Briefly, it's a program which performs or controls the routine tasks that are necessary for any computer to operate. A useful analogy is that of an operating system as an autonomous nervous system. If you had to consciously control such automatic bodily functions as your heartbeat, breathing, digestion, blood production, and so forth, you'd be so preoccupied with keeping yourself alive that there would be very little capacity left over for any other kind of thought or action. In effect, you'd be a plant.

Computers have a number of routine tasks that must be constantly performed in order to function, too. At any given moment, a computer may be scanning its keyboard for keypresses, displaying text or graphics on the screen, waiting for input from a mouse or joystick, communicating with peripherals, updating a realtime clock, and so on. The operating system is a program that takes care of these mundane jobs "in the background"—that is, invisibly. This makes it possible for you to run an application program—a word processor, a spreadsheet, a game, or whatever.

Another useful function performed by an operating system is that it saves application programmers the trouble of reinventing the wheel, so to speak. When a word processor needs to save a document on disk, for instance, it can simply call a subprogram within the operating system that transfers a block of memory to the disk drive. The word processing program itself doesn't have to include a subprogram for this purpose.

A *disk operating system* (DOS) is an extension of an operating system that provides commands for manipulating disk files. Usually there are commands for deleting, copying, and renaming files, as well as for performing many other functions.

A Parade Of Standards

Until the late 1970s, operating systems on microcomputers were so primitive as to be almost nonexistent. Then one fairly powerful operating system emerged as an early standard: CP/M (Control Program / Microcomputers). Designed by Digital Research for computers with the Z80 microprocessor chip, CP/M soon became very popular among small business users. Thousands of programs were written to run with CP/M and were compatible with nearly every CP/M computer.

In 1981, IBM introduced the PC—but without a standard DOS. PC users could choose from CP/M–86, a version of CP/M redesigned for the PC, or a newcomer from Microsoft called MS-DOS. A battle ensued, and when the smoke cleared, MS-DOS had won. Today, MS-DOS (or a slightly customized version for the PC, PC-DOS) is the dominant operating system among business users. All IBM PC and AT computers, plus dozens of PC compatibles and clones, use some version of MS-DOS. Programs properly written for MS-DOS should run on any MS-DOS computer.

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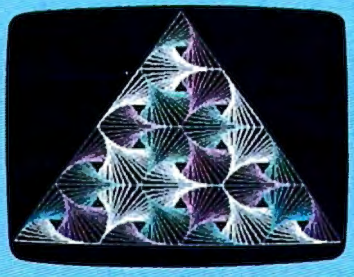

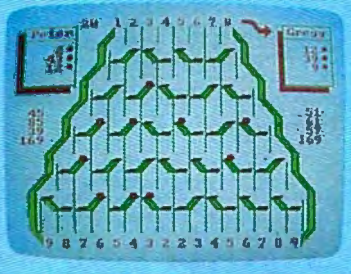

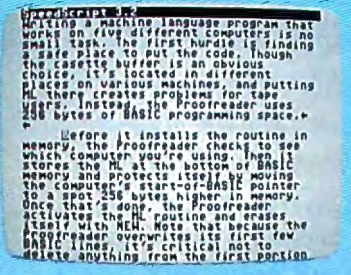

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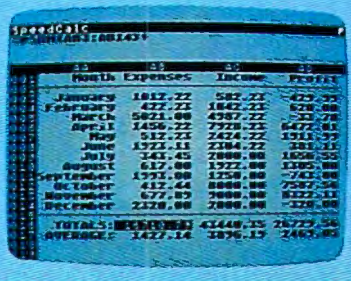

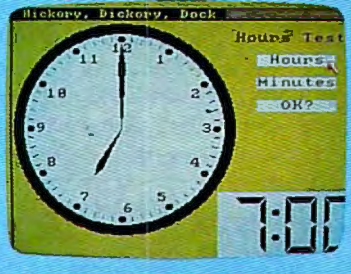

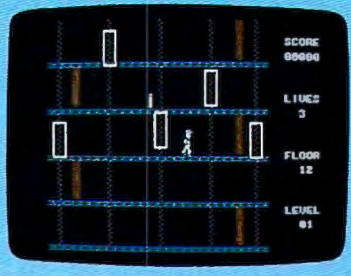

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computer are often called *proprietary* operating systems. A program written for a proprietary operating system generally won't work on any other brand of computer. Machines with proprietary operating systems include nearly all Apples, Ataris, and Commodores, although the Commodore 128 does have a Z80 chip for running CP/M, and hardware is available to convert Apple II and Atari eight-bit computers for use with CP/M. In the past year, software emulators have appeared which allow the Commodore Amiga to run some MS-DOS software, and the Atari ST to run CP/M software.

One of the latest trends in operating systems is the *shell* program. This is a further DOS extension that's intended to make the computer easier to learn and use. One example is Digital Research's *GEM* (Graphics Environment Manager), which is sold for IBM compatibles and is built into the Atari ST operating system. *GEM* is a graphics-oriented shell that lets you copy disk files by dragging them with a mouse between directory windows, delete files by dragging them to a trash-can icon, and so forth. The idea is to reduce the number of DOS commands that must be memorized and typed. Other shell-type programs include IBM's *Topview*, Microsoft's *Windows*, Quarterdeck Office Systems' *Desqview*, Berkeley Softworks' *GEOS* (Graphics Environment Operating System) for the Commodore 64, and the Amiga Workbench.

Sometimes a shell program fills a performance gap between rapidly advancing hardware and a lagging operating system. For instance, *Windows* and *Desqview* both permit some form of multitasking (the ability to run more than one application program simultaneously) on MS-DOS computers. MS-DOS itself wasn't designed with multitasking in mind. MS-DOS also limits system memory to 640K RAM. Five years ago, 640K seemed a reasonable limit; today, computers with a megabyte or more are becoming commonplace. In addition, MS-DOS has trouble handling multiple RAM-resident programs (sometimes called desk accessories), and it doesn't take full advantage of the faster processing speeds offered by the 80286 and 80386 chips now appearing in AT-compatible computers. New versions of MS-DOS which address these shortcomings are expected in 1987 and 1988.

What's to come? As microcomputers grow more powerful, the clear trend is toward operating systems which resemble those on high-end workstations, minicomputers, and mainframes. That means Bell Labs' UNIX is a strong contender in the near future, and it's likely that tomorrow's personal computers will be running operating systems such as MS-DOS as individual tasks under a multitasking UNIX umbrella. Proprietary operating systems such as the Atari ST's TOS and AmigaDOS also may end up within the UNIX shell. And the screens are almost sure to resemble those now found on high-end workstations: a resolution of about 1000 × 1000 pixels, with multiple windows and a graphics-oriented user interface.

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Tom R. Halfhill, Staff Editor

More Bytes Per Buck

One of the prime forces driving the microcomputer revolution of the past decade has been the exploding technology of memory chips. Every couple of years, memory capacity has been quadrupling while prices keep plunging.

Don't confuse *memory* chips with *microprocessor* chips. Memory chips are quite different. Although they share the same microelectronic technology as their microprocessor cousins, memory chips are designed to store—not process—information. One important kind of information they store is the set of program instructions which is executed by the microprocessor. A microprocessor has a tiny amount of memory of its own, but it depends on memory chips to hold the thousands of instructions required to run even the simplest program. When you load a program into a computer from disk or tape, you're copying these program instructions into the memory chips, where they can be quickly accessed by the microprocessor. Memory chips are also the temporary repository for information created with the program—the text you write with a word processor, for instance, or the numbers generated with a spreadsheet.

There are two general types of memory chips: random access memory (RAM) and read-only memory (ROM). RAM chips hold information only as long as electricity is supplied. When the power goes off, they forget everything. That's why you have to save your work on disk or tape before ending a session with a computer.

ROM chips, on the other hand, hold their information even when the computer is switched off. The data is permanently burned into the circuitry of the ROM chips and cannot be altered. That's why ROM chips are used to store information that the computer always needs—such as how to display characters and graphics on the screen, or how to transfer data from RAM chips to disk when you issue the appropriate command.

Better And Cheaper

The miracle of microcomputing is that RAM chips keep getting better and cheaper. In the late 1970s, you were considered lucky if your personal computer had as much as 16K of RAM. In the early 1980s, the new status symbol was 64K of RAM. This was the maximum amount of memory that could be directly addressed by most of the microprocessors then in use, such as the 6502 and Z80. Now, in the mid-1980s, most computers come with at least 128K or 256K of RAM, and machines with a megabyte (1024K) or more are becoming commonplace. Yet, today's one-megabyte computer may cost less than the 16K computer of ten years ago.

The reason is that engineers are continually finding ways of packing more microcircuitry into smaller and smaller spaces. Ten years ago, a typical RAM chip could hold four *kilobits* of data. A kilobit is 1024 bits. It takes 8 of these bits to make 1 *byte*—which is roughly equivalent to one character—and it takes 8 kilobits to make 1 kilobyte. Therefore, it takes 8 of these 4-kilobit chips to equal 4 *kilobytes* of memory, which is commonly abbreviated as 4K or 4KB.

By the late 1970s, 4K memory chips were supplanted by 16K memory chips. Eight of these chips provided 16K of RAM. In contrast, it would take 32 of the 4K chips to yield the same 16K of RAM. By increasing the memory capacity without increasing the chip count, engineers could build computers that were smaller, less expensive, less power-hungry, and more reliable than their predecessors.

In the early 1980s, the 16K chips were in turn superseded by 64K chips. Eight of these chips provided 64K of RAM. It would take 32 of the 16K chips or 128 of the 4K chips to provide the same 64K.

In the mid-1980s, 64K chips are now being phased out in favor of 256K chips. Again, the progress has been exponential. Eight 256K chips yield 256K of RAM, while the same 256K would require 32 of the 64K chips, or 128 of the 16K chips, or 512 of the 4K chips. If you tried to build a one-megabyte computer with the old 4K RAM technology, it would take a whopping 2048 memory chips—not to mention a power transformer the size of a concrete block and an air-conditioning unit, to keep the whole mess from melting itself down.

The next step is the one-megabit RAM chip. Only eight of these chips are needed to provide one megabyte of RAM, and they should start appearing at reasonable prices within a year or two. The one-megabit chip will make it possible for engineers to exhaust the capacity of microprocessors like the 68000, which can directly address up to 16 megabytes of memory. Beyond that are microprocessors such as the 68010, 68020, 68030, and 80386, which can address several *gigabytes* of RAM (a gigabyte equals 1024 megabytes).

Is there a limit to how much memory can be packed on a chip? Scientists may be getting fairly close. If circuits grow too dense, there is some fear that they'll be vulnerable to interference from cosmic rays. And there are weird effects that happen at subatomic levels, such as electron tunneling, which could cause electricity to "leak" from one circuit to another. But most scientists seem confident that we won't encounter any major roadblocks in the near future. And even if we do, there's always hope for the next technological breakthrough.

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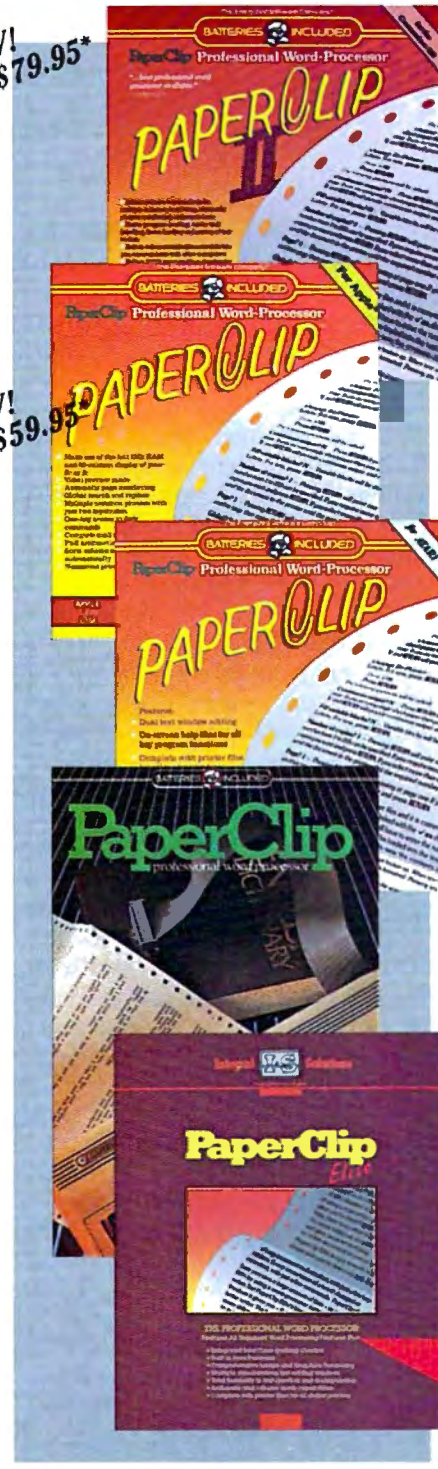

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Lasers That Read, Write, And Print

There was a time in the not-too-distant past when the word *laser* conjured up images of space-age weapons, colorful light shows, and little else. But today, lasers are grabbing the spotlight in fields ranging from delicate eye surgery to the very popular audio compact disc (CD) players that are rivaling standard vinyl records.

Lasers (Light Amplification by Stimulated Emission of Radioactivity) are also red-hot items in the microcomputer marketplace, chiefly in two areas: laser printers and digital compact discs for data storage, sometimes called CD-ROM (Read-Only Memory) or CD-I (Interactive). Although neither of these technologies has yet reached the price/performance point to enter the home computer market, advancing technology and decreasing prices indicate that it's just a matter of time.

A laser printer shares some of the same technology that's found in the typical office photocopy machine. But instead of using a light-reflecting mechanism to form patterns on a rotating cylindrical drum, the laser actually writes on the drum. The image on the drum is then fused onto the paper using electrically charged particles.

A laser printer is a page printer—forming one page at a time—closer to a photocopy machine than dot-matrix and daisywheel printers that form parts of the page or individual characters in different stages. The crispness and clarity of the new laser printers has given rise to the quickly growing field of desktop publishing, or personal publishing. With a computer, a laser printer, and the appropriate software, a computer user can turn out printed pages that rival typeset quality.

Laser printers have already begun to drop in price in just the past two years. While advanced laser printers, capable of printing both text and graphics, still cost at least several thousand dollars, some text-only laser printers are now available for just under $2,000. While still in their infancy, laser printers are advancing so rapidly that some observers believe they may supplant daisywheel printers completely in the future.

CD Technology

Even more in its infancy is the laser-driven compact disc (CD) technology that has been emerging, first with audio and now with computer data. The basics of CD technology are the same, whether it's in audio or simply digital information. A low-power laser beam reads microscopic pits that have been burned into a disc. The pits, which represent the digital ones and zeros that the computer can process, contain encoded data. When connected with a computer and the appropriate software, the compact disc offers a unique combination of massive data storage and instantaneous access.

The first generation of compact discs used with computers, called CD-ROMs, each hold 550 megabytes of information. That would be the equivalent of almost 4000 Apple II disks and about 1500 IBM PC disks. All of that data is packed onto a small plastic disc less than five inches across. In fact, the text of an entire set of encyclopedias can be placed on a CD-ROM disc, taking up less than a third of the space. Sophisticated cross-referencing and indexing of topics can also be placed on the disc.

This specialized CD format is all-text, but a number of companies are already working on more interactive forms of CD technology. CD players, or viewers, are being developed that will serve as both audio and computer-peripheral players. And at the cutting edge of CD technology is CD-I (Interactive), which holds out the promise that future disc players will be able to reproduce high-quality video and audio as well as text.

For example, imagine being able to turn on a CD-I player in your home and take a self-guided tour of parts of San Francisco or New York City or Williamsburg. All of the sights and sounds of those locations would be captured, and you would be able to decide where you wanted to go and what you wanted to see step by step.

The search-and-delivery speed of the laser, plus the massive storage capacity of future CD-I players, will offer an amazing amount of digital information to be manipulated in a variety of ways. And since CD-I system specifications require that the new players "piggyback" on the current success of CD audio, users will be able to play existing audio CDs on the CD-I units.

Also being developed are *writable* CDs, those that allow the user to store new information on a compact disc just as a computer user today can store information magnetically on floppy disks or in hard disk drives. Until recently, CDs were written to only when they were created at the factory. No further modification of the information was possible. But now, with WORM (Write Once, Read Many) technology and similar experiments, reusable CDs are becoming a possibility for the future. C

The time: 1400 hours. Somewhere in the Pacific. Some ill-fated coordinates in World War II.

Damage Control reports a hit on the starboard side. Send in Alpha, Baker and Charlie to repair.

eyeball to eyeball action. This time around you'll be right in the middle of it all. You knew it wouldn't be pretty.

But how tough could it be to rescue a downed pilot?

Will it be the twin 40mm Bofors anti-aircraft guns? Or the 5" lead-spewers aft? Depth charges or torpedoes? Autopilot or guts?

LIFE, LIBERTY AND THE HAPPINESS OF PURSUIT.

Radar spots inbound Zeroes. Ready forward gunnery positions. Man the anti-aircraft turrets. They're coming.

You're at the helm, commanding the greatest concentration of firepower ever put in a lightweight fighter. The deadly Fletcher Class Destroyer.

You've embarked on the first simulation that actually combines the intricate, large-scale strategy of wargaming with the intensity of furious,

It sure seemed a lot easier than shelling islands, escorting a convoy or hunting subs.

Or so you thought. But now look what you've got. Thirteen fully-operational, ear-bursting battle stations to worry about, all armed to the gills. Not to mention radar. Navigation. Sonar.

And half the Japanese fleet crawling up your spine.

Time to make some tactical decisions.

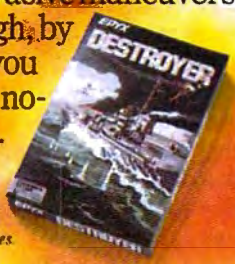
YOU'VE ALWAYS DREAMED OF BEAUTIFUL MODELS. Now you can pick up an entire assault fleet, including a replica Fletcher Class Destroyer, from Revell. Or win an authentic scrambled eggs *flight deck cap. Sweepstakes details are in every box, or write for an entry coupon. No purchase necessary. Sweepstakes ends June 15, 1987. Official rules are available at participating dealers.*

Any choice could be your last, so make it good.

Suddenly, you hear the ominous rumble of incoming Zeroes. You fire, and send one plummeting to the sea, trailing a plume of smoke.

On instinct, you instruct the bridge to commence evasive maneuvers.

Even though, by experience, you know there's nowhere to run.



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Microscope

Sheldon Leemon

The new Apple IIGS is close in price to both existing Apple computer lines. At $995 without a monitor or disk drive, it's only a little more expensive than the IIc and IIe and a little less so than the 512K Macintosh. Before the IIGS came out, many industry analysts were suggesting that its introduction would mean drastic price cuts in the current Apple II line, perhaps causing Apple to start selling them through mass-market distribution channels. Discussing why that hasn't happened may shed some light on the current state of the microcomputer market.

For one thing, it no longer seems inevitable that computer prices will always keep going down. When Commodore brought out the 64C, effectively raising the price of the Commodore 64 for the first time since its introduction, that signaled that the home computer wars were really over. Undoubtedly, one of the reasons the survivors seem less enthusiastic about price cutting is that there is no longer much room for prices to go down. But another factor may be that consumers don't now seem to have the same thirst for ever-lower prices. Now that many have gotten their feet wet with low-cost computers, they've learned some important lessons. They've learned that in order to make a cheap computer do everything you want it to do, you've got to buy some not-so-cheap peripherals. By the time you've bought a monitor, printer, disk drives, and software, the price of the computer itself has become a lot less important. They've also learned that while a bare-bones system will get the job done, spending a little more money can save a lot of time and inconvenience.

Experience has made computer buyers more solution-oriented. They know that while newer computers may offer more performance, they often have less software than the older, established models. So, though the Apple II is ancient in comparison to the less expensive Atari ST, there are many people who prefer to buy the Apple simply because they know it has loads of available software. Even the Commodore 64 has developed such a following that people continue to buy it despite its close pricing to more advanced machines like Commodore's own 128.

Of course, market forces and the desires of the consumer aren't the only factors that control computer pricing. There are very good reasons why a computer manufacturer offers different types of computers which appear to compete with each other in price. For one thing, the relatively high price of the GS makes the low-end Macintosh look like a bargain by comparison. A lot of current Apple II owners are going to think "Why buy a IIGS when I can get a Mac for the same money?" This is probably just what Apple wants, since a customer starting at the low end of the Mac line will eventually spend more than the customer who has reached the end of the Apple II line. And no matter how heroic an effort manufacturers make, at some point 8-bit computers will be truly dead. This provides additional incentive to move as many current customers as possible up to the 16-bit lines. Apple is not the only company using this strategy. The lowest-priced Atari 520 ST system with monochrome monitor ($500–$600 on sale) is not much more than a high-end 130XE system (about $400 with monitor and drive). And Commodore is expected to soon introduce a low-end Amiga that should be priced similarly to a 128 system.

****

Atari once again had the most crowded booth at the November COMDEX (Computer Dealers' Exposition). The only piece of new hardware shown by Atari was a 1200-bps modem for $99, but its display of third-party software, including some very inexpensive desktop publishing ST software, packed them in for the entire show. Though no new ST models were on display, there were rumors of a reconfigured 1040 for the business market. This machine would be introduced to support the efforts of the newly announced Fortune 500/OEM department, which will be headed by former software chief Sig Hartmann. In addition to a new blitter chip and ROMs and an expansion bus that gives access to the 68000 processor, the cosmetic appearance of the machine has been improved by a detached keyboard and modular, stackable CPU.

****

Rumors persist that Commodore is going to downplay or even quietly drop the 128 after Christmas. Although the machine has sold fairly well in its first year it hasn't replaced the 64 in the hearts of the computer-buying public. More importantly, Commodore isn't making nearly as big a profit margin on the 128 as it is on the 64C. And apparently, making the 128 compatible with the 64 wasn't enough for some owners, who wanted the expanded features of the machine to be compatible with the 64 as well. These people will get their wish in the form of a $150 256K RAM expansion for the 64 that will be introduced soon. If that proves to be popular, you may see the C256, a 64 with 256K RAM expansion built-in. And 1987 may be the year that frees 64 owners of the horrendous 1541 disk drive. Expect to see the 1581, a 3½-inch drive, appear sometime early in '87 at a price somewhere between that of the 1541 and the 1571. C

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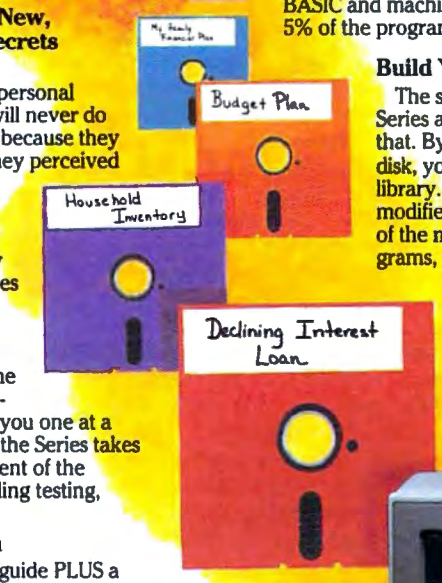

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Readers Feedback

The Editors and Readers of COMPUTE!

If you have any questions, comments, or suggestions you would like to see addressed in this column, write to "Readers' Feedback," COMPUTE!, P.O. Box 5406, Greensboro, NC 27403. Due to the volume of mail we receive, we regret that we cannot provide personal answers to technical questions.

Time For BASIC

When using my Commodore 64 I have found that the variable TI changes to a higher number each time I print its value. When I type TI=0 and press RETURN, I get a syntax error. What does TI have to do with my computer? Have I discovered some sort of bug?

Tim Hamel

Your question pertains to a Commodore computer, but the answer applies to almost all home computers. In Commodore BASIC, TI stands for time; *it is a* reserved variable, *one that BASIC sets aside for a special, limited purpose. The related variable TI$ is also reserved. Together, these variables let you read the value of the 64's internal clock or reset it to a new value. It's a bit misleading to call TI and TI$ variables, since they're not stored in memory along with the "real" variables. However, they behave like variables in the sense that you can discover the values assigned to them and, in some cases, assign new values.*

Let's look at how timer variables work on various computers, beginning with Commodore. When you use TI in a Commodore BASIC statement, TI equals the number of jiffies *(1/60-second units) that have elapsed since the computer's internal clock was reset. Like many personal computers, the 64 has an internal clock that's updated every 1/60 second. Turning the computer on sets the clock to 0 automatically.*

As you have discovered, you cannot assign a new value to TI—it's a read-only variable. *To change the time, you must use the related variable TI$. Whereas TI returns a numeric value, TI$ returns a six-character string which represents the time in hours/minutes/seconds format instead of in jiffies. Unlike TI, TI$ can be assigned a new value. Type and run this program to see TI$ in operation:*

```
10 TI$="000000"
20 PRINT TI$:GOTO 20
```

The first two digits represent hours, the second two show the minutes, and the last two show the seconds. For Commodore computers, this statement prints the time in more readable form:

```
T$=TI$:PRINT LEFT$(T$,2) ":" M
   ID$(T$,3,2) ":" RIGHT$(T$,2
   )
```

The clock is maintained at addresses 160–162 in the Commodore 64, 128, and VIC-20. PEEKing or POKEing those locations has the same effect as reading or resetting the clock with TI or TI$. Though the internal clock is accurate enough for most normal applications, it doesn't keep perfect time (interrupts don't happen at exactly 1/60-second intervals except in the 128). The time can be off by as much as a couple of minutes a day and may vary slightly from one computer to the next as well as in different countries. Because tape operations change the computer's interrupt rate, they disrupt the clock drastically.

IBM BASICA for the PC and Cartridge BASIC for the PCjr provide timer functions with the reserved variables TIMER and TIME$. TIMER returns the number of seconds which have elapsed since the computer was turned on or reset. Like TI in Commodore BASIC, TIMER can be read but not reassigned. (T=TIMER is a legal statement, but TIMER=0 is not.) When you use TIME$ to display the time, BASICA automatically prints colons (:) between the hours, minutes, and seconds values to make them more readable. You must also separate the values with colons when resetting the clock with TIME$.

Amiga BASIC also provides TIMER and TIME$, which work much like their counterparts in IBM BASIC. However, you cannot reset the clock from BASIC by assigning TIME$ a new value. This is consistent with the Amiga's multitasking operating system, which maintains a single clock for all applications. Since the computer might be running more than one application at any given time, it's not desirable to allow one application (BASIC, in this case) to reset the clock arbitrarily.

Amiga BASIC and IBM BASICA and Cartridge BASIC also provide an ON TIMER GOSUB statement which allows you to monitor the timer in the background (while other BASIC statements are being executed) and branch to a specified subroutine when a certain time period has elapsed. The period is specified in seconds, in the range 1–86400 (86400 seconds equal 24 hours).

Atari ST BASIC has no timer functions. Eight-bit Atari computers lack BASIC timer functions but they maintain an internal jiffy clock which you can access with PEEKs and POKEs. The clock is found in locations 18–20. This program demonstrates the Atari BASIC timer:

```
10 FOR J=18 TO 20:POKE J,0:NEX
   T J
20 T = INT((PEEK(18)*65536+PEE
   K(19)*256+PEEK(20))/60)
30 PRINT T:GOTO 20
```

Apple II computers (excluding the IIGS) have no BASIC timer functions or internal clock.

Your version of BASIC may have other reserved variables. For example, Commodore BASIC 2.0 (used in the Commodore 64) also provides ST, a status indicator for input/output operations. In addition to ST, BASIC 7.0 for the Commodore 128 adds DS and DS$, disk status indicators, and ER and EL, BASIC error status indicators. IBM and Amiga BASICs provide ERR and ERL, BASIC error indicators, and DATE$, which functions for the date as TIME$ does for time. Refer to your BASIC manual for more information on reserved variables.

Monochrome In ST BASIC

I own an Atari 520ST with a monochrome monitor. When you publish programs designed to run in low or medium resolution on a color monitor, I have difficulty converting them to work in monochrome. I bought a book about ST BASIC, but it does not explain what I need to know.

Thomas S. Despain

Anyone converting an ST BASIC program from color to monochrome faces two basic problems: screen size and colors. Figures 1–3 illustrate the effect of running the following program in low, medium, and high resolution.

```
10      fullw 2:clearw 2
20      linef 0,0,303,166
30      gotoxy 15,8
40      print "hi"
50      x=inp(2)
```

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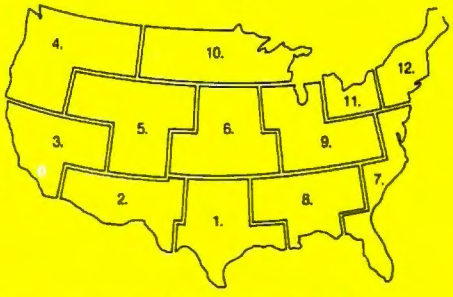

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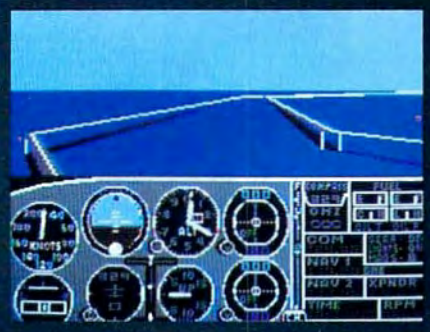


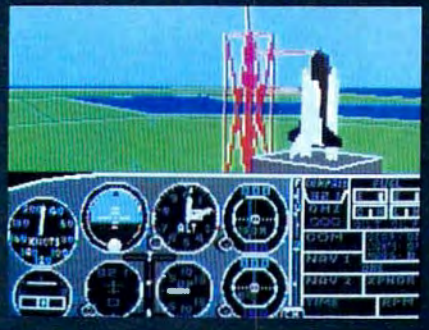


Figure 1. Low Resolution

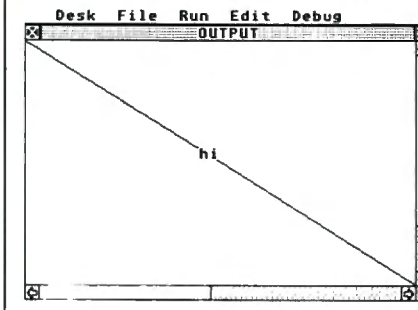


Figure 2. Medium Resolution

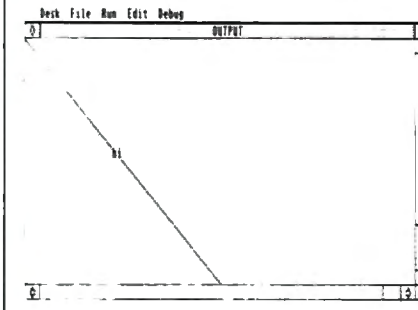
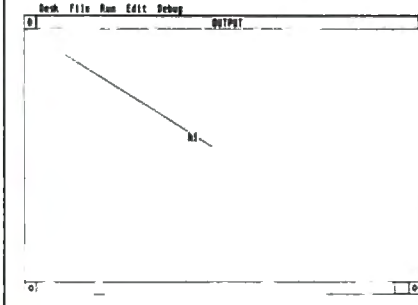


Figure 3. High Resolution



Notice the difference in screen output. The difference in the line's position derives from the fact that the three screens contain different numbers of pixels. LINEF draws to the same endpoint in every case, but since the three screens are different sizes, the endpoint is in different positions relative to the total screen area. The same is true of other graphics commands that rely on screen coordinates. Thus, if you run a lo-res program in high resolution, the graphics appear in the upper left quadrant of the screen. If you run a medium-res program in hi-res, the graphics appear in the upper half of the screen. By adjusting the coordinates used in LINEF and other graphics commands, you can eliminate such distortions.

Text output may also require adjustment when you change resolution. The ST uses the same 8 × 8 character font in both lo res and medium res. In medium resolution, you have twice as many columns as in low resolution. But the number of rows is not doubled when you go from medium to high resolution. Instead, the ST automatically switches to a double-height (8 × 16) character font. Although the screen

contains twice as many vertical pixels in this resolution, it has the same number of character rows because each character is twice as high.

The ideal, at least for programs that aren't wholly color-dependent, would be for everyone to write programs that automatically adjust screen output for any resolution. You can easily discover the current resolution with the statement PEEK(SYSTAB), which returns the values 1, 2, and 4 in low, medium, and high resolution, respectively. Once it has determined the resolution, a program can adjust graphics and text output to fit. (Here's a hint for positioning text: Although you wouldn't expect it to do so, GOTOXY accepts fractional values, allowing you to put characters in positions that overlap normal row and column locations.)

Color presents a stickier problem for conversion, since colors that look different in low or medium resolution often look identical in hi res, where the computer displays only black and white. One solution is to replace colors with different fill patterns for high resolution. This program displays all the built-in patterns, which are selected by the last two parameters in the COLOR statement.

```
100    fullw 2:for j=2 to 3:for
       k=1 to 24
110    color 1,1,1,k,j:clearw 2:
       gotoxy 2,3
120    if j=2 then print "Patter
       n";: else print "Hatch";
130    print k:circle 150,80,50
140    if j=3 and k=12 then k=24
150    fill 150,80:next:next
```

Amiga Knows IBM BASICA

I own an Amiga computer and I am very happy to see you publishing type-in programs that even beginners can use. But do you have a program like "ST Softball Statistics" (COMPUTE!, August 1986) for the Amiga? I keep track of statistics for several softball teams. I nearly fell over when I saw that program, since it's exactly what I need.

Michael P. Schmidt

"Softball Statistics" originally appeared in the July 1985 issue of COMPUTE!, *in versions for several computers. The program was written in generic Microsoft BASIC to simplify the task of translating it to different machines. The ST translation of this program is based on the Microsoft version, but many changes were needed to make it run in ST BASIC, which differs from Microsoft BASIC in a variety of ways.*

We suggest that, rather than convert the ST program, you obtain the July 1985 issue of COMPUTE! *and type in the IBM PC/PCjr version of "Softball Statistics." Amiga BASIC is essentially a superset of IBM BASICA: It contains virtually every-*

thing in BASICA plus additional commands to take advantage of unique Amiga features. Only one line in the IBM program appears to need modification. Replace line 90 with this line:

90 WIDTH (WINDOW(2)/8)

The reason you can't use the statement WIDTH 80 is that Amiga BASIC does not allow a full 80-column window (BASIC doesn't permit a completely borderless window, and the border always takes up a few pixels). To determine the number of characters that will fit in the window, we use WINDOW(2) to find the number of current pixels in the current window and divide by 8. WIDTH ignores any fractional component in the result.

Original Amiga programs are usually written without line numbers, but Amiga BASIC permits line numbers as an option (a line number is treated as a label). This makes it quite easy to translate programs that were originally written for some other machine with Microsoft BASIC. After you have typed in and saved the program, you may wish to eliminate superfluous line numbers or replace all referenced line numbers with meaningful labels. The latter procedure is quite simple if you have a word processor such as Textcraft *with search-and-replace capabilities. If you save the program as an ASCII file from BASIC (add ,A to a normal SAVE command), the word processor can load it for editing like any other ASCII text file.*

When using a word processor to replace line numbers with labels, you should do one replacement at a time to avoid replacing numbers used as constants. For instance, if you're replacing the line number 100 with the label MAIN:, you do want to replace the 100 in statements like GOTO 100, but you don't want to replace the 100 embedded in statements like M=X/1000. (The result in this case would be the nonsense statement M=X/MAIN:0.) When you've finished editing the file with the word processor, be sure to save it as a plain ASCII file so that BASIC can load it correctly.

Atari CX21 Keypad

I have an Atari 800XL. Can you tell me how to read the keypad controller (CX21)? Neither the STICK or PADDLE functions seem to follow the button presses.

Bob Klemenc

There are a multitude of input devices for the controller ports of Atari eight-bit computers. We know of video tablets, joysticks, paddles, light pens, trackballs, a mouse, and two keypads. Some companies even sell modems and printers which interface through these ports.

Of the two keypads available, the CX85 is the more serious. It's a full-size keypad complete with cursor keys and its own ENTER key. This keypad is suitable for data entry in spreadsheets and similar programs. It comes with software in the form of an AUTORUN.SYS file which makes the new keys appear to be keys on the keyboard.

The other keypad, the CX21, was originally designed for the Atari 2600 VCS game system. Although the CX21 was marketed as a game controller for the Atari 800 computer, to our knowledge no commercial software has used this device. Here is an example program to read the CX21 key pad; it's adapted from an example in the original Atari BASIC manual.

```
1 GRAPHICS 0
10 DIM ROW(3),I$(13),BUTT
   ON$(1)
30 GOSUB 6000
60 POSITION 2,7:PRINT "CO
   NTROLLER # 1:";
80 GOSUB 7000:POSITION 19
   ,7:PRINT BUTTON$;
120 GOTO 80
6000 REM
6010 POKE 54018,48:POKE 5
     4016,255:POKE 54018,
     52:POKE 54016,221
6030 ROW(0)=238:ROW(1)=22
     1:ROW(2)=187:ROW(3)=
     119
6040 I$=" 123456789:0#"
6050 RETURN
7000 PORT=54016
7010 P=1:PAD=0
7020 FOR J=0 TO 3
7030 POKE PORT,ROW(J)
7040 FOR I=1 TO 10:NEXT I
7050 IF PADDLE(PAD+1)>10
     THEN P=J+J+J+2:GOTO
     7090
7060 IF PADDLE(PAD)>10 TH
     EN P=J+J+J+3:GOTO 70
     90
7070 IF STRIG(0)=0 THEN P
     =J+J+J+4:GOTO 7090
7080 NEXT J
7090 BUTTON$=I$(P,P)
7100 RETURN
```

Interrupts And *De Re Atari*

We are writing a game for the Atari 800 and we intend to use vertical and horizontal blank interrupt routines for a hires arcade sequence with extensive keyboard input. However, we heard that the keyboard click routine messes up the VBI. How is the keyboard click turned off? We have found several references to a book called *De Re Atari* which supposedly addresses this problem and several others. We can't find it and we don't know who published it. Can you help?

Richard Power
Timothy Power
David Lanphear

First, a bit of explanation. Vertical blank routines and horizontal blank routines have some important differences. Since the electron beam which displays graphics moves more quickly across the screen than it does down the screen, a horizontal blank interrupt routine is shorter and more sensitive to time variations than a vertical blank interrupt routine is. Thus, keyboard clicks (which time their sound by waiting for horizontal syncs) throw off horizontal blank interrupts but they do not disrupt vertical blank interrupts, or VBIs. If you can manage with only using VBIs, you don't have to worry about this problem.

It's only the key-click sound, not the keypress itself, which disrupts the horizontal blank interrupt. One solution is to avoid the keyboard handler and read the keys with PEEK. Location 764 ($2FC) holds the value of the last key pressed. The value in 764 is a keyscan code which differs from both screen codes and ATASCII codes. POKE 764,255 to clear this location.

The book De Re Atari *was published by Atari; it was written by the Software Development Support Group, which included Chris Crawford, Lane Winner, Jim Cox, Amy Chen, Jim Dunion, Kathleen Pitta, Bob Fraser, and Gus Makreas. This book appears to be out of print and is no longer sold by Atari. However, at the time of this writing (November, 1986) we confirmed that copies are still available for $9.95 from San Jose Computer, 1844 Almaden Road, Unit E, San Jose, CA 95125. This company states that they have many copies left, but you may want to call first before you order one. The phone number is (408) 723-2025.* ©

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ACTIVISION
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Shanghai

Ervin Bobo

Requirements: Apple II-series, Commodore 64 and Amiga, Atari ST, IBM PC/PCjr and compatible, Macintosh, and Tandy 1000-series computers.

