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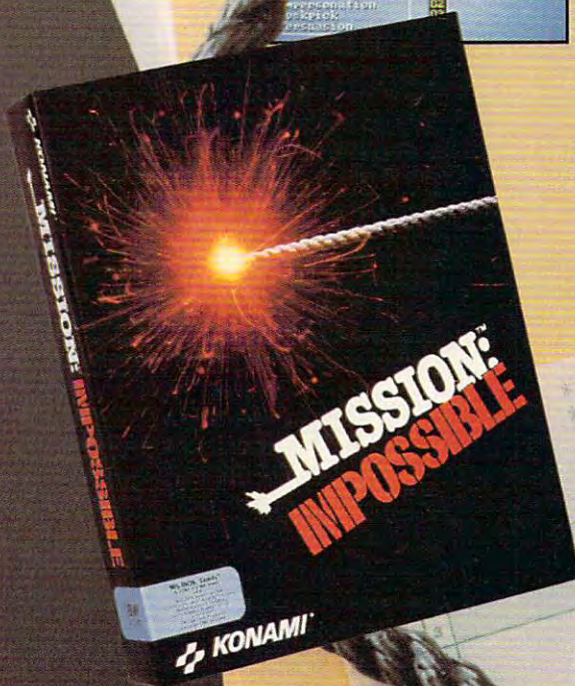
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COMPUTER GAME ETHICS

WHAT CULTURAL VALUES DO COMPUTER GAMES COMMUNICATE TO THEIR USERS?

Consider these notes from the computer-gaming press:

In 1983, Atari seeks to halt the distribution of *Custer's Revenge*, an independently produced game in which the player's objective is to rape an Indian woman bound to a post.

In 1987, one of the most popular Macintosh programs on the market is *MacPlaymate*, an

adult-oriented game in which the player undresses an animated woman and stimulates her with a wide variety of sex toys.

In the summer of 1990, California Assemblywoman Sally Tanner introduces a bill to prohibit the depiction of alcohol and cigarettes in computer games distributed in the state. The bill is defeated in committee.

In 1991, an underground game creates a small flurry in the American computer press. The game, which is circulated on BBSs in Europe, puts players in charge of a Nazi concentration camp and rewards them for the quantity and brutality of their executions.

For game designers, software publishers, and parents who are already uneasy about their children's all-encompassing Nintendo obsessions, news items like these strike an ominous chord. As the novelty of personal computers wears off and electronic games find their way into the mainstream of American culture, thoughtful developers and consumers are starting to face the tough ethical questions. What effect do these games have on kids? Why are they so violent? And, perhaps most centrally, what cultural values do computer games communicate to their users?

The questions aren't new, but they're becoming more pressing as the market grows. The time is fast approaching when game designers and publishers must reckon with



In *Loom* from Lucas Film Games, you can't die.

the moral questions that have dogged their colleagues in other media for decades.

Is the Medium the Message?

"Computer games are definitely not value-free," asserts Chris Crawford, a veteran designer noted for the strong ethical content of his games. "We can't argue that they're mindless entertainment with zero moral value, because it's obvious that there is some form of cultural communication going on whenever someone sits down to play a game. And I think it's very appropriate for people to be concerned about what messages are being communicated."

Roberta Williams, head of development for Sierra On-Line and designer of dozens of games for both children and adults, agrees. "Computer games communicate values the same way any other medium you watch or participate in—movies, books, TV, or magazines. And I'm not convinced that we should hold games to any different moral standards than we hold the movie or TV industries to."

According to Crawford, computer games do get extra scrutiny, mainly because they're perceived as children's entertainment. "Freedom of speech is paramount when you're creating entertainment for adults, who are better able to accept or reject the values presented to them. But we've also established the legal principle that freedom is appropriately re-

strained when you're addressing children. Right now, computer games are closely associated with children, and I think that the public debate about their moral content comes largely out of that association. Our image as a 'kiddie medium' gives us increased exposure to censorship."

Death, War, and Gore

As any parent can tell you, most of the ethical concerns about computer games centers around their notoriously high levels of violence. "It's the one issue that cuts directly to the heart of the industry," says Crawford. Computer game violence comes in a variety of flavors, including the following.

Repetitive death games in which the player's character dies over and over. After each "death," you typically insert another quarter or reload the saved game and start over. (Nervous adults have expressed concern that kids who spend too much time with driving simulations might actually think you can drive that way.)

Military games that simulate (and some say glorify) war. "A goodly portion of Americans find the rather strident militarism of these games objectionable," says Crawford, who has designed several war simulations. "They often present war as an exciting adventure, a noble quest by brave men and women. In short, they tell the player that war is fun."

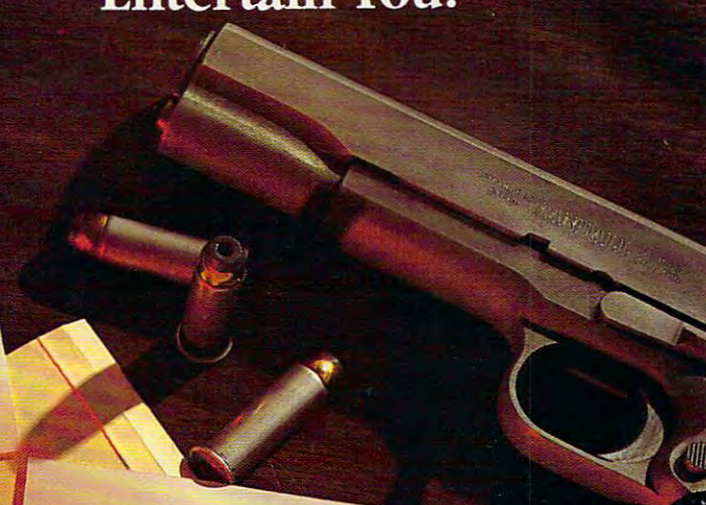
In his games, Crawford attempts to redirect this message by working some humanity into the manual or right into the game itself. Take, for example, his upcoming game, *Patton Strikes Back*.

"After each major battle, there are these interruptions that stop the game to tell you personal stories about Patton and other people in the war—how this battle affected them personally. Some of them are quite graphic. People will still be en-

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IF OUR IDEAS OF CONFLICT ARE LIMITED TO VIOLENCE, WE'VE GOT A LOT TO LEARN ABOUT GAME DESIGN

tertained, but I hope they also walk away with a deeper sense of how horrific a real battle is."

Sid Meier of MicroProse, a company known for its war simulations, takes a different attitude. "You can make a case that war is full of terrible consequences—but I don't think that's news to anyone. There are a lot of movies and books about war, with a lot of different points of view. And I think that's because 'war is terrible' is not the only lesson to be learned; there's also the decision making and leadership and personal growth that occur because people have been through that situation. In our simulations, we want you to come to understand the decision process, the tradeoffs that are involved, the kinds of things people in battle are faced with.

Shoot-'em-up games in which the object is to blow away everything that moves. "It's instructive that all the early computer games were shoot-'em-ups," notes Meier. "In the beginning, it was just technically easier to do those kinds of games. And people didn't know what computer games were all about, so you had to make it clear who the good guys and the bad guys were. It's easy to do that in a battle context." These days, notes Meier, the last bastion of the shoot-'em-up is "your classic Nintendo game, where violence is the focal point of everything that happens."

"This sort of generalized blood-thirstiness, which a lot of games have, makes people very uncomfortable, and I think rightly so," muses Crawford. "This sort of rampant, dehumanized killing generates an aura of tawdriness that does our industry no favors."

Blood and gore. Designers are widely divided about the morality of

showing up-close-and-personal scenes of blood and death. "Of the games I've done, I've stayed away from gore; I don't think it adds anything to the game to show blood and arms and legs flying around," says Meier.

Tom Loughry, who designed the close-range combat simulation *Gunboat* for Accolade, wrestled long

to create game conflict, which is why you see so much of it. But I don't buy the notion that you need it to create dramatic tension. There's almost always a more elegant way to move the plot along if the designer is willing to think a little more creatively. Our perception is that people equate death with failure. And failure is not fun."

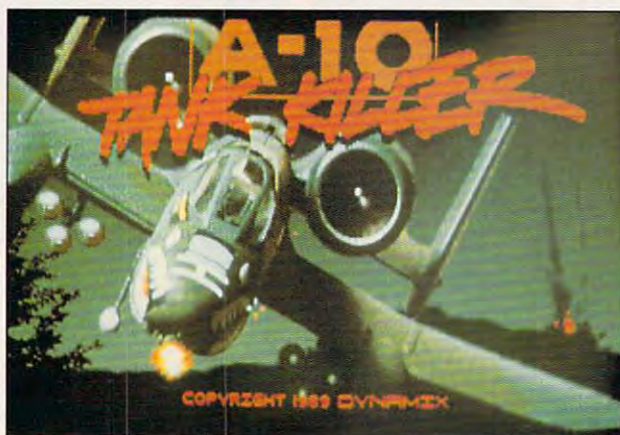
Among Moriarty's more recent games is *Loom*, "which took this idea even further—not only can't you die, you can't fail. The fun of the game is in making choices for your character. Like all good stories, it also has a strong moral.

"After all, computer games do teach people things about the world," he concludes. "If our ideas of conflict are limited to violence, we've got a lot to learn about art, storytelling, and game design."

Moriarty, Crawford, and Williams project that shoot-'em-ups, war games, and other types of violent games will soon be only small niches in a much broader market. In fact, the game shelf at your local Egghead might ultimately be as diverse as your local video rental store with a full spectrum of comedy, drama, mystery, adventure, and children's software. And the analogy may extend one step further to include X-rated adult games behind a curtain in the back of the store.

For Adults Only

Games with strong sexual content have been around almost as long as personal computers. Along with the infamous *Custer's Revenge*, the more notable efforts include *Interlude*, a 1982 text adventure that contained several X-rated scenarios; *Leather Goddesses of Phobos*, a 1986 game that was actually a lot tamer than its hype led one to think;



A-10 Tank Killer from Dynamix is a typical war game.

and hard before coming to the opposite conclusion. "The fact is, when you shoot people, they bleed and die. You're not telling them the truth about war if you sanitize the death scenes."

Why are computer games so violent? According to most of the designers interviewed, they don't need to be. "Violence is a symptom of lazy design," asserts Crawford. "All games must have conflict of some kind, and violence is the most direct and intense form of conflict there is. As the industry matures, we should move away from it, but for that to happen, people have to make the effort to design games that take other approaches."

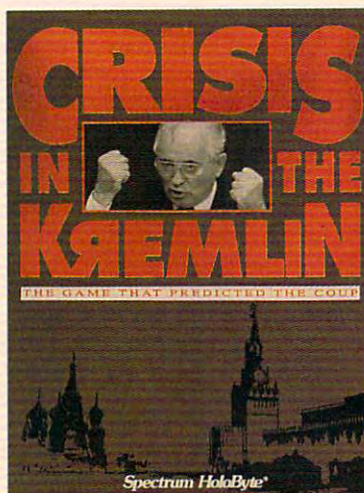
Several thoughtful designers and publishers are already making the effort. "We've all but banned death from our games," boasts Brian Moriarty, a senior game designer at Lucasfilm Games. "The possibility of death is a convenient and easy way



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WE DECIDED AT THE TIME WE DID LARRY THAT THAT WAS OUR ABSOLUTE LIMIT

and Sierra's Leisure Suit Larry series, a tacky spoof on the hot-tubs-and-gold-chains singles lifestyle.

Perhaps the most famous of all, however, are *MacPlaymate* (1986) and its second incarnation, *Virtual Valerie* (1989). "They're probably the most pirated games in the history of Macintosh," sighs creator Mike Saenz, who cobbled *MacPlaymate* together in just three days. "I don't even think the games were very erotic. I did them for a laugh because I think the idea of interactive sexual computer entertainment is patently absurd. *MacPlaymate* was a spoof of all the fetishistic trappings of the average male's preferred sexual imagery."

Saenz says there's no question that his two products objectify women as sexual playthings. "It's like having your own 'Stepford date-on-a-disk'; you don't even have to send her roses," he muses. "But I was hoping that the absurdity of it would sink in, that by putting it into such bold, simplified relief, men would realize how unreal it is to expect women to behave that way sexually. I was hoping to make some of this outrageousness clear. But I overestimated my audience; it ended up in the hands of a bunch of nerdy guys who'd never talked to a woman besides their mother."

Although it seems that there are always one or two popular adult-oriented games on the market at any given time, most mainstream publishers regard X-rated games as a very small niche. "Every company has its moral or ethical limits," says Williams. "There might be some company that decides it wants to make money doing *Playboy*-type games. But that's not what Sierra is about. We decided at the time we did Lar-



Sierra's Leisure Suit Larry series offers mild adult humor.

ry that that was our absolute limit, as far as the R-rated stuff is concerned."

Williams adds that some of her designers approached her about doing a more explicit game, but she refused. "It's not just that I don't like the way women are portrayed in these games. It's also that we'd be shooting ourselves in the foot if we sold them. We might sell quite a few to the men who buy that kind of thing, but over the long run, we'd lose the respect of our market. Even those same men would hesitate to buy our kids' games for their families—and women wouldn't go near us. It would be a long-term loss for us. If some other company decided that that's who they were, fine, but we're in the business to make software for everybody."