When Activision previewed *Shanghai* at a private gathering, I was initially not impressed with what I saw.

And when my wife looked over my shoulder as I was trying out the game on my Commodore 64, she expressed the same feelings. (Though I must admit she is more easily "underwhelmed" than I.) Before too many minutes had gone by, she was helping to solve the puzzle, and we were both hooked.

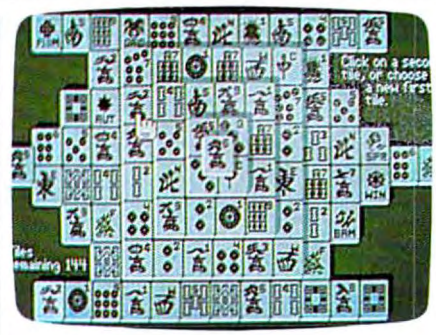
Two days later, I found the Amiga version and we were both overwhelmed. Then the children were similarly affected. As of this writing, our *Shanghai* mania is of such proportions that I am beginning to fear for our health.

For those of you who may know nothing of mah-jongg, from which this computer game is derived, it's an ancient Chinese pastime that is part game, part puzzle, and all challenge. It's played with a number of pieces called tiles, which are stacked in the shape of a dragon. As with playing cards, there are several suits, and within these suits are numbers. To play the game, you remove matching tiles, one pair at a time, until all are gone or until no more matches can be made. On the face of it, that sounds rather simple. It is not.

Because there are four of each tile, the game holds elements of strategy. If, for instance, you have the East, West, and South Wind tiles free, which two will you remove on this turn? In a game of Solitaire, you'd want to remove the two that are blocking the most other tiles, while in Challenge play, against another opponent, your strategy would be the opposite.

An Advantage In Perspective

In *Shanghai*, there are 144 tiles in five suits. At the beginning of each game, the computer stacks these tiles in a random fashion. Because your view is from above the stack, it won't look like a dragon, but it will give you an advantage over those who use real tiles in mah-jongg, for you can see all sides of the stack at once. Tiles can be removed only when they are at the sides of the stack. When bordered on both sides by other tiles that are on the same level, the tiles are not "free" and thus cannot be moved.



The Amiga version of Shanghai *from Activision.*

Because you would be viewing a stack of small objects from above and because your success in the game would be dependent upon the status of the different stack levels, it was necessary to give the playing screen an illusion of depth. On the Amiga, this illusion is astounding. Not only do the "ivory" tiles have yellowed edges to help in differentiating them; they also cast transparent shadows.

And because it is important to identify matching tiles, the designs and the (presumably) Chinese characters as well as the numbers on each tile are done to a sharp perfection. You'll especially appreciate the attention to detail when you're racing against the clock in tournament play.

[Ed. Note: The clarity and visual depth vary from one computer version to another. For example, the Amiga, ST, and Macintosh versions offer greater clarity than the Commodore 64 and Apple II versions.]

Game Choices

Pull-down menus at the top of the screen give you choices between games of Solitaire, Tournaments, Team Play, and Challenge. Solitaire and Team Play are the same game, the difference being that in Team Play turns are passed from one team to another and a different strategy will be involved; in either of them, you have an unlimited amount of time in which to attempt to clear the board, and the number of tiles remaining is displayed at lower left of the screen. Should you get hopelessly stuck, one of the pull-down menus allows you a request to See All Moves. Select it and the next matching pair is illuminated—or, alternatively, you are told that there are no more matches.

Tournaments allows you to race against a clock that you set for 5, 10, or 20 minutes. Scores are on the basis of the number of tiles removed during that time. To keep you apprised of the time—or the lack of it—a digital clock appears at the lower right of the screen, and when a minute is ticked off you'll hear the sound of a faraway gong. As might be expected, no hints are available for the Tournament mode.

Your score for this is stored on the master disk and there are two tournaments that can be played again and again—giving you the same arrangement of tiles each time—just in case you wish to try to beat your best score. Perhaps it should be noted here that not all arrangements of the tiles can be solved and, in keeping with the puzzle aspect of the game, you have no clues as to whether the two tournaments are insoluble.

Should you begin to have doubts, however, it is also possible to play in tournaments where each game can be a new and random arrangement. Since the possibilities here are endless, scores are not written to the disk—unless you elect to play the same arrangement again.

In Challenge Play, each player is given a timed turn, during which he or she is to remove a pair of tiles. If none are found, play reverts to the challenger and the same rules apply. This form of play will support the use of two mice, and you may find that easier than passing one mouse back and forth.

To remove tiles, place the hand-shaped cursor on the first of the pair and click once; then move to the second tile and double-click. If your move is

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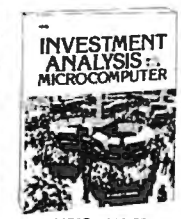

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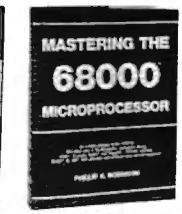

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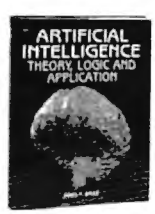

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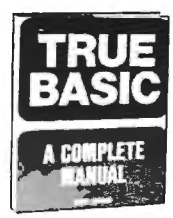

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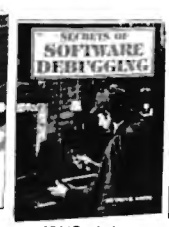

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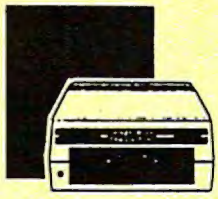

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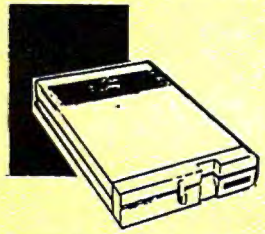

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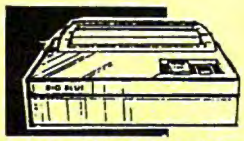

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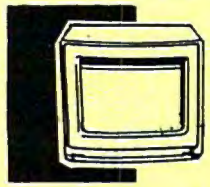

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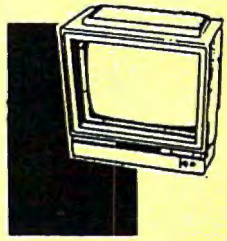

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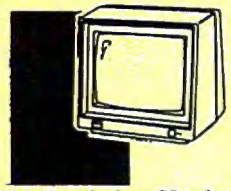

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legal, both tiles disappear and reveal the tiles below them. If the move is illegal because a tile is not free, a polite message informs you of that fact.

Documentation for *Shanghai* is contained on the disk, with the rules for the four game variations as well as the overall strategy being presented in the form of what looks like very old parchment manuscripts. Having the rules so close at hand is a nicety—not really necessary, for the rules are simple and easy to remember. That they have been done up in such fine style when they might have been fluffed off is another tribute to the computer craftsmanship that has gone into the making of this version. As a devoted player of mahjongg might cherish a set of finely engraved ivory tiles, so we who deal with computers can appreciate the craft of *Shanghai*.

As it turns out, there are good reasons why this game has survived the centuries and why it seems to crop up anew with each new generation: It is a good game—simple to play, difficult to master, and providing endless challenge. In its current incarnation as a computer game, it remains just as challenging and just as much fun.

Shanghai
Activision
2350 Bayshore Frontage Rd.
Mountain View, CA 94043
$44.95 Macintosh, Atari ST, Amiga versions
$39.95 IBM, Tandy, Apple II versions
$34.95 Commodore 64 version

OGRE

James V. Trunzo

Requirements: Apple II-series computers (with a 64K minimum of memory) and Commodore 64 computer; Atari eight-bit and ST versions should be available by publication date of this issue.

One definition for the term *ogre*, found in my trusty old *Webster's*, is "a dreaded person or object: someone or something very difficult to cope with." In reference to a new release from Origins software, titled *OGRE*, both definitions fit. In this case the Ogre is a cybernetic tank devised to be the ultimate weapon of destruction and, indeed, it is both dreaded and difficult to cope with.

If the title of this game sounds familiar to some of you, it should. Before the advent of the personal computer, board games were the gamer's medium, and within this genre there was the minigame: a game whose scope was confined and which could be played in a relatively short span of time. Steve Jackson developed a number of very entertaining and very involved minigames, one of which was titled OGRE. That same minigame has now made the transition from paper map and cardboard counters to hi-res graphics and pull-down windows. And very successfully, I might add.

The goal of *OGRE* is simple, regardless of which side you play. If you command the Ogre Mark III or the superior Ogre Mark IV, you have two objectives: Your primary goal is to destroy the opposition's command post; your secondary goal is to eradicate all enemy units. If you command the various tanks, GEVs (Ground Effective Vehicles), howitzers, and infantry that comprise the forces that must oppose the cybertanks, your primary goal is to protect the command post and, failing that, prevent the Mark III or Mark IV from exiting the combat area. In both cases, achieving your objective means destroying the Ogre.

The factors that made OGRE, the board game, so popular are exactly the same ones that make *OGRE*, the computer game, an excellent product. *OGRE* allows the player to focus on a single objective while providing either side with numerous ways of reaching or preventing that objective, depending on the player's perspective.

Different Strategies

Playing the Ogre presents the player with a choice of approaches as the Ogre battles its way inexorably up the battlefield. Using its massive armament (it has numerous weapons, ranging from antipersonnel guns to long-range missiles—it wasn't nicknamed Ogre because it was cute), the cybertank can seek and destroy, attempting to eliminate all units opposing it first, and then proceeding, unimpeded, toward the defenseless command post. The Ogre player can, however, select an alternative plan, employing the Ogre's massive speed and ability to take punishment, and strike out single-mindedly for the command post, confronting only those units that it cannot initially avoid.

Opponents of these futuristic tanks can also choose their poison. Depending on the make-up of their forces, those protecting the command post might wish to use guerilla tactics, harassing the Ogre with hit-and-run attacks—or they might elect to amass all their most powerful armor up front and fight a battle of attrition. In any case, opponents of the Ogre must decide whether to concentrate on attacking the tank's treads in order to slow its movement or whether to concentrate on knocking out its long-range weapons. One hint: Like the pawn in chess, the seemingly weak and unimportant infantry are essential to the destruction of the Ogre. Also like the pawn, the infantry units must often be sacrificed for the good of the cause.

Tactics and strategy aside, *OGRE* is a fascinating piece of work simply due to the mechanics employed in the game's play. Using what is rapidly becoming standard operating procedure, *OGRE* employs liberal use of pull-down windows, "dragging," and clicking—terms usually associated with the Macintosh. These techniques and all other commands can be implemented by using a joystick, mouse, or keyboard. The fact that a joystick can be used as easily as a mouse to move pieces or issue attack orders speaks for itself when you analyze the programming ability that went into *OGRE*'s design.

The game is further enhanced by its ability to design its own scenarios. While many options are automatically included, like the opportunity to select a pre-made battlefield using pre-made forces, or to select a particular skill level, thus altering the depth of the artificial-intelligence routines of the computer opponent, the built-in editor allows the user to create his or her own terrain and force to oppose the Ogre. The simplicity with which this can be accomplished is directly attributed to the use of the aforementioned techniques of dragging and clicking. Place the cursor on a crater and drag it into a new position. Click it permanently into place. That's all there is to it. Of course, customized battlefields and forces can be saved to disk for future use.

OGRE faithfully recreates its board-game predecessor and offers game players an exciting, quick-playing challenge. Its use of Macintosh-style techniques enriches an already excellent game and makes this product a standout among current arcade/strategy war games.

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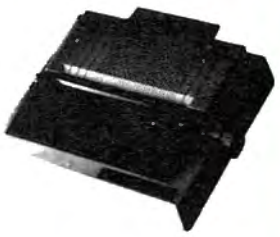

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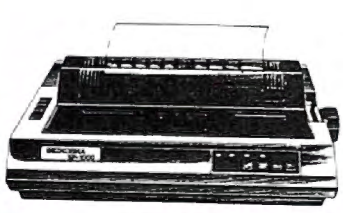

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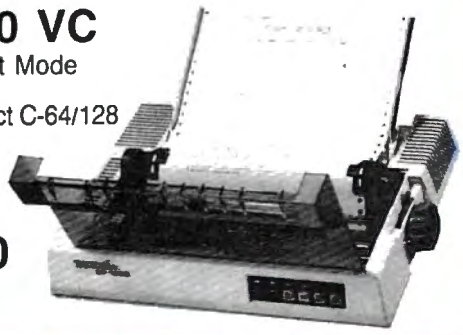

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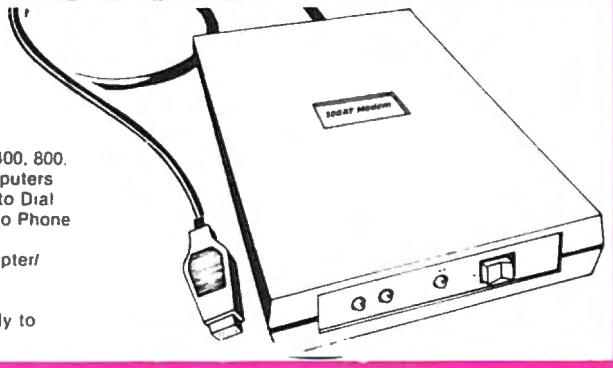

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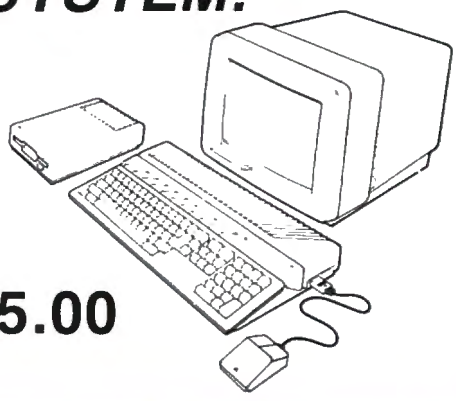

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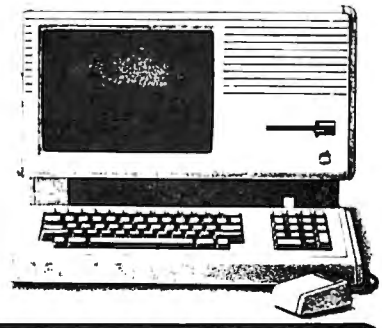

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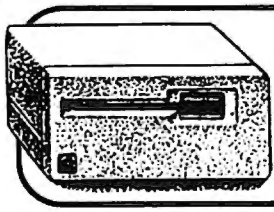

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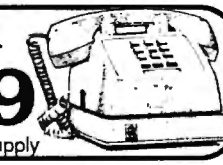

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Quick ProDOS Catalog For Apple II

Larry Sholl

This enhanced ProDOS CATALOG command automatically displays a disk catalog in the correct format for the current screen.

Have you ever typed a CATALOG command for a ProDOS disk when your Apple II was set for a 40-column screen? The result contains plenty of good information, but it's difficult to read 80 columns of information on a 40-column screen. Conversely, you miss a lot of information if you use a 40-column catalog command with an 80-column screen. "Quick ProDOS Catalog" for the Apple II automatically selects the correct CATALOG format for your screen. To view the disk's contents, simply type CC and press RETURN.

BASIC Filemaker

Type in the BASIC filemaker and save a copy to disk. When you run the program, it creates a file named QUICK.CATALOG on disk. Because the filemaker creates a file with this name, do *not* use this name—QUICK.CATALOG—for the BASIC program. If you do, you'll get a FILE TYPE MISMATCH error when you run the BASIC program. To install the utility, first boot the system with a disk that contains both the PRODOS and BASIC.SYSTEM files, then insert a disk containing the QUICK.CATALOG file, type BRUN QUICK.CATALOG, and press RETURN. You can also perform a ProDOS smart run with -QUICK.CATALOG. Quick Catalog prints a brief message to tell you that it's in place. You may run or install other programs without disturbing this one.

To catalog the active drive, type CC and press RETURN. Quick Catalog also accepts any syntax that works with a normal catalog command. Here are some examples:

Command	Purpose
CC,D2	catalog disk in drive 2
CC,D1	catalog disk in drive 1
CC/RAM	catalog RAM drive if it's active
CC/HACK/FUN	catalog subdirectory FUN on disk HACK
CC,S6,D1	catalog disk in drive 1 of slot 6

If Quick Catalog can't find the indicated drive/path, it prints the message ProDOS VOLUME NOT FOUND IN THAT DRIVE/PATH. Should you get that error message, you can display the default path by entering the command PREFIX. You can change the default ProDOS prefix at any time. Here are some typical PREFIX commands:

Command	Purpose
PREFIX,D2	sets drive 2 as default drive
PREFIX,D1	sets drive 1 as default drive
PREFIX/RAM	sets ProDOS volume RAM as default path

ProDOS Notes

Unlike DOS 3.3, ProDOS has well-defined entry points and includes a mechanism for adding new, external commands to its vocabulary. A properly installed external command is as resistant to crashes as ProDOS itself. Pressing CONTROL–RESET has no effect on a new command because the new program and the vector which points to it are both in memory areas protected by ProDOS.

Under normal circumstances, all keyboard input is passed to the BASIC.SYSTEM routine. If BASIC.SYSTEM doesn't recognize the input string as a valid ProDOS command, it passes the input to Applesoft BASIC, which gets a chance to identify it. If Applesoft doesn't recognize the string as a valid BASIC keyword, a syntax error occurs. However, ProDOS allows you to add a detour so that all unclaimed commands are passed to a routine of your own instead of to the usual error handler. An external routine may either claim the command and act on it or pass it to any other external command handler whose address is linked to the first. If no external command claims the input, it is passed to Applesoft. This scheme permits you to add multiple external commands while preserving normal error handling.

The technique for attaching an external command to BASIC.SYSTEM is described in "Apple ProDOS Technical Notes" numbers 6 and 9. Briefly, the process involves requesting memory space from ProDOS, putting your program's new

address into BASIC.SYSTEM, and relocating your program.

Inside Quick Catalog

Here's an outline of what Quick Catalog does. The program first checks to see whether ProDOS is active. If ProDOS is absent, the program prints an error message and returns to BASIC. Once installed as an external command, Quick Catalog waits to receive any command that starts with the characters CC, converting lowercase to uppercase if necessary. When this command appears, the program checks for 40-column or 80-column mode and issues the appropriate CATALOG command along with any additional parameters. If a catalog activity does not follow, an error message is displayed.

If you're familiar with assembly language, you may find it instructive to examine Quick Catalog. BLOAD the file from BASIC, then enter the monitor with the command CALL -151. Type 2000L and press RETURN to disassemble the beginning of the file. The program is located in the area $2000–$21FF. The code at $2000–$20FF prepares the code at $2100–$21FF and relocates it in the area specified by a ProDOS call. After relocation, the code at $2000 is abandoned.

QUICK.CATALOG Filemaker

For instructions on entering this program, please refer to "COMPUTE!'s Guide to Typing In Programs" in this issue of COMPUTEIcp7.

```
3F 70 TEXT : HOME : PRINT "LOADI
      NG ML..."
71 80 FOR I = 8192 TO 8192 + 511
      : READ A: POKE I,A:X = X +
       A: NEXT
B9 90 IF X < > 71906 THEN PRINT
      "ERROR IN DATA STATEMENTS.
      ": STOP
9C 95 PRINT CHR$ (4)"BSAVE QUICK
      .CATALOG,A$2000,L$200"
4E 100 DATA 173,0,191,201,76,240
      ,15,32,221,251,173
A3 110 DATA 247,32,141,120,32,32
      ,116,32,76,113,32
3C 120 DATA 169,1,32,245,190,176
      ,9,141,172,32,141
10 130 DATA 98,32,76,44,32,32,11
      6,32,76,208,3
15 140 DATA 173,7,190,141,186,33
      ,173,8,190,141,187
23 150 DATA 33,169,0,141,7,190,1
      73,172,32,141,8
9F 160 DATA 190,173,172,32,141,6
      ,33,141,12,33,141
B3 170 DATA 83,33,141,200,33,141
      ,72,33,141,203,33
7A 180 DATA 141,166,33,162,0,189
      ,0,33,157,0,255
63 190 DATA 232,224,255,208,245,
      173,207,32,141,120,32
9C 200 DATA 32,116,32,76,208,3,3
      2,251,218,173,155
9C 210 DATA 32,141,169,32,173,12
      0,32,141,140,32,173
D6 220 DATA 121,32,141,141,32,16
      2,1,189,155,32,32
C4 230 DATA 237,253,232,236,169,
      32,144,244,32,251,218
BE 240 DATA 96,13,211,217,211,21
      2,197,205,160,197,210
6E 250 DATA 210,207,210,160,174,
      195,207,196,81,32,209
69 260 DATA 213,201,195,203,174,
      195,193,212,193,204,207
79 270 DATA 199,160,201,211,160,
      206,207,215,160,201,206
B0 280 DATA 211,212,193,204,204,
      197,196,174,160,174,32
F7 290 DATA 37,209,213,201,195,2
      03,174,195,193,212,193
BC 300 DATA 204,207,199,160,210,
      213,206,211,160,207,206
9A 310 DATA 204,217,160,215,201,
      212,200,160,208,210,207
AF 320 DATA 196,207,211,174,160,
      209,32,234,0,0,0
F7 330 DATA 0,183,255,216,173,10
      8,190,141,16,33,173
7A 340 DATA 109,190,141,17,33,16
      2,1,189,170,170,201
93 350 DATA 67,208,105,232,224,3
      ,208,244,162,0,189
A2 360 DATA 0,2,232,221,0,2,208,
      247,42,42,42
F8 370 DATA 24,106,106,106,201,1
      95,208,236,232,160,0
85 380 DATA 189,0,2,153,224,2,23
      2,200,224,15,240
4F 390 DATA 4,201,141,208,240,16
      9,3,141,89,33,173
0C 400 DATA 24,192,10,176,117,16
      2,0,189,188,33,157
D1 410 DATA 0,2,232,224,3,208,24
      5,160,0,185,224
11 420 DATA 2,42,42,144,21,42,24
      ,106,106,106,157
A8 430 DATA 0,2,232,200,192,15,2
      40,15,201,141,208
D5 440 DATA 231,24,144,8,106,106
      ,24,144,235,24,144
59 450 DATA 54,169,255,141,38,2,
      169,0,141,15,190
F8 460 DATA 32,3,190,169,0,141,1
      5,190,141,84,190
5D 470 DATA 141,85,190,24,173,38
      ,2,201,255,208,19
F9 480 DATA 162,0,189,204,33,32,
      237,253,232,224,38
7A 490 DATA 208,245,32,221,251,3
      2,251,218,76,208,3
9C 500 DATA 56,76,208,3,195,193,
      212,193,204,207,199
59 510 DATA 160,169,7,141,89,33,
      76,79,33,208,210
0F 520 DATA 207,196,207,211,160,
      214,207,204,213,205,197
DA 530 DATA 160,206,207,212,160,
      201,206,160,212,200,193
CC 540 DATA 212,160,196,210,201,
      214,197,175,208,193,212
5B 550 DATA 200,174,160,211,232,
      239,236,236,175,195,207
E9 560 DATA 205,208,213,212,197,
      193
```

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Well-

Ulf Larsson-Westlund

This short utility adds flexibility to batch processes on the IBM PC/PCjr and compatible computers.

Many users of the IBM PC/PCjr and compatibles are familiar with batch files. Simply put, a batch file is a text file (with the extension .BAT) which contains a series of MS-DOS commands. When you invoke the batch file by typing its name at the DOS prompt, the computer executes each command in order. The program accompanying this article helps make batch files more interactive. When this program is invoked from DOS, it displays a yes/no prompt and waits for you to press an indicated key, returning an error code which the batch file can use to branch to different parts of the command process.

Type in the program and save a copy. When you run it, the program checks its DATA statements for typing errors. If no errors are found, it creates an assembly language file named YORN.COM. The .COM extension signals that this is an executable machine language file.

To see what YORN.COM does, type YORN at the DOS prompt and press Enter. The drive whirs for a moment; then the computer displays the prompt *Answer (Y)es or (N)o...* and waits for you to indicate your choice. Note that YORN.COM recognizes only the characters *Y*, *y*, *N*, or *n*.

Sample Batch File

Let's create an example to show how YORN.COM works in a batch file. Type the following lines at the DOS prompt, pressing Enter at the end of each line:

Behaved Batch Files

```
COPY CON: YESNO.BAT
ECHO OFF
CLS
:START
ECHO THIS IS A TEST BATCH FILE
  FOR YORN.COM
YORN PLEASE PRESS N TO
  CONTINUE...
IF ERRORLEVEL 255 GOTO WRONG
ECHO
ECHO YOU PRESSED THE N KEY
GOTO END
:WRONG
ECHO
ECHO YOU DIDN'T PRESS THE N KEY
GOTO START
:END
ECHO
ECHO ...ENDING
```

After you have typed every line, press the F6 function key to write the batch file to disk. When the drive stops, you should have the file YESNO.BAT on the current disk. Make sure you also have a copy of YORN.COM on the same disk.

Invoke YESNO.BAT by typing YESNO at the DOS prompt. Note that YORN.COM displays a different prompt this time. Instead of *Answer (Y)es or (N)o*, it prints the message *PLEASE PRESS N TO CONTINUE*. If you answer "Yes" by pressing *Y* or *y*, one series of batch commands is executed. If you answer "No" by pressing *N* or *n*, the batch file branches to a different series of commands.

It's not difficult to see how this capability might be useful. For instance, say that you often boot up with an AUTOEXEC.BAT file that installs an accessory program such as *SideKick*. When you use memory-intensive software such as *Framework* on a machine with only a limited amount of RAM, you may find yourself running out of memory if *SideKick* or a similar accessory is resident. With YORN.COM, your AUTOEXEC.BAT file can ask you whether or not to install the accessory and respond accordingly.

Error Codes

YORN.COM tells you which key is pressed by returning an *error code*. In the example file YESNO.BAT, it returns an error code of 255 when you press *Y* or *y* and an error code of 254 for *N* or *n*. You can check the error code with IF-ERRORLEVEL and branch to the desired destination with GOTO as shown in the sixth line of YESNO.BAT. When you're checking error codes, it is essential to begin with the highest code (255 in this case) and work downward to lower codes systematically.

Customizing YORN.COM

We have already noted how to change the prompt printed by YORN.COM: Simply supply the text of the new prompt after the word YORN in the batch file. If no such text is found, YORN.COM prints the default prompt.

For special purposes, you can also check for characters other than *Y* or *N*. For instance, a batch process that can send output to either the screen or a disk file might prompt you to press S for screen output or D for disk output.

The hex numbers $59 and $79 in lines 390 and 400 of the BASIC filemaker stand for the characters *Y* and *y*, respectively. The hex numbers $4E and $6E in lines 400 and 410 stand for *N* and *n*, respectively. To substitute other characters, replace these values with the values of the characters you wish to test for. Remember that these numbers must be in hexadecimal. (The BASIC function HEX$ converts decimal values to hexadecimal: For instance, PRINT HEX$(13) displays 0D, the hex equivalent of decimal 13.) If you change any of these values, you must also change the checksum value (10731) in line 170 accordingly. Once this is done, rerun the BASIC filemaker to create a new version of YORN.COM.

YORN.COM Filemaker

For instructions on entering this program, please refer to "COMPUTE!'s Guide to Typing In Programs" in this issue of COMPUTE!.

```
KJ 120 PRINT "Checking your typi
       ng - please wait ...";
GI 130 FOR I=0 TO 109
EC 140   READ A$:A=VAL("&H"+A$)
EE 150   CKSUM=CKSUM+A
ND 160 NEXT I
HM 170 IF CKSUM=10731 THEN 210
AB 180 PRINT:PRINT
IB 190 PRINT "Error - please che
       ck your typing!"
OC 200 STOP
HC 210 RESTORE 340
IB 220 OPEN "YORN.COM" AS #1 LEN
       =1
PF 230 FIELD #1,1 AS BYTE$
GL 240 FOR I=0 TO 109
KD 250   READ A$
HM 260   LSET BYTE$=CHR$(VAL("&H
       "+A$))
PJ 270   PUT #1
OI 280 NEXT I
AG 290 CLOSE #1
PD 300 PRINT:PRINT
LJ 310 PRINT "YORN.COM created."
IG 320 PRINT
LC 330 END
DG 340 DATA EB,05,0D,20,20,1A,08
       ,BE,80,00
BE 350 DATA B5,00,8A,0C,83,F9,00
       ,75,0A,BA
KK 360 DATA 54,01,B4,09,CD,21,EB
       ,19,90,46
KJ 370 DATA 8A,5C,01,80,FB,0D,74
       ,08,8A,D3
JE 380 DATA B4,02,CD,21,E2,EF,BA
       ,6D,01,B4
JK 390 DATA 09,CD,15,B4,00,CD,16
       ,3C,59,74
DC 400 DATA 11,3C,79,74,0D,3C,4E
       ,74,04,3C
LN 410 DATA 6E,75,EC,B0,FE,EB,03
       ,90,B0,FF
LH 420 DATA B4,4C,CD,21,41,6E,73
       ,77,65,72
JE 430 DATA 20,59,28,65,73,29,20
       ,6F,72,20
BM 440 DATA 4E,28,6F,29,20,2E,2E
       ,2E,24,24
```

Amiga Jigsaw

Walter Bulawa

This short, elegant program is not only an entertaining activity, but also a demonstration of valuable techniques for programming graphics in Amiga BASIC.

"Jigsaw" is a simple, but absorbing, BASIC game for the Amiga. The program requires you to put together a puzzle after its pieces have been scattered around the screen. The Amiga keeps track of the number of moves you make and the total amount of time you take to complete the puzzle.

Unshuffle The Pieces

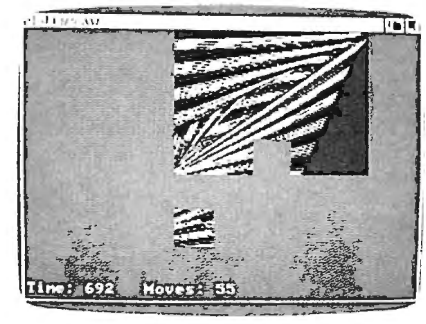
Type in the program and save a copy to disk before you run it. The program begins by drawing a puzzle shape in a small window in the center of the screen. Wait until you see a shape that you like, then press the space bar. The Amiga then divides the picture into a number of equally sized pieces, capturing each piece in a small square on the screen. While this is being done, you should take advantage of the opportunity to memorize the puzzle's shape. After every piece has been captured, the computer shuffles them at random. Begin playing when the center of the screen is cleared.

Your goal is to reconstruct the picture by placing every piece in its original position, using the mouse to move pieces. To pick up a piece, move the mouse pointer over the piece, then press the left button and hold it down. The piece blinks briefly, and the computer emits a beep to indicate that you have the piece. Continue to hold down the mouse button as you move the piece to its destination. When you have positioned the piece, release the button. The square blinks a second time to signal that it has been placed. Continue this process until the entire picture is constructed. When you solve the puzzle, the program lets you play again or quit.

The bottom of the screen contains two counters: a timer that updates continuously and a move counter that shows how many turns you have taken. To increase the game's difficulty and add to its visual appeal, the computer also continuously rotates the palette colors of the puzzle pieces.

You must place each piece reasonably close to the desired destination square, but you need not line it up exactly. If the piece is close enough for the computer to tell which location you intend, the program automatically "snaps" it into perfect alignment.

If you find yourself stumped, you can peek at the original puzzle for a moment, and then return to the puzzle screen. This is done with the back-window and front-window gadgets located at upper left of the window border. To peek at the original, unscrambled puzzle, click the left button once on the back-window gadget. To return to the puzzle screen, click the left button once on the front-window gadget. There is no penalty for peeking. However, keep in mind that the timer continues to tick while you study the original shape.



"Amiga Jigsaw" is an absorbing challenge to puzzle fans of all ages.

Beginning puzzlers should avoid puzzles that include large areas of blank space. Blank squares may look identical to you, but the computer remembers the original location of each piece and won't end the game until you place each one in the correct spot. Thus, a puzzle that contains mostly blank space can be nearly impossible to solve.

Bobs And OBJECT

Programmers may wish to study the way that this program moves and places graphic shapes on the screen. One technique that might have been used is to GET each shape into a variable and PUT it on

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the screen wherever desired. But PUT and GET create slow, flickery animation in BASIC. Instead of PUT and GET, this program makes each puzzle piece into a *bob* and animates it with OBJECT commands. The result is much smoother animation. You can still notice slight jerkiness in the piece's motion when you carry it with the pointer, but this is due to delays created by background routines activated by ON TIMER.

The process of creating a bob involves several steps. First, GET is used to capture all the graphic data for each shape in an integer array. This integer array is then converted into a string array. The string array, in turn, is concatenated into a general string array that holds the bob's features and is used to animate the bob with OBJECT.DRAW commands. This simple method of creating bobs and sprites has not, to my knowledge, been documented widely.

Amiga Jigsaw

For instructions on entering this program, please refer to "COMPUTE!'s Guide to Typing In Programs" in this issue of COMPUTE!.

```
FOR irow=0 TO rLast
FOR icoL=0 TO cLast
WINDOW OUTPUT 3
x=FNXYfmRC(icoL+1,xwidth):y=FNXY
fmRC(irow+1,ywidth)
GET (x,y)-(x+xwidth-1,y+ywidth-1
),a(0,0)
s$(icoL,irow)=""
iLast=getsize-1
FOR i=3 TO iLast:s$(icoL,irow)=s
$(icoL,irow)+MKI$(a(i,0)):NEXT
WINDOW OUTPUT 2
i=icoL+ncoLs.pzL*irow
x=FNXYfmRC(coLs(i),xwidth):y=FNX
YfmRC(rows(i),ywidth)
PUT (x,y),a(0,0)
pcoL(icoL,irow)=coLs(i):prow(ico
L,irow)=rows(i)
NEXT:NEXT
WINDOW 2

' Shuffle the pieces
FOR i=0 TO 20
Pick.RC:
FOR j=1 TO 2
coL(j)=INT(ncoLs.pzL*RND):row(j)
=INT(nrows.pzL*RND)
NEXT j
IF coL(1)=coL(2) AND row(1)=row(
2) THEN GOTO Pick.RC
FOR j=1 TO 2
x(j)=FNXYfmRC(pcoL(coL(j),row(j)
),xwidth)
y(j)=FNXYfmRC(prow(coL(j),row(j)
),ywidth)
GET (x(j),y(j))-(x(j)+xwidth-1,y
(j)+ywidth-1),a(0,j-1)
LINE (x(j),y(j))-(x(j)+xwidth-1,
y(j)+ywidth-1),0,bf
NEXT j
PUT (x(1),y(1)),a(0,1):PUT (x(2)
,y(2)),a(0,0)
SWAP pcoL(coL(1),row(1)),pcoL(co
L(2),row(2))
SWAP prow(coL(1),row(1)),prow(co
L(2),row(2))
NEXT
'
' Main loop
'
t!=TIMER:ON TIMER (1) GOSUB Show
.Time:TIMER ON
done=faLse:seLection.made=faLse
GOSUB Beap
WHILE NOT done
IF MOUSE(0)=-1 THEN
SeLect.Piece:
x=MOUSE(5):y=MOUSE(6) 'get x & y
of mouse
GOSUB Fit2Scn 'see if on screen
coL=FNRCfmXY(x,xwidth):row=FNRCf
mXY(y,ywidth)
GOSUB WhatsThere
IF piece THEN
coL.piece=cp:row.piece=rp
pcoL(coL.piece,row.piece)=-1
prow(coL.piece,row.piece)=-1
GOSUB Beap
xp=FNXYfmRC(coL,xwidth):yp=FNXYf
mRC(row,ywidth)
xdif=xp-x:ydif=yp-y
GET (xp,yp)-(xp+xwidth-1,yp+ywid
th-1),a(0,0)
LINE (xp,yp)-(xp+xwidth-1,yp+ywi
dth-1),0,bf
OBJECT.SHAPE 1,s1$+s$(coL.piece,
row.piece)
OBJECT.X 1,xp:OBJECT.Y 1,yp
OBJECT.ON 1
DEFINT a-z
DEFSNG coLrs
DEF FNXYfmRC(cr,w)=(cr-1)*w
DEF FNRCfmXY(xy,w)=INT((xy+w)/w)

faLse=0:true=-1
ncoLs.pzL=5:nrows.pzL=4
xmin.pzL=0:xmax.pzL=149:ymin.pzL
=0:Move.piece=99
xwidth=(xmax.pzL-xmin.pzL+1)/nco
Ls.pzL
ywidth=(Move.piece-ymin.pzL+1)/n
rows.pzL
getsize=3+INT((16+xwidth-1)/16)*
ywidth*5
rmin=1:rmax=7:cmin=1:cmax=10
xmin=FNXYfmRC(cmin,xwidth)
xmax=FNXYfmRC(cmax,xwidth)
ymin=FNXYfmRC(rmin,ywidth)
ymax=FNXYfmRC(rmax,ywidth)
ncoLrs=9:coLrmin=6:coLrmax=coLrm
in+ncoLrs-1
vmin=1:vmax=3

DIM coLrs(ncoLrs,3),a(getsize,1)
,b(getsize)
DIM pcoL(ncoLs.pzL-1,nrows.pzL-1
),prow(ncoLs.pzL-1,nrows.pzL-1)
DIM coLs(ncoLs.pzL*nrows.pzL-1),
rows(ncoLs.pzL*nrows.pzL-1)
DIM s$(ncoLs.pzL-1,nrows.pzL-1)

PALETTE 0,0,.3,.6
PALETTE 1,1,1,1

d=5
s1$=STRING$(26,0)
POKE SADD(s1$)+11,d
POKE SADD(s1$)+15,xwidth
POKE SADD(s1$)+19,ywidth
POKE SADD(s1$)+21,24
POKE SADD(s1$)+23,2^d-1

RESTORE Nu.CoLors
FOR i=0 TO ncoLrs   'Get new pal
ette coLors from DATA
FOR j=1 TO 3
READ coLrs(i,j)
NEXT j,i

RESTORE CoLs.Rows
FOR i=0 TO ncoLs.pzL*nrows.pzL-1

READ coLs(i):READ rows(i)
NEXT

SCREEN 1,320,200,d,1
WINDOW 2,"Jigsaw",,28,1

Restart:
CLS:RANDOMIZE TIMER:moves=0

coLr.index=ncoLrs:GOSUB CoLr.Shi
ft

p$="Press space bar to stop puzz
le":LOCATE 23,20-INT(LEN(p$)/2):
PRINT p$;
WINDOW 3,"Jigsaw",(80,70)-(229,1
69),16,1
PAINT (10,10),2
GOSUB Make.PuzzLe
WINDOW OUTPUT 2
LOCATE 23,20-INT(LEN(p$)/2):PRIN
T STRING$(LEN(p$)," ");

'Make Bob strings and place piec
es on the screen
cLast=ncoLs.pzL-1:rLast=nrows.pz
L-1
seLection.made=true
END IF
END IF '(mouse)
WHILE seLection.made
WHILE MOUSE(0)=-1
x=MOUSE(5):y=MOUSE(6)
GOSUB Fit2Scn
IF x<>xp-xdif OR y<>yp-ydif THEN

xp=x+xdif:yp=y+ydif
OBJECT.X 1,xp:OBJECT.Y 1,yp
END IF
WEND

GOSUB Fit2Scn
coL=FNRCfmXY(x,xwidth)
row=FNRCfmXY(y,ywidth)
GOSUB WhatsThere
IF NOT piece THEN
x=FNXYfmRC(coL,xwidth)
y=FNXYfmRC(row,ywidth)
OBJECT.OFF 1:PUT (x,y),a(0,0)
seLection.made=faLse
pcoL(coL.piece,row.piece)=coL
prow(coL.piece,row.piece)=row
GOSUB Beap
moves=moves+1:LOCATE 23,13:PRINT
"Moves:";moves;
r0=prow(0,0):c0=pcoL(0,0):count=
0
FOR r=0 TO nrows.pzL-1
FOR c=0 TO ncoLs.pzL-1
IF (prow(c,r)-r0)=r THEN
IF (pcoL(c,r)-c0)=c THEN count=c
ount+1
END IF
NEXT c,r
IF count=nrows.pzL*ncoLs.pzL THE
N done=true
END IF '(not piece)
WEND '(seLection)
WEND '(done)
TIMER OFF
FOR i=0 TO 10:GOSUB Beap:NEXT
p$="Again (Y/N)?"
COLOR 1,0:LOCATE 23,25:PRINT p$;

p$="":FOR i=0 TO 1000:NEXT:WHILE
p$="":p$=INKEY$:WEND
IF p$="y" OR p$="Y" THEN GOTO Re
start
SCREEN CLOSE 1
```

```
END
<
Beap:
SOUND 800,1,100,0:SOUND 1000,1,1
00,0
RETURN
<
Fit2Scn:
IF x<xmin THEN x=xmin
IF x>xmax THEN x=xmax
IF y<ymin THEN y=ymin
IF y>ymax THEN y=ymax
RETURN
<
WhatsThere:
piece=faLse:cLast=ncoLs.pzL-1:rL
ast=nrows.pzL-1
FOR c=0 TO cLast
FOR r=0 TO rLast
IF pcoL(c,r)=coL THEN
IF prow(c,r)=row THEN piece=true
:cp=c:rp=r:RETURN
END IF
NEXT:NEXT
RETURN
<
Make.PuzzLe:
FOR i=0 TO 1
x(i)=xmax.pzL*RND:y(i)=Move.piec
e*RND
v:
vx(i)=2*vmax*RND-vmax:vy(i)=2*vm
ax*RND-vmax
IF vx(i)=0 OR vy(i)=0 THEN GOTO
v
NEXT
coLr=coLrmin
WHILE INKEY$=""
FOR i=0 TO 1
x(i)=x(i)+vx(i)
y(i)=y(i)+vy(i)
IF x(i)<=xmin.pzL OR x(i)>=xmax.
pzL THEN
vx(i)=-SGN(vx(i))*(RND(vmax)+vmi
n)
END IF
IF y(i)<=ymin.pzL OR y(i)>=Move.
piece THEN
vy(i)=-SGN(vy(i))*(RND(vmax)+vmi
n)
END IF
NEXT
coLr=coLr+1:IF coLr>coLrmax THEN
coLr=coLrmin
LINE (x(0),y(0))-(x(1),y(1)),coL
r
WEND
RETURN
<
Show.Time:
T2!=TIMER
LOCATE 23,1:PRINT "Time:";CINT(T
2!-t!);
GOSUB CoLr.Shift
RETURN
<
Nu.CoLors:
DATA .99,.05,.03
DATA .99,.70,.03
DATA .59,.99,.03
DATA .03,.99,.11
DATA .03,.99,.81
DATA .03,.51,.99
DATA .22,.03,.99
DATA .89,.03,.99
DATA .99,.03,.40
<
CoLs.Rows:
DATA 1,1,2,2,1,3,2,4,1,5,2,6,1,7
<
DATA 9,1,10,2,9,3,10,4,9,5,10,6,
9,7
DATA 3,1,4,2,5,1,6,2,7,1,8,2
<
```

Atari *SpeedScript* Customizer

David S. Bryant

This short utility allows Atari users to easily personalize SpeedScript 3.0.