Saenz admits to feeling a similar backlash. He recently published a mainstream fantasy game called *Spaceship Warlock*—"an old-fashioned space opera that's nostalgic in a Flash Gordon/Buck Rogers sort of way, complete with sophomorically bombastic dialogue. Unfortunately, if you really try to capture that 'golden age of science fiction' feel, it will inevitably be somewhat chauvinistic, although it looks very liberated compared to, say, the first *Star Trek* series. Still, be-

cause of *MacPlaymate* and *Valerie*, people are looking for me to have this attitude. It turns out that there are a whole bunch of people who love what I do—a lot of closet Mike Saenz fans out there—and a lot of other people who think, 'That guy's sick.' I've been typecast as a terrible misogynist."

Of Demons, Drugs, and Censorship

Sex and violence may be the big ethical issues, but they're not the only

ones. Over the years, the television, film, recording, and publishing industries have felt pressure to watch their language (as in the recording industry's well-publicized debate over parental warning stickers), Just Say No (as part of the federal government's much-ballyhooed War on Drugs), and beware of demons (at the behest of the fundamentalist Christian movement). Through it all, though, computer game developers have managed to stay well out of the range of fire.

You would think that Mike Saenz, for example, would be an obvious target. "But none of the pressure groups seem to have found me yet," he marvels. "I haven't heard from Tipper Gore or Women Against Pornography. I think the hardliners and fascists must be very small groups that exert a lot of focused pressure—and right now they're going after the record companies."

"Sure, we've all gotten letters from parents who scream that hack-and-slash fantasy games are inspired by the devil," concurs Crawford, "but the numbers are so small that we tend to think of it as a marginal concern."

As computer games go mainstream, though, they're starting to attract at least some attention. And,

WORLD OF ELECTRONIC GAMES

A RATINGS SYSTEM WOULD BE USEFUL BECAUSE YOU'D KNOW WHERE BOUNDARIES EXIST

surprisingly, one of the early battle-grounds wasn't violence or sex, but drug abuse. "Drugs and tobacco just aren't usually a part of the context of most games," says Moriarty. Crawford echoed this, adding that "sometimes players will come across a vial that says, 'Drink me,' like in *Alice in Wonderland*, and you float over the river or something as a result of taking it. But nobody's ever suggested that this promotes drug abuse."

Because designers and publishers regard drugs as such a non-issue, the introduction of California Assembly Bill 3280 in June 1990 took them completely by surprise.

The bill, introduced by Assemblywoman Sally Tanner (D-El Monte), would have prohibited designers from placing any alcohol or tobacco company logos in games or showing characters holding or using alcohol or tobacco products. Even though it was drafted with the loftiest of intentions, the computer game industry was quick to perceive a threat and moved quickly to block the bill. "We ship a children's product called *Mixed-Up Mother Goose*, which has been widely used in classrooms for years," says Williams. "In the game, King Cole loses his pipe, and the child helps him find it. It didn't make sense. Under this bill, reading a book of nursery rhymes would be perfectly legal, but I could go to jail for animating the same nursery rhyme. I don't like my kids seeing people smoke or drink, either, but to be restricted where other media aren't isn't fair."

A Kinder, Gentler Future?

All the designers and publishers interviewed for this article were optimis-

tic that the ethical nature of computer games will continue to improve as the audience broadens in numbers and sophistication.

"Right now, we're locked into a traditional, hobbyist market that has a specific set of expectations about the kinds of games they want," Moriarty observes. "A lot of us want to move beyond those expectations

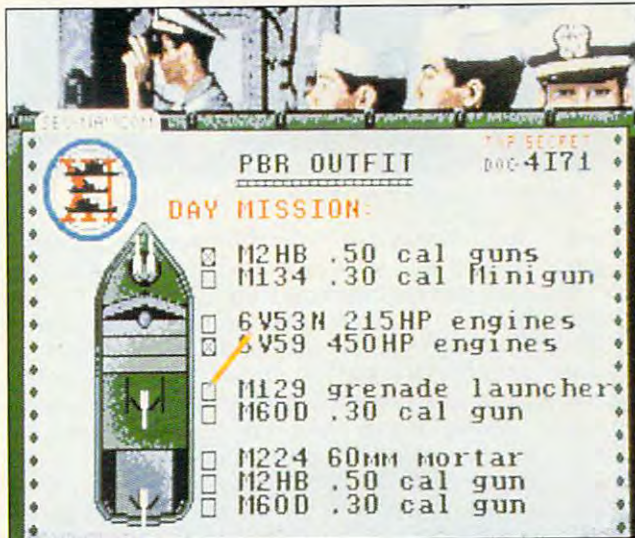
games are categorized as either adult games, like *Leisure Suit Larry* and *Space Quest*; family games, like *King's Quest*, that children and parents will likely play together; or children's games, in which blood, death, and violence are entirely banned. "Our goal is to make software for everyone," says Williams.

There's also widespread talk of an industrywide rating system, based on the system the MPA uses to rate movies. "We're kind of in this window where we don't have a ratings system yet because we're still a new industry and not all the pieces are together," Saenz says. "But I think a ratings system would be useful because you'd know where boundaries exist and it would help both the developers and the audience clear up a lot of the confusion in the marketplace. I don't want to limit freedom of expression, and

a rating system might be one way to protect it."

Crawford points out that, as with books and movies, the truly outrageous games appeal only to very small and specialized niche markets. (The numbers bear this out. *MacPlaymate*, despite its tremendous popularity, was only available through mail order. The concentration-camp game is only distributed via BBS, and no American game designer interviewed had actually seen it.) "Mass marketing will be the key to improving the ethical climate in computer games," Crawford predicts. "You can only push people so fast, but the messages we communicate will certainly improve as we slowly learn how to design games for a larger audience."

SARA REEDER



Accolade's *Gunboat* doesn't sanitize death scenes.

but feel held back. Still, I'm convinced that there are a lot more computer owners out there who are interested in using their machines for entertainment but aren't attracted to the traditional offerings."

He's pleased that *Loom* has been very popular with first-time gamers and women—two groups outside the core market—but complains that publishers are often reluctant to support games that fall outside of standard genres, even if they might open up the world of computer gaming to a broader market.

As game developers look toward the big time, they're taking their cues from the film and recording industries. Many publishers have long adhered to their own internal standards. At Sierra, for example,

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Origin's Wing Commander II has hefty system requirements.

As inconceivable as it may have sounded just two or three years ago, the following statement is now true: In order to play the newest generation of computer games, you need a 386-class machine. Sure, plenty of titles still run on 286s or even XTs, but the next wave of games, even more than the current crop, will need everything the 386 has to offer. The expectations of today's computer game players contribute to this headlong rush toward high-end machines. People demand wall-to-wall VGA graphics, sound, and animation.

Fred Schmidt, general manager of Origin Systems, says it's all quite simple. "If you're going to have graphics and sound moving at high speed, then you need a 386." He means it. Most of Origin's recent major releases basically require a 386 to run satisfactorily. *Strike Commander*, *Ultima VII*, and *Wing Commander II* all warn buyers that they need at minimum a 12-MHz 286 to run, but even then, Schmidt admits, the games' performance on those machines tends to be unacceptably slow. "The settling point for writing games is now a 16- to 20-MHz 386."

John Williams, vice president of marketing at Sierra On-Line, agrees. "This is the... shame of the system right now—VGA is so far ahead of the machine that it necessitates a

386." Simply put, your 286-based PC and your VGA card are not the most compatible of partners. David Bradley, developer of *Bane of the Cosmic Forge*, allows that the 386 chip offers "realtime speed, and that's what's needed for realism."

When these folks talk about speed, they don't just mean chip speed. A 16-MHz 386SX chip, for example, moves information around twice as fast as a comparable 286. On top of that, a 386DX moves that info out twice as fast as its SX cousin. That makes it at least four times as fast as a 286 with the same clock speed. This striking speed advantage allows animation at a realistic rate. A 486 is faster still, but no one expects games to demand 486s for another four or five years.

Today's game machine demands VGA color. A high-resolution video mode that also allows 256 colors to be displayed on the screen at the same time, VGA exhibits dramatic improvement in sharpness and clarity over EGA graphics. VGA comes in a number of different flavors, but as a gamer, your VGA or Super VGA (SVGA) card should have at least 512K of video RAM (VRAM) on board, which handles higher resolution and more colors. Of course, you'll also need a VGA or multisync color monitor to go with the card.

Most game producers now add sound effects and musical scoring to their work, but to hear these, you need a sound card. Sound cards sport everything from low-end synthesizers on a chip to the glorious Roland MT-32, a full-powered synthesizer in a box. Games that support one board may not support another, though most support the Ad Lib board—the de facto standard.

There are still three major items to go. Two of these are absolute necessities today; the third is going to be a necessity very soon.

The problem with all of this gorgeous, cinematic animation and sound is that it consumes an enormous amount of disk space. *King's Quest V* fills over 9 megabytes; *Falcon 3.0*, 8 megs; *Trial by Fire*, more than 4 megs; and *Bane of the Cosmic Forge*, about 3 megs. Most impressive computer simulations, adventures, and role-playing games today begin at about 3 megs. With DOS, *Windows*, and one or two other "serious" applications installed, a typical 40MB hard drive only has room for two or three of the newer games before it runs out of space.

Asked what size hard drive he'd put in a PC game machine, Sierra's director of engineering, Chris Iden, recommends 80 megabytes—minimum. Other experts feel 100 megs would leave room for comfort. So add a jumbo hard drive to your list of necessities.

Don't think you can get along on just 640K of RAM, either. *Wing Commander*, for instance, needs a full meg in order to take full advantage of the game's sound. Soon, games demanding two megs of memory won't be uncommon.

Finally, we arrive at the one piece of optional equipment that will be a ne-



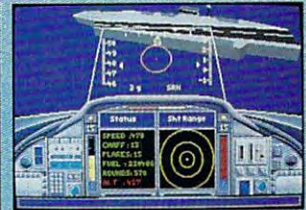
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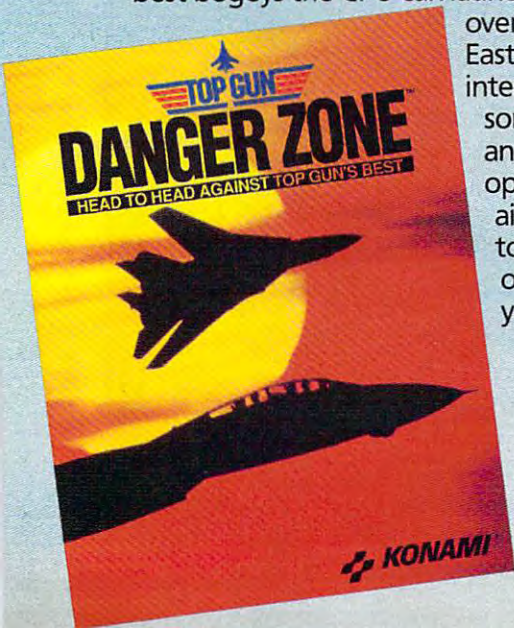


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WORLD OF ELECTRONIC GAMES

THE ADVENT OF THE CD-ROM IS FUELED BY ECONOMY—IT'S MUCH CHEAPER TO PRODUCE A CD THAN DUPLICATE A DOZEN FLOPPY DISKS

cessity before we get the shrink-wrap off this year's latest and greatest games—a CD-ROM drive. The first trickle of CD-based games from major publishers began at Christmas. Soon you will see a steady stream.

The reason for CD-ROM's inevitability, in a word, is money—the cost of duplicating each disk in a game box (over \$1 per disk in many cases) multiplied by the large number of disks it takes to contain one of these monster games. Then there's the added cost to publishers for shipping the heavier boxes. It's no longer economically feasible to ship large games on floppies when publishers can put significantly more information on a CD-ROM that can be duplicated much more cheaply.

Also, the cost of developing these games with all the sound and animation has broken the \$1 million barrier. This adds up to a retail price of \$70 to \$80 on many new games. That, too, is frightening. Schmidt comments that customers can't afford to pay any more. "From now on, [CD-ROM] is not a novelty; it's a requirement. In two years you won't see products from major companies shipped on disk." Williams agrees. "CD-ROM is inevitable. Most games will be shipping on it in two years."

How much will your next gaming PC cost? Today, including a CD-ROM drive, somewhere in the vicinity of \$600 to \$800 more than a basic 386 with VGA and a hard drive—a price that has dropped to well under \$1,500. The extra cost moves closer to \$1,000 if you upgrade from an XT or a 286.

As demand increases, spurring competition among manufacturers, hardware should cost you less. For your money, you'll receive a serious computer with enough power to desktop publish, prepare presentations, and run a business—all without stretching the limits of what you really bought the machine for—playing the best of the newest games.

PETER SPEAR



Falcon 3.0 from Spectrum HoloByte requires 8 megs of disk space.

CD-ROM SOFTWARE

Despite the small numbers of CD-ROM players, some entertainment software is already available. Most titles available now are what Nolan Bushnell (former head of Commodore's CDTV division) calls shovelware; floppy disk software placed on CD-ROM.

Currently, the TurboGrafx-CD and CDTV have the most titles available. Some new products for the TurboGrafx-CD, such as HudsonSoft's *J. B. Harold Murder Club* and Cinemaware's *It Came from the Desert*, were due to ship for Christmas of 1991. In total, there are about 15 titles available or announced for the TurboGrafx-CD.

Over 100 titles have been announced so far for CDTV, with entertainment software as the largest category. Among others, Disney, Interplay, and Maxis announced CDTV titles. Lucasfilm announced three titles for CDTV for Christmas of 1991—*Loom*, *Indy III*, and *Monkey Island*. CDTV *Loom* combines an audio drama with the game and presents every line of dialogue in 16-bit digital stereo. This version sports revised graphics, too.

Several companies, including Brøderbund, Sierra, Maxis, and Virgin Games, have announced products for the MPC standard. Sierra will put its best-selling adventure game titles on CD, including *King's Quest V* (which

will require three CDs!). Expect a number of entertainment titles for the MPC standard by early 1992.

A few CD-only games are being developed by some publishers. ICOM Simulations produces *Sherlock Holmes Consulting Detective* for a variety of CD-ROM systems, including the TurboGrafx-CD, CDTV, and the MPC. This mystery game features video of actors in costume on period sets. Reactor's *SpaceShip Warlock* is one of only a handful of CD-ROM games that are available for the Macintosh. It contains well over a hundred megabytes of graphics and sound to take you through an interstellar adventure. The elaborate high-resolution graphics and animations prove quite compelling.

Look for a pure CD-ROM title from Trilobyte for Virgin Games. Tentatively titled *Guest*, this horror game is designed for the upcoming MPC standard (with versions possible on other CD platforms). *Guest* uses the full audio and video capability of the MPC to create an atmosphere of terror. The game contains an entire 22-room mansion modeled in 3-D, along with digitized video and sound.

Undoubtedly, many more CD titles are under development for each of the systems discussed, but most companies dislike talking about future projects. We'll just have to wait and see.

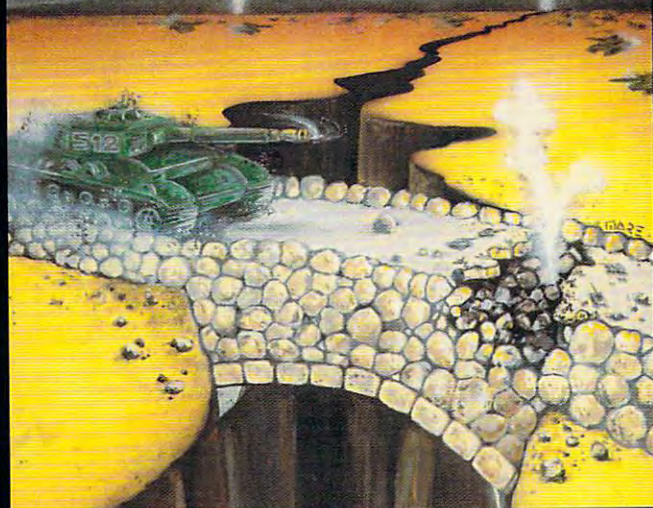
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GAMEPLAY

Howard Millman

THE GAMES USERS PLAY

The single most important factor fueling the accelerating success of computer games is their ability to substitute variety for routine. As a means to put your brain in neutral, idle the cares of the day, or drive away boredom, electronic games have no legal equal. Like the magic genie imprisoned in a bottle, your computer remains poised to release its silicon sorcery to entertain on demand.

The advantages of recreational software over more traditional games are many. Unlike sports, they can be played alone. While most other forms of gameplay from football to Monopoly encourage mixing and mingling, computer games promote isolation. Then again, unlike static board games, computer games are dynamic; they can deliver nonstop action, realistic sound, and vibrant color.

Jay Novins, a White Plains, New York, psychiatrist, recognizes the value computer games have in relieving bore-

dom but echoes a caution that was sounded a decade ago, when electronic games meant Atari 2600 and Colecovision: Don't overindulge or let games become an obsession. Novins says playing computer games is "fine so long as it's in the context of a healthy lifestyle. That means keeping it in balance. Otherwise, this constant interaction with a machine can lead to a self-imposed isolation."

What's wrong with wanting to be by yourself? Is a desire for solitude necessarily unhealthy? That depends on whom you're getting away from and why.

Roger Kallhovd, chairman of the Department of Psychiatry, Phelps Hospital, North Tarrytown, New York, likewise stresses moderation to avoid unpleasant side effects. "Yes, computer game playing can lead to isolation and withdrawal. Many games are deeply absorbing and entirely solitary activities," he says. Some of the complaints he hears about computer games are "from wives who complain that their husbands spend so much time with their computer games [that] they exclude other kinds of interaction." I didn't ask him to elaborate, but the computer widow (or widower) has taken a place in our society right beside spouses widowed by football and golf.

According to mental health professionals, occasional short-term solitude is beneficial. However, ongoing lack of social interaction can lead to isolation, particularly among those who already tend to shy away from social situations.

Steven Witzl, vice president of marketing at Access Software, comments that traditionally "people all across America communicated by sitting on the front porch. They talked with each other. Now

that's gone, taken away by the speed of everyday living and replaced with technology." Witzl sees technology both creating and solving the problem of isolationism. "It helps people keep pace with the faster lifestyle we've adopted. It helps them relax." Computer games can help people relax by enabling them to focus on completing more passes in a football simulation, amassing a taller mound of dead mutants, or even getting higher marks in geometry.

Educational software disguised as games will capture and hold a student's interest. Compared to learning by rote, learning with colorful, dynamic computer screens will prevail every time. Judith Bliss, president of Mindplay (a producer of educational software in Tucson, Arizona), asserts that educational software needs to be fun. "As with adults, life for children is filled with stress. Relief from that stress is healthy and beneficial." Software that entertains "will more effectively communicate its educational message," says Bliss. The range of educational software extends from teaching first graders reading skills to teaching astronauts how to pilot the space shuttle.

Tomorrow's multimedia technology will present mind-bogglingly realistic and innovative games. Online services like America Online and the Sierra Network will allow us to interact socially while playing computer games.

Beyond bolstering intelligence, game playing builds confidence. According to Novins, "It imparts a sense of accomplishment and mastery over the environment that can increase self-esteem." Game playing can enable players to become symbolically triumphant over others, an important, perhaps necessary victory for some. □

Guest columnist
Howard Millman takes a
look at the
psychological aspects of
computer games.



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Macintosh and VGA screens shown. Available for Macintosh. DOS version available soon. SimAnt, SimCity and SimEarth are trademarks of MAXIS. ©1991, MAXIS. All rights reserved worldwide. And then some. CMP192



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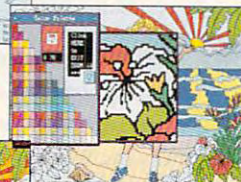
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64/128 VIEW

Two new COMPUTE disks offer great graphics and powerful utilities for your 64 or 128.

Tom Netsel

It's been said that one graphic is worth a thousand bytes. If that's true, don't bother reading this message; just order our *Gazette Graphics Grab Bag* and see for yourself. We've compiled a collection of tools for the 64 and 128 that can soon have you turning out impressive graphic demonstrations and works of computer art.

You say you aren't the artistic type? If the left side of your brain is the dominant side and you prefer logical and practical programs, then check out our *1992 Best of Gazette Utilities*. These programs will help you seize control of your operating system.

Here's a brief look at some of the programs on these disks. Let's start with the *Grab Bag* and some of its programs.

Artists can bring their hi-res graphics to life, producing smooth 3-D animation with *64 Animator*. There's also a 128 version.

Screen Maker lets artists and programmers streamline the construction of custom screens. Packed with features, this fast and efficient program offers joystick operation, a palette of colors, and lots of characters. A separate subroutine makes it easy to access your custom screens from BASIC.

Screen Designer 128 lets 128 owners create impressive text and graphic screens on their machines. These screens can also be sent directly to Commodore odd-series or compatible printers.

Create a menagerie of dynamic hi-res displays with

Starburst Graphics; then sit back and watch colorful graphics fill your screen.

With *Supratechnic* you can take the 64's video chip beyond its natural limits, and *VDC Graphics* adds nine new commands for BASIC 7.0 to let you control bitmapped graphics on the 128's 80-column screen. Then use *Dissolve 128* to make them dissolve in and out of view. Show off a number of images with *Super Slideshow*. This program displays both hi-res and multi-color files in 13 formats.

Special editions of Bruce Bowden's *Graphic Assault System* (separate versions for the 64 and 128) give you exceptional power to manipulate 40-column graphic images. Create your own or load popular-format graphics or sprites, and then invert them, flip them, reverse them, mirror them, rotate them, and experiment with many more techniques.

If utilities appeal to you, then go for the *Best of Gazette Utilities*. This outstanding collection includes BASIC enhancements, an assembly language editor, a 1541 speed enhancer, a BASIC compiler, a character editor, a scientific calculator, and much more.

Try *MetaBASIC*, *Quick*, *Sprint II*, *Ultrafont+*, *RAM-Disk*, *BASSEM*, *SciCalc 64*, *List Formatter*, and *MegaSqueeze* to add punch to your programming library.

These disks are \$11.95 each, plus \$2.00 shipping and handling. Look for an ad in this section or order by writing to COMPUTE's Utilities, 324 West Wendover Avenue, Suite 200, Greensboro, North Carolina 27408. □

GAZETTE

64/128 VIEW

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Two new COMPUTE disks offer great graphics and powerful utilities for your 64 or 128.
By Tom Netsel.

FEEDBACK

G-2

Questions, answers, and comments.

FLYING COLORS

G-6

If you're frustrated by the 64's color cell limitations, check the freedom that FLI can offer.
By Bill Pitts.

REVIEWS

G-14

RAMDrive, RAMLink,
and *Elvira, Mistress of the Dark*

MACHINE LANGUAGE

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Logical operations deal directly with the computer's fundamental elements: bits.
By Jim Butterfield.

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Let color liven the winter doldrums.
By Steve Vander Ark.

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Make sure others see you as you see yourself, with digital electronic cosmetics.
By Fred D'Ignazio.

BEGINNER BASIC

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See what RND can do for sound and graphics.
By Larry Cotton.

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Secret messages and other tips from readers.
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Bug-Swatter

There are a couple of errors in *Showdown* (September 1991). When playing the game, bumping the borders too many times can result in an OUT OF MEMORY error. To fix this, in line 510 change GOSUB 530 to GOTO 530.

The other error is similar, but may not cause problems unless the autoplay feature is used repeatedly. It could also prevent a crash just as someone is about to get a perfect score. Change two lines to read as follows.

```
120 H=0: GOSUB 1000: IF H=-1
    THEN 150
1180 H=-1: PRINT "[CLR]":
    RETURN
```

MIKE STYPE
MICHIGAN CITY, IN

The program listing of *Sci-Calcul 64* (June 1991) has a printing defect in the line which starts at address 0DC1. It makes the checksum value at the end of that line appear to be AE when, in fact, the value is AF.

GEORGE VANLANDEGHEM
STERLING HEIGHTS, MI

Cross Aid, published in the March 1991 Gazette, doesn't allow for words to be edited as stated in the article. Here is a way to correct that.

First, load *Cross Aid* as usual, but don't run it. Then enter the following two lines in immediate mode.

```
POKE 2287,20: POKE 3400,201:
    POKE 3401,141: POKE 3402,
    208
POKE 3403,3: POKE 3404,76:
    POKE 3405,70: POKE 3406,8
```

Save the program with a new name before running it. When you want to delete or change words, use Shift-Return and then, where necessary, the Del key. Use the cursor key if more than one word is displayed, and, finally, press Re-

turn when your changes have been made. Avoid using the Run/Stop key during operations as it ruins the database.

DOREEN HORNE
BRISBANE, QUEENSLAND
AUSTRALIA

Our copy of the program permits editing as the article states, so it's difficult for us to test your correction. If any reader has trouble editing previously saved words, however, give these pokes a try.

Sequential Arrays

I have been trying unsuccessfully for the last year now to write an array to a sequential access file while in BASIC. What am I doing wrong?

NEIL F. COPEL
PLANT CITY, FL

The following BASIC program illustrates how to write numeric and string array data to disk, then read them back.

```
XX 10 POKE 53280,6:POKE5
    3281,6:PRINT"[CLR]"
    {2 DOWN}{N}{WHT}"
DS 20 DIM NA(100),ST$(10
    0),N2(100),S2$(100
    )
SQ 30 INPUT"WHAT NUMBER
    {SPACE}(USE 99 TO
    {SPACE}STOP)";XX
SF 40 IF XX=99 THEN 60
DJ 50 NM=NM+1:NA(NM)=XX:
    GOTO30
CQ 60 INPUT"WHAT STRING
    {SPACE}(USE 99 TO
    {SPACE}STOP)";YY$
XG 70 IF YY$="99" THEN 9
    0
AX 80 SG=SG+1:SR$(SG)=YY
    $:GOTO60
DG 90 PRINT"WHAT DATA FI
    LE NAME DO YOU WAN
    T?":INPUT NA$
XG 100 PRINT"SAVING THE
    {SPACE}DATA..."
PH 110 :
FE 120 REM WRITING THE D
    ATA OUT
GG 130 OPEN1,8,5,(NA$)+"
    ,S,W":PRINT#1,NM;
    CHR$(13);SG;CHR$(
    13)
HE 140 IF NM>0 THEN FOR
    {SPACE}XX=1 TO NM
    :PRINT#1,NA(XX);C
    HR$(13):NEXT
```

```
QS 150 IF SG>0 THEN FOR
    {SPACE}XX=1 TO SG
    :PRINT#1,SR$(XX);
    CHR$(13):NEXT
MM 160 PRINT#1:CLOSE1
DQ 170 :
DR 180 REM READING THE D
    ATA BACK IN
CM 190 OPEN1,8,5,(NA$)+"
    ,S,R":INPUT#1,AA,
    BB:REM LOAD ARRAY
    SIZES
MA 200 IF AA>0 THEN FOR
    {SPACE}XX=1 TO AA
    :INPUT#1,N2(XX):N
    EXT
SG 210 IF BB>0 THEN FOR
    {SPACE}XX=1 TO BB
    :INPUT#1,S2$(XX):
    NEXT
GJ 220 CLOSE1
EX 230 :
HK 240 IF AA>0 THEN FOR
    {SPACE}XX=1 TO AA
    :PRINT"NUMERIC";X
    X;" = ";N2(XX):NEX
    T
MR 250 IF BB>0 THEN FOR
    {SPACE}XX=1 TO BB
    :PRINT"STRING";XX
    ;" = ";S2$(XX):NE
    XT
```

In line 10 we set the screen, border, and text colors, clear the screen, and shift to upper- and lowercase mode.