This menu-driven program makes it possible to customize Atari *SpeedScript 3.0* for your personal use. Using a convenient, onscreen menu, you can choose new screen colors or change the default disk drive, a feature that's very useful for 130XE owners. Type in the program and save it to disk. When you type RUN, an introduction screen appears. Press the space bar to continue to the first menu. Select one of the four choices by pressing the correct numeric key. Press 1 for screen changes, 2 for both changes, or 3 for the RAMdisk change alone. Press 4 to return to BASIC.

If you choose options 1 or 2, the program displays screens describing the method for selecting colors. To change the border color, enter a number from 0 to 127. Following is a list of possible values and their colors:

Black	**0**
Rust	**8**
Red	**32**
Cobalt	**48**
Green	**88**
Orange	**120**

You will also be prompted to enter a number from 0–7 for the text luminance value. A 0 represents the lowest luminance value (dark text), and 7 the highest value (bright text). The screen changes to show your choices. If no text is visible, you have set both text and border luminance at the same values. Press Y to confirm the choices when you are satisfied with the colors.

To change the default disk drive, make sure that the file RAMDISK.COM is on the current disk. The available drives in the disk command menu are changed to 1, 2, 3, and 8 (drive 8 has been exchanged with drive 4). You may not use the F option to format drive 8; however, all other features work as usual.

After you make your selections, insert the disk which contains a copy of *SpeedScript 3.0*. (You should make the changes on a copy of *SpeedScript*, not the original program.) Enter the filename under which *SpeedScript* was saved (AUTORUN.SYS or SCRIPT-30.COM) and press RETURN. The program reads the file into memory, then prompts you to insert a

formatted disk and press the space bar. The program ends by returning you to BASIC ready mode. To prevent filename conflicts, the customized version of *SpeedScript* is given the filename SCRIPT30.BAK. To use the program, perform a binary load from DOS or rename the file AUTORUN.SYS and reboot the system.

Atari *SpeedScript* Customizer

For instructions on entering this program, please refer to "COMPUTE!'s Guide to Typing In Programs" in this issue of COMPUTE!.

```
OD 1  REM ********************
CL 2  REM *****  ATARI  *****
FJ 3  REM *** SPEEDSCRIPT ***
CJ 4  REM *** CUSTOMIZER  ***
DH 5  REM ********************
CM 10 GOTO 200
OI 20 ? CHR$(125):POSITION 4
      ,8:? "WILL CREATE FILE
      : SCRIPT30.BAK":? :? "
      (4 SPACES)ENTER ORIGIN
      AL FILENAME OF"
KO 30 ? "(4 SPACES)SPEEDSCR
      IPT 3.0 PROGRAM! ":? :
      ? :? "(10 SPACES)";:A$=
      "(15 SPACES)":D$="
      (15 SPACES)"
GM 40 TRAP 20:INPUT A$:IF A$
      ="" THEN 20
DK 50 POKE 752,255:? :IF LEN
      (A$)>2 THEN IF A$(2,2)
      =":" OR A$(3,3)=":" TH
      EN 70
HO 60 D$(1,3)="D1:":D$(4,15)
      =A$:A$=D$
EE 70 TRAP 710:OPEN #2,4,0,A
      $
PA 80 DIM SS$(10000),CIO$(7)
      :CIO$="hhh*LV":CIO$(4,
      4)=CHR$(170):CIO$(7)=C
      HR$(228)
EK 90 LET READ=1:X=32:SADR=A
      DR(SS$):MAXLEN=9999:GO
      SUB 630:SS$(TRUELEN)=C
      HR$(0):CLOSE #2
PK 100 IF SS$(7823,7833)<>"S
       peedScript" THEN 700
OH 110 IF NUM<3 THEN SS$(270
       5,2705)=CHR$(SCRCOL)
JL 120 IF NUM<3 THEN SS$(272
       1,2721)=CHR$(TEXCOLR*
       2)
JO 130 IF NUM>1 THEN SS$(490
       9,4909)=CHR$(56)
NN 140 IF NUM>1 THEN SS$(827
       3,8273)=CHR$(184)
BJ 150 ? CHR$(125):POSITION
       4,8:? "WILL CREATE FI
       LE: SCRIPT30.BAK":? :
       ? "(6 SPACES)INSERT F
       ORMATTED DISK"
EI 160 POSITION 2,18:? "** p
       ress -spacebar- to co
       ntinue **"
DJ 170 GET #1,KEY:IF KEY<>32
        THEN 170
DM 180 TRAP 710:OPEN #2,8,0,
       "D1:SCRIPT30.BAK"
GE 190 LET READ=0:X=32:MAXLE
       N=LEN(SS$):SADR=ADR(S
       S$):GOSUB 630:GOTO 72
       0
PO 200 GRAPHICS 0:REM *** IN
       TRO TEXT ***
IO 210 SETCOLOR 1,0,12:SETCO
       LOR 2,3,2:SETCOLOR 4,
       3,2:DIM A$(15),D$(15)
       :POKE 752,255
AB 220 POSITION 4,3:? "THIS
       PROGRAM WILL ALLOW YO
       U TO":? "  CHANGE THE
        DEFAULT BORDER, AND"
EH 230 ? "  TEXT LUMINANCE V
       ALUES,  OR THE":? "
       DISK  DRIVE  SELECTIO
       N FOR THE "
EH 240 ? "  130XE RAMDISK DR
       IVE #8, IN THE":?
CJ 250 ? "  (3 SPACES)SPEEDS
       CRIPT 3.0 PROGRAM
       (4 SPACES)"
CA 260 ? "  (5 SPACES)BY: Ch
       arles Brannon
       (6 SPACES)"
EK 270 ? "  (C)1985 COMPUTE
       PUBLICATIONS ":?
LI 280 ? "  FOR THE ATARI 40
       0,800,XL, & XE":? :?
       :? "(6 SPACES)*******
       ***************"
IK 290 ? :? "** press -space
       bar- to continue **";
KE 300 CLOSE #1:OPEN #1,4,0,
       "K:":GET #1,KEY:IF KE
       Y<>32 THEN 300
JH 310 ? CHR$(125):POSITION
       4,3:? "CHOOSE ROUTINE
        YOU WISH TO USE:":?
       :?
LB 320 ? "(4 SPACES)1:  CHAN
       GE LUMINANCE VALUES":
       ? :? "(4 SPACES)2:  B
       OTH CHANGES  ( 1 & 3
       )":?
HJ 330 ? "(4 SPACES)3:  CHAN
       GE FOR RAMDISK, D8:":
       ?
JJ 340 ? "(4 SPACES)4:  EXIT
        PROGRAM":POSITION 5,
       18:? "** press number
        for choice **":?
DC 350 GET #1,KEY:IF KEY<49
       OR KEY>52 THEN 350
DG 360 NUM=KEY-48:ON NUM GOT
       O 370,370,570,730
FM 370 ? CHR$(125):POSITION
       4,5:? "YOU  WILL  BE
       ASKED TO ENTER A":? "
         VALUE FOR THE BORDE
       R COLOR AND"
DA 380 ? "  THE  TEXT LUMINA
       NCE,  AND  THE":? "
       SCREEN WILL CHANGE TO
        SHOW THE"
ME 390 ? "  EFFECT OF YOUR C
       HOICE.":POSITION 2,18
       :? "** press -spaceba
       r- to continue **"
DB 400 GET #1,KEY:IF KEY<>32
        THEN 400
CB 410 ? CHR$(125):POKE 752,
       0
FH 420 TRAP 420:POSITION 5,8
       :? "ENTER VALUE FOR B
       ORDER COLOR":? "
       (4 SPACES)(0-127)
       (3 SPACES)";:INPUT SC
       RCOL
FH 430 SCRCOL=INT(SCRCOL):IF
        SCRCOL<0 THEN 420
IK 440 IF SCRCOL>127 THEN 42
       0
FH 450 ? CHR$(125):TRAP 450:
       POSITION 5,8:? "ENTER
        VALUE FOR TEXT LUMIN
       ANCE":? "(4 SPACES)(0
       -7)(3 SPACES)";:INPUT
        TEXCOLR
HD 460 TEXCOLR=INT(TEXCOLR):
       IF TEXCOLR<0 THEN 450
II 470 IF TEXCOLR>7 THEN 450
DA 480 SCRCOL=2*SCRCOL:COLR1
       =PEEK(709):COLR2=PEEK
       (710):POKE 709,TEXCOL
       R*2:POKE 710,SCRCOL:P
       OKE 712,SCRCOL
BO 490 POKE 752,255:? CHR$(1
       25):POSITION 8,8:? "T
       HESE ARE YOUR CHOICES
       ":? :? "(6 SPACES)ARE
        COLORS ACCEPTABLE?"
CG 500 ? "(8 SPACES)(Enter -
       Y- or -N-)":GET #1,KE
       Y
BC 510 POKE 709,COLR1:POKE 7
       10,COLR2:POKE 712,COL
       R2
LO 520 IF KEY<>89 THEN 410
NK 530 ? CHR$(125):POSITION
       7,8:? "CHANGE LUMINAN
       CE VALUES"
PE 540 IF NUM=1 THEN POSITIO
       N 15,9:? "ONLY"
NJ 550 ? :IF NUM=2 THEN ? "
       (15 SPACES)&"
HB 560 GOTO 580
MF 570 ? CHR$(125)
CM 580 IF NUM>1 THEN POSITIO
       N 7,12:? "CHANGE FOR
       RAMDISK, D8:"
CG 590 IF NUM=3 THEN POSITIO
       N 15,13:? "ONLY"
IH 600 POSITION 2,16:? "***
        MAKE CHANGES TO PROG
       RAM? ***":POSITION 10
       ,18:? "(Enter -Y- or
       -N-)"
JC 610 GET #1,KEY:IF KEY<>89
        THEN CLR :GOTO 200
JG 620 POKE 752,0:GOTO 20
DA 630 ICCOM=834:ICBADR=836:
       ICBLEN=840:ICSTAT=835
OE 640 H=INT(SADR/256):L=SAD
       R-H*256:POKE ICBADR+X
       ,L:POKE ICBADR+X+1,H
CL 650 H=INT(MAXLEN/256):L=M
       AXLEN-H*256:POKE ICBL
       EN+X,L:POKE ICBLEN+X+
       1,H
JM 660 POKE ICCOM+X,11-4*REA
       D:A=USR(ADR(CIO$),X)
OP 670 TRUELEN=PEEK(ICBLEN+X
       )+256*PEEK(ICBLEN+X+1
       )+1
PA 680 POKE 195,PEEK(ICSTAT)
       :RETURN
IP 690 REM *** ERROR & EXIT
       ROUTINE ***
IH 700 GRAPHICS 0:? :? "  BY
       TE COMPARISON FAILED"
       :? "  INCORRECT SOURC
       E FILE":GOTO 740
KJ 710 GRAPHICS 0:? :? "  *
       FATAL ERROR # = ";:?
       PEEK(195):GOTO 740
DE 720 GRAPHICS 0:? :? "
       (3 SPACES)READ/WRITE
       SUCCESSFUL":GOTO 740
BL 730 GRAPHICS 0
DD 740 ? " *** PROGRAM STOPP
       ED ***":CLOSE #1:CLOS
       E #2:TRAP 40000:POKE
       752,0:END
```

Full-Screen Shell For ST BASIC

David Lindsley

Have you ever wanted to write an ST BASIC program that isn't confined to the BASIC output window? This program shows how to create full-screen graphics that don't depend on the usual window borders.

Windows are integral to the ST BASIC programming environment. Whether you're typing, listing, or running a program, everything occurs within a bordered window. Since ST BASIC provides no commands for monitoring gadgets such as the window scroll bar, the gadgets serve no real purpose in most programs. And in applications such as games, the ever-present borders prevent you from using the full area of the screen.

This program creates a full-screen shell for your own ST BASIC programs. By enclosing a program within this code, you can override BASIC's windowing environment and work with the entire screen surface.

For a demonstration, type in the program at the end of this article and save a copy; then run it. The screen is filled immediately with a graphic design. At the top of the screen, where the ST BASIC menu titles normally appear, is a title bar containing the name of this program. After a short pause, the screen clears and returns to normal, displaying the ST BASIC menu titles which were overdrawn while the program ran.

Enclosed In A Shell

The line numbering of this program is designed to make it easy to merge with your own programs. Lines 10–70 check the current screen resolution and adjust several variables accordingly. Line 80 calls the subroutine PRGNAME which draws a title bar with the title you designate and fills the screen with the specified pattern.

Lines 100–5000 are reserved for your program. In this demonstration, line 110 simply delays long enough for you to look at the screen. In a real program, of course, you would substitute your own code. Just remember that your portion of the program should use only line numbers 100–5000.

Instead of terminating with END, your program should fall through to lines 5010–5030. These lines restore the usual ST BASIC menu titles, clear the output window, and reopen it so that you can use BASIC normally. Since the shell code draws on the entire screen, it erases the ST BASIC menu titles. (However, the menus are still active while the program runs, so that you can select Break to stop the program, and so on.) Thus, it's necessary to redraw the menu titles when the program ends. The string *name$* in line 5010 contains the text for these titles, which you can change if you wish. The END statement at the end of line 5030 terminates the program.

Merging

Unless you write your programs with this shell in mind, most programs will need some modification before you merge them with the shell. This is necessary in order to preserve the windowless screen. Once you have cleared the screen completely, you cannot use ordinary BASIC graphics commands such as PCIRCLE, GOTOXY, LINEF, and CIRCLE. If you do, ST BASIC suddenly redraws the right and lower bars of the output window, even though these commands have nothing specifically to do with those window bars.

To avoid such unwanted effects, you must create all graphics with VDISYS commands which aren't tied to windows. This rule also includes text, which must be placed with VDISYS instead of PRINT. VDISYS commands are more complicated to use than most BASIC commands, but they can operate much faster, giving your program the appearance of something written in machine language. Any graphics or text that you create in ST BASIC can also be created with VDISYS commands. In fact, BASIC itself uses VDI routines to create graphics in the first place.

The simplest way to use the shell program is to delete existing lines 100–110 and MERGE it with your own program code. Here are the steps to follow before you attempt the merge: First, renumber your program if necessary, so that its line numbers fall in the range 100–5000. Then substitute the name of your program in the string *title$* in line 5090. Delete any CLEARW 2 or FULLW 2 commands from the beginning of your program and rename any variables that conflict with the variable names used in the shell code. Once this is done, you can perform the merge.

Program Notes

Lines 50–70 set several important variables used by subroutines in the shell. The variables *dcx* and *dcy* represent the screen size, and the variables *c* and *s* indicate colors.

The PRGNAME subroutine beginning at line 5050 specifies the screen coordinates and color according to the current resolution and passes those values to the RECT subroutine. Lines 5100–5120 draw the top menu bar in the color specified by the variable *s*.

Lines 5130–5160 call a VDI routine which places text at the designated screen coordinates. Line 5150 centers the text on the screen. Line 5160 places the text 8 lines below the top border in low- and medium-resolution modes or 16 lines down in high-resolution mode. Lines 5170–5190 POKE the necessary information into memory prior to the VDISYS call. You can place the title lower on the screen by changing lines 5100 and 5160. You may want to include additional VDISYS calls to enlarge the lettering or create special text effects. Or you can eliminate the title altogether by deleting lines 5090–5190.

The RECT subroutine calls a VDI routine which fills the specified screen rectangle with the designated color and pattern.

The MENU subroutine is similar to the PRGNAME routine, but it's designed to clear the screen back to white, the usual background color (5300). The LEN function used in line 5150 is omitted in lines 5330 and 5360 because the number of characters in the string *name$* (including spaces) is now known to be 28. If you change the length of *name$*, change the 27 in line 5360 to match the new length.

Full-Screen Shell For ST BASIC

```
30    ' FULL SCREEN SHELL PROGR
      AM
40    ps=peek(systab)
50    if ps=1 then dcx=639:dcy=
      399:c=1:s=1
60    if ps=2 then dcx=639:dcy=
      199:c=2:s=3
70    if ps=4 then dcx=319:dcy=
      199:c=4:s=12
80    gosub PRGNAME
90    '
100   'YOUR PROGRAM STARTS HERE

110   for j=1 to 5000:next j '
      delay loop for demonstrat
      ion
5000  '
5010  name$="Desk  File  Run  E
      dit  Debug"
5020  gosub MENU
5030  clearw 2:fullw 2:end
5040  '
5050  PRGNAME:
5060  x1=0:y1=0:x2=dcx:y2=dcy
5070  color 2,c,c,1,4
5080  gosub RECT
5090  title$="Full Screen Shell
      "
5100  x1=0:y1=0:x2=dcx:y2=(dcy/
      20)
5110  color 6,s,s,2,2
5120  gosub RECT
5130  poke contrl,8:poke contrl
      +2,1
5140  poke contrl+6,len(title$)

5150  poke ptsin,(dcx-len(title
      $)*8)/2
5160  poke ptsin+2,(dcy/25)
5170  for i=0 to len(title$)-1
5180  poke intin+i*2,asc(mid$(t
      itle$,i+1,1))
5190  next i:vdisys(1):return
5200  '
5210  RECT:
5220  poke contrl,11:poke contr
      l+2,2
5230  poke contrl+6,0:poke cont
      rl+10,1
5240  poke ptsin,x1:poke ptsin+
      2,y1
5250  poke ptsin+4,x2:poke ptsi
      n+6,y2
5260  vdisys(1):return
5270  '
5280  MENU:
5290  x1=0:y1=0:x2=dcx:y2=dcy
5300  color 1,0,0,8,2
5310  gosub RECT
5320  poke contrl,8:poke contrl
      +2,1
5330  poke contrl+6,28
5340  poke ptsin,25
5350  poke ptsin+2,(dcy/25)
5360  for i=0 to 27
5370  poke intin+i*2,asc(mid$(n
      ame$,i+1,1))
5380  next i:vdisys(1):return
```

File Compressor

Chris Rogers

This Commodore 64 utility crunches BASIC programs and other files so that they occupy less room on a disk. Since smaller files load faster, compressed files can also transfer to and from disk faster than usual. A disk drive is required.

Using a clever programming technique, "File Compressor" makes it possible to squeeze disk files into a smaller space than usual, which conserves disk space and speeds up the transfer of data between the computer and the disk drive. Once you have installed File Compressor, it can automatically compress BASIC programs during any SAVE and decode compressed programs into normal form during a LOAD. You can also compress other data such as hi-res graphics screens.

Typing File Compressor

Type in the program and save a copy. Because File Compressor is written in machine language, you must enter it with the "MLX" machine language entry program listed elsewhere in this issue. Be sure to read the MLX article carefully before you attempt to use it. When you run MLX, you'll be asked for a starting address and an ending address for the data you'll be entering. Here are the correct addresses:

Starting address: C200
Ending address: C617

After you save File Compressor, you can load it with the command LOAD "COMPRESSOR",8,1 (replace COMPRESSOR with the filename you used when saving the program). After the program loads, type NEW and press RETURN to reset important BASIC pointers.

Compressing BASIC

File Compressor can be used two different ways. The first method allows you to save and load a BASIC program in compressed form. To install File Compressor, load it into memory; then type SYS 50600 and press RETURN. To save a BASIC program in compressed form, type SAVE and press RETURN. When the computer prompts you to enter a filename, enter the desired name and press RETURN again. The program is saved to disk in compressed format. To load a compressed BASIC program, type LOAD and press RETURN; then enter the desired filename at the prompt.

To save or load BASIC programs in normal form, supply a filename with the LOAD or SAVE command. For instance, SAVE "TEST",8,1 saves the program TEST to disk as usual. Because it intercepts LOAD and SAVE commands that don't include a filename, File Compressor doesn't save compressed files to tape. However, you can still save and load with tape in uncompressed form by including a filename and adding ,1,1 to the command. For instance, SAVE "TEST",1,1 saves the program TEST to tape as a normal program file.

(Don't confuse File Compressor's crunching with normal program storage. You may have heard that the computer automatically crunches BASIC program lines. When you type in a line, the computer stores the line number in only two bytes and replaces every keyword with a one-byte symbol called a *token*. This process, usually called tokenization, reduces the size of the program significantly, since many BASIC keywords are four or five characters long. File Compressor begins with the already-tokenized BASIC program and crunches it even further.)

Compressing Data

File Compressor also lets you "crunch" and save the contents of any memory area, which may include a hi-res graphics screen, sprite shapes, or any other sort of data. Of course, it also allows you to reload the data in uncompressed form. This routine demonstrates how to save a memory area:

```
10000 REM COMPRESSED SAVE SA=S
   TART OF SAVE: EA=END OF SAV
   E: FL$=FILENAME
10002 POKE 680,SA/256:POKE 679
   ,SA-PEEK(680)*256
10004 POKE 682,EA/256:POKE 681
   ,EA-PEEK(682)*256
10006 FL$=FL$+",P,W"+CHR$(0):F
   OR I=1 TO LEN(FL$)
10008 POKE 831+I,ASC(MID$(FL$,
   I,1)+CHR$(0)):NEXT
10010 SYS 50689:RETURN
```

Before it calls File Compressor with SYS, the routine POKEs the starting and ending addresses of the desired memory area into locations 679–680 and 681–682, respectively. You must also store the ASCII characters for the disk filename in the zone beginning at location 832. Note that the filename must include the extension ,P,W and end with a zero byte. This routine shows how to load a compressed file back into memory:

```
10012 REM COMPRESSED LOAD SA=S
   TART OF LOAD: FL$=FILENAME
10014 POKE 680,SA/256:POKE 679
   ,SA-PEEK(680)*256
10016 FL$=FL$+",P,R"+CHR$(0):F
   OR I=1 TO LEN(FL$)
10018 POKE 831+I,ASC(MID$(FL$,
   I,1)+CHR$(0)):NEXT
10020 SYS 50666:RETURN
```

This procedure is similar to the previous routine. However, you need only specify a beginning address for the load, and the filename should end with ,P,R. When that preparation is complete, SYS 50666 calls File Compressor to decode the file data and put it back in memory.

Less Is More

You can use File Compressor without knowing how it works. However, you may be interested in a

brief explanation of the theory behind the program. The basic concept is to economize on the storage of often-repeated information. Nearly every collection of data involves a significant amount of repetition. For instance, the letter *e* appears very frequently in word processing documents, most graphics screens contain substantial amounts of blank space, and so forth. File Compressor saves space by storing the most frequently repeated data values in less space than usual. To understand how this is done, you'll need to know a little about how the computer usually stores information.

The 64 ordinarily stores all data as a series of byte-length codes. A byte consists of eight *bits*, and each bit is a binary digit (either 1 or 0). The binary number 00000000 equals 0, and the binary number 11111111 equals decimal 255, so a byte can store a number in the range 0–255. Since every byte contains eight bits, the computer simply counts bits to determine where one code ends and the next begins. When it reaches the eighth bit, it knows that the following bit is the first bit of the next code.

(Keep in mind that the meaning of a code depends entirely on the context in which it's used. For word processing, a code of 65 may represent the ASCII value for the character *a*. But for a sprite shape or hi-res graphics screen, the same code represents a pattern of dots. In a machine language program, 65 represents an EOR instruction, and so on.)

File Compressor saves space by storing the most often-used codes in fewer than eight bits. To illustrate, say that you wish to save a word processing document in compressed form. Before it saves the file, File Compressor scans the document to determine which seven characters appear most frequently. Let's say that those characters are *e*, *a*, *d*, *t*, *r*, *n*, and *l*. The program would create this coding table:

Code	1	2	3	4	5	6	7
Character	e	a	d	t	r	n	l

The decoding table is stored at the beginning of the disk file as well as in memory. Note that the most frequently used character (*e*, in this example) is stored in one bit rather than the usual eight. Throughout the saving process, File Compressor substitutes these short codes in place of the usual eight-bit codes. To reload the compressed data, the program reads the decoding table from disk and stores it, then decodes the file bit by bit.

Decoding the compressed file is somewhat trickier than compressing it. Because the file contains codes of varying sizes (anywhere from one to eight bits in length), it's necessary to use a special method for detecting the end of one code and the beginning of the next. File Compressor does this by using a 0 bit as an end-of-code marker. As it reads in each bit from disk, the program increments a counter to keep track of how many 1 bits it has read. When it finds a 0, it uses the counter value as an index to the decoding table. In this example, for instance, the decoding table indicates that six 1 bits stand for the ASCII

character *n*. Whenever File Compressor reads six 1 bits in a row, it stores that character in memory. Then it sets the counter back to zero and begins counting bits again. Three consecutive 1 bits stand for the letter *d*, and so on.

Since File Compressor crunches only the most often repeated codes, every compressed file also contains many normal eight-bit codes. A sequence of two consecutive 0 bits indicates that the program should read the next eight bits as an ordinary byte value. Thus, the 0 bit both marks the end of each compressed code and distinguishes between compressed and uncompressed codes.

One general consequence of this storage scheme is that the more repetition your data contains, the more you stand to gain by compressing it. File Compressor assumes that your disk drive is device 8, but you can change it to use device 9 if necessary. Load File Compressor into memory, then enter this line and press RETURN:

```
POKE 50599, 9
```

File Compressor

Please refer to the "MLX" article in this issue before entering the following listing.

```
C200:A5 2B 85 FB A5 2C 85 FC 79
C208:A0 00 B1 FB 20 1F C2 C8 9F
C210:D0 02 E6 FC A5 FC C5 2E 06
C218:90 F0 C4 2D 90 EC 60 84 0B
C220:02 85 FD A9 00 85 FE 06 7C
C228:FD 26 FE A5 FE 18 69 C0 5C
C230:85 FE A0 00 B1 FD 18 69 6B
C238:01 90 0B C8 B1 FD 18 69 6F
C240:01 91 FD 88 A9 00 91 FD 61
C248:A4 02 60 A9 00 A8 AA 85 C4
C250:FB 85 FD 85 FE A9 C0 85 F2
C258:FC 20 67 C2 C8 D0 02 E6 F1
C260:FC E8 D0 F5 A5 FF 60 B1 B7
C268:FB 85 14 C8 B1 FB 85 15 F9
C270:C5 FE B0 01 60 D0 07 A5 B8
C278:14 C5 FD B0 01 60 A5 14 2D
C280:85 FD A5 15 85 FE 86 FF 83
C288:60 A0 00 84 97 20 4B C2 45
C290:A4 97 99 CB C2 85 FB A9 0C
C298:00 85 FC 06 FB 26 FC A5 97
C2A0:FC 18 69 C0 85 FC A9 00 57
C2A8:A8 91 FB C8 91 FB A4 97 50
C2B0:C8 C0 07 D0 D6 60 A9 00 44
C2B8:A8 99 00 C0 99 00 C1 C8 1E
C2C0:D0 F7 A0 06 99 CB C2 88 2B
C2C8:30 FA 60 00 00 00 00 00 31
C2D0:00 00 02 06 0E 1E 3E 7E DA
C2D8:FE A9 00 85 FB A5 2C 85 F4
C2E0:FC A9 08 85 15 A4 2B B1 EB
C2E8:FB 84 D7 20 25 C3 20 4A 4D
C2F0:C3 A5 02 D0 09 A9 08 85 93
C2F8:FE A5 97 20 4A C3 A4 D7 DE
C300:C8 D0 02 E6 FC A5 FC C5 0D
C308:2E 90 DC C4 2D F0 D8 90 22
C310:D6 A5 15 F0 0F A9 00 38 75
C318:2A 06 14 C6 15 D0 F8 05 08
C320:14 20 D2 FF 60 A2 06 DD 8B
C328:CB C2 D0 0C A9 80 85 02 7D
C330:BD D2 C2 E8 E8 86 FE 60 F1
C338:CA 10 EC 48 A9 00 85 02 A5
C340:A9 01 85 FE 68 85 97 A9 AF
C348:00 60 85 FD A4 FE 46 FD 24
C350:66 FF 88 D0 F9 06 FF 26 37
C358:14 C6 FE C6 15 D0 03 20 F9
C360:67 C3 A5 FE D0 EF 60 A5 DD
C368:14 20 D2 FF A9 08 85 15 E9
C370:60 A2 02 20 C9 FF 20 B6 58
C378:C2 20 00 C2 20 89 C2 20 62
C380:1F C4 20 D9 C2 20 CC FF 9A
C388:A9 02 20 C3 FF AD AB 02 B5
```

```
C390:30 0E A0 00 B9 A1 C3 F0 94
C398:07 20 D2 FF C8 4C 94 C3 6A
C3A0:60 0D 43 52 55 4E 43 48 DB
C3A8:49 4E 47 20 43 4F 4D 50 95
C3B0:4C 45 54 45 2E 00 A0 00 41
C3B8:B9 07 C4 F0 07 20 D2 FF E4
C3C0:C8 4C B8 C3 20 CC FF 20 67
C3C8:E7 FF A0 00 20 CF FF C9 62
C3D0:0D F0 07 99 40 03 C8 4C 81
C3D8:CC C3 A9 2C 99 40 03 99 1D
C3E0:42 03 C8 A9 50 99 40 03 6A
C3E8:C8 C8 A9 57 99 40 03 C8 4E
C3F0:98 A0 03 A2 40 20 BD FF 75
C3F8:A9 02 AE A7 C5 A8 20 BA F1
C400:FF 20 C0 FF 4C 71 C3 4E A7
C408:41 4D 45 20 4F 46 20 46 4A
C410:49 4C 45 20 54 4F 20 43 5F
C418:52 55 4E 43 48 3A 00 A0 E9
C420:00 B9 CB C2 20 D2 FF C8 D2
C428:C0 07 D0 F5 60 A5 62 C9 75
C430:08 F0 05 E6 62 06 63 60 5B
C438:20 47 C4 20 CF FF 85 63 2B
C440:A9 00 85 62 4C 2D C4 A5 BB
C448:90 D0 01 60 68 68 68 68 92
C450:68 68 4C A1 C4 A9 00 85 1E
C458:65 20 2D C4 90 05 E6 65 5A
C460:4C 59 C4 A5 65 F0 06 A8 FC
C468:88 B9 CB C2 60 A9 00 85 79
C470:64 A0 08 20 2D C4 26 64 84
C478:88 D0 F8 A5 64 60 A2 02 DF
C480:20 C6 FF A5 2B 85 FB A5 33
C488:2C 85 FC 20 71 C5 A0 00 0F
C490:84 02 20 55 C4 A4 02 91 84
C498:FB C8 D0 02 E6 FC 4C 90 E0
C4A0:C4 20 CC FF A9 02 20 C3 87
C4A8:FF AD AB 02 10 01 60 A5 1E
C4B0:02 85 2D A5 FC 85 2E A0 97
C4B8:00 B9 EB C4 F0 07 20 D2 31
C4C0:FF C8 4C B9 C4 A5 2C 85 3C
C4C8:FC A9 00 85 FB A4 2B A2 FE
C4D0:00 C8 D0 02 E6 FC B1 FB 51
C4D8:D0 F5 E8 E0 03 D0 F2 C8 7D
C4E0:D0 02 E6 FC 84 2D A5 FC 21
C4E8:85 2E 60 0D 46 49 4C 45 D2
C4F0:20 44 45 43 4F 44 49 4E E4
C4F8:47 20 43 4F 4D 50 4C 45 15
C500:54 45 2E 00 A0 00 B9 59 9E
C508:C5 F0 07 20 D2 FF C8 4C 0A
C510:06 C5 20 CC FF 20 E7 FF 31
C518:A0 00 20 CF FF C9 0D F0 27
C520:07 99 40 03 C8 4C 1A C5 3F
C528:A9 2C 99 40 03 99 42 03 D0
C530:C8 A9 50 99 40 03 C8 C8 96
C538:A9 52 99 40 03 C8 98 A2 73
C540:40 A0 03 20 BD FF A9 02 B9
C548:AE A7 C5 A8 20 BA FF 20 64
C550:C0 FF A9 08 85 62 4C 7E BE
C558:C4 4E 41 4D 45 20 4F 46 66
C560:20 46 49 4C 45 20 54 4F 1E
C568:20 44 45 43 4F 44 45 3A 42
C570:00 A0 00 20 CF FF 99 CB A3
C578:C2 C8 C0 07 D0 F5 60 48 87
C580:A5 B7 D0 09 8D AB 02 68 FE
C588:20 B6 C3 18 60 68 4C ED F6
C590:F5 48 A5 B7 D0 09 8D AB CA
C598:02 68 20 04 C5 18 60 68 3B
C5A0:4C A5 F4 7F C5 91 C5 08 5A
C5A8:AD A5 C5 8D 30 03 AD A6 95
C5B0:C5 8D 31 03 AD A3 C5 8D ED
C5B8:32 03 AD A4 C5 8D 33 03 EB
C5C0:60 AD A7 02 A4 2B 85 2B 05
C5C8:8C A7 02 AD A8 02 A4 2C 62
C5D0:85 2C 8C A8 02 AD A9 02 62
C5D8:A4 2D 85 2D 8C A9 02 AD 42
C5E0:AA 02 A4 2E 85 2E 8C AA 62
C5E8:02 60 20 C1 C5 A9 80 8D 11
C5F0:AB 02 A0 FF C8 B9 40 03 97
C5F8:D0 FA 98 20 3F C5 4C C1 2C
C600:C5 20 C1 C5 A9 80 8D AB 23
C608:02 A0 FF C8 B9 40 03 D0 F0
C610:FA 98 20 F1 C3 4C C1 C5 FC
```

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Label Master

Shamir Juma

Many label-printing programs are available, but how many of them allow you to put custom high-resolution graphics designs on your labels? "Label Master," an all machine language utility program for the Commodore 64, does exactly that. A joystick and Commodore 1525/801/803 or compatible printer are required.

"Label Master" lets you add a personal touch to printed labels by mixing high-resolution graphics designs with text. Although Label Master is as easy to use as a BASIC program, it's written entirely in machine language for maximum speed. Thus, you'll need to enter the program with the "MLX" machine language entry program listed elsewhere in this issue. Follow the MLX instructions carefully. When you run MLX, you'll be asked for a starting address and an ending address for the data you'll be entering. Here are the addresses required for Label Master:

Starting address: 0801
Ending address: 0EF8

Label Master is designed to save and load high-res graphics files from disk. If you use tape instead of disk, follow these steps to convert Label Master to work with a cassette drive:

1. Enter and save Program 1 with MLX.
2. Load Program 1 into memory.
3. Type the following line in direct mode (without a line number) and press RETURN:

POKE 2738,1:POKE 2786,1

4. Save Label Master under a new name.

No matter whether you use disk or tape, Label Master loads and runs like an ordinary BASIC program.

High-Res Graphics Labels

Plug a joystick into port 2 before you run Label Master. When you run the program, it displays a grid 40 dots wide and 21 dots high. The letter *T* in the upper right corner of the screen reminds you that this is the top half of the graphics design grid. To switch to the bottom half, press the f1 function key. The screen now displays a *B* in the upper right corner. To return to the top half, simply press f1 again.

The reverse-video dot in the upper left corner of the grid is the graphics cursor, which you can move with the joystick. To create a dot at the current location, press the plus (+) key. To erase a dot, press the minus (−) key. With these simple controls, you can draw a hi-res design that occupies the full design grid.

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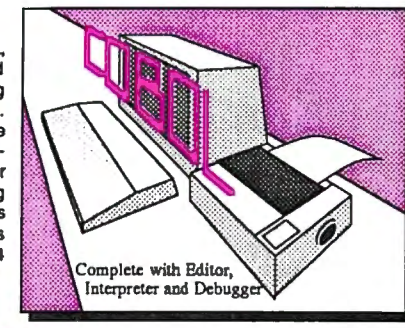

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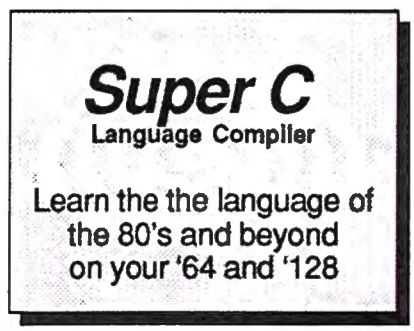

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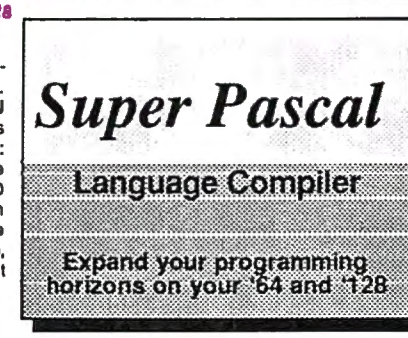

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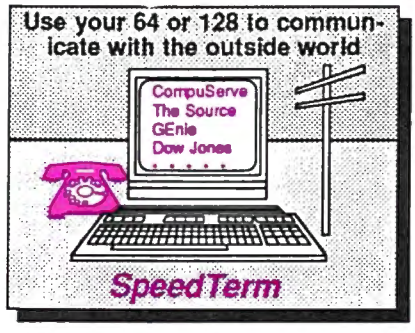

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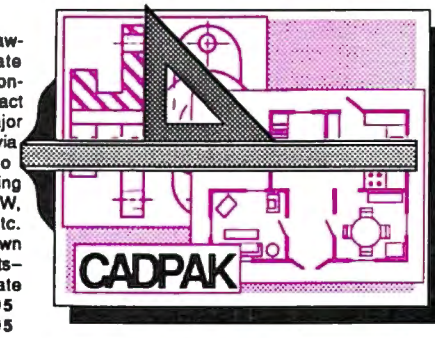

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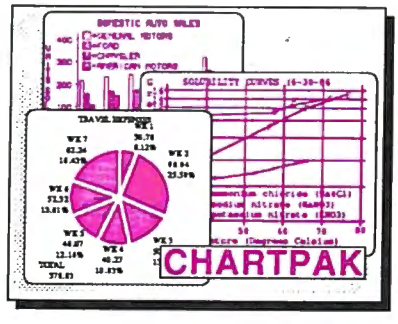

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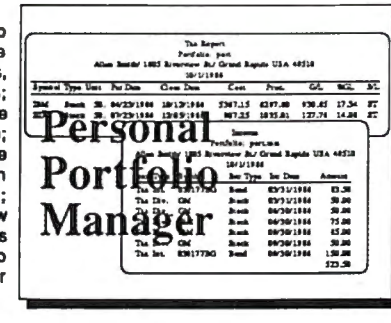

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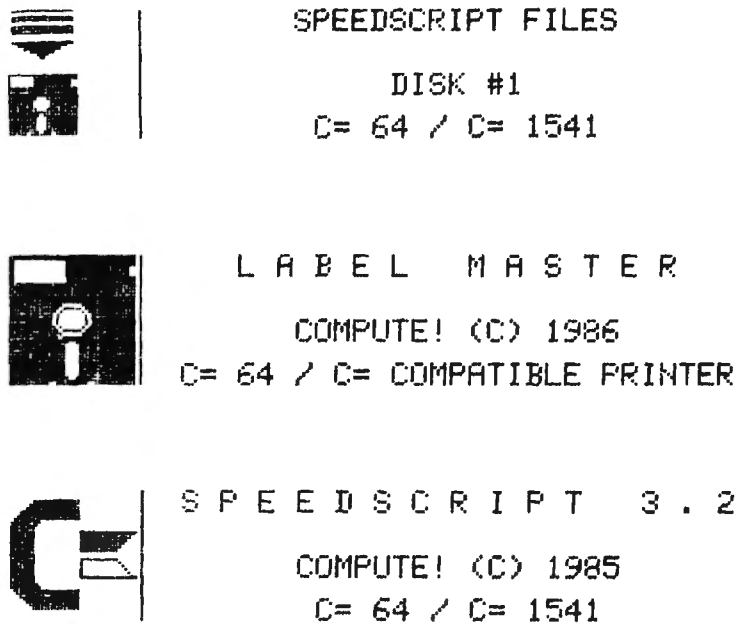

Once the design is complete, press f5 to save it. Label Master prompts you to enter a filename for the design file. After you enter a filename, Label Master saves the graphics information in a disk or tape file. If you change your mind and decide not to save the file, press f1 without entering a filename. Label Master returns you to the design screen.

You can also load a previously created design file. Press f3 and enter the desired filename when prompted. Again, press f1 to return to the design screen if you decide not to load a file.

Adding Text

Once you're satisfied with the graphics portion of the label, press f7 to enter text mode. In this mode, Label Master displays a space in the middle of the screen where you may enter text. To allow some extra flexibility, Label Master provides slightly more text space than you'll need for a standard label (standard labels permit only about 24-character lines).

The blinking cursor shows your position in the text entry space. Since this space is so small, Label Master provides only a few simple editing functions. To enter text, simply type the desired characters. The space bar moves the cursor forward, and DEL deletes a character. To move from the upper line to the lower line, press the cursor-down key. You may clear the text-entry space and home the cursor by pressing SHIFT-CLR/HOME. Press f1 if you wish to exit the text screen and return to the graphics design screen.

When all the text has been entered, press f3. Label Master displays a prompt to remind you that you have two options. If you're ready to print the label, press f3 a second time. If you change your mind and wish to reenter the text, press f1: The text area is cleared, and you may type in whatever you like.

Be sure that the printer is connected and turned on before you attempt to print a label. Label Master is designed to work with the Commodore 1525 and MPS-801 or 803 printer. It can also be used with third-party printers if your printer interface can duplicate 1525/801/803 high-resolution printing (most interfaces can). The program will not work with the Commodore 1526 or MPS-802 printer.

Label Master

Please refer to the "MLX" article in this issue before entering the following program.

```
0801:0B 08 0A 00 9E 32 30 37 2F
0809:30 00 00 00 00 00 00 00 31
0811:00 00 00 00 00 00 A9 02 85 51
0819:FD 8D 20 D0 A9 50 85 FB 32
0821:A9 04 85 FC 18 A9 00 8D 7C
0829:21 D0 A9 93 20 D2 FF A0 59
0831:00 A9 2E A0 00 99 00 C0 A2
0839:99 FF C0 99 FE C1 99 FD F7
0841:C2 99 FC C3 99 FB C4 99 D4
0849:FA C5 99 50 04 99 4F 05 AA
0851:99 4E 06 99 98 06 88 D0 DA
0859:DC A0 00 20 7B 0B A0 00 4B
0861:B1 FB 49 80 91 FB AD 00 52
0869:DC C9 7E D0 20 38 A5 FB 60
0871:E9 28 85 FE A5 FC E9 00 16
0879:85 FF A0 00 B1 FE C9 20 9D
0881:F0 5D A5 FE 85 FB A5 FF 6D
0889:85 FC 4C E0 08 C9 77 D0 5A
0891:11 A0 01 B1 FB C9 20 F0 C5
0899:46 E6 FB D0 42 E6 FC 4C 07
08A1:E0 08 C9 7B D0 20 38 A5 32
08A9:FB E9 01 85 FE A5 FC E9 1D
08B1:00 85 FF A0 00 B1 FE C9 BB
08B9:20 F0 24 A5 FE 85 FB A5 A0
08C1:FF 85 FC 4C E0 08 C9 7D CF
08C9:D0 15 A0 28 B1 FB C9 20 4F
08D1:F0 0D 18 A5 FB 69 28 85 56
08D9:FB A5 FC 69 00 85 FC A0 38
08E1:00 18 B1 FB 09 80 91 FB 57
08E9:A5 C5 C9 04 D0 06 20 38 CE
08F1:09 4C 2B 09 C9 28 D0 09 29
08F9:A9 D1 A0 00 91 FB 4C 2B A7
0901:09 C9 2B D0 09 A9 AE A0 69
0909:00 91 FB 4C 2B 09 C9 14 E8
0911:D0 03 4C 1D 0B C9 05 D0 02
0919:03 4C CD 0A C9 06 D0 03 25
0921:4C DF 09 C9 03 D0 03 4C BC
0929:BF 0B A2 32 A0 00 88 D0 3C
0931:FD CA D0 FA 4C 5F 08 A0 4F
0939:00 B1 FB 49 80 91 FB A5 B3
0941:FD C9 01 F0 03 4C 93 09 6D
0949:E6 FD A0 00 B9 50 04 99 13
0951:48 C3 B9 4F 05 99 47 C4 86
0959:B9 4E 06 99 46 C5 B9 98 8B
0961:06 99 90 C5 C8 D0 E5 A0 41
0969:00 B9 00 C0 99 50 04 B9 C5
0971:FF C0 99 4F 05 B9 FE C1 AA
0979:99 4E 06 B9 48 C2 99 98 61
0981:06 C8 D0 E5 A9 94 8D 27 23
0989:04 A0 00 B1 FB 09 80 91 77
0991:FB 60 A9 01 85 FD A0 00 64
0999:B9 50 04 99 00 C0 B9 4F 7C
09A1:05 99 FF C0 B9 4E 06 99 55
09A9:FE C1 B9 98 06 99 48 C2 56
09B1:C8 D0 E5 A0 00 B9 48 C3 5E
09B9:99 50 04 B9 47 C4 99 4F 98
09C1:05 B9 46 C5 99 4E 06 B9 B5
09C9:90 C5 99 98 06 C8 D0 E5 2D
09D1:A9 82 8D 27 04 A0 00 B1 D1
09D9:FB 09 80 91 FB 60 20 38 2F
09E1:09 20 E8 09 4C A0 0A A9 D0
09E9:93 20 D2 FF A0 00 B9 FD 9E
09F1:09 C9 00 F0 12 20 D2 FF C0
09F9:C8 4C EF 09 1C 46 49 4C EA
0A01:45 4E 41 4D 45 3A 00 18 73
0A09:A2 00 A0 0B 20 F0 FF 86 7E
0A11:C6 A9 00 85 CC A9 00 85 DD
0A19:CF 20 E4 FF C9 00 F0 F5 DF
0A21:C9 11 F0 F1 C9 13 F0 ED 06
0A29:C9 1D F0 E9 C9 91 F0 E5 82
0A31:C9 9D F0 E1 C9 0D D0 1B 0D
0A39:AD 0B 04 C9 20 F0 D6 C9 40
0A41:A0 F0 D2 A0 01 84 CC 88 82
0A49:84 CF A9 20 20 D2 FF 20 37
0A51:82 0A 60 C9 85 D0 0A A0 F5
0A59:01 84 CC 88 84 CF 4C F0 1E
0A61:0A C9 14 D0 0E 38 20 F0 FE
0A69:FF C0 0B F0 A8 20 D2 FF 89
```

```
0A71:4C 16 0A 38 20 F0 FF C0 7B
0A79:1B F0 9A 20 D2 FF 4C 16 F1
0A81:0A A0 00 18 B9 0B 04 C9 10
0A89:1F 10 05 69 40 4C 97 0A D4
0A91:C9 40 30 02 A9 20 99 F3 B5
0A99:0E C8 C0 10 D0 E5 60 20 FE
0AA1:CC FF 20 4F 0B A9 10 A2 D6
0AA9:F3 A0 0E 20 BD FF A9 00 E4
0AB1:A2 08 A0 FF 85 FE 20 BA 50
0AB9:FF A9 C0 85 FF A9 FE A2 EF
0AC1:FA A0 C6 20 D8 FF 20 CC 2A
0AC9:FF 4C F0 0A 20 CC FF 20 04
0AD1:E8 09 20 6A 0B A9 10 A2 09
0AD9:F3 A0 0E 20 BD FF A9 00 15
0AE1:A2 08 A0 01 20 BA FF A9 03
0AE9:00 20 D5 FF 20 CC FF A9 9E
0AF1:93 20 D2 FF 20 7B 0B A9 E0
0AF9:02 85 FD A0 00 A9 50 85 07
0B01:FB A9 04 85 FC 20 6A 09 9E
0B09:4C 5F 08 13 1C 12 53 55 74
0B11:52 45 20 28 59 2F 4E 29 75
0B19:20 20 92 00 A0 00 B9 0C 1E
0B21:0B C9 00 F0 07 20 D2 FF 9C
0B29:C8 4C 1F 0B A5 C5 C9 40 63
0B31:F0 FA C9 19 D0 03 4C 16 8A
0B39:08 C9 27 D0 EF 20 7B 0B B9
0B41:4C 2B 09 13 53 41 56 49 30
0B49:4E 47 2E 2E 2E 00 A0 00 B3
0B51:B9 44 0B C9 00 F0 60 20 F7
0B59:D2 FF C8 4C 51 0B 13 4C DF
0B61:4F 41 44 49 4E 47 2E 2E A6
0B69:00 A0 00 B9 5F 0B C9 00 FD
0B71:F0 45 20 D2 FF C8 4C 6C AA
0B79:0B 60 A0 00 B9 8B 0B C9 1D
0B81:00 F0 F6 20 D2 FF C8 4C 29
0B89:7D 0B 13 1C 12 4C 41 42 CB
0B91:45 4C 20 4D 41 53 54 45 7B
0B99:52 20 20 20 20 20 20 20 C8
0BA1:20 20 20 20 20 20 20 20 B7
0BA9:20 20 20 20 20 20 20 20 BF
0BB1:20 20 20 20 54 92 00 A0 73
0BB9:00 60 00 00 00 00 20 38 60
0BC1:09 A9 00 8D BD 0B 8D BE 93
0BC9:0B 85 FE 8D BB 0B A9 C0 9D
0BD1:85 FF 8D BC 0B 20 0C 0C 25
0BD9:EE BD 0B AC BD 0B C0 06 A4
0BE1:D0 03 4C 91 0C 18 AD BB 9B
0BE9:0B 69 18 8D BB 0B 85 FE CF
0BF1:AD BC 0B 69 01 8D BC 0B C8
0BF9:85 FF 4C D6 0B 18 A5 FE CC
0C01:69 28 85 FE A5 FF 69 00 78
0C09:85 FF 60 A0 00 A2 00 B1 36
0C11:FE C9 2E F0 01 E8 20 FE DA
0C19:0B B1 FE C9 2E F0 02 E8 C1
0C21:E8 20 FE 0B B1 FE C9 2E 91
0C29:F0 04 E8 E8 E8 20 FE 90
0C31:0B B1 FE C9 2E F0 05 18 0F
0C39:8A 69 08 AA 20 FE 0B B1 61
0C41:FE C9 2E F0 05 18 8A 69 27
0C49:10 AA 20 FE 0B B1 FE C9 EE
0C51:2E F0 05 18 8A 69 20 AA C3
0C59:20 FE 0B B1 FE C9 2E F0 2A
0C61:05 18 8A 69 40 AA 18 8A 51
0C69:69 80 8C 8F 0C AC BE 0B 7C
0C71:99 30 75 C8 8C BE 0B AC BF
0C79:8F 0C C8 C0 28 F0 10 AD 54
0C81:BB 0B 85 FE AD BC 0B 85 D6
0C89:FF A2 00 4C 10 0C 00 60 20
0C91:A0 00 B9 A1 0C C9 00 F0 C3
0C99:34 20 D2 FF C8 4C 93 0C D8
0CA1:93 1C 12 45 4E 54 45 52 C1
0CA9:20 54 45 58 54 3A 20 20 01
0CB1:20 20 20 20 20 20 20 20 C9
0CB9:20 20 20 20 20 20 20 20 D1
0CC1:27 46 33 27 20 2D 20 44 12
0CC9:4F 4E 45 92 00 18 A0 05 95
0CD1:A2 0A 20 F0 FF A9 75 8D EF
0CD9:94 05 8D BC 05 8D E4 05 28
0CE1:A0 1F 99 94 05 99 BC 05 9B
0CE9:99 E4 05 A9 1E 8D 11 06 92
0CF1:8D 16 06 8D 1B 06 8D 20 1C
0CF9:06 8D 25 06 8D 2A 06 A9 48
0D01:00 85 CC 85 C6 A9 05 8D E2
0D09:3C 03 8D 3D 03 8D 3E 03 55
0D11:20 E4 FF C9 00 F0 F9 A0 69
0D19:00 84 CF C9 86 D0 0D 84 01
0D21:CF C8 84 CC A9 20 20 D2 93
0D29:FF 4C F5 0D C9 0D F0 E0 2B
0D31:C9 13 F0 DC C9 93 D0 03 22
0D39:4C 91 0C C9 1D F0 D1 C9 16
0D41:91 F0 CD C9 9D F0 C9 C9 C4
0D49:14 D0 10 A9 20 20 D2 FF 65
0D51:A9 9D 20 D2 FF 20 D2 FF FE
0D59:4C AE 0D C9 11 D0 3D A9 73
0D61:20 20 D2 FF 38 20 F0 FF 12
0D69:88 E0 0A D0 0E 8C 3C 03 6C
0D71:AC 3D 03 E8 18 20 F0 FF 43
0D79:4C 11 0D E0 0B D0 0E 8C F1
0D81:3D 03 AC 3E 03 E8 18 20 80
0D89:F0 FF 4C 11 0D 8C 3E 03 D0
0D91:AC 3C 03 A2 0A 18 20 F0 7D
0D99:FF 4C 11 0D C9 85 D0 0A C9
0DA1:A0 01 85 CC 88 85 CF 4C 10
0DA9:F0 0A 20 D2 FF 38 20 F0 02
0DB1:FF C0 23 30 06 A0 22 18 72
0DB9:20 F0 FF C0 05 10 05 A9 48
0DC1:B5 20 D2 FF 4C 11 0D 13 EC
0DC9:1E 12 27 46 31 27 20 2D 54
0DD1:20 52 45 43 4F 4E 53 49 11
0DD9:44 45 52 20 20 20 20 20 95
0DE1:27 46 33 27 20 2D 20 50 40
0DE9:52 49 4E 54 20 4C 41 42 85
0DF1:45 4C 92 00 A9 00 85 C6 33
0DF9:A0 00 B9 C8 0D C9 00 F0 A8
0E01:07 20 D2 FF C8 4C FB 0D 7F
0E09:20 E4 FF C9 00 F0 F9 C9 8C
0E11:86 F0 07 C9 85 D0 F1 4C C9
0E19:91 0C A9 04 85 B8 A9 04 DC
0E21:85 BA A9 00 85 B7 20 C1 F0
0E29:E1 20 CC FF A2 04 20 C9 07
0E31:FF A9 8D 20 D2 FF 4C 87 22
0E39:0E A9 08 20 D2 FF A9 0D C0
0E41:20 D2 FF B1 FC 20 D2 FF 4B
0E49:C8 C0 28 D0 F6 20 6F 0E 31
0E51:60 B1 FE 20 60 0E 20 D2 3A
0E59:FF C8 C0 1E D0 F3 60 18 D0
0E61:C9 1F 10 03 69 40 60 C9 33
0E69:40 30 02 69 20 60 A9 80 DE
0E71:20 D2 FF A9 FF 20 D2 FF 13
0E79:A9 0F 20 D2 FF A9 20 20 66
0E81:D2 FF 20 D2 FF 60 A9 30 3D
0E89:A0 75 85 FC 84 FD A0 00 31
0E91:20 3A 0E A9 94 A0 05 85 5F
0E99:FE 84 FF A0 00 20 52 0E 93
0EA1:A9 58 85 FC A0 00 20 3A A8
0EA9:0E A9 80 85 FC A0 00 20 2A
0EB1:3A 0E A9 A8 85 FC A0 00 8F
0EB9:20 3A 0E A9 BC 85 FE A0 6B
0EC1:00 20 52 0E A9 D0 85 FC A9
0EC9:A0 00 20 3A 0E A9 F8 85 6C
0ED1:FC A0 00 20 3A 0E A9 E4 D8
0ED9:85 FE A0 00 20 52 0E A9 9C
0EE1:0D 20 D2 FF A9 04 20 C3 48
0EE9:FF 20 E7 FF 20 CC FF 4C 8B
0EF1:91 0C 20 D3 CA 00 00 00 71
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Wari

Don Donati

"Wari," based on an ancient strategy game, lets you match your wits against the computer. The original version of this program is written for the Commodore 64. We've included translations for the Apple II series, Atari 520ST and 1040ST, IBM PC/PCjr, Amiga, and Atari 400, 800, XL, and XE. The IBM PC/PCjr game requires a color/graphics card for the PC.

"Wari" is a strategy game which has been played for centuries in Africa and the Middle East. The object of the game is to capture as many of your opponent's pieces as you can, while trying to prevent the capture of your own pieces. Type in the version of Wari for your computer and read the specific instructions for your machine before you run the program.

Electronic Beans

Wari is played on a board which has 12 compartments arranged in two rows of 6 (the arrangement is similar to that of an egg carton). In the original versions of this game, the compartments were actual depressions in a board or simply holes scooped into the ground, and the game was played by moving counters (beans, pebbles, or other small objects) among the various compartments. In the computerized version of Wari, the compartments are rectangles drawn on the screen, and the counters are represented by numbers. If the number 4 appears in a compartment, that compartment holds four counters, and so on.

Six of the compartments are yours and the other six belong to your opponent, which is always the computer. When the game begins, four counters are placed in each of the 12 compartments, for a total of 48 counters. Each player, then, starts the game with 24 counters. Once play begins, however, counters are considered yours when they rest in one of the six compartments on your side of the board. The program then asks whether you or the computer should make the first move.

Counterclockwise Movement

A move consists of taking all the counters from one compartment on your side of the board and sowing, or distributing, one counter into each of the adjacent compartments in a counterclockwise direction. In the original game, this was done by picking up the counters and sowing them by hand. In this version of Wari, you simply indicate which compartment you wish to sow by pressing the letter key printed by that compartment. The computer automatically sows that compartment's counters for you.

The figures illustrate the effect of making a move at the beginning of a game in which you have chosen to move first. Figure 1 shows the board

before a move is made. Each compartment contains four counters, represented by the number 4.

Figure 1: Before The First Move

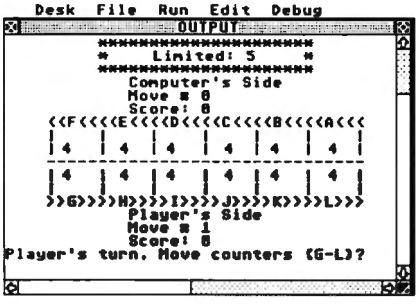
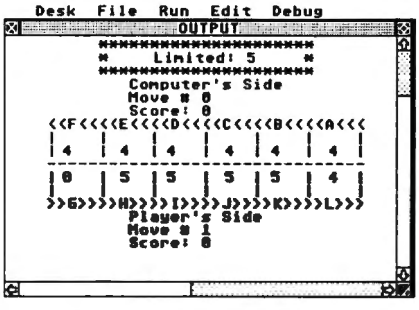


Figure 2 shows the board after you press the G key. The four counters from compartment G are sown in compartments H, I, J, and K. Each of those compartments now contains five counters; the original compartment (G) is now empty.

Figure 2: After The First Move



Depending on which compartment you sow, the sowing can wrap around from one side of the board to the other. For instance, say that your next move sows the counters from compartment H: Compartments I, J, and K now contain 6 counters; compartment L contains 5 counters, and the fifth counter from compartment H is sown in compartment A. Should you sow 12 or more counters, you return to the compartment where you started: In that case the original compartment is skipped and sowing resumes in the next one.

Captures

You score points in Wari by capturing counters. A capture occurs when you sow your last counter in an opponent's compartment which previously contained either one or two counters. The counters from that compartment are then removed from play. Each captured counter is equal to one point. If the previous compartment in line also contains two or three counters at the end of the move, its counters are captured, as well. This process continues until no more counters can be captured in that turn (in some cases, it's possible capture all of your opponent's counters in a single move).

The game can end in several different ways. Play must end whenever the board is empty (all counters have been captured) or whenever one player has no more counters to move. The game also ends when one player has captured more than half of the counters (if you have more than 24 counters, it's numerically impossible for your opponent to win the game). Wari also permits a stalemate, where each player chases the other around the board fruitlessly; a stalemate game should be ended by mutual agreement.

At the end of the game, your score is increased by the number of counters remaining on your side of the board. The computer automatically totals the score and announces the winner. You may end the game at any time by pressing the *Q* key.

Game Limits

At the beginning of each game, the computer also asks whether you wish to play a limited or unlimited game. A limited game consists of a set number of moves for each player; an unlimited game lasts until the game ends in one of the ways described above. Press L for a limited game or U for an unlimited game.

Limits of 25–35 moves make for interesting games. In a very short limited game (say, five moves) it's usually more important to protect counters on your side of the board than to capture the opponent's counters (when the game ends, you are awarded all the counters on your side).

Commodore 64 Version

The Commodore version of Wari (Program 1) runs on any Commodore 64 (or 64C), and also in 64 mode on the Commodore 128.

Apple II Version

This version of Wari (Program 2) runs on any Apple II–series computer, under either ProDOS or DOS 3.3.

Atari ST Version

Wari for the ST (Program 3) looks best on a color monitor set to low resolution, but it can be played in any screen resolution, including high resolution on a monochrome monitor.

IBM PC/PCjr Version

A color/graphics card is required to play Wari on the IBM PC (Program 4).

Amiga Version

The Amiga version of Wari (Program 5) runs on any Amiga computer.

Atari 400, 800, XL, And XE Version

This version of Wari (Program 6) runs on any eight-bit Atari computer.

For instructions on entering these programs, please refer to "COMPUTE!'s Guide to Typing In Programs" in this issue of COMPUTE!.

Program 1: Commodore 64 Wari

```
EG 10 DIM A(12),B(12),SC(12),I
      (12)
EM 20 D$="{HOME}{22 DOWN}"
MK 30 S$="{39 SPACES}"
MP 40 DS$=D$+S$+D$
RJ 50 POKE 53280,0:POKE 53281,
      0:PRINT CHR$(147);
KM 60 PRINT TAB(9)"{YEL}******
      ***************"
GD 70 PRINT TAB(9)"*{RVS}{7}
      {19 SPACES}{OFF}{YEL}*"
FD 80 PRINT TAB(9)"*{RVS}{7} C
      OMMODORE 64 WARI {OFF}
      {YEL}*"
AC 90 PRINT TAB(9)"*{RVS}{7}
      {19 SPACES}{OFF}{YEL}*"
AR 100 PRINT TAB(9)"**********
       ***********"
BQ 110 PRINT:PRINT TAB(12)"
       {CYN}COMPUTER'S SIDE":C
       P=0:MC=0
AG 120 PRINT TAB(12)"{PUR}MOVE
        #{7}"MC:PRINT TAB(12)"
       {PUR}SCORE:{3}"CP
HK 130 PRINT:PRINT"{6}
       {4 SPACES}<<F<<<<E<<<<D
       <<<<C<<<<B<<<<A<<<"
SQ 140 PRINT"{7}{4 SPACES}-
       {4 SPACES}-{4 SPACES}-
       {4 SPACES}-{4 SPACES}-
       {4 SPACES}-{4 SPACES}-"
AC 150 PRINT"{4 SPACES}-
       {4 SPACES}-{4 SPACES}-
       {4 SPACES}-{4 SPACES}-
       {4 SPACES}-{4 SPACES}-"
```

The Commodore 64 version of "Wari," an ancient strategy game.

```
CK 160 PRINT"{4 SPACES}{Q}CCCC
       +CCCC+CCCC+CCCC+CCCC+CC
       CC{W}"
JE 170 PRINT"{4 SPACES}-
       {4 SPACES}-{4 SPACES}-
       {4 SPACES}-{4 SPACES}-
       {4 SPACES}-{4 SPACES}-"
QH 180 PRINT"{4 SPACES}-
       {4 SPACES}-{4 SPACES}-
       {4 SPACES}-{4 SPACES}-
       {4 SPACES}-{4 SPACES}-"
MF 190 PRINT"{6}{4 SPACES}>>G>
       >>>H>>>>I>>>>J>>>>K>>>>
       L>>>"
BD 200 PRINT:PRINT TAB(12)"
       {WHT}PLAYER'S SIDE":PL=
       0:MP=0
FS 210 PRINT TAB(12)"{PUR}MOVE
       #{7}"MP:PRINT TAB(12)"
       {PUR}SCORE:{3}"PL
XM 220 FOR T=1 TO 12:A(T)=4:B(
       T)=4:GOSUB 1190:NEXT T
GA 230 REM ***GAME TYPE & FIRS
       T TURN***
QS 240 PRINT DS$"{YEL}{RVS}L
       {OFF}IMITED OR {RVS}U
       {OFF}NLIMITED GAME? ";
XP 250 GOSUB 1500:IF B$<>"L" A
       ND B$<>"U" THEN 250
HH 260 PRINT B$:FOR TM=1 TO 20
       0:NEXT TM:ML=0
DD 270 IF B$="U" THEN PRINT LE
       FT$(D$,4)TAB(15)"{RVS}
       {7}UNLIMITED{OFF}":GOTO
        310
AK 280 PRINT DS$"MOVE LIMIT";:
       INPUT ML
MM 290 ML=INT(ML):IF ML<=0 THE
       N 280
XF 300 PRINT LEFT$(D$,4)TAB(14
       )"{RVS}{7}LIMITED:"+STR
       $(ML)+"{OFF}"
GX 310 PRINT DS$"{8}WHO GOES F
       IRST: {RVS}C{OFF}OMPUTE
       R OR {RVS}P{OFF}LAYER?
       {SPACE}";
BB 320 GOSUB 1500:IF B$<>"C" A
       ND B$<>"P" THEN 320
CJ 330 PRINT B$:FOR TM=1 TO 20
       0:NEXT TM
BJ 340 IF B$="C" THEN 520
QC 350 REM ***PLAYER'S MOVE***
AK 360 P$="P":P=0:SP=0:MP=MP+1
HM 370 PRINT LEFT$(D$,20)TAB(1
       8)"{7}"MP
JB 380 FOR F=7 TO 12:P=P+A(F):
       NEXT F
QP 390 PRINT DS$"{WHT}PLAYER'S
        TURN. MOVE COUNTERS (G
       -L)";
JB 400 IF P=0 THEN 910
BA 410 GOSUB 1500:I=ASC(B$)-64
       :PRINT "{CYN}"B$
PR 420 IF B$="Q" THEN 1130
AP 430 IF B$>="G" AND B$<="L"
       {SPACE}THEN IF A(I)<>0
       {SPACE}THEN 460
MS 440 PRINT DS$"{1}ILLEGAL MO
       VE!!!"
MD 450 FOR TM=1 TO 900:NEXT TM
       :GOTO 390
GH 460 DS=1:GOSUB 1280:FOR TM=
       1 TO 900:NEXT TM
PP 470 PT=0:FOR F=1 TO 12:A(F)
       =B(F):PT=PT+A(F):NEXT F
AX 480 IF MP=ML AND MC=ML THEN
        970
GR 490 IF PT=0 THEN 910
KC 500 IF PL>24 THEN 970
KJ 510 REM ***COMPUTER'S MOVE*
       **
FR 520 P$="C":PA=0:PB=0:IA=0:I
       B=0:P=0:MC=MC+1
RM 530 PRINT LEFT$(D$,8)TAB(18
       )"{7}"MC
PQ 540 FOR F=1 TO 6:P=P+A(F):N
       EXT F
FF 550 PRINT DS$"{CYN}COMPUTER
       'S TURN. MOVES COUNTERS
        A-F. ";
PM 560 IF P=0 THEN 910
AC 570 REM ***CHECK ALL MOVES*
       **
EA 580 FOR G=1 TO 12
MM 590 SC(G)=0:I(G)=0
FX 600 IF G=7 THEN P$="P"
AR 610 IF A(G)=0 THEN 650
JP 620 SC=0:SP=0:I=G
AJ 630 DS=0:GOSUB 1280
ER 640 SC(G)=S1 OR S2:I(G)=T0
DR 650 NEXT G
PG 660 P$="C"
CJ 670 REM ***PICK BEST MOVE**
       *
MD 680 FOR F=1 TO 6
CH 690 IF PA>=SC(F) THEN 710
BP 700 IA=F:PA=SC(F)
CD 710 IF PB>=SC(F+6) OR A(I(F
       +6))=0 THEN 730
PP 720 IB=I(F+6):PB=SC(F+6)
KC 730 NEXT F
CE 740 IF IA=0 AND IB=0 THEN 7
       70
SQ 750 I=IA:IF PB>PA THEN I=IB
SE 760 GOTO 830
MM 770 P=0:FOR F=7 TO 12:P=P+A
       (F):NEXT F
RF 780 IF P<>0 THEN 820
FJ 790 FOR F=1 TO 5
BS 800 IF A(F)<>0 AND A(F)<=6-
       F THEN I=F:GOTO 830
QH 810 NEXT F
CH 820 I=INT(RND(0)*6)+1:IF A(
       I)=0 THEN 820
XF 830 PRINT "{WHT}"CHR$(I+64)
       :SC=0:FOR TM=1 TO 750:N
       EXT TM
EJ 840 DS=1:GOSUB 1280:FOR TM=
       1 TO 900:NEXT TM
BD 850 PT=0:FOR F=1 TO 12:A(F)
       =B(F):PT=PT+A(F):NEXT F
SH 860 IF MP=ML AND MC=ML THEN
        970
EF 870 IF PT=0 THEN 910
HH 880 IF CP>24 THEN 970
MQ 890 GOTO 360
HP 900 REM ***NO COUNTERS***
JX 910 FOR TM=1 TO 400:NEXT TM
CH 920 PRINT DS$"{1}NO COUNTER
       S!!! ";
MX 930 IF PT=0 THEN PRINT "{1}
       GAME OVER."
QF 940 FOR TM=1 TO 900:NEXT TM
HP 950 IF PT=0 THEN 1030
EJ 960 REM ***AWARD COUNTERS**
       *
MG 970 PRINT DS$"{1}GAME OVER.
        {YEL}AWARD COUNTERS."
EE 980 FOR F=1 TO 6
PH 990 P$="C":SC=A(F):T=F:B(T)
       =0:GOSUB 1190
HP 1000 P$="P":SP=A(F+6):T=F+6
       :B(T)=0:GOSUB 1190
JG 1010 NEXT F
CR 1020 REM ***WHO WON***
QM 1030 PRINT DS$;
PF 1040 IF PL=CP THEN PRINT "
       {CYN}A DRAW. ";:GOTO 1
       080
XM 1050 IF PL>CP THEN PRINT "
       {6}PLAYER WINS. ";:GOT
       O 1080
KK 1060 IF CP>PL THEN PRINT "
       {3}COMPUTER WINS. ";
AX 1070 REM ***ANOTHER GAME***
DH 1080 PRINT "{WHT}ANOTHER GA
       ME (Y/N)? ";
CR 1090 GOSUB 1500:IF B$<>"Y"
       {SPACE}AND B$<>"N" THE
       N 1090
DQ 1100 PRINT B$:IF B$="Y" THE
       N 20
PQ 1110 PRINT "{CLR}":END
RS 1120 REM ***QUIT GAME***
PD 1130 FOR TM=1 TO 100:NEXT T
       M
HS 1140 PRINT DS$"{1}QUIT GAME
       . ARE YOU SURE (Y/N)?
       {SPACE}";
QB 1150 GOSUB 1500:IF B$<>"Y"
       {SPACE}AND B$<>"N" THE
       N 1150
KA 1160 IF B$<>"Y"THEN 390
RS 1170 PRINT DS$;:PT=0:GOTO 9
       30
FH 1180 REM ***UPDATE DISPLAY*
       **
AJ 1190 PRINT LEFT$(D$,13-2*(T
       >6))"{WHT}";
CJ 1200 IF T<7 THEN TB=35-5*T:
       GOTO 1220
HX 1210 IF T>6 THEN TB=5*(T-6)
XJ 1220 PRINT TAB(TB)B(T);:IF
       {SPACE}B(T)<10 THEN PR
       INT "{LEFT} "
RP 1230 FOR TM=1 TO 300:NEXT T
       M
JH 1240 IF B(T)<>0 THEN RETURN
KJ 1250 IF P$="P" THEN GOSUB 1
       540:RETURN
DJ 1260 IF P$="C" THEN GOSUB 1
       590:RETURN
PH 1270 REM ***MOVE COUNTERS**
       *
ER 1280 T=I:S1=0:S2=0
ED 1290 FOR F=1 TO 12:B(F)=A(F
       ):NEXT F
ES 1300 B(T)=0:IF DS THEN GOSU
       B 1190
BC 1310 FOR F=1 TO A(T)
PJ 1320 T=T+1
GX 1330 IF T>12 THEN T=1
MD 1340 B(T)=B(T)+1:IF DS THEN
        GOSUB 1190
SJ 1350 NEXT F:T0=T
FX 1360 REM ***ANY CAPTURES***
CF 1370 IF B(T0)<2 OR B(T0)>3
       {SPACE}THEN RETURN
BA 1380 IF P$="P" AND T0<=6 TH
       EN 1420
```

```
PH 1390 IF P$="C" AND T0>=7 TH
        EN 1420
SG 1400 RETURN
BF 1410 REM ***TOTAL CAPTURES*
        **
RC 1420 LS=1:IF P$="C" THEN LS
        =7
SX 1430 FOR F=T0 TO LS STEP -1
XF 1440 IF B(F)<2 OR B(F)>3 TH
        EN RETURN
BG 1450 IF P$="P" THEN SP=B(F)
        :S2=S2+SP:GOTO 1470
HK 1460 IF P$="C" THEN SC=B(F)
        :S1=S1+SC
CF 1470 B(F)=0:IF DS THEN T=F:
        GOSUB 1190
HC 1480 NEXT F:RETURN
RK 1490 REM ***GET A CHARACTER
        ***
SQ 1500 GET B$:IF B$<>"" THEN
        {SPACE}1500
KX 1510 GET B$:IF B$="" THEN 1
        510
SS 1520 RETURN
PK 1530 REM ***DISPLAY PLAYER'
        S SCORE***
CD 1540 IF SP=0 THEN RETURN
DE 1550 FOR H=PL+1 TO PL+SP
ES 1560 PRINT LEFT$(D$,21)TAB(
        18)"[3]"H:GOSUB 1640
GA 1570 NEXT H:PL=PL+SP:RETURN
JB 1580 REM ***DISPLAY COMPUTE
        R'S SCORE***
KA 1590 IF SC=0 THEN RETURN
GJ 1600 FOR H=CP+1 TO CP+SC
SM 1610 PRINT LEFT$(D$,9)TAB(1
        8)"[3]"H:GOSUB 1640
GM 1620 NEXT H:CP=CP+SC:RETURN
HG 1630 REM ***SOUND***
AK 1640 S=54272:FOR X=S TO S+2
        4:POKE X,0:NEXT X
GJ 1650 POKE S+5,0:POKES+6,240
ER 1660 IF P$="C" THEN 1680
GJ 1670 POKE S+1,45:POKE S,135
        :POKE S+4,17:GOTO 1690
AX 1680 POKE S+1,8:POKE S,135:
        POKE S+2,255:POKE S+4,
        65
BG 1690 POKE S+24,15:FOR TM=1
        {SPACE}TO 50:NEXT TM:P
        OKE S+24,0
AK 1700 IF P$="C" THEN POKE S+
        4,64:RETURN
BX 1710 POKE S+4,16:RETURN
```

Program 2: Apple II Wari

Version by Patrick Parrish, Programming Supervisor

```
BA 10 DIM A(12),B(12),SC(12),I(1
      2)
5B 20 TEXT : HOME : PRINT "LOADI
      NG ML. PLEASE WAIT...": GO
      SUB 1670: GOSUB 1810
1F 30 IF PEEK (190 * 256) = 76 T
      HEN PRINT CHR$ (4)"PR#A768
      ": GOTO 50
84 40 POKE 54,0: POKE 55,3: CALL
       1002
E6 50 POKE 6,0: POKE 7,138: POKE
       230,64
F6 60 HGR2 : GOTO 100
F2 70 HTAB 10: PRINT "**********
      **********": RETURN
7E 80 PRINT TAB( 10)"*";: INVERS
      E : PRINT SPC( 19);: NORMA
      L : PRINT "*": RETURN
```

"Wari" for Apple II computers.