In line 20, we dimension four arrays—two for the original numeric and string data when it is written to disk as a sequential file and two to receive the data when it is read from the disk.

Lines 30-80 comprise two loops for getting numeric and string data. Enter as many numbers as you like. Enter 99 when you wish to stop. You'll then be asked to enter a string, which can be a letter, word, or sentence. It can also be a number that is saved as a string. To stop, enter 99 again. Variables in these loops also keep track of the number of elements in each of the arrays.

The data is saved to a sequential file in lines 130-160, starting with the number of elements in the array. Notice that each datum is delineated by a carriage return,

Questions and
answers
about previous
programs,
sequential arrays,
and more

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CHR\$(13). The sequential file is saved with the filename you provided in line 90.

In lines 190-220, the data is read from disk and loaded into two new arrays. Lines 240-250 verify that the data was saved properly by printing the loaded values to the screen.

Manuals Needed

I was never into the "computer thing," but recently I inherited some computers that included a 128D, a 64C, and a Plus/4. There were manuals with all the devices except for the Plus/4. Does anybody know where I can get one? Suddenly I am excited about computers.

JIM HOUGH
1107 ARKANSAS AVE.
KILLEEN, TX 76541

You could write to Commodore, Department C, 1200 Wilson Avenue, West Chester, Pennsylvania 19380 and ask if the Plus/4 manual (#310196-01) is still available. The price was \$7.30, plus \$3.00 shipping and handling, but there's a good chance one of our readers will help you find one.

Do Not List

I am writing a text adventure game for the 64. A couple of years ago you published information about a command that could be used to prevent users from listing a program. Can you tell me how to do this so I can keep users from prying into my game?

Also, can you tell me where I can still purchase Infocom games?

DANIEL POLSTON
JACKSONVILLE, AR

One of the more common tricks is to enter a Shift-L after a REM statement on the first line of your program. This will print a syntax-error message on the screen when anyone

tries to list the program.

To answer your second question, try Software Support International, 2700 NE Andresen Road, Suite A-10, Vancouver, Washington 98661. It has a number of new and used Infocom games available. Call (800) 356-1179 to order or request a free catalog.

Uninterrupted Power Source

I recently acquired an UPS Datashield AT 800 which appears to be in excellent working condition. It is my understanding that the unit maintains a constant green light and will emit a beeping sound when the local power to the computer and disk drive is cut off. I'd like to find someone from whom I could obtain a manual or operating instructions.

MERLE WILLIAMS
842 RIVERVIEW LN.
TARPON SPRINGS, FL 34689

We're not familiar with that power supply, but perhaps our readers can help.

More on Printer Ribbons

A few months ago a Gazette reader wrote requesting information about where he could find ribbons for an Okidata 10 printer. I get mine from Quill Corporation, Box 4700, Lincolnshire, Illinois 60197-4700; (708) 634-4800. The price is \$3.49 each. I buy six at a time and pay a total of \$22.72, which includes shipping. You can't beat that.

DURHAM J. "BUD" BELANGER
LAS VEGAS, NV

If anyone is looking for a ribbon for a 1525 printer, try Radio Shack. Ask for the ribbon with stock number 26-1424.

DAN WAGNER
LEWISTON, ID

Missing SYS Address

In your April issue I read about someone's problem

with missing SYS addresses for machine language programs. The following short program may help. After the program runs, insert the disk that contains the program whose address you need, type in the name, and that's it.

```
10 INPUT "[CLR] [DOWN] FILE
NAME";F$
20 PRINT "LOAD ADDRESS IS";
30 OPEN 1,8,1,"0:"+F$
40 GET#1,LS
50 GET#1,HS
60 X$=H$:GOSUB100:H=X*256
70 X$=L$:GOSUB100:L=X
80 PRINT H+L:CLOSE1
90 END
100 IF X$="" THEN X=0: RETURN
110 X=ASC(X$)
120 RETURN
```

JERRY JOHNSON
SUGARCREEK, OH

Thanks for your suggestion, Jerry. Your program does provide the address where a program starts to load in memory, but that is not necessarily the SYS address needed to run it. Of course, that's a good address to try if you can't remember the other. If that doesn't work, however, you may still have to examine the program with an assembler to determine the proper address to make it run. Fortunately, many programmers these days include code that makes their machine language programs load and run like BASIC ones. Another trick before you forget the SYS address is to write your own BASIC loader that automatically loads and runs the machine language program for you.

If you have a question, comment, or problem, we want to hear from you. Send your letters to Gazette Feedback, COMPUTE Publications, 324 West Wendover Avenue, Suite 200, Greensboro, North Carolina 27408. □

Readers need help with manuals, and others offer tips about SYS addresses and printer ribbons.

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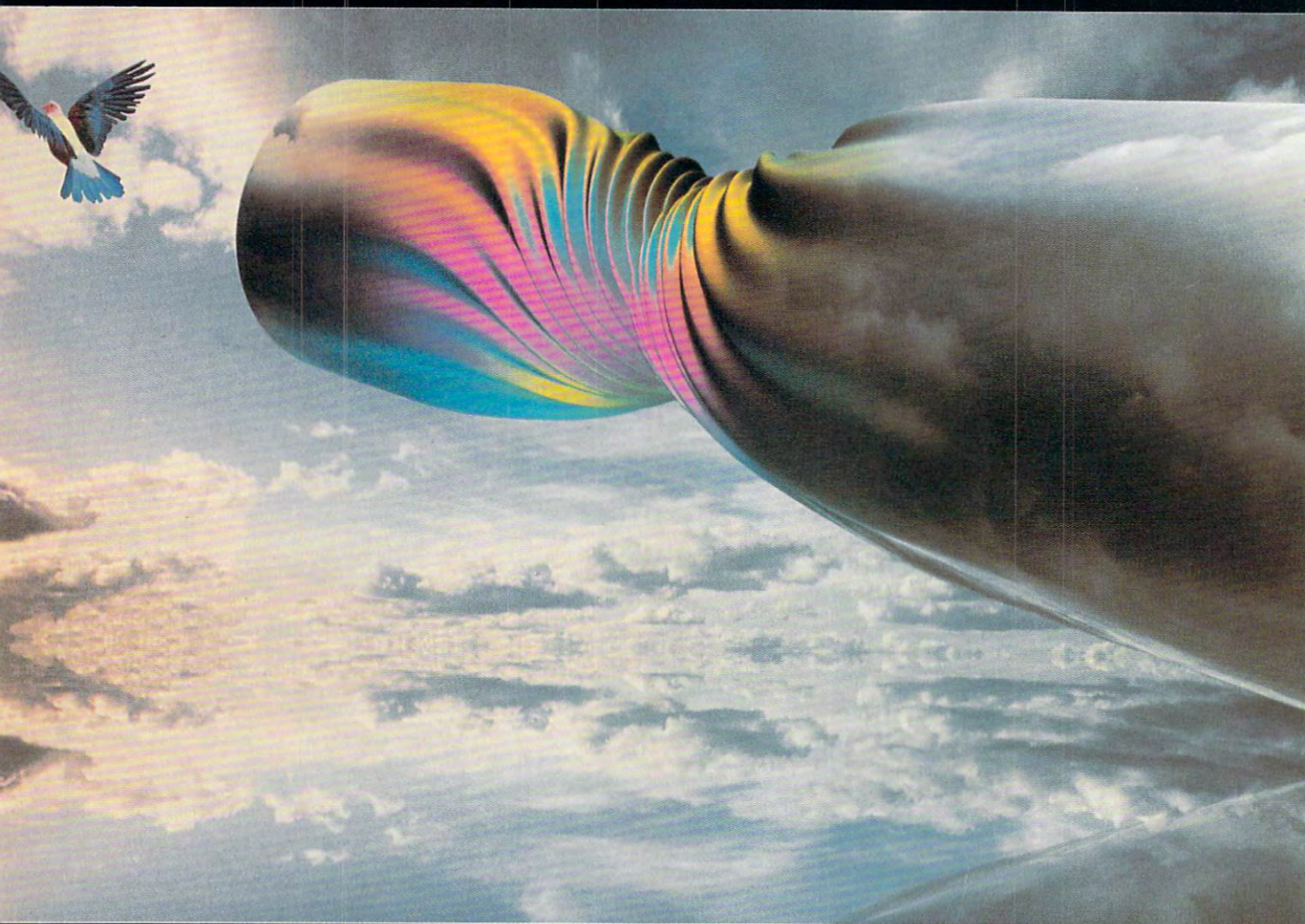


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FLYING

COLORS

Whether you're a beginner or an accomplished computer artist, if you find the color cell limitations of the 64 to be a source of frustration, then I'm sure you'll welcome the added freedom that FLI can offer.

Article by
Bill Pitts



What is FLI? Well, depending on whom you ask, FLI stands for Flexible Line Interrupt or Flexible Line Interpretation. European software producers originally developed FLI to create more colorful logos for their software demonstrations.

What FLI does is to offer the use of all 16 of the 64's colors in each 4 x 8 multicolor (medium resolution) cell. The standard multicolor format limits the number of colors used to four.

Due to technical limitations, which I'll discuss shortly, there are currently no full-blown paint programs that use FLI. There are several FLI editors currently available, however, with each having its own unique features. I'll mention more about them later.

A Little Background

To explain the benefits and limitations of FLI, I'll start with an overview of how the 64 uses color and then explain how this relates to FLI. The designers of the 64 realized that certain compromises would have to be made to obtain the desired range of colors, flexibility, and speed needed to make the 64 the marvelous game machine that it is.

They came up with a unique color cell or card system based on the 8-dot x 8-dot character grid, where each dot or pixel is represented by one bit in memory. This system allowed a palette of 16 colors when other personal computers of that era were hard-pressed to produce four colors.

Hi-Res Mode

This system has several operating modes, but I'm going to concentrate on the so-called color bitmap modes. The first of these is hi-res (high resolution) mode, where we have an 8K area of memory corresponding to the 64,000 bits of a 320 x 200 bitmap screen, divided into one thousand 8 x 8 cells or cards.

In addition, another 1K area of memory must be set aside to hold the information for one foreground and one background color per cell. This is done by dividing each byte (8 bits) in this special color memory into a lower nybble and upper nybble of four bits each. Reading from right to left in binary notation, the first four bits (0-3), the lower nybble, hold the color information for the background color, while the second four bits (4-7) hold the foreground color information. Since the maximum number you can count with four bits in binary is 16 (0-15), that's the origin of the 16-color limitation.

Multicolor Mode

The other bitmap mode, the one we're most concerned with here, is the mul-

ticolor mode, so named because it allows three foreground colors per cell instead of the single color of hi-res mode. Since, as the old saying goes, you don't get something for nothing, there is a tradeoff. That tradeoff is twofold. There is a limit of only one background color for the entire bitmap, and the horizontal bitmap resolution is cut in half, from 320 single-bit dots to 160 double-wide bit-pair dots, with the cells themselves reduced from 8 x 8 to 4 x 8 "fat dots."

Why? Well, if you want two more foreground colors, you're going to need another 1K block of color memory or video matrix. You have to store this added color information somewhere, and you'll need a means of keeping track of where you stored it. That's where the VIC registers come in.

There are only so many registers available in the VIC chip. We now have four areas of color information to manage: the background color—one per screen—and three foreground colors per cell. One of the foreground areas is stored in color RAM from 55296 to 56295 and the other two within 1000-byte video matrices in locations of our choosing.

With all this added information to deal with, we need to do a bit of borrowing from somewhere to point to our stored colors. Now we'll see why the horizontal resolution must be cut in half. With four areas to keep track of, we obviously cannot use the high/low nybble system we used in hi-res. Instead, we get the needed pointers by splitting the eight bits in each graphics bitmap data byte into four bit-pairs instead of the high/low nybbles of hi-res color mode.

We then use these bit pairs (0-1, 2-3, 4-5, 6-7) to control the corresponding horizontal pairs of screen bits (dots). The source of the color nybble that each bit pair points to will depend on the binary number combination contained in that pair, according to the following binary chart:

- 11 - Low nybble of color RAM, starting at \$D800 (55296)
- 10 - Low nybble of screen RAM, (video matrix) often starting at \$0400 (1024)
- 01 - High nybble of screen RAM (video matrix)
- 00 - Low nybble of background color register at \$D021 (53281)

Since we are doing this on a cell-by-cell basis and there are four choices we can make above (one for each of the four bit-pairs), we can have up to four colors per cell, with one being the common background color set at

\$D021 (53281 in decimal).

The other three colors will be whatever we set in the appropriate screen and color RAM maps that parallel our visible screen. If we change any of the color nybbles already set, we will affect all occurrences of that color within the cell that point to that nybble.

For example, if we set the low nybble of screen RAM to 14 (binary 1110), then all bit pairs in that cell that we set to point there (10) would show up as Commodore light blue, number 14. If we change that nybble to 15 (1111), then all occurrences of the 10 bit-pair for that cell would now show up as light gray, number 15.

The Artist's Point of View

So what does all this mean to the artist? Well, let's say you've fired up your favorite drawing program and started work on the ultimate masterpiece. You've carefully shaded the hair and beard in a portrait by judiciously combining brown and two shades of gray (dark and medium) on a black background.

Now, perhaps you decide that a touch of light gray or white here and there would really set this off. So you choose light gray from your palette and click your mouse or joystick button on a dot that you have already set to medium gray. POW! Much to your surprise and chagrin, not only is that medium gray dot now light gray, all the other medium gray dots in that cell have also changed to light gray. You probably think you've done something wrong as you laboriously redo all the changed dots back to medium gray.

You try one more time, and it happens again! At this point, your language may be more colorful than the screen. Welcome to the world of computer graphics! You have just encountered your first color collision or color blowout.

Some paint programs try to get around this problem by preventing you from entering a fifth color or by reverting all instances of the affected color to the background color, which is really no solution at all.

Now the Good (and Bad) Stuff

By now you're thinking there has to be a better way. There is. Suppose we create seven more 1K screen RAM (video matrix) areas, for a total of eight, and set up a way to choose between any one of these color sources as we draw each of a cell's eight horizontal rows.

While we're at it, why not add a special 256-byte area that has enough free nybbles to allow each horizontal screen row (40 cells wide) to have its

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AN ARTIST'S EXPLANATION

The original *Illuminatus* picture accompanying this article only took me an hour or so to rough out using various commands and features of the *OCP Advanced Art Studio*. I can't begin to estimate how much time it would have taken to do it if I'd had to draw it all freehand with a mouse.

To begin with, the actual pyramid shape was created with the triangle option. It actually took me longer to position the cursor exactly halfway between the left and right margins than it did to draw the pyramid.

The bricks were done with the Fill and Pattern Edit commands. The brick wall pattern was slightly edited for color. I changed the color of the red bricks to yellow and the white mortar to black. I used the Line and Magnify commands to isolate the apex of the pyramid from the rest of the pyramid in order to keep from filling the whole thing. Magnify was used again to smooth out the resulting rough sides of the pyramid and to give it a more realistic stepped appearance.

The oval portion of the eye was done by cutting and pasting arc segments of a circle until I was satisfied with it; then the entire oval was cut and pasted inside the apex. From there, it was just a matter of using the Fill and Magnify features to do the detailing.

I'm rather proud of the drop shadow text effect. I've never seen it done else-

where, and it's easy to do with the Exclude option on the *Art Studio's* color menu. Think of the picture as having several planes. There is a background plane (the screen color), a midground plane (the area where the text is written), and a foreground plane (the text itself). In the case of my picture, the background color is black, the midground is brown, and the foreground is light gray. I selected black and brown to be excluded on the Color menu, then used the Cut, Clear, and Paste option to move the text (the foreground) a few pixels up and to the left. The drop shadow effect is the result of the black and brown colors being excluded in the cut-and-paste operation.

I estimate I spent about 20 hours in total work on this picture, mainly trying various color combinations of text and background, and tweaking the pixels of the eye and the star field.

The FLI version was created from the original multicolor picture. Since FLI cannot use the leftmost 12 columns of pixels and the bottom 8 rows of pixels, I used the Cut and Paste options to erase the rightmost six and topmost four pixels. I then centered the picture so that four pixels on the left and four on the bottom would be erased by the FLI editor, effectively producing a balanced, centered picture. The rest of the FLI detailing was in adding 3-D shading to

each brick and some detailing in the background and corners of the pyramid apex.

The FLI pixel tweaking added another three hours or so of work to the picture.

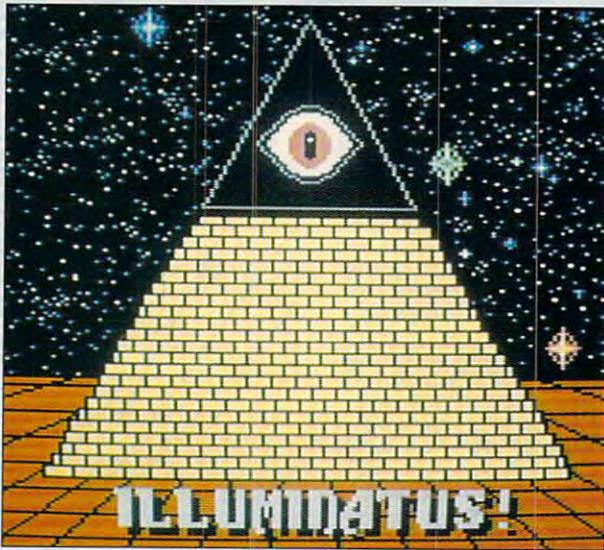
Had I intended this to be an FLI picture from the start, I would have done several things differently. For example, I would have used the Pattern Edit feature to create a somewhat larger brick which would have allowed me to add individual detailing and shading to each brick. Also, I would have used the Paintbrush command to place individual bricks in rows.

The eye in the apex would have been modeled on the eye and pyramid of the Great Seal of the United States. I also might have chosen a larger font with serifs to better add shadowing and detailing to the letters.

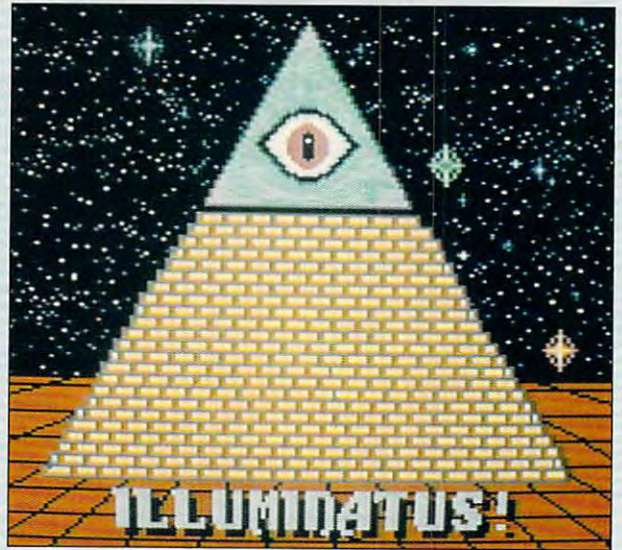
There are several aspects to FLI graphics that I find intriguing, not the least of which is that it stretches the envelope of what the 64 can do. From a strictly pedestrian standpoint, it allows a degree of detailing that multicolor mode is incapable of displaying.

—CHRIS TUCKER

Chris Tucker lives in Vermont. He is interested in space sciences, science fiction, shortwave radio, and computers and international networks as tools of communication and education. He can be contacted on Q-Link as Chris43.



Since no FLI paint programs exist, Chris Tucker created Illuminatus in multicolor mode.



This FLI version has been enhanced around the bricks and background. See "An Artist's Explanation" for more details.

own background color? That's exactly what Flexible Line Interpretation does. This way, we can call up any of eight sets of two foreground colors and one unique background color per row. This makes it possible to use all 16 available colors in each cell. This is similar to the concept of Page Flipping for bitmap screens but with multiple color maps instead.

While FLI will allow greater freedom of color usage, it is not a cure-all for the 64's color cell limitations. There are still certain restrictions that prevent complete freedom of color placement within each cell. We can now create and point to multiple copies of the screen RAM or video matrix by manipulating the VIC II register at 53272 (\$D018). We also can look at up to 200 individual custom background color registers in the newer FLI editors. (Some older editors still use the standard register at 53281.) However, we still cannot move or duplicate the fixed-location color RAM (55296-56295). This restriction limits us to only two new foreground colors in each horizontal row of the cell. The other two colors must be taken from the color RAM and background register.

How the background color is handled depends on the editor in use. Most newer editors allow for a different color on each screen row as noted above, while older editors use a common background color for the entire screen. Once the color RAM value is set to any particular color other than the background color, that color becomes the global value for the cell, meaning it will be in effect for the entire 4 x 8 cell.

From the artist's point of view, once this value is set, that color must be used as the third foreground color in any horizontal row in that cell. You can always change this global color to any other nonbackground value. How this color is set or cleared depends on the editor you are using. Each of the three editors that I have do it a slightly different way.

The Bottom Line

While you can now have all 16 colors per cell, you are still limited to one background and three foreground colors per row, and one of these three must be common to the entire cell. Any attempt to get around this within various editors will result in the old familiar color blowout or in no response at all.

Space will not permit me to elaborate on all the different ways these color priorities can be handled. I'd like to note here that most older editors that use a common background color for the entire screen have been modified to be compatible with the newer multiple-background editors. While they don't actually use the 256-byte area for extra colors (it remains all black or \$00), they will recognize it to allow disk file load/save compatibility with the newer editors. If you run across an editor that saves 68-block files rather than 69, then most likely you have an older, unmodified editor.

There are a few more limitations that are very important. For starters, the first 12 columns (3 cells) on the left side of the screen must be left blank, usually by setting them to the background color of the screen. The reason for this is that we need a certain

amount of time to execute the needed switch from one video matrix to another before scanning the remainder of each line. That switch takes place while the scan for each line is still within these first 12 columns. Any attempt to use these 12 columns during this switch will result in garbage dots at these locations unless all dots are colored alike (usually black) or "blanked out" in these leftmost cells.

This means you'll have to exercise a bit of artistic license here by adding an equally sized right border to your picture or using some other means of hiding or balancing this offset. (There are supposedly some editors that allow up to eight colors in these columns, although at present they are only available in a European PAL version.)

The reason there are presently no full-blown FLI drawing programs is mainly due to the critical timing needed to ensure that the video matrix switch will always take place in these first 12 columns. This means no program features like fancy sprite pointers; plotted squares, circles, or other shapes; drop-down windows; and so on.

There is one final timing-related limitation. In most editors set up for NTSC (American) systems, the top and bottom horizontal rows may be unusable. This does not usually cause serious problems, but you should be aware that the situation exists. I've included a set of diagrams to illustrate many of the above points for both the standard multicolor and FLI formats.

Making the Most of FLI

As you can see, FLI is not some revolutionary new method that is going to

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FLI SOFTWARE

The present crop of FLI editors is limited for the most part to zoom mode that lets you edit pictures on a dot-by-dot basis. There are three editors presently available in the graphics section of QuantumLink's public domain libraries. They may also be found on various BBSs as well.

FLI Graph 2.2 has the most options, including the ability to import Koala and other standard multicolor format files into the editor. It also lets you choose a new background color when loading. Unfortunately, it's not very user-friendly.

FLI Editor V3.2 has the most advanced editing options of the three, with the ability to change the background color on every line. It also has a unique color tracking feature.

Perhaps the nicest offering on any of these editors is the split screen used in *FLI Editor* (no version number). This feature allows you to keep track of an actual-size image of the screen area you are currently editing. As any computer artist will tell you, that is a very handy feature. Unfortunately, this editor does not offer many of the oth-

er features mentioned above.

Other handy FLI utilities that can be found in the Q-Link libraries and on BBSs are two Koala-FLI converters, a viewer for FLI images, and the *SR-FLI Creator* program by Jon Purkey (known as Gullible on Q-Link) that creates self-running files of your FLI masterpieces. It also offers the added advantage of optional file compression. This is a handy feature that can reduce the size of a standard 69-block FLI file to as little as 10 blocks. The reason that the original file is so large is that each 1K of data takes four disk blocks, and you need 40 blocks for the 10K of the standard multicolor file (8K for the bitmap and 2K for the color info [video matrix], color RAM, and background color).

In addition, we need another 7K, or 1K for each additional video matrix file used with FLI. This adds 28 more blocks to our FLI file, plus 1 more block for our custom background registers, for a total of 69 blocks. Since much of this information is redundant or repetitive, FLI pictures lend themselves well to file compression.

Since it is upwardly compatible with standard multicolor files, the logical way to use it would be to do most of the groundwork in a standard paint program like *KoalaPainter* or *OCP Advanced Art Studio* and then import the image into an FLI editor for the final touch-ups not possible in standard multicolor.

As the sample pictures included with this article illustrate, the differences between regular and FLI multicolor are more subtle than dramatic, with results depending on the artist and subject. Above all, this illustrates that, while the 64 may be ancient by today's computer standards, it still has capabilities that we have not yet fully explored or exploited! This has been proven repeatedly by innovative programmers like the creators of FLI. As you can plainly see, Flexible Line Interpretation is a very appropriate name for this new way to paint on your 64!

Bill Pitts, an industrial electrician in Warren, Ohio, has been a graphics sysop on QuantumLink for more than four years. Additional information about FLI can be found in Q-Link's graphic areas. Questions may be addressed to Pitts (Sysop WP), Chris Tucker (Chris43), or other online artists. □

make an Amiga or Super VGA machine out of your 64. It is a very handy tool for the artist who is looking for a way to get that extra mile from existing hardware and who wants to exercise more creative control over his or her im-

ages. Since there are no commercial paint programs available for FLI, its primary use will likely be in utilizing the enhanced color options to improve or clean up areas in detailed images where color collisions are a problem.



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RAMLINK AND RAMDRIVE

Random access memory (RAM) devices exist either to instantly load software or quickly save and load data. Until recently, all external RAM expansion units (REUs) had handicaps of one kind or another.



Most REUs have volatile memory. That means they lose any data in memory whenever the computer's power is turned off. Power itself can be a problem since the 64's power supply isn't rugged enough to supply power to many REUs. Another problem is that most programs have to be adapted in some way to take advantage of an REU.

Creative Micro Designs has developed two units, RAMLink and RAMDrive, which overcome most of these problems. Since the software that accompanies these units is virtually identical, I'll describe the similarities between the devices before stating their differences. The CMD systems create par-

titions and subpartitions. These may be accessed via direct mode or from within adapted versions of certain programs, such as *The Write Stuff* word processor or CMD's *gateWay* program.

Partitions default to native mode. This format means the unit will accept data files from most applications and can store the programs themselves, such as *SpeedScript* and all of its files.