```
8D 90 VTAB 23: PRINT SPC( 39): H
      TAB 1: RETURN
5A 100 HOME : VTAB 1
7D 110 GOSUB 70
80 120 GOSUB 80
28 130 PRINT TAB( 10)"*";: INVER
      SE : PRINT "   ";: NORMAL
       : PRINT "APPLE ][ WARI";
      : INVERSE : PRINT "   ";:
       NORMAL : PRINT "*"
84 140 GOSUB 80
85 150 GOSUB 70
D4 160 PRINT : PRINT TAB( 13)"CO
      MPUTER'S SIDE":CP = 0:MC
      = 0
CA 170 PRINT TAB( 13)"MOVE # "MC
      : PRINT TAB( 13)"SCORE: "
      CP
03 180 PRINT : PRINT "     <<F<<<
      <E<<<<D<<<<C<<<<B<<<<A<<<
      "
B3 190 FOR J = 1 TO 2: FOR I = 1
       TO 7: PRINT "     $";: NE
      XT : PRINT : NEXT
68 200 PRINT "     %^^^^";: FOR I
       = 1 TO 5: PRINT "&^^^^";
      : NEXT : PRINT "@"
A4 210 FOR J = 1 TO 2: FOR I = 1
       TO 7: PRINT "     $";: NE
      XT : PRINT : NEXT
B7 220 PRINT "     >>G>>>>H>>>>I>
      >>>J>>>>K>>>>L>>>"
21 230 PRINT : PRINT TAB( 13)"PL
      AYER'S SIDE":PL = 0:MP =
      0
EC 240 PRINT TAB( 13)"MOVE # "MP
      : PRINT TAB( 13)"SCORE: "
      PL
75 250 FOR T = 1 TO 12:A(T) = 4:
      B(T) = 4: GOSUB 1220: NEX
      T
E4 260 REM *** GAME TYPE & FIRST
       TURN ***
F8 270 PRINT : VTAB 23: INVERSE
      : PRINT "L";: NORMAL : PR
      INT "IMITED OR ";: INVERS
      E : PRINT "U";: NORMAL :
      PRINT "NLIMITED GAME? ";
30 280 GOSUB 1530: IF B$ < > "L"
       AND B$ < > "U" THEN 280
DE 290 PRINT B$: FOR TM = 1 TO 2
      00: NEXT :ML = 0
34 300 IF B$ = "U" THEN VTAB 4:
      HTAB 16: PRINT "UNLIMITED
      ": GOTO 340
9E 310 GOSUB 90: HTAB 1: PRINT "
      MOVE LIMIT";: INPUT ML
B9 320 ML = INT (ML): IF ML < =
      0 THEN 310
6C 330 HTAB 15: VTAB 4: PRINT "L
      IMITED: " + STR$ (ML)
3B 340 VTAB 23: PRINT "WHO GOES
      FIRST: ";: INVERSE : PRIN
      T "C";: NORMAL : PRINT "O
      MPUTER OR ";: INVERSE : P
      RINT "P";: NORMAL : PRINT
       "LAYER? ";
2C 350 GOSUB 1530: IF B$ < > "C"
       AND B$ < > "P" THEN 20
B1 360 PRINT B$: FOR TM = 1 TO 2
      00: NEXT
47 370 IF B$ = "C" THEN 550
56 380 REM ** PLAYER'S MOVE **
34 390 P$ = "P":P = 0:SP = 0:MP
      = MP + 1
E1 400 VTAB 20: HTAB 20: PRINT M
      P
E9 410 FOR F = 7 TO 12:P = P + A
      (F): NEXT F
DB 420 GOSUB 90: PRINT "PLAYER'S
       TURN. MOVE COUNTERS (G-L
      )? ";
CD 430 IF P = 0 THEN 940
24 440 GOSUB 1530:I = ASC (B$) -
       64: PRINT B$
29 450 IF B$ = "Q" THEN 1160
70 460 IF B$ > = "G" AND B$ < =
      "L" THEN IF A(I) < > 0 TH
      EN 490
7F 470 GOSUB 90: PRINT "ILLEGAL
      MOVE!!!"
5E 480 FOR TM = 1 TO 900: NEXT T
      M: GOTO 420
A1 490 DS = 1: GOSUB 1310: FOR T
      M = 1 TO 900: NEXT
DF 500 PT = 0: FOR F = 1 TO 12:A
      (F) = B(F):PT = PT + A(F)
      : NEXT
2C 510 IF MP = ML AND MC = ML TH
      EN 1000
1C 520 IF PT = 0 THEN 940
0A 530 IF PL > 24 THEN 1000
AD 540 REM ** COMPUTER'S MOVE **
23 550 P$ = "C":PA = 0:PB = 0:IA
       = 0:IB = 0:P = 0:MC = MC
      + 1
F4 560 VTAB 8: HTAB 20: PRINT MC
22 570 FOR F = 1 TO 6:P = P + A(
      F): NEXT F
F2 580 GOSUB 90: PRINT "COMPUTER
      'S TURN. MOVES COUNTERS A
      -F. ";
DA 590 IF P = 0 THEN 940
D4 600 REM ** CHECK ALL MOVES **
8E 610 FOR G = 1 TO 12
6B 620 SC(G) = 0:I(G) = 0
4C 630 IF G = 7 THEN P$ = "P"
E0 640 IF A(G) = 0 THEN 680
2B 650 SC = 0:SP = 0:I = G
C9 660 DS = 0: GOSUB 1310
14 670 POKE 254,S1: POKE 255,S2:
       CALL 856:SC(G) = PEEK (2
      54):I(G) = T0
F1 680 NEXT G
A2 690 P$ = "C"
95 700 REM ** PICK BEST MOVE **
4C 710 FOR F = 1 TO 6
6C 720 IF PA > = SC(F) THEN 740
D4 730 IA = F:PA = SC(F)
D9 740 IF PB > = SC(F + 6) OR A(
      I(F + 6)) = 0 THEN 760
AA 750 IB = I(F + 6):PB = SC(F +
      6)
6E 760 NEXT F
41 770 IF IA = 0 AND IB = 0 THEN
       800
98 780 I = IA: IF (PB > PA) THEN
       I = IB
2C 790 GOTO 860
F4 800 P = 0: FOR F = 7 TO 12:P
      = P + A(F): NEXT F
B7 810 IF P < > 0 THEN 850
47 820 FOR F = 1 TO 5
72 830 IF A(F) < > 0 AND A(F) <
      = 6 - F THEN I = F: GOTO
      860
```

```
6B 840 NEXT F
7E 850 I = INT ( RND (1) * 6) +
       1: IF A(I) = 0 THEN 850
39 860 PRINT CHR$ (I + 64):SC =
       0: FOR TM = 1 TO 800: NEX
       T TM
A1 870 DS = 1: GOSUB 1310: FOR T
       M = 1 TO 900: NEXT
5F 880 PT = 0: FOR F = 1 TO 12:A
       (F) = B(F):PT = PT + A(F)
       : NEXT F
3F 890 IF MP = ML AND MC = ML TH
       EN 1000
1C 900 IF PT = 0 THEN 940
69 910 IF CP > 24 THEN 1000
A0 920 GOTO 390
56 930 REM ** NO COUNTERS **
D1 940 FOR TM = 1 TO 400: NEXT
95 950 GOSUB 90: PRINT "NO COUNT
       ERS!!! ";
DC 960 IF PT = 0 THEN PRINT "GAM
       E OVER."
62 970 FOR TM = 1 TO 1500: NEXT
DD 980 IF PT = 0 THEN 1060
B2 990 REM ** AWARD COUNTERS **
42 1000 PRINT : GOSUB 90: PRINT
       "GAME OVER. AWARD COUNTE
       RS."
3C 1010 FOR F = 1 TO 6
6A 1020 P$ = "C":SC = A(F):T = F
       :B(T) = 0: GOSUB 1220
FA 1030 P$ = "P":SP = A(F + 6):T
       = F + 6:B(T) = 0: GOSUB
       1220
78 1040 NEXT F
45 1050 REM ** WHO WON **
C2 1060 GOSUB 90
B5 1070 IF PL = CP THEN PRINT "A
       DRAW. ";: GOTO 1110
6F 1080 IF PL > CP THEN PRINT "P
       LAYER WINS. ";: GOTO 111
       0
49 1090 IF CP > PL THEN PRINT "C
       OMPUTER WINS.";
E5 1100 REM ** ANOTHER GAME **
76 1110 PRINT "ANOTHER GAME (Y/N
       )? ";
E5 1120 GOSUB 1530: IF B$ < > "Y
       " AND B$ < > "N" THEN 11
       20
5C 1130 PRINT B$: IF B$ = "Y" TH
       EN HGR2 : GOTO 100
5F 1140 TEXT : HOME : END
77 1150 REM ** QUIT GAME **
EC 1160 FOR TM = 1 TO 100: NEXT
C1 1170 GOSUB 90: PRINT "QUIT GA
       ME. ARE YOU SURE (Y/N)?
       "
81 1180 GOSUB 1530: IF B$ < > "Y
       " AND B$ < > "N" THEN 11
       80
EF 1190 IF B$ < > "Y" THEN 420
5E 1200 GOSUB 90:PT = 0: GOTO 96
       0
CE 1210 REM ** UPDATE DISPLAY **
FC 1220 VTAB 13 + 2 * (T > 6)
F1 1230 IF T < 7 THEN TB = 37 -
       5 * T: GOTO 1250
3B 1240 IF T > 6 THEN TB = 5 * (
       T - 6) + 2
CE 1250 HTAB TB: PRINT SPC( 2);:
       HTAB TB: PRINT B(T);
4F 1260 FOR TM = 1 TO 400: NEXT
5F 1270 IF B(T) < > 0 THEN RETUR
       N
6A 1280 IF P$ = "P" THEN GOSUB 1
       560: RETURN
F7 1290 IF P$ = "C" THEN GOSUB 1
       610: RETURN
63 1300 REM ** MOVE COUNTERS **
50 1310 T = I:S1 = 0:S2 = 0
3B 1320 FOR F = 1 TO 12:B(F) = A
       (F): NEXT F
F8 1330 B(T) = 0: IF DS THEN GOS
       UB 1220
1E 1340 FOR F = 1 TO A(T)
37 1350 T = T + 1
30 1360 IF T > 12 THEN T = 1
F5 1370 B(T) = B(T) + 1: IF DS T
       HEN GOSUB 1220
53 1380 NEXT F:T0 = T
B0 1390 REM ** ANY CAPTURES **
3B 1400 IF B(T0) < 2 OR B(T0) >
       3 THEN RETURN
DD 1410 IF P$ = "P" AND T0 < = 6
       THEN 1450
B9 1420 IF P$ = "C" AND T0 > = 7
       THEN 1450
E5 1430 RETURN
23 1440 REM ** TOTAL CAPTURES **
33 1450 LS = 1: IF P$ = "C" THEN
       LS = 7
6C 1460 FOR F = T0 TO LS STEP -
       1
52 1470 IF B(F) < 2 OR B(F) > 3
       THEN RETURN
6E 1480 IF P$ = "P" THEN SP = B(
       F):S2 = S2 + SP: GOTO 15
       00
B1 1490 IF P$ = "C" THEN SC = B(
       F):S1 = S1 + SC
C2 1500 B(F) = 0: IF DS THEN T =
       F: GOSUB 1220
B9 1510 NEXT F: RETURN
7E 1520 REM ** GET A CHARACTER *
       *
29 1530 K = PEEK ( - 16384): IF
       K < = 127 THEN 1530
F4 1540 POKE - 16368,0:B$ = CHR$
       (K - 128): RETURN
7E 1550 REM ** DISPLAY PLAYER'S
       SCORE **
19 1560 IF SP = 0 THEN RETURN
FC 1570 FOR H = PL + 1 TO PL + S
       P
83 1580 VTAB 21: HTAB 20: PRINT
       H: GOSUB 1650
52 1590 NEXT H:PL = PL + SP: RET
       URN
8D 1600 REM ** DISPLAY COMPUTER'
       S SCORE **
80 1610 IF SC = 0 THEN RETURN
F5 1620 FOR H = CP + 1 TO CP + S
       C
CD 1630 VTAB 9: HTAB 20: PRINT H
       : GOSUB 1650
71 1640 NEXT H:CP = CP + SC: RET
       URN
BD 1650 FOR I = 1 TO 10:A = PEEK
       ( - 16336): NEXT : RETU
       RN
D5 1660 REM DATA STATEMENT SET #
       1 - HROUT
79 1670 FOR I = 768 TO 862: READ
       A:CS = CS + A: POKE I,A
       : NEXT
46 1680 IF CS < > 9320 THEN PRIN
       T "ERROR IN DATA STATEME
       NT SET #1": STOP
82 1690 RETURN
A0 1700 DATA 216,120,133,69,134,
       70,132,71,166,7,10
E0 1710 DATA 10,176,4,16,62,48,4
       ,16,1,232,232
0B 1720 DATA 10,134,27,24,101,6,
       133,26,144,2,230
A7 1730 DATA 27,165,40,133,8,165
       ,41,41,3,5,230
CE 1740 DATA 133,9,162,8,160,0,1
       77,26,36,50,48
45 1750 DATA 2,73,127,164,36,145
       ,8,230,26,208,2
D6 1760 DATA 230,27,165,9,24,105
       ,4,133,9,202,208
7D 1770 DATA 226,165,69,166,70,1
       64,71,88,76,240,253
73 1780 REM NEXT LINE IS BITWISE
       OR
D7 1790 DATA 165,254,5,255,133,2
       54,96
E5 1800 REM DATA STATEMENT SET #
       2 - CHARACTER SET DATA
19 1810 CS = 0: FOR I = 35328 TO
       35839: READ A:CS = CS +
       A: POKE I,A: NEXT : IF
       CS < > 9833 THEN PRINT "
       ERROR IN DATA STATEMENT
       SET #2": STOP
E9 1820 RETURN
66 1830 DATA 0,0,0,0,0,0,0,0
9D 1840 DATA 8,8,8,8,8,0,8,0
D4 1850 DATA 20,20,20,0,0,0,0,0
DD 1860 DATA 20,20,62,20,62,20,2
       0,0
CB 1870 DATA 8,8,8,8,8,8,8,8
E7 1880 DATA 8,8,8,120,120,8,8,8
63 1890 DATA 8,8,8,127,127,8,8,8
85 1900 DATA 8,8,8,0,0,0,0,0
AB 1910 DATA 8,4,2,2,2,4,8,0
2B 1920 DATA 8,16,32,32,32,16,8,
       0
10 1930 DATA 8,42,28,8,28,42,8,0
8D 1940 DATA 0,8,8,62,8,8,0,0
D8 1950 DATA 0,0,0,0,8,8,4,0
A4 1960 DATA 0,0,0,62,0,0,0,0
F8 1970 DATA 0,0,0,0,0,0,8,0
D9 1980 DATA 0,32,16,8,4,2,0,0
64 1990 DATA 28,34,50,42,38,34,2
       8,0
BB 2000 DATA 8,12,8,8,8,8,28,0
19 2010 DATA 28,34,32,24,4,2,62,
       0
54 2020 DATA 62,32,16,24,32,34,2
       8,0
DB 2030 DATA 16,24,20,18,62,16,1
       6,0
66 2040 DATA 62,2,30,32,32,34,28
       ,0
4C 2050 DATA 56,4,2,30,34,34,28,
       0
6F 2060 DATA 62,32,16,8,4,4,4,0
60 2070 DATA 28,34,34,28,34,34,2
       8,0
E8 2080 DATA 28,34,34,60,32,16,1
       4,0
F7 2090 DATA 0,0,8,0,8,0,0,0
36 2100 DATA 0,0,8,0,8,8,4,0
BE 2110 DATA 16,8,4,2,4,8,16,0
96 2120 DATA 0,0,62,0,62,0,0,0
50 2130 DATA 4,8,16,32,16,8,4,0
33 2140 DATA 28,34,16,8,8,0,8,0
7A 2150 DATA 8,8,8,15,15,8,8,8
1D 2160 DATA 8,20,34,34,62,34,34
       ,0
F8 2170 DATA 30,34,34,30,34,34,3
       0,0
D8 2180 DATA 28,34,2,2,2,34,28,0
11 2190 DATA 30,34,34,34,34,34,3
       0,0
95 2200 DATA 62,2,2,30,2,2,62,0
38 2210 DATA 62,2,2,30,2,2,2,0
6E 2220 DATA 60,2,2,2,50,34,60,0
21 2230 DATA 34,34,34,62,34,34,3
       4,0
FD 2240 DATA 28,8,8,8,8,8,28,0
D9 2250 DATA 32,32,32,32,32,34,2
       8,0
71 2260 DATA 34,18,10,6,10,18,34
       ,0
98 2270 DATA 2,2,2,2,2,2,62,0
80 2280 DATA 34,54,42,42,34,34,3
       4,0
D6 2290 DATA 34,34,38,42,50,34,3
       4,0
3C 2300 DATA 28,34,34,34,34,34,2
       8,0
```

```
5D 2310 DATA 30,34,34,30,2,2,2,0
FE 2320 DATA 28,34,34,34,42,18,4
      4,0
6F 2330 DATA 30,34,34,30,10,18,3
      4,0
47 2340 DATA 28,34,2,28,32,34,28
      ,0
0B 2350 DATA 62,8,8,8,8,8,8,0
4D 2360 DATA 34,34,34,34,34,34,2
      8,0
AE 2370 DATA 34,34,34,34,34,20,8
      ,0
04 2380 DATA 34,34,34,42,42,54,3
      4,0
1A 2390 DATA 34,34,20,8,20,34,34
      ,0
60 2400 DATA 34,34,20,8,8,8,8,0
E4 2410 DATA 62,32,16,8,4,2,62,0
8B 2420 DATA 62,6,6,6,6,6,6,62,0
0E 2430 DATA 0,2,4,8,16,32,0,0
D7 2440 DATA 62,48,48,48,48,48,6
      2,0
79 2450 DATA 0,0,0,127,127,0,0,0
BC 2460 DATA 0,0,0,0,0,0,0,127
```

The Atari ST version of "Wari" runs in any screen resolution, on a color or monochrome monitor.

Program 3: Atari ST Wari

Version by Patrick Parrish, Programming Supervisor

```
10    RANDOMIZE 0:FOR I=0 TO 14
      :READ A$:FOR J=0 TO 3:REM
       SET COLORS
20    C$=MID$(A$,J,1):C0=VAL("&
      H"+C$)*125:POKE INTIN+J*2,C0:N
      EXT
30    POKE INTIN,I:POKE CONTRL,
      14:POKE CONTRL+6,4:VDISYS
      (0):NEXT
40    DATA 000,007,050,077,500,
      507,000,555,000,000,000,0
      00,000,000,770
50    REM Title Page
60    DIM A(12),B(12),SC(12),I(
      12)
70    FOR I=1 TO 6:READ P(I):NE
      XT
80    DATA 27,22.9,18.0,13.9,9.
      2,4.7
90    FULLW 2:CLEARW 2:COLOR 14

100   PRINT TAB(10);:PRINT STRI
      NG$(21,42)
110   PRINT TAB(10)"*";:COLOR 1
      :PRINT"   Atari ST Wari
       ";:COLOR 14:PRINT "*"
120   PRINT TAB(10);:PRINT STRI
      NG$(21,42)
130   COLOR 3:PRINT TAB(13)"Com
      puter's Side":CP=0:MC=0
140   COLOR 5:PRINT TAB(13)"Mov
      e #";:COLOR 1:PRINT MC
150   COLOR 5:PRINT TAB(13)"Sco
      re:";:COLOR 4:PRINT CP
160   COLOR 2:PRINT "     <<F<<<
      <E<<<<D<<<<C<<<<B<<<<A<<<
      "
170   COLOR 1:FOR I=1 TO 2:FOR
      J=1 TO 7:PRINT "     "CHR$
      (124);:NEXT J:PRINT
180   NEXT I
190   PRINT "     "STRING$(31,45
      )
200   FOR I=1 TO 2:FOR J=1 TO 7
      :PRINT "     "CHR$(124);:N
      EXT:PRINT:NEXT
210   COLOR 2:PRINT "     >>G>>>
      >H>>>>I>>>>J>>>>K>>>>L>>>
      "
220   COLOR 7:PRINT TAB(13)"Pla
      yer's Side":PL=0:MP=0
230   COLOR 5:PRINT TAB(13)"Mov
      e #";:COLOR 1:PRINT MP
240   COLOR 5:PRINT TAB(13)"Sco
      re:";:COLOR 4:PRINT PL
250   PRINT:FOR T=1 TO 12:A(T)=
      4:B(T)=4:GOSUB 1250:NEXT
      T
260   REM * GAME TYPE & FIRST T
      URN
270   GOSUB 1650:COLOR 5:PRINT
      "L";:COLOR 14:PRINT "imit
      ed or ";
280   COLOR 5:PRINT "U";:COLOR
      14:PRINT "nlimited game?
      ";
290   GOSUB 1540:IF B$<>"L" AND
       B$<>"U" THEN 290
300   PRINT B$:FOR TM=1 TO 200:
      NEXT TM:ML=0
310   IF B$="U" THEN COLOR 1:GO
      TOXY 11,1:PRINT "   Unlim
      ited   ":GOTO 350
320   GOSUB 1650:PRINT "Move Li
      mit";:INPUT ML
330   ML=INT(ML):IF ML<=0 THEN
      320
340   GOTOXY 11,1:COLOR 1:PRINT
       "  Limited:"+STR$(ML)+"
       "
350   GOSUB 1650:COLOR 3:PRINT
      "Who goes first: ";
360   COLOR 1:PRINT "C";:COLOR
      3
370   PRINT "omputer or ";:COLO
      R 1:PRINT "P";:COLOR 3:PR
      INT "layer? ";
380   GOSUB 1540:IF B$<>"C" AND
       B$<>"P" THEN 380
390   PRINT B$:FOR TM=1 TO 200:
      NEXT TM
400   IF B$="C" THEN 580
410   REM * PLAYER'S MOVE *
420   P$="P":P=0:SP=0:MP=MP+1
430   COLOR 1:GOTOXY 16,14:PRIN
      T MP
440   FOR F=7 TO 12:P=P+A(F):NE
      XT F
450   GOSUB 1650:COLOR 7:PRINT
      "Player's turn. Move coun
      ters (G-L)? ";
460   IF P=0 THEN 960
470   GOSUB 1540:I=ASC(B$)-64:C
      OLOR 2:PRINT B$
480   IF B$="Q" THEN 1190
490   IF B$>="G" AND B$<="L" TH
      EN IF A(I)<>0 THEN 520
500   COLOR 4:GOSUB 1650:PRINT
      "Illegal move!!!"
510   FOR TM=1 TO 900:NEXT TM:G
      OTO 450
520   DS=1:GOSUB 1320:FOR TM=1
      TO 900:NEXT TM
530   PT=0:FOR F=1 TO 12:A(F)=B
      (F):PT=PT+A(F):NEXT
540   IF MP=ML AND MC=ML THEN 1
      020
550   IF PT=0 THEN 960
560   IF PL>24 THEN 1020
570   REM * COMPUTER'S MOVE *
580   P$="C":PA=0:PB=0:IA=0:IB=
      0:P=0:MC=MC+1
590   COLOR 1:GOTOXY 16,4:PRINT
       MC
600   FOR F=1 TO 6:P=P+A(F):NEX
      T F
610   COLOR 3:GOSUB 1650:PRINT
      "Computer's turn (Moves A
      -F). ";
620   IF P=0 THEN 960
630   FOR G=1 TO 12
640   SC(G)=0:I(G)=0
650   IF G=7 THEN P$="P"
660   IF A(G)=0 THEN 700
670   SC=0:SP=0:I=G
680   DS=0:GOSUB 1320
690   SC(G)=S1 OR S2:I(G)=TO
700   NEXT G
710   P$="C"
720   REM * PICK BEST MOVE *
730   FOR F=1 TO 6
740   IF PA>=SC(F) THEN 760
750   IA=F:PA=SC(F)
760   IF PB>=SC(F+6) OR A(I(F+6
      ))=0 THEN 780
770   IB=I(F+6):PB=SC(F+6)
780   NEXT
790   IF IA=0 AND IB=0 THEN 820

800   I=IA:IF PB>PA THEN I=IB
810   GOTO 880
820   P=0:FOR F=7 TO 12:P=P+A(F
      ):NEXT
830   IF P<>0 THEN 870
840   FOR F=1 TO 5
850   IF A(F)<>0 AND A(F)<=6-F
      THEN I=F:GOTO 880
860   NEXT F
870   I=INT(RND*6)+1:IF A(I)=0
      THEN 870
880   COLOR 2:PRINT CHR$(I+64):
      SC=0:FOR TM=1 TO 900:NEXT
       TM
890   DS=1:GOSUB 1320:FOR TM=1
      TO 900:NEXT TM
900   PT=0:FOR F=1 TO 12:A(F)=B
      (F):PT=PT+A(F):NEXT
910   IF MP=ML AND MC=ML THEN 1
      020
920   IF PT=0 THEN 960
930   IF CP>24 THEN 1020
940   GOTO 420
950   REM * NO COUNTERS *
960   FOR TM=1 TO 400:NEXT TM
970   GOSUB 1650:COLOR 4:PRINT
      "No counters!!! ";
980   IF PT=0 THEN PRINT "Game
      over."
990   FOR TM=1 TO 1600:NEXT
1000  IF PT=0 THEN 1090
1010  REM * AWARD COUNTERS *
1020  COLOR 4:GOSUB 1650:PRINT
      "Game over. ";:COLOR 14
1030  PRINT "Award counters."
1040  FOR F=1 TO 6
1050  P$="C":SC=A(F):T=F:B(T)=0
      :GOSUB 1250
1060  P$="P":SP=A(F+6):T=F+6:B(
      T)=0:GOSUB 1250
1070  NEXT
1080  REM * WHO WON *
1090  GOSUB 1650
1100  IF PL=CP THEN COLOR 3:PRI
      NT "A draw. ";:GOTO 1140
```

```
1110  IF PL>CP THEN COLOR 2:PRI
      NT "Player wins. ";:GOTO
      1140
1120  COLOR 4:PRINT "Computer w
      ins. ";
1130  REM * ANOTHER GAME *
1140  COLOR 7:PRINT "Another ga
      me (Y/N)? ";
1150  GOSUB 1540:IF B$<>"Y" AND
       B$<>"N" THEN 1150
1160  PRINT B$:IF B$="Y" THEN 9
      0
1170  CLEARW 2:CLOSEW 2:END
1180  REM * QUIT GAME *
1190  FOR TM=1 TO 100:NEXT
1200  COLOR 4:GOSUB 1650:PRINT
      "Quit game. Are you sure
      (Y/N)? ";
1210  GOSUB 1540:IF B$<>"Y" AND
       B$<>"N" THEN 1210
1220  IF B$<>"Y" THEN 450
1230  GOSUB 1650:PT=0:GOTO 980
1240  REM * UPDATE DISPLAY *
1250  COLOR 7
1260  GOTOXY P(T+(T>6)+(T>7)*2*
      (T-7)),8-2*(T>6):PRINT B(
      T);
1270  FOR TM=1 TO 600:NEXT
1280  IF B(T)<>0 THEN RETURN
1290  IF P$="P" THEN GOSUB 1560
      :RETURN
1300  IF P$="C" THEN GOSUB 1610
      :RETURN
1310  REM * MOVE COUNTERS *
1320  T=I:S1=0:S2=0
1330  FOR F=1 TO 12:B(F)=A(F):N
      EXT
1340  B(T)=0:IF DS THEN GOSUB 1
      250
1350  FOR F=1 TO A(T)
1360  T=T+1
1370  IF T>12 THEN T=1
1380  B(T)=B(T)+1:IF DS THEN GO
      SUB 1250
1390  NEXT F:TO=T
1400  REM * ANY CAPTURES *
1410  IF B(TO)<2 OR B(TO)>3 THE
      N RETURN
1420  IF P$="P" AND TO<=6 THEN
      1460
1430  IF P$="C" AND TO>=7 THEN
      1460
1440  RETURN
1450  REM * TOTAL CAPTURES
1460  LS=1:IF P$="C" THEN LS=7
1470  FOR F=TO TO LS STEP -1
1480  IF B(F)<2 OR B(F)>3 THEN
      RETURN
1490  IF P$="P" THEN SP=B(F):S2
      =S2+SP:GOTO 1510
1500  IF P$="C" THEN SC=B(F):S1
      =S1+SC
1510  B(F)=0:IF DS THEN T=F:GOS
      UB 1250
1520  NEXT F:RETURN
1530  REM * GET A CHARACTER *
1540  B$=CHR$(INP(2)):RETURN
1550  REM * DISPLAY PLAYER'S SC
      ORE *
1560  IF SP=0 THEN RETURN
1570  FOR H=PL+1 TO PL+SP
1580  COLOR 4:GOTOXY 16,15:PRIN
      T H:PRINT CHR$(7):FOR TM=
      1 TO 300:NEXT
1590  NEXT H:PL=PL+SP:RETURN
1600  REM * DISPLAY COMPUTER'S
      SCORE *
1610  IF SC=0 THEN RETURN
1620  FOR H=CP+1 TO CP+SC:COLOR
       4
1630  GOTOXY 16,5:PRINT H:SOUND
       1,12,1,2,20
1640  SOUND 1,0,2,2:NEXT H:CP=C
      P+SC:RETURN
1650  GOTOXY 0,15:PRINT:PRINT S
      TRING$(39,32);:GOTOXY 0,15
      :PRINT:RETURN
```

IBM PC/PCjr version of "Wari."

Program 4: IBM PC/PCjr Wari

Version by Patrick Parrish, Programming Supervisor

```
FI 10  KEY OFF:DEF SEG=0:POKE 104
       7,PEEK(1047) OR 64:WIDTH 4
       0
FH 20  DIM A(12),B(12),SC(12),I(1
       2):RANDOMIZE TIMER
OF 30  D$=STRING$(1,11)+STRING$(2
       2,31):E$=CHR$(179):F$=CHR$
       (195):G$=CHR$(196):H$=CHR$
       (180):I$=CHR$(197)
JP 40  DS$=D$+STRING$(39,32)+D$
PF 50  COLOR ,0,0:CLS:SCREEN 0,0,
       0
BF 60  COLOR 14:LOCATE 1,10,0:PRI
       NT STRING$(21,42)
CF 70  PRINT TAB(10)"*";:COLOR 0,
       1:PRINT "
         ";:COLOR 14,0:PRINT "*"
MI 80  PRINT TAB(10)"*";:COLOR 0,
       1:PRINT " IBM PC/PCjr  War
       i ";:COLOR 14,0:PRINT "*"
CH 90  PRINT TAB(10)"*";:COLOR 0,
       1:PRINT "
         ";:COLOR 14,0:PRINT "*"
CE 100 PRINT TAB(10)STRING$(21,4
       2)
BC 110 PRINT:COLOR 3:PRINT TAB(1
       3)"Computer's Side":CP=0:
       MC=0
PA 120 COLOR 5:PRINT TAB(13)"Mov
       e #";:COLOR 1:PRINT MC:CO
       LOR 5:PRINT TAB(13)"Score
       :";:COLOR 4:PRINT CP
OH 130 COLOR 2:PRINT:PRINT "
       <<F<<<<E<<<<D<<<<C<<<<B<<
       <<A<<<"
BC 140 COLOR 1:FOR J=1 TO 2:FOR
       I=1 TO 7:PRINT "     "E$;:
       NEXT:PRINT:NEXT
NF 150 PRINT "     "F$STRING$(4,1
       96);:FOR I=1 TO 5:PRINT I
       $STRING$(4,196);:NEXT:PRI
       NT H$
FM 160 FOR J=1 TO 2:FOR I=1 TO 7
       :PRINT "     "E$;:NEXT:PRI
       NT:NEXT
AF 170 COLOR 2:PRINT "     >>G>>>
       >H>>>>I>>>>J>>>>K>>>>L>>>
       "
EC 180 PRINT:COLOR 7:PRINT TAB(1
       3)"Player's Side":PL=0:MP
       =0
AD 190 COLOR 5:PRINT TAB(13)"Mov
       e #";:COLOR 1:PRINT MP:CO
       LOR 5:PRINT TAB(13)"Score
       :";:COLOR 4:PRINT PL
EC 200 FOR T=1 TO 12:A(T)=4:B(T)
       =4:GOSUB 1160:NEXT T
PE 210 REM ***GAME TYPE & FIRST
       TURN***
FC 220 PRINT DS$;:COLOR 0,14:PRI
       NT"L";:COLOR 14,0:PRINT "
       imited or ";:COLOR 0,14:P
       RINT "U";:COLOR 14,0:PRIN
       T "nlimited game? ";
PB 230 GOSUB 1470:IF B$<>"L" AND
       B$<>"U" THEN 230
FH 240 PRINT B$:FOR TM=1 TO 200:
       NEXT:ML=0
KC 250 IF B$="U" THEN COLOR 0,1:
       LOCATE 4,16:PRINT "Unlimi
       ted":GOTO 290
HD 260 PRINT DS$"Move Limit";:IN
       PUT ML
LG 270 ML=INT(ML):IF ML<=0 THEN
       260
LN 280 LOCATE 4,15:COLOR 0,1:PRI
       NT "Limited:"+STR$(ML)
MA 290 COLOR 3,0:PRINT DS$"Who g
       oes first: ";:COLOR 0,3:P
       RINT "C";:COLOR 3,0:PRINT
        "omputer or ";:COLOR 0,3
       :PRINT "P";:COLOR 3,0:PRI
       NT "layer? ";
AF 300 GOSUB 1470:IF B$<>"C" AND
       B$<>"P" THEN 300
AG 310 PRINT B$:FOR TM=1 TO 200:
       NEXT TM
HD 320 IF B$="C" THEN 500
CD 330 REM ** PLAYER'S MOVE **
HO 340 P$="P":P=0:SP=0:MP=MP+1
KJ 350 COLOR 1:LOCATE 20,19:PRIN
       T MP
FM 360 FOR F=7 TO 12:P=P+A(F):NE
       XT F
BO 370 COLOR 7:PRINT DS$"Player'
       s turn. Move counters (G-
       L)? ";
LB 380 IF P=0 THEN 880
OA 390 GOSUB 1470:I=ASC(B$)-64:C
       OLOR 2:PRINT B$
DN 400 IF B$="Q" THEN 1100
IK 410 IF B$>="G" AND B$<="L" TH
       EN IF A(I)<>0 THEN 440
QP 420 COLOR 4:PRINT DS$"Illegal
        move!!!"
JM 430 FOR TM=1 TO 900:NEXT:GOTO
       370
IM 440 DS=1:GOSUB 1250:FOR TM=1
       TO 900:NEXT
PA 450 PT=0:FOR F=1 TO 12:A(F)=B
       (F):PT=PT+A(F):NEXT
CL 460 IF MP=ML AND MC=ML THEN 9
       40
CA 470 IF PT=0 THEN 880
EM 480 IF PL>24 THEN 940
II 490 REM ** COMPUTER'S MOVE **
IE 500 P$="C":PA=0:PB=0:IA=0:IB=
       0:P=0:MC=MC+1
GB 510 COLOR 1:LOCATE 8,19:PRINT
        MC
BJ 520 FOR F=1 TO 6:P=P+A(F):NEX
       T F
GA 530 COLOR 3:PRINT DS$"Compute
       r's turn (Moves counters
       A-F). ";
OB 540 IF P=0 THEN 880
IJ 550 FOR G=1 TO 12
OI 560 SC(G)=0:I(G)=0
OK 570 IF G=7 THEN P$="P"
OK 580 IF A(G)=0 THEN 620
BB 590 SC=0:SP=0:I=G
LJ 600 DS=0:GOSUB 1250
IP 610 SC(G)=S1 OR S2:I(G)=T0
MM 620 NEXT G
```

```
IO 630 P$="C"
GC 640 REM ** PICK BEST MOVE **
HP 650 FOR F=1 TO 6
FA 660 IF PA>=SC(F) THEN 680
KF 670 IA=F:PA=SC(F)
FJ 680 IF PB>=SC(F+6) OR A(I(F+6
       ))=0 THEN 700
GI 690 IB=I(F+6):PB=SC(F+6)
ND 700 NEXT
AB 710 IF IA=0 AND IB=0 THEN 740
CI 720 I=IA:IF PB>PA THEN I=IB
FO 730 GOTO 800
MM 740 P=0:FOR F=7 TO 12:P=P+A(F
       ):NEXT
FC 750 IF P<>0 THEN 790
BC 760 FOR F=1 TO 5
AC 770 IF A(F)<>0 AND A(F)<=6-F
       THEN I=F:GOTO 800
MP 780 NEXT F
CE 790 I=INT(RND*6)+1:IF A(I)=0
       THEN 790
JP 800 COLOR 2:PRINT CHR$(I+64):
       SC=0:FOR TM=1 TO 900:NEXT
        TM
IK 810 DS=1:GOSUB 1250:FOR TM=1
       TO 900:NEXT
PO 820 PT=0:FOR F=1 TO 12:A(F)=B
       (F):PT=PT+A(F):NEXT
CJ 830 IF MP=ML AND MC=ML THEN 9
       40
CO 840 IF PT=0 THEN 880
PB 850 IF CP>24 THEN 940
FP 860 GOTO 340
FB 870 REM ** NO COUNTERS **
PA 880 FOR TM=1 TO 400:NEXT
CL 890 COLOR 4:PRINT DS$"No coun
       ters!!! ";
LL 900 IF PT=0 THEN PRINT "Game
       over."
EI 910 FOR TM=1 TO 900:NEXT
PF 920 IF PT=0 THEN 1000
MM 930 REM ** AWARD COUNTERS **
HI 940 COLOR 4:PRINT DS$"Game ov
       er. ";:COLOR 14:PRINT "Aw
       ard counters."
HC 950 FOR F=1 TO 6
IC 960 P$="C":SC=A(F):T=F:B(T)=0
       :GOSUB 1160
JN 970 P$="P":SP=A(F+6):T=F+6:B(
       T)=0:GOSUB 1160
OF 980 NEXT
MP 990 REM ** WHO WON **
CB 1000 PRINT DS$;
NI 1010 IF PL=CP THEN COLOR 3:PR
        INT "A draw. ";:GOTO 105
        0
GE 1020 IF PL>CP THEN COLOR 2:PR
        INT "Player wins. ";:GOT
        O 1050
JN 1030 COLOR 4:PRINT "Computer
        wins. ";
CO 1040 REM ** ANOTHER GAME **
CC 1050 COLOR 7:PRINT "Another g
        ame (Y/N)? ";
MG 1060 GOSUB 1470:IF B$<>"Y" AN
        D B$<>"N" THEN 1060
MM 1070 PRINT B$:IF B$="Y" THEN
        50
CN 1080 CLS:END
ED 1090 REM ** QUIT GAME **
JL 1100 FOR TM=1 TO 100:NEXT
GH 1110 COLOR 4:PRINT DS$"Quit g
        ame. Are you sure (Y/N)?
         ";
EO 1120 GOSUB 1470:IF B$<>"Y" AN
        D B$<>"N" THEN 1120
EG 1130 IF B$<>"Y" THEN 370
MN 1140 PRINT DS$;:PT=0:GOTO 900
EC 1150 REM ** UPDATE DISPLAY **
KP 1160 COLOR 7
EG 1170 IF T<7 THEN TB=36-5*T:GO
        TO 1190
CA 1180 IF T>6 THEN TB=5*(T-6)+1
CL 1190 LOCATE 13-2*(T>6),TB:PRI
        NT B(T);
MD 1200 FOR TM=1 TO 400:NEXT
EH 1210 IF B(T)<>0 THEN RETURN
BF 1220 IF P$="P" THEN GOSUB 150
        0:RETURN
AA 1230 IF P$="C" THEN GOSUB 155
        0:RETURN
BC 1240 REM MOVE COUNTERS
ME 1250 T=I:S1=0:S2=0
LO 1260 FOR F=1 TO 12:B(F)=A(F):
        NEXT
DH 1270 B(T)=0:IF DS THEN GOSUB
        1160
DL 1280 FOR F=1 TO A(T)
FA 1290 T=T+1
DN 1300 IF T>12 THEN T=1
JH 1310 B(T)=B(T)+1:IF DS THEN G
        OSUB 1160
LJ 1320 NEXT F:T0=T
GI 1330 REM ** ANY CAPTURES **
IF 1340 IF B(T0)<2 OR B(T0)>3 TH
        EN RETURN
HE 1350 IF P$="P" AND T0<=6 THEN
         1390
BC 1360 IF P$="C" AND T0>=7 THEN
         1390
JB 1370 RETURN
MD 1380 REM ** TOTAL CAPTURES **
AA 1390 LS=1:IF P$="C" THEN LS=7
BF 1400 FOR F=T0 TO LS STEP -1
CG 1410 IF B(F)<2 OR B(F)>3 THEN
         RETURN
FB 1420 IF P$="P" THEN SP=B(F):S
        2=S2+SP:GOTO 1440
JP 1430 IF P$="C" THEN SC=B(F):S
        1=S1+SC
HB 1440 B(F)=0:IF DS THEN T=F:GO
        SUB 1160
BH 1450 NEXT F:RETURN
OF 1460 REM ** GET A CHARACTER *
        *
PF 1470 B$=INKEY$:IF B$<>"" THEN
         1470
JA 1480 B$=INKEY$:IF B$="" THEN
        1480 ELSE RETURN
PL 1490 REM ** DISPLAY PLAYER'S
        SCORE **
KN 1500 IF SP=0 THEN RETURN
PE 1510 FOR H=PL+1 TO PL+SP
ON 1520 COLOR 4:LOCATE 21,19:PRI
        NT H:SOUND 440,2:FOR TM=
        1 TO 300:NEXT
BB 1530 NEXT H:PL=PL+SP:RETURN
BC 1540 REM ** DISPLAY COMPUTER'
        S SCORE **
DK 1550 IF SC=0 THEN RETURN
LD 1560 FOR H=CP+1 TO CP+SC
IJ 1570 COLOR 4:LOCATE 9,19:PRIN
        T H:SOUND 110,2:FOR TM=1
         TO 300:NEXT
CP 1580 NEXT H:CP=CP+SC:RETURN
```

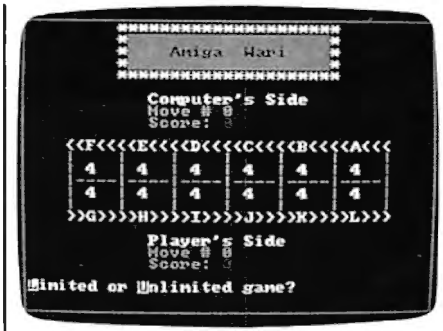
Program 5: Amiga Wari

Version by Patrick Parrish, Programming Supervisor