Emulation modes imitate the 1541, 1571, and 1581 to increase compatibility for some drive-specific software. Direct access mode is useful if an REU needs to be accessed by a program that cannot work directly with the CMD unit. For example, I use a 1571, a CMD unit, and a 1750 REU in direct mode. CMD's *GEOS* adaptation for its RAM units, *gateWay*, recognizes each of these units as a separate drive.

Since each partition acts like a disk drive, most files can be loaded to and saved from these partitions, and the speed is virtually instantaneous. Programs stored within a CMD unit are instantly available once you press Return.

When a program such as *GEOS* switches layers in and out, the rapid interchange gives the illusion of a very large computer memory. Saving and loading is so fast that you may want to check the directory just to make sure that the file was actually saved.

CMD partitions in RAMLink and RAMDrive can handle a wide range of programs. They will accept most newer unprotected programs from Timeworks and DOSerm, most text-based *Dungeons and Dragons*

games, *Superbase V3*, and the *Stereo Sid Player* version 10.1 or newer. I also store *Print Shop* graphics and a number of *SpeedScript* programs. The *Fleet System 2+* word processor recognizes its spelling dictionary and most of its thesaurus when they are stored in a CMD RAM device.

Usually, if a program can be transferred from a 1541 to a 1571, it can be stored in and run from a CMD unit. Two programs that work particularly well with CMD products, *gateWay* and *The Write Stuff*, take advantage of the large storage space and quick access. This means *GEOS* can be immediately available, with all applications and accessories appearing at the click of a mouse button.

The Write Stuff will store files in subpartitions and will allow the user to move among partitions from within the program. *TWS* has numerous features, which include several pages of onscreen help files and a large dictionary. There is practically no waiting time when any of these features are called.

CMD devices recognize the *Maverick V5* disk copier, but I can't vouch for most cartridges. The Turbomaster speedup CPU is not yet compatible, but may soon be adapted to work with CMD units. The Commodore 1700 series of REUs will work with CMD units, including those that have been expanded to two megabytes. CMD has included a wedge that abbreviates most drive commands and speeds up floppy disk access when a special CMD chip is inserted in the floppy drive. Without the special drive chip, floppy saves and loads are the same as those of a stock 64/128. Since I had already installed CMD's

JiffyDOS in my computer and 1571 drive (which also eliminated the usual 1571 problems), I had to set my computer's JiffyDOS switch to off for the wedge in the RAM device to work.

The floppy disk access is as fast as it was previously. The wedge is still available and works for both the floppy and RAM device. It also uses the built-in disk copier that allows one floppy to be copied to another via the RAM device with only one change of disks in the floppy drive.

With the included software, it's easy to create partitions, change their modes, and copy files between partitions and another drive. Since a disk is used for system initialization, it should be easy to make upgrades of the operating system.

The default device number for CMD drives is 16. This can be changed through software, however, to any desired number. *The Write Stuff* expects a default of 12, and *gateWay* (*GEOS*) requires 8 or 9. A pressure-sensitive spot on CMD units makes it easy to assign device 8 or 9 to the RAM device. This feature lets you load and save files to and from the CMD unit from most programs. I load *Print Shop* from my floppy drive, depress the Swap 8 location on my RAM unit, and load picture files from the RAM drive. A reset button helps 64 owners clear their machine without turning off the computer. Users of *gateWay* will be able to reset and recall *GEOS* with no data loss.

If the CMD units interfere with the operation of any software, they each have an enable/disable switch that isolates them from your system. I haven't discovered any problems with software, though.

RAMLink

RAMLink is housed in a 6 x 2 x 5 inch metal case with two openings on the top for an REU and a cartridge. CMD offers an optional RAMCard that can be used alone as a RAM disk or in conjunction with other REUs for a maximum capacity of 16MB.

In addition to the enable/disable toggle switch common to both CMD devices, there is a normal/direct switch that allows the attached REU to be treated separately if it contains a direct-access partition. The memory of the attached REU remains permanent when the computer is turned off. This is because RAMLink has its own AC

power supply. An optional backup battery is available that will power RAMLink for several hours.

I have used the battery while switching the AC cord between wall outlets and found that memory contents were retained. Three outlets on the back of the unit are for the AC supply, a battery backup, and parallel connection to a CMD hard drive.

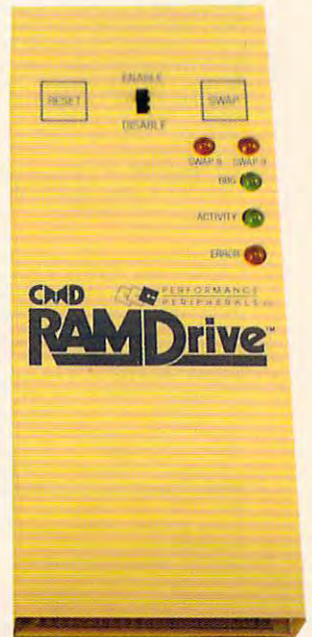
I have 2MB in my unit plus the 512K contained in my 1750. The type of memory chips (SIMM) installed in my unit would allow expansion to 4MB plus my REU. A different size of SIMM would permit expansion to 16MB. Mixing two SIMM types will not work. The CMD operating system is

able to use the maximum range of memory.

The Final Cartridge III, which according to its U.S. distributors is not designed to work with any other cartridge or REU, works quite well with RAMLink and my attached 1750 REU. The Final Cartridge will perform all normal disk operations on my floppy drive. While it will identify the contents of the default partition on RAMLink, it will not perform disk operations on the RAM device. My other cartridges function normally when attached to this unit.

RAMDrive

This unit can either be inserted into the cartridge port or share an Aprospand car-



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REVIEWS

tridge holder with a Commodore series REU of any size. The geoRAM cartridge will not work with RAMDrive. No cartridges other than the 1700 series REUs will work in conjunction with this unit. It has a built-in battery and AC power source, putting no additional load on the 64. Its maximum capacity is two megabytes. While it has no normal/direct switch, its controls are otherwise similar to those found on RAMLink.

What makes this device unique is that once its battery is charged, it will operate for several days without connection to any power source. Although I leave the AC source connected while RAMDrive is in use, I can easily carry this metal-cased unit between home and work in my jacket.

There are at least three aspects to RAMDrive's portability. It is much smaller and lighter than RAMLink. Its built-in battery allows for memory retention over several days, while RAMLink's battery is for short-term blackouts or accidentally interrupted power supplies.

RAMDrive can easily be connected/disconnected from cartridge ports without any loss of data and in most cases without the need of a special jumper wire. RAMLink requires that a jumper cable be connected between a chip within the computer and RAMLink to synchronize timing. Only some 64/128 computers will need this adjustment with RAMDrive. A software test will tell the user whether this installation is required. Although I am a very timid technician, I performed the installation in about half an hour with no special tools. Many users of RAMDrive will not need to do this with their computers.

Customer Service

One of the devices' designers from Performance Peripherals told me that to make the CMD devices work they had to make the 64 do what it wasn't designed to do. They quickly discovered that the wide variety of chips in the 64 and 128 added to the difficulties in making RAMLink and RAMDrive work with all 64 or 128 computers. My 64 was especially stubborn with RAMDrive, but the designers modified another RAMDrive and sent it to me by courier. It worked with no problems.

I made innumerable calls to the

CMD office for technical advice and discussions. The help was not only effective but friendly. Only a tiny minority of you will have computer compatibility problems. If you do have difficulties, CMD will fix them. In one case the CMD staff even worked on a customer's computer in their lab. Now that's service!

I use *GeoWorks Ensemble* at work on an IBM-compatible AT with a 40MB hard disk. It's a wonderful program that takes full advantage of the machine. That 286 cost us nearly \$2,000 when we bought it two years ago. I am running *GEOS* (CMD's *gateWay*) on my 64 with a CMD RAM device. I have faster response time for all activities on my Commodore than I do with the more expensive IBM clone and software. For many 64 or 128 owners, a CMD RAM unit may be a more effective upgrade than the purchase of a more expensive machine.

JOHN ELLIOTT

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ELVIRA, MISTRESS OF THE DARK

Hollywood's influence on the computer software field is far-reaching. Every time you turn around, another game based on a movie pops up on the software shelves. With *Elvira, Mistress of the Dark*, the video vixen stars in an adventure game that has nothing to do with her dud movie of the same title and everything to do with the atmosphere and invitingly haunting images that Elvira evokes.

Elvira has established herself as a hostess of the macabre, and her computer game reeks of the horror genre in a delightfully disgusting way. Lots of gruesome images, fearsome monsters,

and campy humor await the role-playing adventurer in need of a challenging game.

In *Elvira*, you must help the hostess with the mostest rid her inherited castle of her insane, evil Aunt Emelda's ghost. The only way to do this is to find the six keys that will unlock a chest that contains the Scroll of Spiritual Mastery. This scroll is the only means of resurrecting the departed Emelda.

After collecting the keys, you must also unearth the chest and destroy the scroll so that no one will try to bring Emelda back to life again. *Elvira* is an enjoyable game, but it's so large that many players may give up before they finish the quest.

Elvira's icon-driven interface is effortless to use. The center window displays a first-person view of your surroundings. Objects like doors and weapons may be selected right in this window. A list of commands on the right side of the picture window and directional arrows and inventory icons on the left side complete the interface. All are clickable. Underneath the picture window is space for your inventory or game messages. You play *Elvira* by clicking command icons, objects in your inventory, directional arrows, or objects in the main window.

Elvira is not a simple game, but its interface makes it much more playable than it might have been.

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The best part of the game is the design of the castle and its surrounding locations. Particularly interesting are the hedge maze, garden, and moat.

Elvira's inherited castle is easily the best representation of a stony fortress in a computer game. From the dungeon to the ramparts, the castle is large and detailed. You'll forget you're in a computer game. Particularly nasty areas are the dungeon and the ramparts. Watch out for monsters, and always be ready with an effective potion.

Potions and spells are a large part of *Elvira*. In your journeys throughout the castle grounds, you'll find many strange plants and other ingredients. Every now and then, return to the castle's kitchen, and Elvira herself will tell you which potions may be mixed effectively with the ingredients in your inventory. You can learn all about the potions in *Emelda's Book of Recipes*

and *Spells* that comes with the game. It acts as copy protection because you need a piece of red plastic to read the spells. The book also reveals the many possible combinations of ingredients.

Some spells affect monsters and other evil characters you may encounter. Others protect you or restore life points. Your character has a few role-playing characteristics (strength, resilience, dexterity, skill, and life) that may be affected by one or more potions. Experiment, but save your game often.

After a complete journey through the game, I can verify that not all spells are necessary, and you may interchange specific spells in some instances. Some spells increase knowledge and reveal information desperately needed to complete portions of the game. Save your position often, and never use a spell in combat unless absolutely necessary.

The graphics in *Elvira* are most impressive. Although a

little bland in some areas of the castle, most of the screens are suitably detailed. The death scenes are particularly fun because there are so many ways to die in this game. In all cases, your character's picture pops up onscreen to reveal a gruesome form of death.

In combat sequences, you must block your attacker's blows and return them when you have the advantage. Animation is smooth, and you'll pick up the rhythm in no time. Keep those potions ready!

Elvira is perfect for the graphic adventurer in need of a bizarre twist. Mapping is not necessary in the game, but a good sense of spatial orientation is important. The castle is large and full of surprises. The game is packed on three double-sided disks to eliminate excessive disk swapping.

Elvira is also perfect for the fans of the fright flick femme fatale who want a game that offers a complex

but fair challenge. Still pushing the 64 computer beyond its preconceived limits, *Elvira* mixes fantasy and fun in a ghoulishly delicious potion that entices players to drink.

RUSS CECCOLA

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MACHINE LANGUAGE

Jim Butterfield

SMOOTH OPERATORS

The logical instructions of the 65xx microprocessors deal directly with its fundamental elements: bits.

The three instructions are AND (logical AND), OR (logical OR), and EOR (exclusive OR). All three work with the A register and a specified memory location, placing the results of the operation into A. All three are capable of manipulating one or several bits within the 8-bit byte, leaving the other bits untouched. Another instruction, BIT, is capable of testing selected bits but will not change data.

Though logical operators can be used to calculate checksums, determine game strategy, or form complex decision values, programmers most often use these instructions to select or change data bits by means of a mask value.

To use a mask, select the bits you want to change and set up a mask value of ones and zeros to specify those bits. AND turns bits off, OR turns bits on, and EOR flips bits.

AND: A 1 in the mask leaves the corresponding data bit alone; a 0 bit forces the corresponding data bit to 0 (turns it off).

OR: A 0 leaves the data bit alone, and a 1 forces it to 1 (turns it on).

EOR: A 0 bit leaves the data bit alone, but a 1 bit causes the data bit to flip from 0 to 1 or 1 to 0.

The AND and OR instructions destroy data. Whatever the bits were before, they are forced to one or zero and the previous information is gone. But EOR flips bits, and such bits could be flipped back to their original state if desired.

AND, which sets bits to 0, is often used to extract bits for testing. This is especially true

of I/O (Input/Output) ports, where each of the eight bits of a port or register may have an individual meaning. AND is also frequently used to eliminate the higher bits of an ASCII character in order to convert it to a number; an ASCII digit from 0 to 9 (hexadecimal \$30 to \$39) can be reduced to its value with AND #\$0F.

OR will do the reverse of this; it can convert a binary value in the range 0 to 9 into an ASCII decimal digit. It's also a valuable instruction for turning on a bit in an output port.

EOR is good for use as a counter, or it can be used to create oscillating effects, such as making parts of the screen blink.

The following program performs the three operations on screen data. To work on a 64 or a 128 in 40-column mode, the program assumes that the screen is located at hex 0400.