```
setup:
CLEAR ,250000
CLEAR ,65536&
SCREEN 1,320,200,3,1:WINDOW 3,"'
,(0,0)-(311,186),16,1
WINDOW OUTPUT 3
PALETTE 0,0,0,0:PALETTE 1,.1,.2,.
.8    ' black, blue
PALETTE 2,.33,.9,0:PALETTE 3,0,.
93,.87    ' green, aqua
PALETTE 4,1,.1,.27:PALETTE 5,.8,
0,.93     ' red, purple
PALETTE 6,1,1,.13:PALETTE 7,1,1,
1    ' yellow, white
DIM a(12),b(12),sc(80),i(80)
RANDOMIZE TIMER:ds$=STRING$(39,3
2)
DIM waveform%(255)
wavedata=-128
FOR n=0 TO 255:waveform%(n)=wave
data
wavedata=wavedata+1:NEXT
WAVE 0,waveform%
restart:
CLS:LOCATE 1,10:COLOR 6,0:PRINT
STRING$(21,42)
PRINT TAB(10)"*";:COLOR 0,1:PRIN
T STRING$(19,32);
COLOR 6,0:PRINT "*"
PRINT TAB(10)"*";:COLOR 0,1:PRIN
T "     Amiga  Wari     ";
COLOR 6,0:PRINT"*"
PRINT TAB(10)"*";:COLOR 0,1:PRIN
T STRING$(19,32);
COLOR 6,0:PRINT "*"
PRINT TAB(10)STRING$(21,42)
PRINT:COLOR 3:PRINT TAB(13)"Comp
uter's Side":cp=0:mc=0
COLOR 5:PRINT TAB(13)"Move #";:C
OLOR 1:PRINT mc
COLOR 5:PRINT TAB(13)"Score:";:C
OLOR 4:PRINT cp
COLOR 2:PRINT:PRINT "     <<F<<<<
E<<<<D<<<<C<<<<B<<<<A<<<"
GOSUB dash:PRINT "     ";
FOR i=1 TO 6:PRINT CHR$(124)"---
-";:NEXT:PRINT CHR$(124)
GOSUB dash
COLOR 2:PRINT "     >>G>>>>H>>>>I
>>>>J>>>>K>>>>L>>>"
PRINT:COLOR 7:PRINT TAB(13)"Play
er's Side":pl=0:mp=0
COLOR 5:PRINT TAB(13)"Move #";:C
OLOR 1:PRINT mp
COLOR 5:PRINT TAB(13)"Score:";:C
OLOR 4:PRINT pl
FOR t=1 TO 12:a(t)=4:b(t)=4:GOSU
B placepieces:NEXT t

gametype:
LOCATE 23,1:COLOR 0,6:PRINT"L";:
COLOR 6,0
PRINT "imited or ";:COLOR 0,6:PR
INT "U";
COLOR 6,0:PRINT "nlimited game?
";

type:
GOSUB getchar:IF b$<>"L" AND b$<
>"U" THEN type
PRINT b$:FOR tm=1 TO 400:NEXT:ml
=0
IF b$="U" THEN COLOR 0,1:LOCATE
4,16:PRINT "Unlimited":GOTO firs
t
```



"Wari" for the Amiga computer.

```
moves:
GOSUB cline:PRINT "Move Limit";:
INPUT ml
ml=INT(ml):IF ml<=0 THEN moves
LOCATE 4,15:COLOR 0,1:PRINT "Lim
ited:"+STR$(ml)
'
first:
LOCATE 23,1:COLOR 3,0:PRINT "Who
goes first: ";:
COLOR 0,3:PRINT "C";:COLOR 3,0:P
RINT "omputer or ";
COLOR 0,3:PRINT "P";:COLOR 3,0:P
RINT "layer? ";
'
getfirst:
GOSUB getchar:IF b$<>"C" AND b$<
>"P" THEN getfirst
PRINT b$:FOR tm=1 TO 400:NEXT tm
'
IF b$="C" THEN computer
'
player:
p$="P":p=0:sp=0:mp=mp+1
COLOR 1:LOCATE 20,19:PRINT mp
FOR f=7 TO 12:p=p+a(f):NEXT f
entry:
COLOR 7:LOCATE 23,1:PRINT ds$:LO
CATE 23,1
PRINT "Player's turn. Move count
ers (G-L)? ";
IF p=0 THEN nocounters
GOSUB getchar:i=ASC(b$)-64:COLOR
3:PRINT b$
IF b$="Q" THEN quit
IF b$>="G" AND b$<="L" THEN IF a
(i)<>0 THEN okmove
COLOR 4:GOSUB cline:PRINT "Illeg
al move!!!"
FOR tm=1 TO 1500:NEXT:GOTO entry
'
okmove:
ds=1:GOSUB movecounters:FOR tm=1
TO 900:NEXT tm
pt=0:FOR f=1 TO 12:a(f)=b(f):pt=
pt+a(f):NEXT f
IF mp=ml AND mc=ml THEN award
IF pt=0 THEN nocounters
IF pl>24 THEN award
'
computer:
p$="C":pa=0:pb=0:ia=0:ib=0:p=0:m
c=mc+1
COLOR 1:LOCATE 8,19:PRINT mc
FOR f=1 TO 6:p=p+a(f):NEXT f

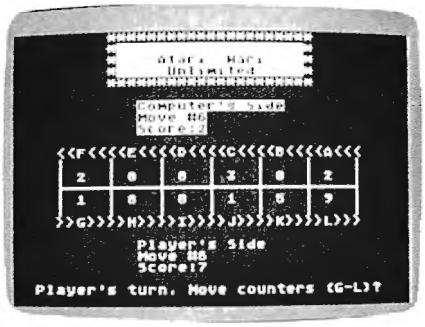
COLOR 3:GOSUB cline
PRINT "Computer's turn (Move cou
nters A-F). ";
IF p=0 THEN nocounters
'
checkmoves:
FOR g=1 TO 12
sc(g)=0:i(g)=0
IF g=7 THEN p$="P"
IF a(g)=0 THEN skip
sc=0:sp=0:i=g
ds=0:GOSUB movecounters
sc(g)=s1 OR s2:i(g)=t0
skip:
NEXT g
p$="C"
'
pickbest:
FOR f=1 TO 6
IF pa>=sc(f) THEN ahead
ia=f:pa=sc(f)
ahead:
IF pb>=sc(f+6) OR a(i(f+6))=0 TH
EN skip2
ib=i(f+6):pb=sc(f+6)
skip2:
NEXT f
IF ia=0 AND ib=0 THEN skip3
i=ia:IF pb>pa THEN i=ib
GOTO printit
skip3:
p=0:FOR f=7 TO 12:p=p+a(f):NEXT
f
IF p<>0 THEN random
FOR f=1 TO 5
IF a(f)<>0 AND a(f)<=6-f THEN i=
f:GOTO printit
NEXT f
random:
i=INT(RND*6)+1:IF a(i)=0 THEN ra
ndom
'
printit:
COLOR 7:PRINT CHR$(i+64):sc=0
ds=1:GOSUB movecounters:FOR tm=1
TO 1500:NEXT tm
pt=0:FOR f=1 TO 12:a(f)=b(f):pt=
pt+a(f):NEXT f
IF mp=ml AND mc=ml THEN award
IF pt=0 THEN nocounters
IF cp>24 THEN award
GOTO player
'
nocounters:
FOR tm=1 TO 600:NEXT
COLOR 4:GOSUB cline:PRINT "No co
unters!!! ";
gameend:
IF pt=0 THEN PRINT "Game over."
FOR tm=1 TO 1500:NEXT
IF pt=0 THEN winner
'
award:
COLOR 4:GOSUB cline:PRINT "Game
over. ";
COLOR 6:PRINT "Award counters."
FOR f=1 TO 6
p$="C":sc=a(f):t=f:b(t)=0:GOSUB
placepieces
p$="P":sp=a(f+6):t=f+6:b(t)=0:GO
SUB placepieces
NEXT
'
winner:
GOSUB cline
COLOR 3:IF pl=cp THEN PRINT "A d
raw. ";:GOTO another
IF pl>cp THEN COLOR 2:PRINT "Pla
yer wins. ";:GOTO another
COLOR 4:PRINT "Computer wins. ";

'
'
another:
COLOR 7:PRINT "Another game (Y/N
)? ";
another2:
GOSUB getchar:IF b$<>"Y" AND b$<
>"N" THEN another2
PRINT b$:IF b$="Y" THEN restart
WINDOW CLOSE 3
SCREEN CLOSE 1
WINDOW 1,"Wari",,31,-1
CLEAR ,25000
END
'
quit:
FOR tm=1 TO 200:NEXT
COLOR 4:GOSUB cline
PRINT "Quit game. Are you sure (
Y/N)? ";
again:
GOSUB getchar:IF b$<>"Y" AND b$<
>"N" THEN again
IF b$<>"Y" THEN entry
GOSUB cline:pt=0:GOTO gameend
'
placepieces:
COLOR 7
IF t<7 THEN tb=36-5*t:GOTO place
'
IF t>6 THEN tb=5*(t-6)+1
place:
LOCATE 13-2*(t>6),tb:PRINT b(t)
FOR tm=1 TO 1000:NEXT tm
IF b(t)<>0 THEN RETURN
IF p$="P" THEN GOSUB playerscore
:RETURN
IF p$="C" THEN GOSUB computersco
re:RETURN
'
movecounters:
t=i:s1=0:s2=0
FOR f=1 TO 12:b(f)=a(f):NEXT
b(t)=0:IF ds THEN GOSUB placepie
ces
FOR f=1 TO a(t)
t=t+1
IF t>12 THEN t=1
b(t)=b(t)+1:IF ds THEN GOSUB pla
cepieces
NEXT f:t0=t
'
captures:
IF b(t0)<2 OR b(t0)>3 THEN RETUR
N
IF p$="P" AND t0<=6 THEN total
IF p$="C" AND t0>=7 THEN total
RETURN
'
total:
ls=1:IF p$="C" THEN ls=7
FOR f=t0 TO ls STEP -1
IF b(f)<2 OR b(f)>3 THEN RETURN
IF p$="P" THEN sp=b(f):s2=s2+sp:
GOTO total2
IF p$="C" THEN sc=b(f):s1=s1+sc
total2:
b(f)=0:IF ds THEN t=f:GOSUB plac
epieces
NEXT f:RETURN
'
getchar:
b$=UCASE$(INKEY$):IF b$<>"" THEN
getchar
getchar2:
b$=UCASE$(INKEY$):IF b$="" THEN
getchar2 ELSE RETURN
'
playerscore:
IF sp=0 THEN RETURN
FOR h=p1+1 TO p1+sp
COLOR 4:LOCATE 21,19:PRINT h
SOUND 440,2,255,0:FOR tm=1 TO 50
0:NEXT
NEXT h:p1=p1+sp:RETURN
'
computerscore:
IF sc=0 THEN RETURN
FOR h=cp+1 TO cp+sc
COLOR 4:LOCATE 9,19:PRINT h
SOUND 220,2,255,0:FOR tm=1 TO 50
0:NEXT
NEXT h:cp=cp+sc:RETURN
'
dash:
COLOR 1:FOR j=1 TO 2:FOR i=1 TO
7:PRINT "    "CHR$(124);
NEXT:PRINT:NEXT:RETURN
'
cline:
LOCATE 23,1:PRINT ds$:LOCATE 23,
1:RETURN
```

Program 6: Wari For Atari 400, 800, XL, And XE

Version by Patrick Parrish, Programming Supervisor

```
10 OPEN #1,4,0,"K:":DIM A
   (12),B(12),SC(12),I(12
   ),A$(3),X$(3),B$(1),P$
   (1),SP$(37)
20 FOR I=0 TO 11:READ A:P
   OKE 1664+I,A:NEXT I
30 DATA 104,165,203,5,204
```



"Wari" for Atari 400, 800, XL, and XE computers.

```
      ,133,212,169,0,133,213
      ,96
KM 40 SP$="{37 SPACES}"
KI 50 GRAPHICS 0:POKE 752,1:
      SETCOLOR 4,6,6:SETCOLO
      R 2,10,1
JN 60 POSITION 9,0:PRINT "**
      **********************"
LB 70 POSITION 9,1:PRINT "*
      {19 SPACES}*"
BH 80 POSITION 9,2:PRINT "*
      {4 SPACES}Atari  Wars
      {4 SPACES}*"
LF 90 POSITION 9,3:PRINT "*
      {19 SPACES}*"
BM 100 POSITION 9,4:PRINT "*
      **********************"
FB 110 POSITION 12,6:PRINT "
      Computer's Side":CP=0
      :MC=0
DH 120 POSITION 12,7:PRINT "
      Move #";:X$=STR$(MC):
      GOSUB 950
JI 130 POSITION 12,8:PRINT "
      Score:";:X$=STR$(CP):
      GOSUB 950
EH 140 POSITION 4,10:PRINT "
      <<F<<<<E<<<<D<<<<C<<<
      <B<<<<A<<<"
OE 150 FOR J=1 TO 2:POSITION
       0,10+J:FOR I=1 TO 7:
       PRINT "{4 SPACES}!";:
       NEXT I:NEXT J
MF 160 PRINT :PRINT "  {A}";
       :FOR I=1 TO 5:PRINT "
       {4 R}{S}";:NEXT I:PRI
       NT "{4 R}{D}"
OJ 170 FOR J=1 TO 2:POSITION
       0,13+J:FOR I=1 TO 7:
       PRINT "{4 SPACES}!";:
       NEXT I:NEXT J
PI 180 PRINT :PRINT "  >>G>>
       >>H>>>>I>>>>J>>>>K>>>
       >L>>>"
CF 190 POSITION 12,18:PRINT
       "Player's Side":PL=0:
       MP=0
FF 200 POSITION 12,19:PRINT
       "Move #";MP:POSITION
       12,20:PRINT "Score:";
       PL
LH 210 FOR T=1 TO 12:A(T)=4:
       B(T)=4:GOSUB 1190:NEX
       T T
BO 220 POSITION 2,22:PRINT '
       Limited or Unlimited
       Game? ";
CL 230 GOSUB 1480:IF B$<>"L"
        AND B$<>"U" THEN 230
MJ 240 PRINT B$:ML=0
AP 250 IF B$="U" THEN POSITI
       ON 15,3:PRINT "Unlimi
       ted":GOTO 290
YP 260 GOSUB 1610:PRINT "Mov
       e Limit";:INPUT ML
BG 270 ML=INT(ML):IF ML<=0 T
       HEN 260
AN 280 POSITION 14,3:PRINT "
       Limited: ";:X$=STR$(M
       L):GOSUB 950
ED 290 GOSUB 1610:PRINT "Who
        goes first: Computer
       or Player? ";
BJ 300 GOSUB 1480:IF B$<>"C"
        AND B$<>"P" THEN 300
IH 310 PRINT B$
BC 320 IF B$="C" THEN 500
PI 330 REM PLAYER'S MOVE
CK 340 P$="P":P=0:SP=0:MP=MP
       +1
HA 350 POSITION 18,19:PRINT
       MP
BJ 360 FOR F=7 TO 12:P=P+A(F
       ):NEXT F
IA 370 GOSUB 1610:PRINT "Pla
       yer's turn. Move coun
       ters (G-L)? ";
LH 380 IF P=0 THEN 890
PH 390 GOSUB 1480:I=ASC(B$)-
       64:PRINT CHR$(I+192)
EP 400 IF B$="Q" THEN 1130
MM 410 IF B$>="G" AND B$<="L
       " THEN IF A(I)<>0 THE
       N 440
JN 420 GOSUB 1610:PRINT "Ill
       egal Move !!!"
DK 430 FOR TM=1 TO 300:NEXT
       TM:GOTO 370
JP 440 DS=1:GOSUB 1270:FOR T
       M=1 TO 100:NEXT TM
CO 450 PT=0:FOR F=1 TO 12:A(
       F)=B(F):PT=PT+A(F):NE
       XT F
AE 460 IF MP=ML AND MC=ML TH
       EN 970
AL 470 IF PT=0 THEN 890
DK 480 IF PL>24 THEN 970
KB 490 REM COMPUTER'S MOVE
IL 500 P$="C":PA=0:PB=0:IA=0
       :IB=0:P=0:MC=MC+1
CA 510 POSITION 18,7:X$=STR$
       (MC):GOSUB 950
OE 520 FOR F=1 TO 6:P=P+A(F)
       :NEXT F
MF 530 GOSUB 1610:PRINT "Com
       puter's turn (Moves F
       -F) ";
LF 540 IF P=0 THEN 890
DP 550 REM CHECK ALL MOVES
DN 560 FOR B=1 TO 12
LP 570 SC(B)=0:I(B)=0
FL 580 IF B=7 THEN P$="P"
DL 590 IF A(B)=0 THEN 630
DK 600 SC=0:SP=0:I=B
BP 610 DS=0:GOSUB 1270
FJ 620 POKE 203,S1:POKE 204,
       S2:SC(B)=USR(1664):I(
       B)=T0
BP 630 NEXT B
MC 640 P$="C"
AL 650 REM PICK BEST MOVE
BA 660 FOR F=1 TO 6
DD 670 IF PA>=SC(F) THEN 690
DA 680 IA=F:PA=SC(F)
HB 690 IF PB>=SC(F+6) OR A(I
       (F+6))=0 THEN 710
DH 700 IB=I(F+6):PB=SC(F+6)
BN 710 NEXT F
LF 720 IF IA=0 AND IB=0 THEN
        750
BE 730 I=IA:IF PB>PA THEN I=
       IB
BN 740 GOTO 810
BD 750 P=0:FOR F=7 TO 12:P=P
       +A(F):NEXT F
ON 760 IF P<>0 THEN 800
BB 770 FOR F=1 TO 5
IE 780 IF A(F)<>0 AND A(F)<=
       6-F THEN I=F:GOTO 810
CF 790 NEXT F
FD 800 I=INT(RND(0)*6)+1:IF
       A(I)=0 THEN 800
BB 810 PRINT CHR$(I+64):SC=0
       :FOR TM=1 TO 100:NEXT
        TM
KB 820 DS=1:GOSUB 1270:FOR T
       M=1 TO 100:NEXT TM
DA 830 PT=0:FOR F=1 TO 12:A(
       F)=B(F):PT=PT+A(F):NE
       XT F
KE 840 IF MP=ML AND MC=ML TH
       EN 950
AN 850 IF PT=0 THEN 890
DD 860 IF CP>24 THEN 970
GP 870 GOTO 340
JE 880 REM NO COUNTERS
OF 890 FOR TM=1 TO 100:NEXT
       TM
LK 900 GOSUB 1610:PRINT "No
       counters !!!";
JO 910 IF PT=0 THEN PRINT "G
       ame over."
MP 920 FOR TM=1 TO 100:NEXT
       TM
CP 930 IF PT=0 THEN 1030
HG 940 GOTO 970
MA 950 FOR NUM=1 TO LEN(X$):
       PRINT CHR$(ASC(X$(NUM
       ,NUM))+128);:NEXT NUM
       :RETURN
GF 960 REM AWARD COUNTERS
JH 970 GOSUB 1610:PRINT "Gam
       e over. Award counter
       s."
BF 980 FOR F=1 TO 6
DD 990 P$="C":SC=A(F):T=F:B(
       T)=0:GOSUB 1190
MO 1000 P$="P":SP=A(F+6):T=F
       +6:B(T)=0:GOSUB 1190
EH 1010 NEXT F
IJ 1020 REM WHO WON
AM 1030 GOSUB 1610
FE 1040 IF PL=CP THEN PRINT
       "A draw. ";:GOTO 108
       0
JF 1050 IF PL>CP THEN PRINT
       "Player wins. ";:GOT
       O 1080
DM 1060 IF CP>PL THEN PRINT
       "Computer wins. ";
MH 1070 REM ANOTHER GAME
KG 1080 PRINT "Another game
       (Y/N)? ";
JL 1090 GOSUB 1480:IF B$<>"Y
       " AND B$<>"N" THEN 1
       090
FC 1100 PRINT B$:IF B$="Y" T
       HEN 50
FF 1110 GRAPHICS 0:END
AF 1120 REM QUIT GAME
AJ 1130 FOR TM=1 TO 100:NEXT
        TM
FJ 1140 GOSUB 1610:PRINT "Qu
       it game. Are you sur
       e (Y/N)? ";
JF 1150 GOSUB 1480:IF B$<>"Y
       " AND B$<>"N" THEN 1
       150
JN 1160 IF B$<>"Y" THEN 370
GJ 1170 GOSUB 1610:PT=0:GOTO
        910
IH 1180 REM UPDATE DISPLAY
KC 1190 IF T<7 THEN TB=35-5*
       T:GOTO 1210
```

```
ID 1200  IF T>6 THEN TB=5*(T-
         6)
ML 1210  POSITION TB+1,(T>6)*
         2+12:PRINT B(T);:IF
         B(T)<10 THEN PRINT "
         ";
NN 1220  FOR TM=1 TO 50:NEXT
         TM
PF 1230  IF B(T)<>0 THEN RETU
         RN
CN 1240  IF P$="P" THEN GOSUB
          1520:RETURN
CF 1250  IF P$="C" THEN GOSUB
          1570:RETURN
FN 1260  REM MOVE COUNTERS
PL 1270  T=I:S1=0:S2=0
FO 1280  FOR F=1 TO 12:B(F)=A
         (F):NEXT F
PK 1290  B(T)=0:IF DS THEN GO
         SUB 1190
OI 1300  FOR F=1 TO A(T)
AG 1310  T=T+1
DL 1320  IF T>12 THEN T=1
AI 1330  B(T)=B(T)+1:IF DS TH
         EN GOSUB 1190
JN 1340  NEXT F:T0=T
PN 1350  REM ANY CAPTURES
BG 1360  IF B(T0)<2 OR B(T0)>
         3 THEN RETURN
JK 1370  IF P$="P" AND T0<=6
         THEN 1410
JB 1380  IF P$="C" AND T0>=7
         THEN 1410
KN 1390  RETURN
JE 1400  REM TOTAL CAPTURES
BB 1410  LS=1:IF P$="C" THEN
         LS=7
JB 1420  FOR F=T0 TO LS STEP
         -1
JI 1430  IF B(F)<2 OR B(F)>3
         THEN RETURN
BC 1440  IF P$="P" THEN SP=B(
         F):S2=S2+SP:GOTO 146
         0
KN 1450  IF P$="C" THEN SC=B(
         F):S1=S1+SC
PN 1460  B(F)=0:IF DS THEN T=
         F:GOSUB 1190
GL 1470  NEXT F:RETURN
KA 1480  XX=VAL(STR$(0)):GET
         #1,B:B$=CHR$(B):REM
         IF B$<>"" THEN 7000
II 1490  REM GET #1,B:B$=STR$
         (B):IF B$="" THEN 70
         10
KB 1500  RETURN
IE 1510  REM DISPLAY PLAYER'S
          SCORE
HB 1520  IF SP=0 THEN RETURN
BK 1530  FOR H=PL+1 TO PL+SP
JA 1540  POSITION 18,20:PRINT
          H:SOUND 1,53,10,12:
         FOR I=1 TO 20:NEXT I
         :SOUND 1,0,0,0
OJ 1550  NEXT H:PL=PL+SP:RETU
         RN
CL 1560  REM DISPLAY COMPUTER
         'S SCORE
BO 1570  IF SC=0 THEN RETURN
CA 1580  FOR H=CP+1 TO CP+SC
JB 1590  POSITION 18,8:X$=STR
         $(H):GOSUB 950:SOUND
          1,255,10,12:FOR I=1
          TO 20:NEXT I:SOUND
         1,0,0,0
MB 1600  NEXT H:CP=CP+SC:RETU
         RN
BI 1610  POSITION 2,22:PRINT
         SP$:POSITION 2,22:RE
         TURN
```

©

Bill Wilkinson

Number-Base Conversions

This column was prompted by a letter in COMPUTE!'s letters column, in which the author asked for a program to convert decimal numbers to binary. "Why," I asked myself, "do all these conversion programs work with only one pair of bases (for example, base 10 to base 2)?" Answer: because few realize that a more general program is almost as easy these specific ones. Don't believe me? Keep reading.

Number Bases

You probably learned about number bases back in third or fourth grade, though you might not have realized that's what you were learning. Specifically, you likely were taught that the number 735 represented "seven hundreds, three tens, and five ones." The fact that digits in a number represent powers of ten is kind of an accident. If humans were normally born with only three fingers and a thumb on each hand, you can bet that 735 would have meant "seven sixty-fours, three eights, and five ones" (that is, we would have used base 8).

Since computers are "born" with only two "fingers," their natural tendency is to use base 2, also known as *binary* numbers or notation. (A computer's "fingers" are its memory cells, but each cell can remember only off or on, equivalent in function to counting on two human fingers.) Yet you seldom see a computer memory dump printed in binary, simply because such a printout would be gigantic! Binary numbers take up a lot of room compared to equivalent decimal numbers. Instead, because of the neat way that powers of two can be grouped together, we tend to see computer memory represented in either octal (base 8) or hexadecimal (base 16) notation.

One thing you may have noticed is that a base's number is the same as the number of counting symbols needed to represent it. Thus base 10 uses 0–9. Base 8 uses only 0–7. What about bases beyond 10, such as base 16, the hexadecimal base most often used in microcomputer work? Doesn't it need 16 counting symbols? Yes, indeed, and the symbols most commonly used are 0–9, followed by A–F. (Why not use completely new symbols for the digits beyond 9? Simple: Early computer printers had only 64 different symbols available, so uppercase letters were used.)

Why Hex?

Sidelight: Since we are working on computers that tend to work with bytes, and since a byte can have a value from 0 to 255 (decimal), base 256 notation would seem to be a logical choice. But now we can see why it is not used—humans would be forced to learn 256 unique digit symbols! Still, there are two "nybbles" in each byte, and a nybble can have a value from 0 to 15 (decimal), so hexadecimal (base 16) notation is a very logical alternative.

Now, when you see a hexadecimal number such as A88C, what does it mean? Well, you can read that as "A four-thousand-ninety-sixes, 8 two-hundred-fifty-sixes, 8 sixteens, and C ones." In turn though, A and C may be read in decimal as 10 and 12, respectively. Whew! Now how about base 19?

Confused? Don't worry, help is at hand. Program 1 consists of a short main program followed by two special-purpose subroutines. These routines are designed to make it easy to allow entry and display of any number using any base or pair of bases. The first one (from line 9200 to line 9330) takes a number in variable N and converts it to a string in variable N$ using the number base given by the variable BASE. The second routine (lines 9400–9560) performs the reverse operation, converting a string in N$ (which is supposed to be a number in BASE notation) and converting it to N for use as a number anywhere in BASIC.

Try it. Type in the main code and the subroutines and try the various options. And use some bizarre number bases, such as 13 or 37 or 53. In keeping with the tradition of hexadecimal numbering, the digit symbols used are 0–9 (same as decimal for the first ten symbols), followed by A–Z, and then a–z (good enough for anything up to base 62!).

So now I have one set of routines which take care of *all* conversions. And it's kind of fun. You could even make a game of it: Try to make two English words "equal" by changing bases! For example, RIB base 35 equals some animal (which happens to enjoy ribs) in some other base. Can you find the animal word and its base? Maybe tricks like this could make a hard-to-break encryption scheme? (This can really cause you to lose sleep!)

Be Just A Bit Wiser

I couldn't quit with simple number conversions, of course. One of the handy features of most higher-level languages is (usually) the presence of operators which do *bitwise* operations. I like such operators so much I put them into the first of the advanced Atari-compatible BASICs we did, way back in 1981. Unfortunately, Atari BASIC does not have bitwise operators. In Atari BASIC, operators such as AND and OR always perform logical comparisons rather than bitwise comparisons. Though, in fairness, I should point out that there are occasions where Atari's logical operators are worth as much as or more than bitwise operators. Some authors have agreed with me to the extent that they have written machine

language USR calls for use in their BASIC programs. But this is beyond the ken of most BASIC users.

Fortunately, bitwise operators *can* be implemented in Atari BASIC. And that's exactly the purpose of the subroutines of lines 9000 through 9090 (bitwise AND) and lines 9100 through 9190 (bitwise OR) in Program 2. I don't have space in this column to explain the theory and operation of bitwise operators, but we can quickly look at one example of their use.

Suppose you want to perform some subroutine only when the user of your program hits the SELECT key. Further, suppose that in your program it is legitimate and possible that the user may be pushing down either (or both) the START and OPTION keys at that same time as SELECT. If you look in most any good reference book (COMPUTE!'s *Mapping the Atari*, for example), you will find a little table something like this:

Push this key	PEEK(53279) decimal	shows this binary
none	7	111
START	6	110
SELECT	5	101
OPTION	3	011

Here we have listed the binary values (even though you could have run Program 1 to convert the decimal values yourself) to show clearly what the console keys are doing: Each of those three keys changes a single bit of the specified address from 1 to 0 when it is pushed. So, we would like a way to isolate the state of the middle bit (of the three) to test for SELECT being pressed. No sooner said than done.

In most languages, you would use something equivalent to this:

```
SELECTPUSHED = NOT ( PEEK(53279)
  AND 2 )
```

In Atari BASIC, you can do it the way I did it in Program 2. Enough said?

Finally, there is Program 3. You can *not* use this program by itself. You must first add all four of the subroutines (on lines numbered 9000 or greater) from Programs 1 and 2. Be sure to keep those subroutines handy so they can be used by Program 3 or, I hope, by some of your own programs. (Remember, if you LIST a range of lines to disk or cassette, you can use ENTER to merge them with a program in memory.)

Program 3 is a catchall. It allows you to enter two numbers using two (optionally) different number bases. It then allows you to choose a number base for display purposes and shows you the conversions of the two numbers along with the results of bitwise ANDing them and bitwise ORing them. For a thorough understanding of bitwise operations, you might choose base 2 (binary) for all input and output. Happy hacking. ©

Program 1: Base Converter

```
EI 100 REM ***** PROGRAM TO
       DEMONSTRATE
DC 110 REM ***** NUMBER BASE
        CONVERSION
HH 120 REM
EH 130 DIM N$(40):REM (MUST
       BE AT LEAST 32)
HJ 140 REM
JO 200 ? :? :PRINT "BASE FOR
        INPUT";:INPUT BASEIN
KE 210 PRINT "NUMBER  ";:INP
       UT N$
NJ 220 BASE=BASEIN:GOSUB 940
       0:DECIMAL=N
CE 230 IF N<0 THEN PRINT "OO
       PS":GOTO 200
HK 240 PRINT "BASE FOR OUTPU
       T";:INPUT BASE
CE 250 PRINT
MK 260 PRINT N$;" BASE ";BAS
       EIN;" ="
NJ 270 GOSUB 9200:PRINT N$;"
        BASE ";BASE;" ="
BB 280 PRINT DECIMAL;" BASE
       10"
GG 290 GOTO 200
BP 9200 REM ***** CONVERT N
        TO N$ USING GIVEN BA
        SE
PN 9210 REM ENTER:  N,BASE
JB 9220 REM USES:{3 SPACES}D
        IG$,DIGIT,WORK,TEMP
MF 9230 TRAP 9250
FK 9240 DIM DIG$(62)
FE 9250 DIG$="0123456789ABCD
        EFGHIJKLMNOPQRSTUVWX
        YZabcdefghijklmnopqr
        stuvwxyz"
ME 9260 N$="0000000000000000
        0000000000000000"
KA 9270 WORK=N
DL 9280 FOR DIGIT=32 TO 1 ST
        EP -1
LF 9290 TEMP=INT(WORK/BASE):
        WORK=WORK-TEMP*BASE
MC 9300 N$(DIGIT,DIGIT)=DIG$
        (WORK+1)
GO 9310 WORK=TEMP:IF WORK TH
        EN NEXT DIGIT
HD 9320 IF N$(1,1)="0" THEN
        N$=N$(2):GOTO 9320
KP 9330 RETURN
CB 9400 REM ***** CONVERT N$
         TO N USING GIVEN BA
        SE
II 9410 REM ENTER:  N$ HAS P
        RESUMED NUMBER IN ST
        RING FORM
ED 9420 REM .{7 SPACES}BASE
        IS BASE TO USE
BJ 9430 REM EXIT:{3 SPACES}N
         HAS NUMBER IN INTER
        NAL FORM (<0 IF ERRO
        R)
AC 9440 REM USES:{3 SPACES}D
        IGIT,TEMP
OJ 9450 REM NOTE:{3 SPACES}D
        IGITS GO TO BASE 66,
         IN ORDER
PA 9460 REM .{7 SPACES}0..9,
        A..Z,A..Z
HP 9470 IF N$(1,1)="0" THEN
        N$=N$(2):GOTO 9470
JA 9480 N=0
OB 9490 FOR DIGIT=1 TO LEN(N
        $)
MD 9500 TEMP=ASC(N$(DIGIT))-
        48:IF TEMP<0 THEN N=
        -1:RETURN
BF 9510 IF TEMP>9 THEN TEMP=
        TEMP-7:IF TEMP<10 TH
        EN N=-1:RETURN
EM 9520 IF TEMP>35 THEN TEMP
        =TEMP-6:IF TEMP<36 T
        HEN N=-1:RETURN
FO 9530 IF TEMP>=BASE THEN N
        =-1:RETURN
FB 9540 N=N*BASE+TEMP
ID 9550 NEXT DIGIT
LE 9560 RETURN
```

Program 2: Bitwise Operations

```
ME 100 REM ***** PROGRAM TO
       SHOW STATE
PP 110 REM ***** OF CONSOLE
       KEYS AND
HJ 120 REM ***** DEMONSTRATE
        BITWISE AND
AB 130 X=PEEK(53279):IF X=7
       THEN 130
NP 140 Y=1:GOSUB 9000
FE 150 IF  NOT XANDY THEN PR
       INT "START",
OC 160 Y=2:GOSUB 9000
II 170 IF  NOT XANDY THEN PR
       INT "SELECT",
OG 180 Y=4:GOSUB 9000
KD 190 IF  NOT XANDY THEN PR
       INT "OPTION",
BP 200 PRINT
PJ 210 IF PEEK(53279)=X THEN
        210
FO 220 GOTO 100
CD 9000 REM **** REM BITWISE
         AND
ED 9010 REM ENTER:  X,Y
MH 9020 REM EXIT:{3 SPACES}X
        ANDY IS X AND Y
ML 9030 REM USES:{3 SPACES}T
        EMPX,TEMPY,MASK
EO 9040 TEMPX=X:TEMPY=Y:XAND
        Y=0:MASK=1
PG 9050 TEMPX=INT(TEMPX)/2:T
        EMPY=INT(TEMPY)/2
AF 9060 IF TEMPX=0 OR TEMPY=
        0 THEN RETURN
KD 9070 IF TEMPX<>INT(TEMPX)
         AND TEMPY<>INT(TEMP
        Y) THEN XANDY=XANDY+
        MASK
LM 9080 MASK=MASK+MASK
NJ 9090 GOTO 9050
AO 9100 REM **** BITWISE OR
EE 9110 REM ENTER:  X,Y
GE 9120 REM EXIT:{3 SPACES}X
        ORY IS X OR Y
MM 9130 REM USES:{3 SPACES}T
```

```
        EMPX,TEMPY,MASK
BN 9140 TEMPX=X:TEMPY=Y:XORY=0:MASK=1
PN 9150 TEMPX=INT(TEMPX)/2:TEMPY=INT(TEMP
        Y)/2
DI 9160 IF TEMPX=0 AND TEMPY=0 THEN RETUR
        N
AO 9170 IF TEMPX<>INT(TEMPX) OR TEMPY<>IN
        T(TEMPY) THEN XORY=XORY+MASK
LO 9180 MASK=MASK+MASK
ML 9190 GOTO 9150
```

Program 3: Subroutine Demo

```
EI 100 REM ***** PROGRAM TO DEMONSTRATE
DC 110 REM ***** NUMBER BASE CONVERSION
BP 120 REM ***** AND BIT-WISE OPERATORS
HI 130 REM
EI 140 DIM N$(40):REM (MUST BE AT LEAST 3
       2)
HK 150 REM
CH 200 ? :? :PRINT "IN BASE ";:INPUT BASE
KE 210 PRINT "NUMBER  ";:INPUT N$
PO 220 GOSUB 9400:X=N
CE 230 IF N<0 THEN PRINT "OOPS":GOTO 200
BJ 240 PRINT "BASE FOR INPUT";:INPUT BASE
KI 250 PRINT "NUMBER  ";:INPUT N$
AD 260 GOSUB 9400:Y=N
CI 270 IF N<0 THEN PRINT "OOPS":GOTO 200
HO 280 PRINT "BASE FOR OUTPUT";:INPUT BAS
       E
CI 290 PRINT
PI 300 PRINT "===== RESULTS ====="
DP 310 N=X:GOSUB 9200:PRINT "FIRST NUMBER
       : ";N$
HF 320 N=Y:GOSUB 9200:PRINT "SECOND NUMBE
       R : ";N$
BD 330 GOSUB 9000:GOSUB 9100
AH 340 N=XANDY:GOSUB 9200:PRINT "  BITWIS
       E AND : ";N$
KE 350 N=XORY:GOSUB 9200:PRINT "  BITWISE
       OR : ";N$
GE 360 GOTO 200
MP 999 REM ***** END OF MAIN CODE ***** ©
```


CAPUTE!

Atari DOS Switcher

This utility program from the December 1986 issue (p. 71) does not work as published because the final five lines of the listing are missing. To create a working version, add the following lines:

```
NA 1140 DATA 238,107,23,238,
        111,23,238,114,23,23
        8
KA 1150 DATA 118,23,173,107,
        23,201,52,208,218,76
LG 1160 DATA 66,25,63,25,82,
        25,76,70,23,173
JJ 1170 DATA 1,211,9,1,141,1
        ,211,169,64,141
LN 1180 DATA 14,212,88,160,1
        ,96,0
```

Fontier 128

Line 1890 of this program from the December 1986 issue (p. 82) cannot be typed in as listed. Unlike the Commodore 64, the 128 always prints the key definitions rather than characters when the function keys are pressed. Replace the line with the following:

```
HD 1890 K$="+-{UP}{DOWN}{LEFT}
        {RIGHT}"+CHR$(137)+CHR
        $(139)+CHR$(133)+CHR$(
        135)+CHR$(138)+CHR$(14
        0)+CHR$(134)+CHR$(136)
```

Laser Strike

Line 700 of the Apple version of this game from the December 1986 issue (Program 2, p. 52) ends with an incomplete statement—there is nothing following the THEN. The IF statement was never executed during our extensive testing of the game, so this should not cause a problem. However, you may want to delete the bad statement. Remove everything in that line following (and including) the last colon.

Biker Dave For Atari

The corrections in last month's CAPUTE! column fix the bugs in the Atari version of this program from the November 1986 issue. However, we have discovered that the program will not function properly if you stop the program with the BREAK key and then restart it with RUN. If you ever have cause to break out of this program, you'll need to reset the computer and reload the program before continuing.

Lumpies Of Lotis IV

A comma was inadvertantly removed during printing in line 260 of this IBM game from the October 1986 issue (p. 53). The line should begin with **IF ABS(Z(X,Y,LEV−1))**. ©

ST Outlook

Philip I. Nelson, Assistant Editor

Strong Showing At Fall COMDEX

As this issue goes to press (November) the Fall COMDEX (Computer Dealer Expo) is just ending in Las Vegas, with a strong showing by the Atari ST. Atari's large exhibit was packed throughout the show, and new products were present in abundance—including some of the mature, professional-quality software that the ST will need in order to remain viable over the long term. Here are a few highlights.

Publishing

Desktop publishing was a major theme at this year's show. One of the strongest new entries in this field is *Publishing Partner*, a Postscript-compatible package marketed by SoftLogik (Postscript is a page-description language used by laser printers and commercial typesetters). The program combines page layout, forms creation, and word processing in an integrated package. *Publishing Partner* operates on a "what you see is what you get" basis, letting you perform page design and composition right on the screen. You can also load *NEOchrome* or *DEGAS* graphic screens and then crop, reduce, enlarge, or squeeze the images as needed.

From Mirrorsoft in Great Britain comes the Fleet Street series of publishing programs. *Fleet Street Editor* is designed for novice and small-volume users, while *Fleet Street Publisher* comes in two different versions aimed at the middle and high ends of the desktop publishing market. The high-end package, scheduled for mid-1987 release, is also Postscript-compatible.

Graphics And Sound

Aegis Development is featuring *Aegis Animator*, styled as a "metamorphic cel animation system" for the ST. This program can handle *NEOchrome* images and it supports page flipping, color cycling, cinematic effects such as fades and wipes, and *tweening*, a means of creating intermediate forms to smooth the flow of animation from one frame to the next.

Digital Vision attracted lots of attention with its Computereyes color video digitizer. The hardware component of this $249.95 system plugs into the ST's cartridge port. Using a slow-scan process, Computereyes can capture video images from an NTSC composite video source such as a video camera or VCR.

The Video Digitizer Expert system, scheduled as a January 1987 release from MichTron, is a German import which promises a super-high 1024 × 512 resolution in addition to the usual ST screen modes. Another MichTron import is Sound Expert, a sound digitizer for the ST with a claimed sampling rate of 40 kHz. (The sound digitizer sends output to an internal speaker in the hardware interface rather than to the ST's audio output—a possible limitation.)

Entertainment

In the games category, Jez San's *Star Glider*, distributed by Firebird, is still one of the hottest tickets in town. Flight simulator fans will be glad to hear that SubLOGIC now offers *Flight Simulator II* for the ST, Amiga, and Macintosh. The 16-bit versions of this popular program feature greatly improved graphics and several functions not available on 8-bit versions. Multiple viewing windows let you watch your progress from more than one vantage point at a time, and the program supports a multiplayer option that allows two ST owners to "fly together" if their computers are linked through the modem port.

Hardware

Atari continues to keep major hardware projects under wraps, but it did show its new SX212 modem, a Hayes-compatible 300/1200 bps unit to be priced under $100. In addition to a standard RS-232 connector (for the ST) the modem has an extra connector for plugging directly into any eight-bit Atari machine as well.

Another attractive hardware product is The Monitor Box from JNL Technologies, which converts the ST's video output to standard composite video. This $59.95 device allows you to connect any ST to a TV, composite monitor, or VCR.

For power users, one of the more interesting utilities comes from Beckemeyer Development. Their *Hard Disk Accelerator* software works in the background and speeds up hard-disk access by a factor of 100–300 percent through the use of a *caching* system in RAM.

Aegis Development
2115 Pico Blvd.
Santa Monica, CA 90405

Beckemeyer Development Tools
478 Santa Clara Ave.
Oakland, CA 94610

Digital Vision
14 Oak St., Suite 2
Needham, MA 02192

Firebird Licensees
P.O Box 49
Ramsey, NJ 07446

JNL Technologies
3460 Harold St.
Oceanside, NY 11572

MichTron
576 S. Telegraph
Pontiac, MI 48053

Mirrorsoft
Maxwell House
74 Worship St.
London EC2A 2EN

SoftLogik
4129 Old Baumgartner
St. Louis, MO 63129

SubLOGIC
713 Edgebrook Dr.
Champaign, IL 61820

AmigaView

Sheldon Leemon

The Latest Amiga Products

I just returned from the Second Annual Amiga Developers' Conference sponsored by Commodore-Amiga, a three-day gathering of those who live, breathe, eat, and sleep Amiga. It's impossible to describe everything so I'll just touch on the final eight hours, the Faire, where developers showed their products.

On the hardware side, Computer System Associates was showing its Turbo Amiga expansion box, containing a 68020 microprocessor running at 14MHz with 512K or 16-bit static RAM and a 68881 math coprocessor. Benchmarks showed this $5000 system to be five times as fast as a VAX-11/780, when running a program compiled with Absoft's 68020 Fortran 77 compiler (Absoft's Microsoft BASIC compiler, which should be ready soon, was also shown). The Turbo Amiga even ran an ABASIC version of the test program faster than the PC/AT with math coprocessor could run a Fortran version.

There were a number of manufacturers showing hard disks and RAM expansion modules (at last). C Ltd. (formerly CardCo) was showing the first under-$1000 20-megabyte hard drive. Microbotics and Byte by Byte had 20-meg units which were a little more costly, and Xebec, a well-known maker of IBM PC hard disk controllers, was showing off a very attractive $895 10-megabyte hard disk as well as a $1295 20-meg version.

RAM Expansion

There was even more activity in the RAM-expansion field. C Ltd. offered a $500 1-megabyte card, and ASDG had a 2-meg board in a small card cage which allows a RAM disk to survive a warm reboot. Pacific Cypress was showing the Xpander II, a 2-meg box for $700. Microbotics brought the Starboard II, a 512K 2-meg expansion module, with a socket for a multifunction board containing a clock/calendar, 68881 coprocessor socket, and reset-protection for the RAM disk. And Alegra was showing its $350 512K expander. All of these units auto-configure, which means that when using the 1.2 operating system (which was officially released during the conference) the system automatically recognizes the extra memory at power-on time. Except for the Alegra, all pass on the expansion bus, and all of them work with one another. Though not shown, the U.S. distributor had flyers for the Alphatron internal 1-meg expansion. This $350 German board mounts inside the Amiga, and plugs into the 68000 socket.

So many outstanding products were shown that it's hard to single any out, but Tim Jennison's Digi-View video digitizer and *DigiPaint* software deserve special mention. This low-budget, high-quality system has been living in the shadow of A-Squared's unreleased frame grabber, since it takes about half a minute to capture a color picture while *Live!* is reported to capture about 20 frames a second. But the quality of images captured by the Digi-View system is outstanding, the product is constantly being improved through software upgrades, and it's available. The latest hi-res program digitizes a color image in 640 × 400 resolution with 16 colors (if you have 1.5-meg of memory). By the way, A-Squared once again showed *Live!* and though much delayed, it's by no means down for the count.

New Music Software

The long wait for powerful music software appears to be almost over. Electronic Arts' *Deluxe Music Construction Set*, due any day, is an excellent note-entry system according to the fortunate few who have used it. And Mimetic's *Pro Midi Studio* software has been substantially improved, making it an impressive keyboard-entry system. The best part is that both use IFF music files, so they can trade data back and forth. Aegis surprised everyone by announcing that it has picked up the long-delayed *Musicraft* program, and will be releasing it as *Sonix*. The enhanced package now features support for IFF files and MIDI instruments.

EA also is ready to release *Deluxe Paint II*, which marks yet another giant step forward. Among its outstanding features are perspective fill, anti-aliasing, and display screens up to 1008 × 1008 for those blessed with extra memory. It also allows the user to change easily between resolution modes, and will convert the picture in memory to the new resolution.

Product Awards

On the final night of the conference, the First Amiga Users Group (FAUG) held a banquet, and gave out awards for outstanding Amiga products. Electronic Arts won the most awards, but a partisan programmers' crowd gave the second biggest round of applause to Jim Goodnow II for his *Aztec C* compiler (Jim said that he was just glad that EA didn't write compilers). The biggest hand of the evening went to Fred Fish, who took upon himself the burden of collecting and distributing free software for the Amiga. Fred's compilation of programs and source code has become a vital resource for Amiga programmers and users alike. Information about the contents of the 40 Fish disks can be found on many bulletin boards and information services.

If nothing else, this gathering of a couple hundred determined Amiga fans showed that the machine has attracted enthusiastic support among developers, and that those developers are busy translating that enthusiasm into exceptional products for the Amiga.©

Making Movies With *Print Shop* And *Magic Slate*

"I don't belong here!" cried the teacher, shaking her head and frowning. "My principal made me come to this course to learn word processing. But this isn't a computer course at all."

As I looked around the room, I had to agree with her. I had taken over the elementary school's library to conduct my summer workshops on how to set up a multimedia classroom. There *were* computers. But they were dwarfed by an array of other high-tech equipment which surrounded them. There were electronic keyboards, tape decks, turntables, huge stereo speakers and amplifiers, video cameras, tripods, VCRs, and boom boxes. The room was littered with stacks of videotapes, audio cassettes, boxes of disks, and record albums. Dozens of gray and black cables snaked their way across the floor. On the walls were colorful *Print Shop* banners proclaiming, "Fred's Multi-Media Sandbox" and "Imagination, Creativity, and Storytelling."

The room was a twenty-first–century street bazaar raucous with exotic, high-tech sounds.

Beatles music blared from one speaker, punctuated by helicopter noises and the gut-thumping vibrations from a temple gong produced by a synthesizer. One teacher had digitized her voice and was playing it back on our Mirage sampling keyboard: "Welcome ... Well .... Well ... Well ... Welcome ... to Fred's sandbox," she sang—in a chorus of voices accompanied by a marimba and a hammer dulcimer.

20-Column Word Processing

I agreed with the disgruntled teacher that she had perhaps been sent to the wrong workshop. "Look, Cherry," I said optimistically, "Now that you're here, let's try to make the best of it."

I steered her over to one of the workshop's several Apple computers, sat her down, and got her started using the *Magic Slate* word processor from Sunburst Communications. Since she had never used a computer before, I chose the word processor's 20-column mode. Only 20 letters fit on a line, and each of the letters is really big. In 20-column mode, it was easy to fill an entire screen quickly.

I left Cherry searching for letters on the keyboard and went to help a teacher who was trying to plug her computer into a VCR. For the next half-day I was so busy I didn't even think about how Cherry was doing.

The next morning while I was training a teacher on Brøderbund's *Fantavision* program, someone grabbed me, spun me around, and gave me a bear hug. It was Cherry! But she was smiling—delirious, even. "Come with me," she said, taking my hand and pulling me over to her computer. "See what I've done!"

We went over to her computer and looked at the screen. She had written a wicked-witch story called Gundala—all on one screen. "That's my daughter, Gundala," she said, beaming. "What do you think?"

A New Movie

Before I could answer, one of my other teachers, Mike Roberts, said, "Let's set it to music." "And we can videotape it," said another teacher. "And Cherry can read it aloud," suggested another.

In five minutes the teachers had it all arranged. Mike made haunted-house sounds on the Yamaha DX100 keyboard. Beverley shot the Apple picture screen with the video camera, and Cherry sat right beneath the camera reading her story aloud. Beverley was so small she had to stand on a chair while she did the videotaping.

We turned off all the lights, played back the tape, and watched our little movie on the library's TV. It was great! The big, bright *Magic Slate* letters appeared on the TV screen as if they were floating in a black, nighttime sky. Mike's music was spooky and funereal. And Cherry had really hammed it up when she read the story.

We all applauded Cherry, and she stood up and took a little bow. "Now that I know word processing," she said, "I want to learn *Print Shop*."

I had to make a phone call, so I assigned another teacher to work with Cherry for a while.

I returned to the room 45 minutes later. "How's everything go...." "Silence!" shouted Mara, a kindergarten teacher from Cahaba Heights Community School. "We're taping Cherry's *Print Shop* movie."

Cherry's *Print Shop* MOVIE? I wondered. I groped my way into the darkened room and sat down in one of the kid-sized library chairs. There at the front of the library, centered in a bright spotlight, was Cherry. Over her head, taped to one of the bookshelves, was a *Print Shop* sign. "Fun in the sun!" it said. "Cherry Norman." In the middle was a happy little sun, peeking out of a cloud and grinning.

Our workshop had gotten off to a rocky beginning. Cherry had led a revolt among several of the teachers who had come to the workshop expecting a basic primer on computers, keyboards, and word processing. I had visions of the whole workshop collapsing even before it got started.

But once Cherry began creating stories, poems, and movies on *Magic Slate* and *Print Shop*, she was on a roll. And the other teachers followed her. It was amazing to see how much progress they made in only two days. ©

Demons And Events, Part 1

The feature of the Macintosh that has attracted the most attention is its user interface—menus, mice, windows, dialog boxes, and all the other distinguishing features of this computer have now taken their place in the lexicon of most computer users.

Features that were introduced to the public on the Macintosh have now appeared on numerous other computers as well. One can hardly walk past a display of Atari, Commodore, Apple II, or IBM computers without seeing some aspects of a highly visual user interface. Apple's commitment to this interface is so complete that the Apple IIGS contains ToolBox routines to facilitate the creation of Mac-like programs.

But just as the Macintosh looks "different" from the user's perspective, it also looks different from the programmer's perspective. Programming for computers like the Macintosh is very different from programming for other computers. If the user interface of this computer is changing the way we use computers, it may well change how we program them as well.

Computational Metaphors

Every programming language supports a computational metaphor. For example, LISP programs are sets of functions to be evaluated, PROLOG programs are sets of theorems to be proved, Pascal programs are sets of commands to be carried out, and so on. The reason we have so many different kinds of programming languages is because different programming tasks are better expressed in one metaphor than another.

But metaphoric differences aside, programs in most languages consist of strings of text containing sequences of instructions to be carried out by the computer. In many languages the order of program execution is the same as the order of the instructions in the program. When the user wants to change the order (by calling a subroutine, for example) a special branching instruction is explicitly invoked to cause the program to jump from one set of instructions to another set.

Event-Driven Programs

There is another model of program construction that works differently: It breaks a program into two parts. The first part is a traditional program that is executed unconditionally. The program also includes the definition of other parts of the program (collected subroutines) that are executed whenever certain events occur.

In other words, if you wanted to have a subroutine executed whenever a joystick button was held down, you would include a line somewhere in your program indicating that, whenever the button is pressed, the program is to stop whatever it is doing at that time and execute another routine instead. This command lets the program know that, in addition to its other tasks, it is to check for a "button" event. Let's pretend that, later on, the program starts to draw a complex picture on the screen. While it is drawing this picture, you decide to press the joystick button. As soon as you do, the program automatically detects this "event" (without being "told" to by a special instruction) and execution is automatically transferred to a subroutine. Once this routine is finished, control is returned to the original picture-drawing task.

This is the programming model that is used in creating programs for the Macintosh, although I first encountered it with Atari Logo.

Atari Logo (for the Atari 800 and 400 computers) has a special feature called a WHEN demon. A WHEN demon is a special object that continuously monitors the computer, looking for any of 21 special events to occur. Whenever one of these events takes place, the demon associated with the event executes its own set of Logo instructions, no matter what other instructions or procedures are being used at the time. When these demon instructions are finished and the WHEN condition is no longer satisfied, Logo goes back to doing whatever it was doing before the WHEN demon was activated.

Demon programs can be thought of as sets of code that are just lying asleep in the computer waiting for a certain condition to become true. Whenever the condition is satisfied, the appropriate routine wakes up, does its task, and then goes to sleep again. Each demon procedure is independent of the others and is executed only when its chosen condition or event occurs.

Notice how different this is from our traditional method of programming. Normally, if we wanted to test for a certain number of events, we would write a program that spent the bulk of its time in a loop checking for each event on a case-by-case basis.

Next month we'll explore this topic some more by taking apart a Macintosh program—"peering under the hood," so to speak—to see just what it is that makes programs for this computer appear to be so responsive to the whims of the user.

Dr. Thornburg's most recent product is Calliope™, *a nonlinear idea processor for the Apple IIe, c,GS, Macintosh, and MS-DOS computers. He welcomes letters from readers and can be reached in care of this magazine.*©

The Beginner's Page

C. Regena

The RESTORE Statement

Last month we talked about READ and DATA statements. A often used associated statement is RESTORE, which can be used with READ and DATA. RESTORE forces the computer to start READing the very first item in the first DATA statement in the program. You thus can reuse DATA statements if necessary. Here is a simple example:

```
10 READ A,B,C
20 DATA 2,4,3,8,2,7
30 PRINT A+B+C
40 READ D,E
50 PRINT D*E
60 END
```

When this program is run, line 10 reads data (from line 20) for the variables A, B, and C. A will equal 2, B will be 4, and C will have the value 3. Line 30 prints the sum. Line 40 is another READ statement which reads the next two data items for D and E. D will have the value 8 and E will be 2. Line 50 prints the product. (Remember that you can put the DATA statement of line 20 anywhere in the program and the results will be the same.)

Now add a line:

```
35 RESTORE
```

This line says to restore the data, or to start the list of data items over again with the very next READ statement. This time the values for D and E will be 2 and 4 because the data pointer starts with the very first data item in the program.

Restoring DATA Lines

Many versions of BASIC even allow you to RESTORE a certain data line. For example, RESTORE 200 means "With the very next READ statement encountered, start the data with the DATA statement in line 200." This feature makes programming with DATA statements much easier because you can make sure the READ statements start with certain DATA statements. It's particularly helpful in long programs with many DATA statements.

The RESTORE statement need not appear right next to the READ statement. It simply resets the data pointer.

Here is a way you can make use of DATA, READ, and RESTORE. Write a short program to read numbers for musical note values, and then play those notes. Place this in a subroutine at line 900. An example for the Atari ST might be:

```
900 FOR C=1 TO X
910 READ NOTE,OCTAVE
920 SOUND 1,15,NOTE,OCTAVE,10
930 NEXT C
940 RETURN
```

Now in your main program you can have DATA statements containing numbers for musical phrases. The variable X in this example is the number of notes in the phrase. Using RESTORE you can play phrases more than once without retyping DATA statements. For example:

```
100 X=35
110 GOSUB 900
120 DATA ...(numbers for music)
130 DATA ...(more note numbers)
140 DATA ...(more note numbers)
150 X=14
160 RESTORE 130
170 GOSUB 900
180 X=7
190 RESTORE 140
200 GOSUB 900
210 RESTORE
220 GOSUB 900
230 END
```

First, X is set to 35, and the subroutine will read and play 35 notes from the data starting at line 120. Line 160 says to start the data over beginning with line 130. Fourteen notes will be played—a chorus, for example. Line 190 then says to start the data over with line 140 and play 7 notes—repeating a musical phrase. Line 210 says to restore the data completely, or to start with the very first line of data. The value of X is still 7, so 7 notes will be played and the rest of the data will be ignored.

Selecting Items From A List

Computers which use line labels permit a RESTORE to target a particular label. For example, RESTORE UTAH tells the computer that with the very next READ statement start the data with the line labeled UTAH. The data might be information used by the program to draw the state using numbers for graphic coordinates.

RESTORE is also used if you have lots of information and the computer is supposed to select particular items from a list. Suppose you have names, addresses, phone numbers, and codes in data statements for a list of clients. You can first read each item and print only those with a certain zip code. Next, you can RESTORE the data, then read each item, and print only those with a certain phone prefix. Another time you could RESTORE the data, then read each item, and print only those with a certain code. You can let the computer do the work of searching through information in one data list and save your having to write several different programs.

This should get you started on understanding programs with DATA, READ, and RESTORE statements. You might not even consider yourself a beginner anymore if you can manipulate DATA statements, but I hope to see you again next month. ©

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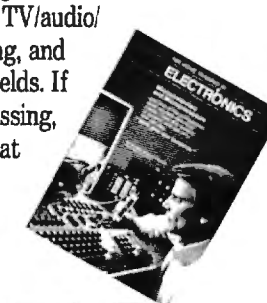

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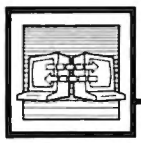

Telecomputing Today

Arlan R. Levitan

New Products And Improved Services

Life in the fast lane for telecomputers no longer requires a Ferrari-level machine. At last November's COMDEX show in Las Vegas, U.S. Robotics introduced the $995 Courier HST, an external 9600-bps modem, designed for use on standard dial-up telephone lines. In high-speed mode, the HST actually uses two communications channels, one a 9600-bps and the other a 300-bps data channel. The high-speed channel direction is automatically assigned according to data-flow demand. The 9600-bps channel is designed for fast downloading and uploading of files, and the low-speed channel is suitable for manual data entry and error-control coding.

Confusing? Not really. Consider what the "typical" user of a BBS or information service usually does. Downloading or uploading files is usually a lopsided affair, with most of the data moving in one direction. The only data traffic sent to a BBS while a user is downloading a file is checksum or other error-detection information, often only one or two bytes of data per received block. Depending on the protocol being used, the ratio of received to sent data is somewhere in the range of 100:1 to 1000:1. Dividing the limited bandwidth of the phone line into a high- and low-speed channel makes perfect sense.

Dynamically assigning the 9600-bps channel should also work well for reading and responding to messages on BBS message bases and information service SIGs. The high-speed channel will end up being assigned to the slew of messages that most users peruse. If the user wishes to reply to a message or reply to a prompted response, the 300-bps channel's maximum rate of 300 words per minute can still outrun even the speediest typists.

The HST also supports standard 300-, 1200-, and 2400-bps operation. It is equipped with nonvolatile memory for storing settings and phone numbers, and uses a superset of the Hayes "AT" command set. At 9600 bps, the modem uses a proprietary error and flow-control protocol that's an enhanced version of MNP (Microcom Networking Protocol).

In all fairness, don't expect the commercial information services to jump on the HST bandwagon. At this point, most of the interest seems to be coming from the sysops of privately operated BBSs. As it has in the past, U.S. Robotics is offering special purchase terms for system operators of popular bulletin board systems.

For more information, contact U.S. Robotics, 8100 North McCormick Blvd., Skokie, IL 60076, (312) 982-5010.

PC Pursuit Expands

Speaking of other high-speed surprises, CompuServe raised more than a few eyebrows last November when it removed connect-time premiums for 2400-bps service. Subscribers now pay the same rate for both 1200- and 2400-bps connections ($12.50 an hour, non-prime time).

GTE Telenet has announced a major expansion of its PC Pursuit Service. The addition of 11 new service areas by the end of 1986 will almost double PCP's coverage. Modem mavens can add access to remote systems in Portland (area code 503), San Jose (408), Glendale (818), Phoenix (602), Milwaukee (414), Minneapolis (612), Tampa (813), Miami (305), Cleveland (216), Salt Lake City (801), and North Carolina's Research Triangle Park (919).

Pursuit has also started offering direct access to selected public multi-user BBSs on a trial basis. The systems involved charge a yearly subscription fee (usually $25) for unlimited access and offer extensive download libraries. If the trial is successful we may see public BBSs on the PC Pursuit network putting even more pressure on the commercial services.

Pursuit has also announced delayed implementation of their 2400-bps service to March of '87. Implementation was originally announced for this past fall, but insiders at PCP say it may take well into the summer to work out noise and throughput problems that are being encountered in developing the higher speed service. For more information on PC Pursuit, call the PCP bulletin board at 1-800-835-3001.

Trintex In Trouble?

CBS has ended its involvement in the Trintex videotex project. Announced in 1984, Trintex was a joint venture of CBS, Sears Roebuck, and IBM. Earlier this year Trintex officials announced that it would forgo a text-based information system in favor of a graphics-based system using the NAPLPS (North American Presentation Level Protocol Syntax) standard. Two other graphics-based systems, Knight-Ridder's Viewtron and Times Mirror's Gateway, folded early in 1986.

IBM maintains that it has made significant enhancements to NAPLPS that will make it more acceptable to the consumer market. Although the new service is supposed to debut in 1988, Sears is said to be getting cold feet as well and may soon pull out. ©

Donald B. Trivette

The CD-ROMs Are Coming

Six years ago, when I bought an IBM PC, it came with two state-of-the-art floppy disk drives. A floppy back then was single-sided and held 180,000 characters of information—a lot, I thought. Two years later 180,000 bytes didn't seem like so much and I replaced one of the single-sided drives with two half-height floppy drives—each capable of reading and writing double-sided disks. At that point, the three drives had a total capacity of 900,000 bytes. Last year I replaced the old single-sided floppy drive with a half-height hard disk. Capacity: 20 million bytes.

In November I upgraded again. To my six-year-old computer I added a storage device that wasn't even dreamed of in 1981. The Compact Disc–Read Only Memory, better known as a CD-ROM, has a capacity of half a *billion* characters. The CD-ROM player is smaller than its musical counterpart, although the electronics are almost identical. The unit I connected to my PC is a free-standing Sony CDU-100, about the size of a telephone-answering machine. Sony also makes a reader that slips right into one of the PC's disk cavities.

The computer compact disc is identical to the 4.7–inch audio variety that records 60 minutes of music and has become the salvation of the record industry. Both record a digital "message" of zeros and ones, called *lands* and *pits*, on one side of the shiny aluminum platter. But unlike a floppy disk which has data recorded in concentric tracks, the CD records information on a continuous spiral track similar to a conventional phonograph record. Unrolled it would cover more than three miles; on the disc it packs to a density of 16,000 tracks per inch.

Bacterium-Sized Bits

The high density is possible because the CD-ROM is an optical device, not magnetic. The disc is recorded at the factory with a laser by *burning* pits about the size of a bacterium into the disc's surface.

CD-ROM disc advantages include its low production cost—Sony says less than $1 per hundred—and its staggering capacity. The 550 million bytes available on a disc make the equivalent of 1500 double-sided floppies or approximately 275,000 manuscript pages. One disc can store the equivalent of 1000 books. And one disc could, and will, contain the telephone directories for an entire region of the country. Someday we may have a national telephone book recorded on three or four CD-ROMs. Once you understand the capacity of a CD-ROM, you begin to appreciate the complexity of converting music to a digital format: It takes the equivalent of 152,000 characters to produce one second of music; an hour of music uses the entire half-billion characters of a disc.

One of the first home applications of CD-ROM technology is the *Academic American Encyclopedia* published by Grolier. This 20-volume reference set takes more than two feet of shelf space in paper form, but fits nicely on a CD. In fact, the entire encyclopedia along with a huge index to speed up searches uses less than 20 percent of the disc's capacity—four more encyclopedia sets could be placed on this same CD.

In order to use the encyclopedia, you first load the information-retrieval software from a floppy disk into the PC. This works just like loading any computer software. Once the retrieval program is running, you can use a variety of search terms to find one, or dozens of articles on a topic. In less than ten seconds you can examine every word in the entire encyclopedia.

It's a delight to use. I entered SURFING as a search word and in four seconds found there were 20 occurrences in six articles: 1 each in the Beach Boys, Hawaii, periodical, rock music, and skateboarding articles, and 15 in the article on surfing.

By moving the cursor to one of these topics and pressing a function key—the program operates from menus and function keys—I can have the article displayed on my screen. And by pressing another function key, I can have the article printed. I can even press a key and look at an outline of the article—a by-product of the extensive indexing system.

Special Searches

Searches that would be impossible with a conventional encyclopedia take only a few seconds. By modifying the search conditions to select only articles where the word *BORN* appears within five words of *JAN 31*, I looked for people with whom I share a common birthday. Thirty seconds later the computer found 34 notables, ranging from André Antoine, a French theater director born in 1858, to James G. Watt, secretary of the interior from 1981 to 1983.

The *Grolier Academic American Encyclopedia* sells for $199 and the Sony CD-ROM player is about $900 (but as low as $600 in quantity.) Volume and competition are sure to bring these prices down. About 18,000 CD-ROM discs were produced in 1986; industry sources estimate that more than 12 million will be produced in 1990.

And even now, it's technically practical to mix still-video, sound, and text on the same disk. Imagine an unabridged dictionary on a CD-ROM. Look up *Beethoven*, press a key, and hear a passage from his *Fifth Symphony*. Look up *respiratory*, press a key, and hear the correct pronunciation. Press another key, and hear the word spoken in French. In German. In Chinese. ©

News & Products

Sylvia Porter Series: *Swiftax*

Timeworks has announced the release of *Swiftax*, the third volume in its Sylvia Porter Personal Finance Series for the Apple II, IBM, and Atari ST computers.

Produced jointly by the editors of *Sylvia Porter's Personal Finance Magazine* and Timeworks, *Swiftax* enables you to prepare and complete the 1986 Federal income tax returns without prior knowledge of accounting or computers. The package includes a copy of the 1987 edition of Porter's *Income Tax Book*.

Features include complete Schedules A, B, C, D, E, F, G, R, SE, W, and Forms 2106, 2441, 4562, 6251; income averaging and other tax alternatives; automatic entry of information onto Forms 1040, 1040A, and 1040EZ; printing of itemized lists of dividends, interest, etc., and amortization schedules; and a built-in memo pad and calculator that operate concurrently with *Swiftax*.

The program is available for $69.95.

Timeworks, 444 Lake Cook Rd., Deerfield, IL 60015.

Circle Reader Service Number 208.

New Activision Programs

Portal: A Computer Novel, Titanic: The Recovery Mission, Aliens: The Computer Game, and *Greeting Card Maker* are among a variety of new entertainment and creativity programs recently released by Activision.

Portal is a multidisk graphics and text adventure game initially released for the Commodore 64 and 128, with versions for most major computer systems to follow. Returning to the earth in the year 2106, you find a world devoid of people. You tap into the Worldnet databases and begin scanning the records of the entire civilization, slowly uncovering the mysterious disappearance through the aid of a biological computer called Homer. *Portal* is priced at $39.95 for all versions.

Titanic is a combination adventure, strategy, and puzzle-solving game in which you attempt to raise the sunken ship. You also have to raise money for your ventures, keep media interest high, and explore and retrieve the ship. Available on the Commodore 64 and 128, the game is priced at $29.95.

Based on the recent popular movie of the same name, *Aliens* is a Commodore 64/128 fast-action program that reproduces many of the elements in the motion picture through the use of simulation, mazes, karate sequences, and other arcade-style game features. Suggested retail price is $34.95.

Greeting Card Maker is a do-it-yourself card generator for the Apple II-series and Commodore 64/128 computers. Cards, invitations, and announcements for any occasion can be created and printed out with the program. There are six different card sizes, including pop-up cards; scores of pictures, designs, and scenes; two dozen background patterns and borders; eight type styles; and a wide variety of verses. The program is priced at $39.95 for the Apple version and $34.95 for the Commodore version.

Activision, 2350 Bayshore Parkway, Mountain View, CA 94043.

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COMPUTE!'s Guide To Typing In Programs

Computers are precise—type the program *exactly* as listed, including necessary punctuation and symbols, except for special characters noted below. We have provided a special listing convention as well as a program to check your typing—"The Automatic Proofreader."

Programs for the IBM, TI-99/4A, and Atari ST models should be typed exactly as listed; no special characters are used. Programs for Commodore, Apple, and Atari 400/800/XL/XE computers may contain some hard-to-read special characters, so we have a listing system that indicates these control characters. You will find these Commodore and Atari characters in curly braces; *do not type the braces.* For example, {CLEAR} or {CLR} instructs you to insert the symbol which clears the screen on the Atari or Commodore machines. A complete list of these symbols is shown in the tables below. For Commodore, Apple, and Atari, a single symbol by itself within curly braces is usually a control key or graphics key. If you see {A}, hold down the CONTROL key and press A. This will produce a reverse video character on the Commodore (in quote mode), a graphics character on the Atari, and an invisible control character on the Apple.

Graphics characters entered with the Commodore logo key are enclosed in a special bracket: [<A>]. In this case, you would hold down the Commodore logo key as you type A. Our Commodore listings are in uppercase, so shifted symbols are underlined. A graphics heart symbol (SHIFT-S) would be listed as S. One exception is {SHIFT-SPACE}. When you see this, hold down SHIFT and press the space bar. If a number precedes a symbol, such as {5 RIGHT}, {6 S}, or [<8 Q>], you would enter five cursor rights, six shifted S's, or eight Commodore-Q's. On the Atari, inverse characters (white on black) should be entered with the inverse video

Atari 400/800/XL/XE

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

Commodore PET/CBM/VIC/64/128/16/+4

When You Read:	Press:	See:
{CLR}	SHIFT + CLR/HOME	
{HOME}	CLR/HOME	
{UP}	SHIFT + ↑ CRSR ↓	
{DOWN}	↑ CRSR ↓	
{LEFT}	SHIFT + ← CRSR →	
{RIGHT}	← CRSR →	
{RVS}	CTRL + 9	
{OFF}	CTRL + 0	
{BLK}	CTRL + 1	
{WHT}	CTRL + 2	
{RED}	CTRL + 3	
{CYN}	CTRL + 4	
{PUR}	CTRL + 5	
{GRN}	CTRL + 6	
{BLU}	CTRL + 7	
{YEL}	CTRL + 8	

When You Read:	Press:	See:
[<1>]	COMMODORE + 1	
[<2>]	COMMODORE + 2	
[<3>]	COMMODORE + 3	
[<4>]	COMMODORE + 4	
[<5>]	COMMODORE + 5	
[<6>]	COMMODORE + 6	
[<7>]	COMMODORE + 7	
[<8>]	COMMODORE + 8	
{ F1 }	f1	
{ F2 }	SHIFT + f1	
{ F3 }	f3	
{ F4 }	SHIFT + f3	
{ F5 }	f5	
{ F6 }	SHIFT + f5	
{ F7 }	f7	
{ F8 }	SHIFT + f7	
←	←	

key (Atari logo key on 400/800 models).

Whenever more than two spaces appear in a row, they are listed in a special format. For example, {6 SPACES} means press the space bar six times. Our Commodore listings never leave a single space at the end of a line, instead moving it to the next printed line as {SPACE}.

Amiga program listings contain only one special character, the left arrow (←) symbol. This character marks the end of each program line. Wherever you see a left arrow, press RETURN or move the cursor off the line to enter that line into memory. Don't try to type in the left arrow symbol; it's there only as a marker to indicate where each program line ends.

The Automatic Proofreader

Type in the appropriate program listed below, then save it for future use. The Commodore Proofreader works on the Commodore 128, 64, Plus/4, 16, and VIC-20. Don't omit any lines, even if they contain unfamiliar commands or you think they don't apply to your computer. When you run the program, it installs a machine language program in memory and erases its BASIC portion automatically (so be sure to save several copies before running the program for the first time). If you're using a Commodore 128, Plus/4 or 16, do *not* use any GRAPHIC commands while the Proofreader is active. You should disable the Commodore Proofreader before running any other program. To do this, either turn the computer off and on or enter SYS 64738 (for the 64), SYS 65341 (128), SYS 64802 (VIC-20), or SYS 65526 (Plus/4 or 16). To reenable the Proofreader, reload the program and run it as usual. Unlike the original VIC/64 Proofreader, this version works the same with disk or tape.

On the Atari, run the Proofreader to activate it (the Proofreader remains active in memory as a machine language program); you must then enter NEW to erase the BASIC loader. Pressing SYSTEM RESET deactivates the Atari Proofreader; enter PRINT USR(1536) to reenable it.

The Apple Proofreader erases the BASIC portion of itself after you run it, leaving only the machine language portion in memory. It works with either DOS 3.3 or ProDOS. Disable the Apple Proofreader by pressing CTRL-RESET before running another BASIC program.

The IBM Proofreader is a BASIC program that simulates the IBM BASIC line editor, letting you enter, edit, list, save, and load programs that you type. Type RUN to activate. Be sure to leave Caps Lock on, except when typing lowercase characters.

Once the Proofreader is active, try typing in a line. As soon as you press RETURN, either a hexadecimal number (on the Apple) or a pair of letters (on the Commodore, Atari, or IBM) appears. The number or pair of letters is called a *checksum*.

Compare the value displayed on the screen by the Proofreader with the checksum printed in the program listing in the magazine. The checksum is given to the left of each line number. Just type in the program a line at a time (without the printed checksum), press RETURN or Enter, and compare the checksums. If they match, go on to the next line. If not, check your typing; you've made a mistake. Because of the checksum method used, do not type abbreviations, such as ? for PRINT. On the Atari and Apple Proofreaders, spaces are not counted as part of the checksum, so be sure you type the right number of spaces between quote marks. The Atari Proofreader does not check to see that you've typed the characters in the right order, so if characters are transposed, the checksum still matches the listing. The Commodore Proofreader catches transposition errors and ignores spaces unless they're enclosed in quotation marks. The IBM Proofreader detects errors in spacing and transposition.

IBM Proofreader Commands

Since the IBM Proofreader replaces the computer's normal BASIC line editor, it has to include many of the direct-mode IBM BASIC commands. The syntax is identical to IBM BASIC. Commands simulated are LIST, LLIST, NEW, FILES, SAVE, and LOAD. When listing your program, press any key (except Ctrl-Break) to stop the listing. If you enter NEW, the Proofreader prompts you to press Y to be especially sure you mean yes.

Two new commands are BASIC and CHECK. BASIC exits the Proofreader back to IBM BASIC, leaving the Proofreader in memory. CHECK works just like LIST, but shows the checksums along with the listing. After you have typed in a program, save it to disk. Then exit the Proofreader with the BASIC command, and load the program as usual (this replaces the Proofreader in memory). You can now run the program, but you may want to resave it to disk. This will shorten it on disk and make it load faster, but it can no longer be edited with the Proofreader. If you want to convert an existing BASIC program to Proofreader format, save it to disk with SAVE *"filename"*,A.

Program 1: Atari Proofreader

By Charles Brannon, Program Editor

```
100 GRAPHICS 0
110 FOR I=1536 TO 1700:REA
    D A:POKE I,A:CK=CK+A:N
    EXT I
120 IF CK<>19072 THEN ? "E
    rror in DATA Statement
    s.  Check Typing.":END

130 A=USR(1536)
140 ? :? "Automatic Proofr
    eader Now Activated."
150 END
160 DATA 104,160,0,185,26,
    3,201,69,240,7
170 DATA 200,200,192,34,20
    8,243,96,200,169,74
180 DATA 153,26,3,200,169,
    6,153,26,3,162
190 DATA 0,189,0,228,157,7
    4,6,232,224,16
200 DATA 208,245,169,93,14
    1,78,6,169,6,141
210 DATA 79,6,24,173,4,228
    ,105,1,141,95
220 DATA 6,173,5,228,105,0
    ,141,96,6,169
230 DATA 0,133,203,96,247,
    238,125,241,93,6
240 DATA 244,241,115,241,1
    24,241,76,205,238
250 DATA 0,0,0,0,0,32,62,2
    46,8,201
260 DATA 155,240,13,201,32
    ,240,7,72,24,101
270 DATA 203,133,203,104,4
    0,96,72,152,72,138
280 DATA 72,160,0,169,128,
    145,88,200,192,40
290 DATA 208,249,165,203,7
    4,74,74,74,24,105
300 DATA 161,160,3,145,88,
    165,203,41,15,24
310 DATA 105,161,200,145,8
    8,169,0,133,203,104
320 DATA 170,104,168,104,4
    0,96
```

Program 2: IBM Proofreader

By Charles Brannon, Program Editor

```
10 'Automatic Proofreader Vers
   ion 3.0 (Lines 205,206 adde
   d/190 deleted/470,490 chang
   ed from V2.0)
100 DIM L$(500),LNUM(500):COLO
   R 0,7,7:KEY OFF:CLS:MAX=0:
   LNUM(0)=65536!
110 ON ERROR GOTO 120:KEY 15,C
   HR$(4)+CHR$(70):ON KEY(15)
    GOSUB 640:KEY (15) ON:GOT
   O 130
120 RESUME 130
130 DEF SEG=&H40:W=PEEK(&H4A)
140 ON ERROR GOTO 650:PRINT:PR
   INT"Proofreader Ready."
150 LINE INPUT L$:Y=CSRLIN-INT
   (LEN(L$)/W)-1:LOCATE Y,1
160 DEF SEG=0:POKE 1050,30:POK
   E 1052,34:POKE 1054,0:POKE
    1055,79:POKE 1056,13:POKE
    1057,28:LINE INPUT L$:DEF
    SEG:IF L$="" THEN 150
170 IF LEFT$(L$,1)=" " THEN L$
   =MID$(L$,2):GOTO 170
```

```
180 IF VAL(LEFT$(L$,2))=0 AND
    MID$(L$,3,1)=" " THEN L$=M
    ID$(L$,4)
200 IF ASC(L$)>57 THEN 260 'no
     line number, therefore co
    mmand
205 BL=INSTR(L$," "):IF BL=0 T
    HEN BL$=L$:GOTO 206 ELSE B
    L$=LEFT$(L$,BL-1)
206 LNUM=VAL(BL$):TEXT$=MID$(L
    $,LEN(STR$(LNUM))+1)
210 IF TEXT$="" THEN GOSUB 540
    :IF LNUM=LNUM(P) THEN GOSU
    B 560:GOTO 150 ELSE 150
220 CKSUM=0:FOR I=1 TO LEN(L$)
    :CKSUM=(CKSUM+ASC(MID$(L$,
    I))*I) AND 255:NEXT:LOCATE
     Y,1:PRINT CHR$(65+CKSUM/1
    6)+CHR$(65+(CKSUM AND 15))
    +" "+L$
230 GOSUB 540:IF LNUM(P)=LNUM
    THEN L$(P)=TEXT$:GOTO 150
    'replace line
240 GOSUB 580:GOTO 150 'insert
     the line
260 TEXT$="":FOR I=1 TO LEN(L$
    ):A=ASC(MID$(L$,I)):TEXT$=
    TEXT$+CHR$(A+32*(A>96 AND
    A<123)):NEXT
270 DELIMITER=INSTR(TEXT$," ")
    :COMMAND$=TEXT$:ARG$="":IF
     DELIMITER THEN COMMAND$=L
    EFT$(TEXT$,DELIMITER-1):AR
    G$=MID$(TEXT$,DELIMITER+1)
     ELSE DELIMITER=INSTR(TEXT
    $,CHR$(34)):IF DELIMITER T
    HEN COMMAND$=LEFT$(TEXT$,D
    ELIMITER-1):ARG$=MID$(TEXT
    $,DELIMITER)
280 IF COMMAND$<>"LIST" THEN 4
    10
290 OPEN "scrn:" FOR OUTPUT AS
     #1
300 IF ARG$="" THEN FIRST=0:P=
    MAX-1:GOTO 340
310 DELIMITER=INSTR(ARG$,"-"):
    IF DELIMITER=0 THEN LNUM=V
    AL(ARG$):GOSUB 540:FIRST=P
    :GOTO 340
320 FIRST=VAL(LEFT$(ARG$,DELIM
    ITER)):LAST=VAL(MID$(ARG$,
    DELIMITER+1))
330 LNUM=FIRST:GOSUB 540:FIRST
    =P:LNUM=LAST:GOSUB 540:IF
    P=0 THEN P=MAX-1
340 FOR X=FIRST TO P:N$=MID$(S
    TR$(LNUM(X)),2)+" "
350 IF CKFLAG=0 THEN A$="":GOT
    O 370
360 CKSUM=0:A$=N$+L$(X):FOR I=
    1 TO LEN(A$):CKSUM=(CKSUM+
    ASC(MID$(A$,I))*I) AND 255
    :NEXT:A$=CHR$(65+CKSUM/16)
    +CHR$(65+(CKSUM AND 15))+"
     "
370 PRINT #1,A$+N$+L$(X)
380 IF INKEY$<>"" THEN X=P
390 NEXT :CLOSE #1:CKFLAG=0
400 GOTO 130
410 IF COMMAND$="LLIST" THEN O
    PEN "lpt1:" FOR OUTPUT AS
    #1:GOTO 300
420 IF COMMAND$="CHECK" THEN C
    KFLAG=1:GOTO 290
430 IF COMMAND$<>"SAVE" THEN 4
    50
440 GOSUB 600:OPEN ARG$ FOR OU
    TPUT AS #1:ARG$="":GOTO 30
    0
450 IF COMMAND$<>"LOAD" THEN 4
    90
460 GOSUB 600:OPEN ARG$ FOR IN
    PUT AS #1:MAX=0:P=0
470 WHILE NOT EOF(1):LINE INPU
    T #1,L$:BL=INSTR(L$," "):B
    L$=LEFT$(L$,BL-1):LNUM(P)=
    VAL(BL$):L$(P)=MID$(L$,LEN
    (STR$(VAL(BL$)))+1):P=P+1:
    WEND
480 MAX=P:CLOSE #1:GOTO 130
490 IF COMMAND$="NEW" THEN INP
    UT "Erase program - Are yo
    u sure";L$:IF LEFT$(L$,1)=
    "y" OR LEFT$(L$,1)="Y" THE
    N MAX=0:LNUM(0)=65536!:GOT
    O 130:ELSE 130
500 IF COMMAND$="BASIC" THEN C
    OLOR 7,0,0:ON ERROR GOTO 0
    :CLS:END
510 IF COMMAND$<>"FILES" THEN
    520
515 IF ARG$="" THEN ARG$="A:"
    ELSE SEL=1:GOSUB 600
517 FILES ARG$:GOTO 130
520 PRINT"Syntax error":GOTO 1
    30
540 P=0:WHILE LNUM>LNUM(P) AND
     P<MAX:P=P+1:WEND:RETURN
560 MAX=MAX-1:FOR X=P TO MAX:L
    NUM(X)=LNUM(X+1):L$(X)=L$(
    X+1):NEXT:RETURN
580 MAX=MAX+1:FOR X=MAX TO P+1
     STEP -1:LNUM(X)=LNUM(X-1)
    :L$(X)=L$(X-1):NEXT:L$(P)=
    TEXT$:LNUM(P)=LNUM:RETURN
600 IF LEFT$(ARG$,1)<>CHR$(34)
     THEN 520 ELSE ARG$=MID$(A
    RG$,2)
610 IF RIGHT$(ARG$,1)=CHR$(34)
     THEN ARG$=LEFT$(ARG$,LEN(
    ARG$)-1)
620 IF SEL=0 AND INSTR(ARG$,".
    ")=0 THEN ARG$=ARG$+".BAS"
630 SEL=0:RETURN
640 CLOSE #1:CKFLAG=0:PRINT"St
    opped.":RETURN 150
650 PRINT "Error #";ERR:RESUME
     150
```

Program 3: Commodore Proofreader

By Philip Nelson, Assistant Editor

```
10 VEC=PEEK(772)+256*PEEK(773)
   :LO=43:HI=44
20 PRINT "AUTOMATIC PROOFREADE
   R FOR ";:IF VEC=42364 THEN
   {SPACE}PRINT "C-64"
30 IF VEC=50556 THEN PRINT "VI
   C-20"
40 IF VEC=35158 THEN GRAPHIC C
   LR:PRINT "PLUS/4 & 16"
50 IF VEC=17165 THEN LO=45:HI=
   46:GRAPHIC CLR:PRINT"128"
60 SA=(PEEK(LO)+256*PEEK(HI))+
   6:ADR=SA
70 FOR J=0 TO 166:READ BYT:POK
   E ADR,BYT:ADR=ADR+1:CHK=CHK
   +BYT:NEXT
80 IF CHK<>20570 THEN PRINT "*
    ERROR* CHECK TYPING IN DATA
    STATEMENTS":END
90 FOR J=1 TO 5:READ RF,LF,HF:
   RS=SA+RF:HB=INT(RS/256):LB=
   RS-(256*HB)
100 CHK=CHK+RF+LF+HF:POKE SA+L
   F,LB:POKE SA+HF,HB:NEXT
110 IF CHK<>22054 THEN PRINT "
   *ERROR* RELOAD PROGRAM AND
   {SPACE}CHECK FINAL LINE":EN
   D
120 POKE SA+149,PEEK(772):POKE
    SA+150,PEEK(773)
130 IF VEC=17165 THEN POKE SA+
   14,22:POKE SA+18,23:POKESA+
   29,224:POKESA+139,224
140 PRINT CHR$(147);CHR$(17);"
   PROOFREADER ACTIVE":SYS SA
150 POKE HI,PEEK(HI)+1:POKE (P
   EEK(LO)+256*PEEK(HI))-1,0:N
   EW
160 DATA 120,169,73,141,4,3,16
   9,3,141,5,3
170 DATA 88,96,165,20,133,167,
   165,21,133,168,169
180 DATA 0,141,0,255,162,31,18
   1,199,157,227,3
190 DATA 202,16,248,169,19,32,
   210,255,169,18,32
200 DATA 210,255,160,0,132,180
   ,132,176,136,230,180
210 DATA 200,185,0,2,240,46,20
   1,34,208,8,72
220 DATA 165,176,73,255,133,17
   6,104,72,201,32,208
230 DATA 7,165,176,208,3,104,2
   08,226,104,166,180
240 DATA 24,165,167,121,0,2,13
   3,167,165,168,105
250 DATA 0,133,168,202,208,239
   ,240,202,165,167,69
260 DATA 168,72,41,15,168,185,
   211,3,32,210,255
270 DATA 104,74,74,74,74,168,1
   85,211,3,32,210
280 DATA 255,162,31,189,227,3,
   149,199,202,16,248
290 DATA 169,146,32,210,255,76
   ,86,137,65,66,67
300 DATA 68,69,70,71,72,74,75,
   77,80,81,82,83,88
310 DATA 13,2,7,167,31,32,151,
   116,117,151,128,129,167,136
   ,137
```

Program 4: Apple Proofreader

By Tim Victor, Editorial Programmer

```
10 C = 0: FOR I = 768 TO 768 +
   68: READ A:C = C + A: POKE I
   ,A: NEXT
20 IF C < > 7258 THEN PRINT "ER
   ROR IN PROOFREADER DATA STAT
   EMENTS": END
30 IF PEEK (190 * 256) < > 76 T
   HEN POKE 56,0: POKE 57,3: CA
   LL 1002: GOTO 50
40 PRINT CHR$ (4);"IN#A$300"
50 POKE 34,0: HOME : POKE 34,1:
    VTAB 2: PRINT "PROOFREADER
   INSTALLED"
60 NEW
100 DATA 216,32,27,253,201,141
110 DATA 208,60,138,72,169,0
120 DATA 72,189,255,1,201,160
130 DATA 240,8,104,10,125,255
140 DATA 1,105,0,72,202,208
150 DATA 238,104,170,41,15,9
160 DATA 48,201,58,144,2,233
170 DATA 57,141,1,4,138,74
180 DATA 74,74,74,41,15,9
190 DATA 48,201,58,144,2,233
200 DATA 57,141,0,4,104,170
210 DATA 169,141,96
```

MLX Machine Language Entry Program For Commodore 64

Ottis Cowper, Technical Editor

"MLX" is a labor-saving utility that allows almost fail-safe entry of Commodore 64 machine language programs.

Type in and save some copies of MLX—you'll want to use it to enter future machine langauge (ML) programs from COMPUTE!. When you're ready to enter an ML program, load and run MLX. It asks you for a starting address and an ending address. These addresses appear in the article accompanying the MLX-format program listing you're typing.

If you're unfamiliar with machine language, the addresses (and all other values you enter in MLX) may appear strange. Instead of the usual decimal numbers you're accustomed to, these numbers are in *hexadecimal*—a base 16 numbering system commonly used by ML programmers. Hexadecimal—hex for short—includes the numerals 0–9 and the letters A–F. But don't worry—even if you know nothing about ML or hex, you should have no trouble using MLX.

After you enter the starting and ending addresses, you'll be offered the option of clearing the workspace. Choose this option if you're starting to enter a new listing. If you're continuing a listing that's partially typed from a previous session, don't choose this option.

A functions menu will appear. The first option in the menu is ENTER DATA. If you're just starting to type in a program, pick this. Press the E key, and type the first number in the first line of the program listing. If you've already typed in part of a program, type the line number where you left off typing at the end of the previous session (be sure to load the partially completed program before you resume entry). In any case, make sure the address you enter corresponds to the address of a line in the listing you are entering. Otherwise, you'll be unable to enter the data correctly. If you pressed E by mistake, you can return to the command menu by pressing RETURN alone when asked for the address. (You can get back to the menu from most options by pressing RETURN with no other input.)

Entering A Listing

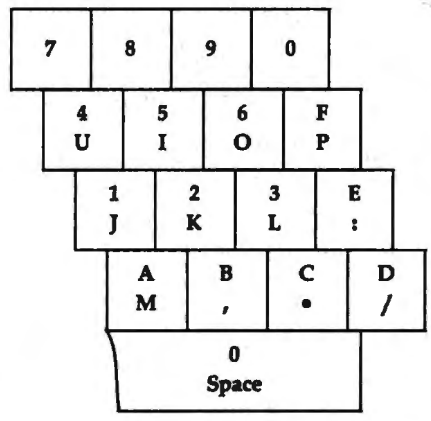
Once you're in Enter mode, MLX prints the address for each program line for you. You then type in all nine numbers on that line, beginning with the first two-digit number after the colon (:). Each line represents eight data bytes and a checksum. Although an MLX-format listing appears similar to the "hex dump" listings from a machine language monitor program, the extra checksum number on the end allows MLX to check your typing.

When you enter a line, MLX recalculates the checksum from the eight bytes and the address and compares this value to the number from the ninth column. If the values match, you'll hear a bell tone, the data will be added to the workspace area, and the prompt for the next line of data will appear. But if MLX detects a typing error, you'll hear a low buzz and see an error message. The line will then be redisplayed for editing.

Invalid Characters Banned

Only a few keys are active while you're entering data, so you may have to unlearn some habits. You *do not* type spaces between the columns; MLX automatically inserts these for you. You *do not* press RETURN after typing the last number in a line; MLX automatically enters and checks the line after you type the last digit.

Only the numerals 0–9 and the letters A–F can be typed in. If you press any other key (with some exceptions noted below), you'll hear a warning buzz. To simplify typing, a numeric keypad is now incorporated in the listing. The keypad is active only while entering data. Addresses must be entered with the normal letter and number keys. The figure below shows the keypad configuration:



MLX checks for transposed characters. If you're supposed to type in A0 and instead enter 0A, MLX will catch your mistake. There is one error that can slip past MLX: Because of the checksum formula used, MLX won't notice if you accidentally type FF in place of 00, and vice versa. And there's a very slim chance that you could garble a line and still end up with a combination of characters that adds up to the proper checksum. However, these mistakes should not occur if you take reasonable care while entering data.

Editing Features

To correct typing mistakes before finishing a line, use the INST/DEL key to delete the character to the left of the cursor. (The cursor-left key also deletes.) If you mess up a line really badly, press CLR/HOME to start the line over. The RETURN key is also active, but only before any data is typed on a line. Pressing RETURN at this point returns you to the command menu. After you type a character of data, MLX disables RETURN until the cursor returns to the start of a line. Remember, you can press CLR/HOME to quickly get to a line number prompt.

More editing features are available when correcting lines in which MLX has detected an error. To make corrections in a line that MLX has redisplayed for editing, compare the line on the screen with the one printed in the listing, then move the cursor to the mistake and type the correct key. The cursor left and right keys provide the normal cursor controls. (The INST/DEL key now works as an alternative cursor-left key.) You cannot move left beyond the first character in the line. If you try to move beyond the rightmost character, you'll reenter the line. During editing, RETURN is active; pressing it tells MLX to recheck the line. You can press the CLR/HOME key to clear the entire line if you want to start from scratch, or if you want to get to a line number prompt to use RETURN to get back to the menu.

Display Data

The second menu choice, DISPLAY DATA, examines memory and shows the contents in the same format as the program listing (including the checksum). When you press D, MLX asks you for a starting address. Be sure that the starting address you give corresponds to a line number in the listing. Otherwise, the checksum display will be meaningless. MLX displays program lines until it reaches the end of the program, at which point the menu is redisplayed. You can pause the display by pressing the space bar. (MLX finishes printing the current line before halting.) Press space again to

restart the display. To break out of the display and get back to the menu before the ending address is reached, press RETURN.

Other Menu Options

Two more menu selections let you save programs and load them back into the computer. These are SAVE FILE and LOAD FILE; their operation is quite straightforward. When you press S or L, MLX asks you for the filename. You'll then be asked to press either D or T to select disk or tape.

You'll notice the disk drive starting and stopping several times during a load or save. Don't panic; this is normal behavior. MLX opens and reads from or writes to the file instead of using the usual LOAD and SAVE commands. Disk users should also note that the drive prefix 0: is automatically added to the filename (line 750), so this should *not* be included when entering the name. This also precludes the use of @ for Save-with-Replace, so remember to give each version you save a different name.

Remember that MLX saves the entire workspace area from the starting address to the ending address, so the save or load may take longer than you might expect if you've entered only a small amount of data from a long listing. When saving a partially completed listing, make sure to note the address where you stopped typing so you'll know where to resume entry when you reload.

MLX reports the standard disk or tape error messages if any problems are detected during the save or load. (Tape users should bear in mind that Commodore computers are never able to detect errors during a save to tape.) MLX also has three special load error messages: INCORRECT STARTING ADDRESS, which means the file you're trying to load does not have the starting address you specified when you ran MLX; LOAD ENDED AT *address*, which means the file you're trying to load ends before the ending address you specified when you started MLX; and TRUNCATED AT ENDING ADDRESS, which means the file you're trying to load extends beyond the ending address you specified when you started MLX. If you see one of these messages and feel certain that you've loaded the right file, exit and rerun MLX, being careful to enter the correct starting and ending addresses.

The QUIT menu option has the obvious effect—it stops MLX and enters BASIC. The RUN/STOP key is disabled, so the Q option lets you exit the program without turning off the computer. (Of course, RUN/STOP–RESTORE also gets you out.) You'll be asked for verification; press Y to exit to BASIC, or any other key to return to the menu. After quitting, you can type RUN again and reenter MLX without losing your data, as long as you don't use the clear workspace option.

The Finished Product

When you've finished typing all the data for an ML program and saved your work, you're ready to see the results. The instructions for loading and using the finished product vary from program to program. Some ML programs are designed to be loaded and run like BASIC programs, so all you need to type is LOAD *"filename"*,8 for disk or LOAD *"filename"* for tape, and then RUN. Such programs will usually have a starting address of 0801 for the 64. Other programs must be reloaded to specific addresses with a command such as LOAD *"filename"*,8,1 for disk or LOAD *"filename"*,1,1 for tape, then started with a SYS to a particular memory address. On the Commodore 64, the most common starting address for such programs is 49152, which corresponds to MLX address C000. In either case, you should always refer to the article which accompanies the ML listing for information on loading and running the program.

An Ounce Of Prevention

By the time you finish typing in the data for a long ML program, you may have several hours invested in the project. Don't take chances—use our "Automatic Proofreader" to type the new MLX, and then test your copy *thoroughly* before first using it to enter any significant amount of data. Make sure all the menu options work as they should. Enter fragments of the program starting at several different addresses, then use the Display option to verify that the data has been entered correctly. And be sure to test the Save and Load options several times to ensure that you can recall your work from disk or tape. Don't let a simple typing error in the new MLX cost you several nights of hard work.

MLX For Commodore 64

```
SS 10 REM VERSION 1.1: LINES 8
      30,950 MODIFIED, LINES 4
      85-487 ADDED
EK 100 POKE 56,50:CLR:DIM IN$,
      I,J,A,B,A$,B$,A(7),N$
DM 110 C4=48:C6=16:C7=7:Z2=2:Z
      4=254:Z5=255:Z6=256:Z7=
      127
CJ 120 FA=PEEK(45)+Z6*PEEK(46)
      :BS=PEEK(55)+Z6*PEEK(56
      ):H$="0123456789ABCDEF"
SB 130 R$=CHR$(13):L$="{LEFT}"
      :S$=" ":D$=CHR$(20):Z$=
      CHR$(0):T$="{13 RIGHT}"
CQ 140 SD=54272:FOR I=SD TO SD
      +23:POKE I,0:NEXT:POKE
      {SPACE}SD+24,15:POKE 78
      8,52
FC 150 PRINT"{CLR}"CHR$(142)CH
      R$(8):POKE 53280,15:POK
EJ 160 PRINT T$" {RED}{RVS}
      {2 SPACES}{8 @}
      {2 SPACES}"SPC(28)"
      {2 SPACES}{OFF}{BLU} ML
      X II {RED}{RVS}
      {2 SPACES}"SPC(28)"
      {12 SPACES}{BLU}"
FR 170 PRINT"{3 DOWN}
      {3 SPACES}COMPUTE!'S MA
      CHINE LANGUAGE EDITOR
      {3 DOWN}"
JB 180 PRINT"{BLK}STARTING ADD
      RESS{4}";:GOSUB300:SA=A
      D:GOSUB1040:IF F THEN18
      0
GF 190 PRINT"{BLK}{2 SPACES}EN
      DING ADDRESS{4}";:GOSUB
      300:EA=AD:GOSUB1030:IF
      {SPACE}F THEN190
KR 200 INPUT"{3 DOWN}{BLK}CLEA
      R WORKSPACE [Y/N]{4}";A
      $:IF LEFT$(A$,1)<>"Y"TH
      EN220
PG 210 PRINT"{2 DOWN}{BLU}WORK
      ING...";:FORI=BS TO BS+
      EA-SA+7:POKE I,0:NEXT:P
      RINT"DONE"
DR 220 PRINTTAB(10)"{2 DOWN}
      {BLK}{RVS} MLX COMMAND
      {SPACE}MENU {DOWN}{4}":
      PRINT T$"{RVS}E{OFF}NTE
      R DATA"
BD 230 PRINT T$"{RVS}D{OFF}ISP
      LAY DATA":PRINT T$"
      {RVS}L{OFF}OAD FILE"
JS 240 PRINT T$"{RVS}S{OFF}AVE
       FILE":PRINT T$"{RVS}Q
      {OFF}UIT{2 DOWN}{BLK}"
JH 250 GET A$:IF A$=N$ THEN250
HK 260 A=0:FOR I=1 TO 5:IF A$=
      MID$("EDLSQ",I,1)THEN A
      =I:I=5
FD 270 NEXT:ON A GOTO420,610,6
      90,700,280:GOSUB1060:GO
      TO250
EJ 280 PRINT"{RVS} QUIT ":INPU
      T"{DOWN}{4}ARE YOU SURE
       [Y/N]";A$:IF LEFT$(A$,
      1)<>"Y"THEN220
EM 290 POKE SD+24,0:END
JX 300 IN$=N$:AD=0:INPUTIN$:IF
      LEN(IN$)<>4THENRETURN
KF 310 B$=IN$:GOSUB320:AD=A:B$
      =MID$(IN$,3):GOSUB320:A
      D=AD*256+A:RETURN
PP 320 A=0:FOR J=1 TO 2:A$=MID
      $(B$,J,1):B=ASC(A$)-C4+
      (A$>"@")*C7:A=A*C6+B
JA 330 IF B<0 OR B>15 THEN AD=
      0:A=-1:J=2
GX 340 NEXT:RETURN
CH 350 B=INT(A/C6):PRINT MID$(
      H$,B+1,1);:B=A-B*C6:PRI
      NT MID$(H$,B+1,1);:RETU
      RN
RR 360 A=INT(AD/Z6):GOSUB350:A
      =AD-A*Z6:GOSUB350:PRINT
      ":";
BE 370 CK=INT(AD/Z6):CK=AD-Z4*
      CK+Z5*(CK>Z7):GOTO390
PX 380 CK=CK*Z2+Z5*(CK>Z7)+A
JC 390 CK=CK+Z5*(CK>Z5):RETURN
QS 400 PRINT"{DOWN}STARTING AT
      {4}";:GOSUB300:IF IN$<>
      N$ THEN GOSUB1030:IF F
      {SPACE}THEN400
EX 410 RETURN
HD 420 PRINT"{RVS} ENTER DATA
      {SPACE}":GOSUB400:IF IN
      $=N$ THEN220
JK 430 OPEN3,3:PRINT
SK 440 POKE198,0:GOSUB360:IF F
      E 53281,15
```

```
      THEN PRINT IN$:PRINT"
      {UP}{5 RIGHT}";
GC 450 FOR I=0 TO 24 STEP 3:B$
      =S$:FOR J=1 TO 2:IF F T
      HEN B$=MID$(IN$,I+J,1)
HA 460 PRINT"{RVS}"B$L$;:IF I<
      24THEN PRINT"{OFF}";
HD 470 GET A$:IF A$=N$ THEN470
FK 480 IF(A$>"/"ANDA$<":")OR(A
      $>"@"ANDA$<"G")THEN540
GS 485 A=-(A$="M")-2*(A$=",")-
      3*(A$=".")-4*(A$="/")-5
      *(A$="J")-6*(A$="K")
FX 486 A=A-7*(A$="L")-8*(A$=:
      ")-9*(A$="U")-10*(A$="I
      ")-11*(A$="O")-12*(A$="
      P")
CM 487 A=A-13*(A$=S$):IF A THE
      N A$=MID$("ABCD123E456F
      0",A,1):GOTO 540
MP 490 IF A$=R$ AND((I=0)AND(J
      =1)OR F)THEN PRINT B$;:
      J=2:NEXT:I=24:GOTO550
KC 500 IF A$="{HOME}" THEN PRI
      NT B$:J=2:NEXT:I=24:NEX
      T:F=0:GOTO440
MX 510 IF(A$="{RIGHT}")ANDF TH
      ENPRINT B$L$;:GOTO540
GK 520 IF A$<>L$ AND A$<>D$ OR
      ((I=0)AND(J=1))THEN GOS
      UB1060:GOTO470
HG 530 A$=L$+S$+L$:PRINT B$L$;
      :J=2-J:IF J THEN PRINT
      {SPACE}L$;:I=I-3
QS 540 PRINT A$;:NEXT J:PRINT
      {SPACE}S$;
PM 550 NEXT I:PRINT:PRINT"{UP}
      {5 RIGHT}";:INPUT#3,IN$
      :IF IN$=N$ THEN CLOSE3:
      GOTO220
QC 560 FOR I=1 TO 25 STEP3:B$=
      MID$(IN$,I):GOSUB320:IF
       I<25 THEN GOSUB380:A(I
      /3)=A
PK 570 NEXT:IF A<>CK THEN GOSU
      B1060:PRINT"{BLK}{RVS}
      {SPACE}ERROR: REENTER L
      INE [4]":F=1:GOTO440
HJ 580 GOSUB1080:B=BS+AD-SA:FO
      R I=0 TO 7:POKE B+I,A(I
      ):NEXT
QQ 590 AD=AD+8:IF AD>EA THEN C
      LOSE3:PRINT"{DOWN}{BLU}
      ** END OF ENTRY **{BLK}
      {2 DOWN}":GOTO700
GQ 600 F=0:GOTO440
QA 610 PRINT"{CLR}{DOWN}{RVS}
      {SPACE}DISPLAY DATA ":G
      OSUB400:IF IN$=N$ THEN2
      20
RJ 620 PRINT"{DOWN}{BLU}PRESS:
       {RVS}SPACE{OFF} TO PAU
      SE, {RVS}RETURN{OFF} TO
       BREAK[4]{DOWN}"
KS 630 GOSUB360:B=BS+AD-SA:FOR
      I=BTO B+7:A=PEEK(I):GOS
      UB350:GOSUB380:PRINT S$
      ;
CC 640 NEXT:PRINT"{RVS}";:A=CK
      :GOSUB350:PRINT
KH 650 F=1:AD=AD+8:IF AD>EA TH
      ENPRINT"{DOWN}{BLU}** E
      ND OF DATA **":GOTO220
KC 660 GET A$:IF A$=R$ THEN GO
      SUB1080:GOTO220
EQ 670 IF A$=S$ THEN F=F+1:GOS
      UB1080
AD 680 ONFGOTO630,660,630
CM 690 PRINT"{DOWN}{RVS} LOAD
      {SPACE}DATA ":OP=1:GOTO
      710
PC 700 PRINT"{DOWN}{RVS} SAVE
      {SPACE}FILE ":OP=0
RX 710 IN$=N$:INPUT"{DOWN}FILE
      NAME[4]";IN$:IF IN$=N$
      {SPACE}THEN220
PR 720 F=0:PRINT"{DOWN}{BLK}
      {RVS}T{OFF}APE OR {RVS}
      D{OFF}ISK: [4]";
FP 730 GET A$:IF A$="T"THEN PR
      INT"T{DOWN}":GOTO880
HQ 740 IF A$<>"D"THEN730
HH 750 PRINT"D{DOWN}":OPEN15,8
      ,15,"I0:":B=EA-SA:IN$="
      0:"+IN$:IF OP THEN810
SQ 760 OPEN 1,8,8,IN$+",P,W":G
      OSUB860:IF A THEN220
FJ 770 AH=INT(SA/256):AL=SA-(A
      H*256):PRINT#1,CHR$(AL)
      ;CHR$(AH);
PE 780 FOR I=0 TO B:PRINT#1,CH
      R$(PEEK(BS+I));:IF ST T
      HEN800
FC 790 NEXT:CLOSE1:CLOSE15:GOT
      O940
GS 800 GOSUB1060:PRINT"{DOWN}
      {BLK}ERROR DURING SAVE:
      [4]":GOSUB860:GOTO220
MA 810 OPEN 1,8,8,IN$+",P,R":G
      OSUB860:IF A THEN220
GE 820 GET#1,A$,B$:AD=ASC(A$+Z
      $)+256*ASC(B$+Z$):IF AD
      <>SA THEN F=1:GOTO850
RX 830 FOR I=0 TO B:GET#1,A$:P
      OKE BS+I,ASC(A$+Z$):IF(
      I<>B)AND ST THEN F=2:AD
      =I:I=B
FA 840 NEXT:IF ST<>64 THEN F=3
FQ 850 CLOSE1:CLOSE15:ON ABS(F
      >0)+1 GOTO960,970
SA 860 INPUT#15,A,A$:IF A THEN
       CLOSE1:CLOSE15:GOSUB10
      60:PRINT"{RVS}ERROR: "A
      $
GQ 870 RETURN
EJ 880 POKE183,PEEK(FA+2):POKE
      187,PEEK(FA+3):POKE188,
      PEEK(FA+4):IFOP=0THEN92
      0
HJ 890 SYS 63466:IF(PEEK(783)A
      ND1)THEN GOSUB1060:PRIN
      T"{DOWN}{RVS} FILE NOT
      {SPACE}FOUND ":GOTO690
CS 900 AD=PEEK(829)+256*PEEK(8
      30):IF AD<>SA THEN F=1:
      GOTO970
SC 910 A=PEEK(831)+256*PEEK(83
      2)-1:F=F-2*(A<EA)-3*(A>
      EA):AD=A-AD:GOTO930
KM 920 A=SA:B=EA+1:GOSUB1010:P
      OKE780,3:SYS 63338
JF 930 A=BS:B=BS+(EA-SA)+1:GOS
      UB1010:ON OP GOTO950:SY
      S 63591
AE 940 GOSUB1080:PRINT"{BLU}**
       SAVE COMPLETED **":GOT
      O220
XP 950 POKE147,0:SYS 63562:IF
      {SPACE}ST>0 THEN970
FR 960 GOSUB1080:PRINT"{BLU}**
       LOAD COMPLETED **":GOT
      O220
DP 970 GOSUB1060:PRINT"{BLK}
      {RVS}ERROR DURING LOAD:
      {DOWN}[4]":ON F GOSUB98
      0,990,1000:GOTO220
PP 980 PRINT"INCORRECT STARTIN
      G ADDRESS (";:GOSUB360:
      PRINT")":RETURN
GR 990 PRINT"LOAD ENDED AT ";:
      AD=SA+AD:GOSUB360:PRINT
       D$:RETURN
FD 1000 PRINT"TRUNCATED AT END
       ING ADDRESS":RETURN
RX 1010 AH=INT(A/256):AL=A-(AH
      *256):POKE193,AL:POKE1
      94,AH
FF 1020 AH=INT(B/256):AL=B-(AH
      *256):POKE174,AL:POKE1
      75,AH:RETURN
FX 1030 IF AD<SA OR AD>EA THEN
      1050
HA 1040 IF(AD>511 AND AD<40960
      )OR(AD>49151 AND AD<53
      248)THEN GOSUB1080:F=0
      :RETURN
HC 1050 GOSUB1060:PRINT"{RVS}
      {SPACE}INVALID ADDRESS
       {DOWN}{BLK}":F=1:RETU
      RN
AR 1060 POKE SD+5,31:POKE SD+6
      ,208:POKE SD,240:POKE
      {SPACE}SD+1,4:POKE SD+
      4,33
DX 1070 FOR S=1 TO 100:NEXT:GO
      TO1090
PF 1080 POKE SD+5,8:POKE SD+6,
      240:POKE SD,0:POKE SD+
      1,90:POKE SD+4,17
AC 1090 FOR S=1 TO 100:NEXT:PO
      KE SD+4,0:POKE SD,0:PO
      KE SD+1,0:RETURN
```

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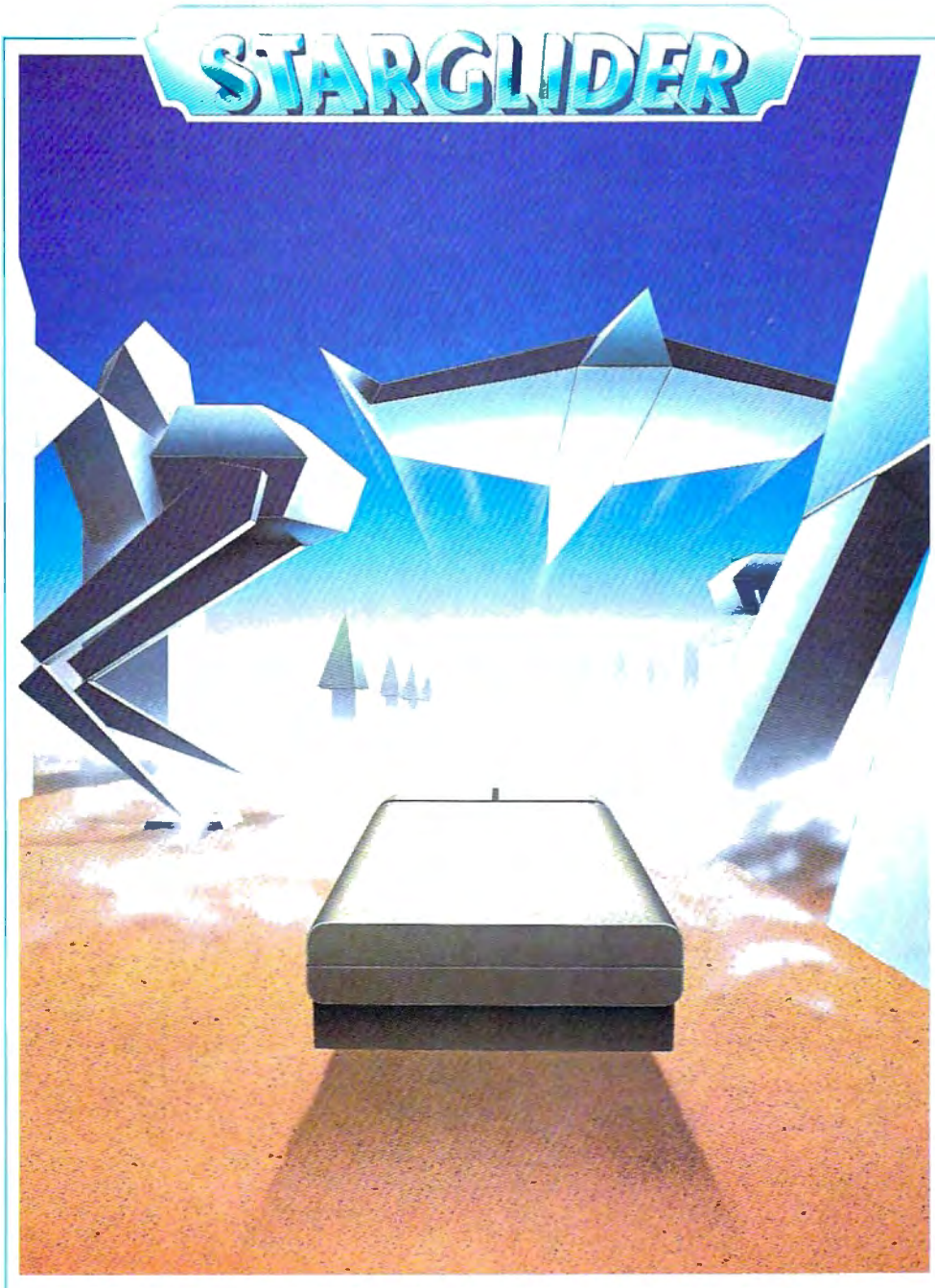

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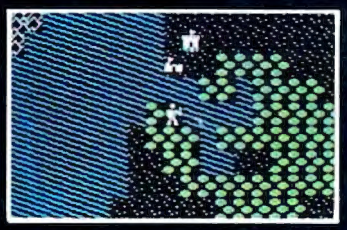

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