Keep in mind that screen memory uses a special code for data. The alphabetic characters A to Z are represented as values 1 to 26; that's different from ASCII code. Numeric digits 0 to 9 are the same as ASCII (hex \$30 to \$39), as is the space character (hex \$20). Watch for screen binary zero, the @ character.

The BASIC program given below prints a number of identical lines to the screen then POKEs a tiny program into memory. The program is modified during the run, but it starts like this:

```
2000 A2 00 LDX #$00
2002 BD 50 04 LDA $0450,X
2005 29 0F AND #$0F
2007 9D 50 04 STA $0450,X
200A E8 INX
200B E0 12 CPX #$12
200D D0 F3 BNE $2002
200F 60 RTS
```

As the BASIC program runs, the logical operation changes to OR and then to EOR, and

the address of the line is adjusted upward to match following screen lines. The BASIC program runs the whole logical set nine times. Lines modified by AND and OR won't change after the first time. The bits have been set off or on, and they stay that way. But the bits affected by EOR will flip back to their original values and then flip again, and so on. You'll quickly notice that the high bit of the screen display (mask \$80) creates reverse video when it's turned on so that EOR creates a flash effect.

```
100 PRINT CHR$(147);
"LOGIC OPERATORS!"
110 DATA ORIGINAL,AND-
$0F,OR--$30
120 DATA EOR-$1,EOR-$30,
EOR-$80
130 FOR J=1 TO 6
140 READ X$
150 PRINT "ABCDEFGHI
123456789";TAB(20);X$
160 NEXT J
200 DATA 162,0,189,80,4,41,15,
157,80,4,232,224,18,208,
243,96
210 FOR J=8192 TO 8207
220 READ X:POKE J,X
230 NEXT J
300 FOR J=1 TO 9
320 POKE 8195,80:POKE 8200,
80:POKE 8197,41:POKE
8198,15
330 SYS 8192
340 POKE 8195,120:POKE 8200,
120:POKE 8197,9:POKE
8198,48
350 SYS 8192
360 POKE 8195,160:POKE 8200,
160:POKE 8197,73:POKE
8198,1
370 SYS 8192
380 POKE 8195,200:POKE 8200,
200:POKE 8197,73:POKE
8198,48
390 SYS 8192
400 POKE 8195,240:POKE 8200,
240:POKE 8197,73:POKE
8198,128
410 SYS 8192
420 FOR K=1 TO 500:NEXT K
500 NEXT J
```

Logical operations AND, OR, and EOR deal directly with the 65xx's fundamental elements: bits.

Steve Vander Ark

BRIGHTEN UP YOUR WINTER

Winter sure gets dreary once the holidays have careened past. Here in Michigan, the stretch from New Year's to the end of February seems to consist of little more than scraping the windshield and shoveling the driveway. What January needs is a little pick-me-up—something to add a little pizzazz to computing.

This is the perfect time for a splash of graphics. There are quite a few good sources for graphics to perk up your documents, and just because graphics aren't in *geoPaint* format doesn't mean you can't use them for *GEOS*.

You can convert just about any kind of graphic image into *GEOS* using one conversion utility or another. Commercially available packages include *Graphics Integrator 2* from Inkwell Systems (P.O. Box 1997, Imperial Beach, California 91933) and Solutions Unlimited's *Icon Factory* (Briwall, P.O. Box 129, Kutztown, Pennsylvania 19530). Either of these programs will convert between Commodore formats. *Graphics Integrator* also includes a routine to convert to *GEOS* from *Doodle*, while a separate utility called *Grafix Link* does the conversion for *Icon Factory*.

GEOS users do have the option of making the conversions from within *GEOS* itself using a program called *Graphics Storm* (Storm Systems, 464 Beale Street, West Quincy, Massachusetts 02169) or *Import Runner*, two similar programs written by Joe Buckley. Each of these conversion programs has its own distinctive features; both will convert *Doodle* graphics format and standard bitmaps.

Import Runner will also convert regular or compressed mul-

ticolor images as well as *MacPaint* and RLE files. *Graphics Storm* also handles clip art from *The Newsroom*, *The Print Shop*, and *PrintMaster*. Between the two, there are few graphic files that can't be converted into the *GEOS* universe. Both programs can be found on Q-Link.

Armed with conversion programs like these, you're ready to track down a few new graphics. Some sources are pretty well known. *Newsroom* clip art disks, for example, are certainly some of the best buys.

The Print Shop graphics abound as well, not only in *The Print Shop* collections themselves but also in numerous collections by other artists. You'll find them on BBSs and in user group libraries; Q-Link also has a nice selection. You owe it to yourself to track down the collections by Kathy Wright (KathyW5/Syshelp KW on Q-Link); they are some of the best around.

The Print Shop, *PrintMaster*, or *Newsroom* graphics can be grabbed and converted into *GEOS* photo scraps using *Graphic Storm* or the *Graphics Grabber* found on the *DeskPack Plus* disk from Berkeley.

If you have a disk full of *The Print Shop* graphics you'd like to turn into *GEOS* photo scraps, *GetGraphic V1.2* from Nick Vrtis (5863 Pinetree SE, Kentwood, Michigan 49508) will nicely automate the process. Vrtis' program displays clips by name, allowing you to select those you'd like to convert. The program then converts the ones you've picked until you have a new photo album filled with the selected clips.

Screen-sized high-resolution images, such as the ones created by *Doodle*, can be easily converted to *GEOS* using one of the conversion programs available. *GEOS* itself

operates in high-resolution mode, so the image will not be distorted at all. Multicolor images, those generated by *KoalaPaint*, for example, are another matter. They can be converted, but the results may be less than perfect. Since the size of the pixels (the dots on the screen that make up the image) and the color information are different in the two modes, even a fine program like *Import Runner* may not do the job perfectly.

You needn't confine yourself to Commodore formats. If you have a modem, you have access to thousands of images in formats designed for other computers, images which you can download and convert into *GEOS* with the help of other utilities.

On IBM bulletin boards you'll find scads of graphics in a format called GIF. There are several utilities which will convert these into Commodore multicolor images, but since a conversion from multicolor to *GEOS* is problematic, it's better to convert them directly to *GEOS*. One program, *geoGIF* by Randy Weems, which is available on Q-Link, converts GIF files into a *geoPaint* image. The results can be quite spectacular when printed out.

Another common type of graphics image is from the Macintosh program called *MacPaint*. These files, identified by their MAC suffix, are full-page bitmaps just like *geoPaint*, so a conversion to *GEOS* is quick and painless. The job can be accomplished using *Import Runner* or with a program called *MacAttack*, also written by the ubiquitous and talented Joe Buckley.

So forget about shoveling the driveway. It'll just fill up with snow again anyhow. Come in out of the cold and liven the winter doldrums with a splash of graphics. It sure beats scraping ice! □

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out of the cold
and let a
splash of graphics
liven the
winter doldrums.

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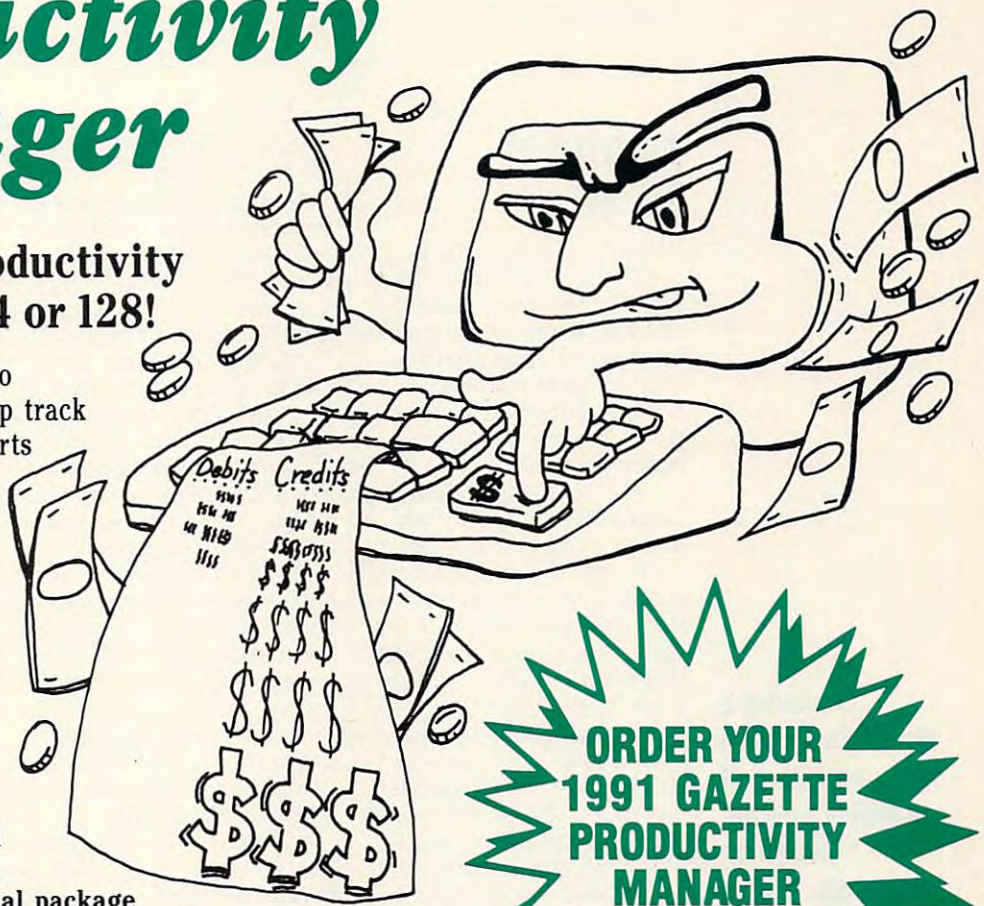
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D'IVERSIONS

Fred D'Ignazio

AS OTHERS SEE ME

Yesterday, I went to the beauty salon for my monthly facial tune-up. After hairdresser Laura Dantzer finished trimming the five or six hairs remaining on the top of my head, I lay back in her chair, and she began trimming my beard beneath my chin.

"This sure is an interesting perspective," Laura remarked as she snipped and clipped.

"I'll bet." I imagined her counting the hairs in my nostrils and the fillings in my teeth. I visualized the Neanderthal pose I struck—all nose, buck teeth, cavernous eyebrows, and massive forehead.

Embarrassing images such as these led me to speculate on images others may have of us, including dentists, aerobics instructors, gynecologists, morticians, and proctologists.

As Laura chopped at the jungle beneath my chin, it dawned on me that the "me" who preens and poses in the mirror each morning might not be the image that others see.

Like any vain human being, I wish other people would see me as I see myself—or even better! Because of this natural and powerful human longing, I predict a big business for a new kind of cosmetics industry—an industry based on electronic, digital cosmetics.

Today people spend billions of dollars on cosmetics to become prettier, sexier, and more handsome. The persona who walks out of the bathroom might be wearing a deliberate mask and creating an intentional illusion, but it is part of the consensual virtual reality that everyone shares.

Now think about life in the next century. We will do a lot less physical interacting with each other and a lot more *virtual* interacting. Instead of com-

muting to work and play, we will telecommute.

Many of us have already experienced telecommuting and are accustomed to working in virtual offices, peopled by office mates who may physically be thousands of miles apart. Today the cosmetics side of things doesn't get in the way. Our interaction is chiefly via voice, voice mail, electronic mail, and wide-area networking. It's strictly a text-and-talk kind of life, so how we look is delightfully unimportant.

Beware, however, of what happens when telecommunications merges with television. Think about the video conferences of high-powered corporations. Can members sit around a virtual "tele-table" in undershorts, hair a mess, a can of beer in one hand and a Twinkie in the other?

I don't think so. Video teleconferences and picture phones will be an inescapable part of our work and leisure lives sometime in the next decade. But I bet they'll have an escape hatch built in. Unlike the Ma Bell television phones of yesteryear, the new picture phones will be nine-tenths computer and only one-tenth telephone and television. The computer will massage all images, data, and sound.

So if you don't want to look like you really are—all nostril hairs, beard stubble, and skimpy eyelashes—you can call up cosmetic clip art from a library of persona-enhancing facial templates online in your CD-ROM optical library. For example, I might be a wimp of a guy with glasses, thinning hair, and an understated bony body, but when I attend my corporate video conferences in 1997, I will appear with Mel Gibson's head on Arnold Schwarzenegger's body and sound like James Earl Jones. Similarly, a female attorney who needs a quick "do"

to attend a high-powered stockholder's meeting can assemble her persona from electronic body parts and appear with a Candice Bergen head, a Madonna body, and a Katherine Hepburn voice.

Today's computer networks are only a muted, shadowy reflection of the multimedia, video networks of the future. People who hang around electronic malls, game arcades, and forums today have only their words to introduce themselves or to judge others.

Think about electronic parties held on future networks. People will have gigantic CD-ROM libraries to mix-and-match body parts from movie actors, musicians, circus performers, politicians, cartoon characters, or historical figures. Composite persons will come to these parties with bodies that resemble anything from King Kong to Attila the Hun; faces from Chewbacca to Freddie Kruger; and voices that mimic Dolly Parton, Judy Garland, or M. C. Hammer.

Things sound idyllic, don't they? Perhaps. But you'd better be on guard for "cosmetic viruses." For example, you might think you are transmitting an image of yourself with Oprah Winfrey's head atop Ann-Margret's body (a recent virtual composite person on the cover of *TV Guide*). But your colleagues at the video teleconference may be receiving your image as Pee Wee Herman's head atop Rosanne Barr's body, and they might hear you speaking with the voice of Strawberry Shortcake.

After a hectic and mystifying day at the virtual office of the future, staffed by dozens of mix-and-match telepresences, the rallying cry might be for a little sense, a little sanity. Wanting just one unedited shot, office buddies may cry: Will the real Fred D'Ignazio please stand up? □

I predict a big business for a new kind of cosmetics industry based on electronic, digital cosmetics.

BEGINNER BASIC

Larry Cotton

MUSIC PATTERNS

Happy 1992! We're nearing the finale of our series on RND, the BASIC keyword which creates randomness.

Sound and graphics can be enhanced by judicious use of the RND statement. This month, I'll try to prove it by re-writing one of my first programs, *Music Patterns*, which appeared in *COMPUTE!'s Gazette* (February 1985). This 64 program creates colorful semi-random patterns accompanied by randomly generated tones. We begin with a classic randomizing statement to prevent the program's always starting with the same pattern:

```
10 X=RND(-TI)
```

One statement, DEF FN, and one function, FN, work particularly well with RND. DEF FN and FN are always used together to create programmer-defined functions. These functions are usually written as formulas or equations. DEF FN and FN save you from having to type the same formula over and over. Enter these lines, which will be the next ones in our new *Music Patterns* program:

```
20 DEFFNA(X)=INT(110*RND(1))+20
30 DEFFNB(X)=INT(14*RND(1))+1
40 DEFFNC(X)=INT(11*RND(1))+1
50 DEFFND(X)=INT(25*RND(1))+1
60 DEFFNE(X)=INT(959*RND(0))+1024
```

Run this program now; then, in the immediate mode, type the following.

```
PRINT FN A(X)
```

Run the cursor up and repeat this a few times. You'll see several numbers from 20-129, inclusive. Thus a random statement must be defined only once, but it can then be exe-

cuted using FN as many times and as late in the program as desired.

Next, we dimension a one-dimensional array.

```
70 DIM T(26)
```

This sets aside 26 pigeon-holes which we now will fill.

```
80 FORI=1TO26:READT(I):NEXT
```

The data will appear later in the program, but we can enter it now. (As in the past, I know what the line numbers are since I've written the whole program. You don't normally program this way.)

```
430 DATA81,95,105,127,160,170,171,174,186,192,205,206,209,214,215,219,221
440 DATA223,226,230,233,236,251,252,254,255
```

What are these data? They're CHR\$ codes for some of the keyboard characters appropriate for the patterns. If you enter PRINT CHR\$(81) (in immediate mode), you'll see what character the first data item would produce. (If you'd like to use other characters, feel free to change this data.) After the program is run, the array T(1) through T(26) will be filled with these CHR\$ codes. We're going to choose one of these characters randomly later and then poke it to the screen in interesting patterns accompanied by randomly generated musical tones.

Speaking of tones, let's set up SID in our usual way.

```
90 FORI=54272TO54295:POKEI,0:
NEXT: POKE54296,15:
POKE54277,16:POKE54275,8
```

Generous use of constants (variables which don't vary) significantly speeds up the execution of a BASIC program. Let's define those which will be used the most.

```
100 FR=54273:VC=54276:SC=1024:MN=1063:MO=1064:MA=1983:
CO=40:LO=39:LI=41
110 VN=65:VO=64:C=54272
```

By studying these constant values, the experienced BASIC programmer can get clues about what's going on.

FR and VC are obviously memory registers; they're too big to be pokeable numbers. They happen to be two SID registers—one to determine Voice 1's pitch (frequency) and the other to turn Voice 1 on and off.

SC, MN, MO, and MA are also too big to be pokeable; they are memory registers for screen locations. CO, LO, and LI are of pokeable size, but they also should remind you of screen width. Since the screen is 40 columns wide, these must be limits of some sort. (They are. We don't want characters poked offscreen!)

VN and VO are also pokeable values. You may recall that the square wave is turned on by poking a 65 and off by poking a 64. The most ambiguous constant is C, which could be a SID register, or it could be the number that's added to the screen memory location to add color to the poked characters. It happens to be the latter.

Later, you'll see what all these constants do. Now, let's prepare the screen and present a short message.

```
120 PRINTCHR$(147)CHR$(5):
POKE53280,0: POKE53281,0
130 FORT=1TO10:PRINT:NEXT
140 PRINTTAB(4)“PRESS SPACE
BAR FOR NEW PATTERN”
150 FORT=1TO1000:NEXT
160 PRINTCHR$(147)
```

You should know what all these lines do. Next month we'll finish *Music Patterns* and our study of RND. □

Sound and graphics can be enhanced by the judicious use of the RND statement.

PROGRAMMER'S PAGE

Randy Thompson

READER TIPS

Here are more programming tips from our readers.

Fast Format

If you ever need to format a disk that has been formatted before, here's a quick way to get the job done. When you issue the format command, don't include the disk ID. For example, the usual way to format a disk is to issue a command such as the following.

```
OPEN 15,8,15,"NO:
DISKNAME,ID":CLOSE 15
```

To perform a fast format, you change the syntax to look like the following.

```
OPEN 15,8,15,"NO:
DISKNAME":CLOSE 15
```

If you decide to use this shorter command, the disk drive formats your floppy disk in about two seconds, and the disk ID remains the same.

STEVE MILLER
BAYVILLE, NJ

Secret Messages

Type in and run the following 64 program to see a secret message and a listing of all of the BASIC commands and error messages.

```
10 FOR I=40964 TO 40974
20 PRINT CHR$(PEEK(I));
30 NEXT
40 PRINT
50 FOR I=41118 TO 41767
60 PRINT CHR$(PEEK(I));
70 NEXT
```

If you own a 1581 disk drive, try running this program for yet another hidden message.

```
10 OPEN 1,8,15
20 PRINT#1,"M-R"CHR$(50)
CHR$(167) CHR$(45)
30 FOR I=1 TO 45
40 GET#1,A$:M1$=M1$+A$
50 NEXT
```

```
60 PRINT#1,"M-R"CHR$(96)
CHR$(167) CHR$(26)
```

```
70 FOR I=1 TO 26
```

```
80 GET#1,A$:M2$=M2$+A$
```

```
90 NEXT
```

```
100 CLOSE 1
```

```
110 PRINT M1$CHR$(13)M2$
```

HENNING VAHLENKAMP
MATAWAN, NJ

DIM for Faster Programs

Believe it or not, you can actually speed up your programs by dimensioning nonarray variables. For example, type in and run the following program.

```
10 TI$="000000"
20 DIM A$(1000),B(1000),
C%(1000)
30 A=1:B=75:C$="D LEE"
40 PRINT TI/60;"SECONDS"
```

Now enter the line

```
15 DIM A,B,C$
```

and run the program again. Notice the difference? The program is noticeably faster with line 15.

In line 20, BASIC dimensions the variables A\$(), B(), and C%() by allocating array tables in computer memory just above the program code. Nonarray variables are always stored in memory between the program code and BASIC's array tables, so when BASIC encounters line 30, it must take the time to move up its array tables to make room for the three new variables A, B, and C\$.

By adding line 15, you force BASIC to allocate space for A, B and C\$ before the array tables are built. This saves the computer from having to move the array tables. In this simple example, you could simply switch lines 20 and 30 to speed up the program. In a much larger program, however, you might find it easier to use DIM to ensure the optimum order of var-

iable definitions.

DAVID LEE
WAVERLY, TN

How Much Is a Period Worth?

How much is a period worth? Nothing. Or more accurately, 0. Wherever you use the digit 0 all by itself, you can replace it with a period. BASIC even interprets the period faster than it does the digit 0. In other words, the program

```
10 POKE 53281,,: POKE
53281,1:GOTO 10
```

executes faster than the following program.

```
10 POKE 53281,0: POKE
53281,1:GOTO 10
```

RANDY THOMPSON
EUGENE, OR

Easy-Load Filenames

Try this the next time you save a program to disk: Immediately after entering a filename in a Save command (before you enter the closing quotation mark), hold down the Shift key and press the space bar; hold down the Commodore key and type DUDE; hold down the Shift key and press @; and then type the terminating ",8 and press Return. When you list the disk directory, the computer shows the filename with a ,8,1 extension. Now, all you have to do to load and run the program is move the cursor to the first column of the line containing the filename and press Shift-Run/Stop.

STACY OLIVAS
GRAHAM, WA

Send your programming tips and tricks to Programmer's Page, COMPUTE's Gazette, 324 West Wendover Avenue, Suite 200, Greensboro, North Carolina 27408. We pay \$25-\$50 for each tip or trick we use in the magazine. □

IMPROVED FRE

By Louis Giglio

Improved FRE is a small utility for the 64 that provides a quick, useful free-memory function. The FRE command provided by the 64's BASIC interpreter is awkward to use, can be slow, and doesn't always provide the information you need. Unlike FRE, *Improved FRE* accurately reports free memory, program size, variable workspace size, array workspace size, string workspace size, and total RAM available for programs and data. In addition, *Improved FRE* doesn't force the potentially time-consuming task of garbage collection.

To understand these benefits, it is important to understand how BASIC uses memory. A BASIC program is stored in memory starting at the bottom of the BASIC workspace. Directly above the program is a region of memory used to store variables created by the program. Just above this area is the section used to store array data. (These areas are created when the program is run, as variables are assigned and arrays are dimensioned.)

BASIC keeps information about strings in the variable and array storage areas, but the actual string data is stored in the string workspace, which expands from the top of memory downward. This is because BASIC strings are dynamic objects that have no fixed size. The region above the array workspace and below the string workspace is free memory.

If a string variable such as A\$ = "APPLE" is redefined as A\$ = "ORANGE", the new string will be added to the string workspace. This will leave the old string inactive, but still resident in the computer's memory.

The garbage collection process overwrites strings which are inactive with active strings, freeing up additional memory. In programs where a lot of string manipulation has occurred, the procedure can be time consuming.

In addition to forcing garbage collection, FRE has other drawbacks. For instance, if the amount of free memory is greater than 32,768 bytes, FRE returns a negative number instead of the actual amount of free memory. *Improved FRE* does not suffer from either of these limitations.

Typing It In

Improved FRE is a machine language program in the form of a BASIC loader. To avoid typing errors, type it in using *The Automatic Proofreader*. See "Typing Aids" elsewhere in this section. Be sure to save a copy before you exit *The Automatic Proofreader*.

Counting Bytes

To use the program, load and run it. A message will indicate that the machine language program has been installed. Now, you may go ahead and enter or load other programs.

Improved FRE commands are issued with the seldom-used USR function. For example, X=USR(n), where n is any BASIC variable or expression having an integer value in the range from 0 to 5, is a valid command. The value of n will determine the type of information returned by the USR function. The meanings of the values are listed in the table printed below.

Function call	Return value (bytes)
USR(0)	Free memory
USR(1)	Program size
USR(2)	Variable workspace size
USR(3)	Array workspace size
USR(4)	String workspace size
USR(5)	Total RAM available for program and variables

As an example, to determine the size of your BASIC program, you could use the command PRINT USR(1).

Keep in mind that even after performing a NEW, USR(1) will report a program size of two bytes. This is because a BASIC program is stored with two zero bytes attached to its end.

Memory Conflicts

The program resides in the 64's cassette buffer and modifies the USR vector at 785 (\$0311). Other programs that use these areas will probably not work with *Improved FRE*.

IMPROVED FRE

```

0801:16 08 0A 00 8F 20 49 4D 3C
0809:50 52 4F 56 45 44 20 46 E6
0811:52 45 28 29 00 1F 08 14 D3
0819:00 43 4B B2 30 00 32 08 7C
0821:1E 00 81 20 49 B2 38 32 2A
0829:38 20 A4 20 31 30 31 34 D4
    
```

```

0831:00 48 08 28 00 87 20 42 77
0839:3A 97 20 49 2C 42 3A 43 07
0841:4B B2 43 4B AA 42 00 4E 6D
0849:08 32 00 82 00 7E 08 3C 58
0851:00 8B 20 43 4B B3 B1 32 3B
0859:34 38 30 32 20 A7 20 99 34
0861:22 45 52 52 4F 52 20 49 90
0869:4E 20 44 41 54 41 20 53 80
0871:54 41 54 45 4D 45 4E 54 4B
0879:53 22 3A 90 00 93 08 46 B0
0881:00 97 20 37 38 35 2C 36 14
0889:30 3A 97 20 37 38 36 2C 68
0891:33 00 AF 08 50 00 99 20 87
0899:22 50 52 4F 47 52 41 4D 61
08A1:20 49 4E 53 54 41 4C 4C 9F
08A9:45 44 22 3A 80 00 D4 08 0B
08B1:5A 00 83 20 33 32 2C 31 4D
08B9:36 31 2C 31 38 33 2C 32 E2
08C1:32 34 2C 30 2C 32 30 38 43
08C9:2C 31 39 2C 31 36 35 2C 1F
08D1:35 31 00 F8 08 64 00 83 AD
08D9:20 31 33 33 2C 32 35 31 A5
08E1:2C 31 36 35 2C 35 32 2C 35
08E9:31 33 33 2C 32 35 32 2C 7F
08F1:31 36 35 2C 34 39 00 1C 34
08F9:09 6E 00 83 20 31 33 33 C1
0901:2C 32 35 33 2C 31 36 35 57
0909:2C 35 30 2C 31 33 33 2C 30
0911:32 35 34 2C 37 36 2C 31 EE
0919:39 38 00 40 09 78 00 83 87
0921:20 33 2C 32 32 34 2C 31 A4
0929:2C 32 30 38 2C 31 39 2C 2C
0931:31 36 35 2C 34 35 2C 31 D2
0939:33 33 2C 32 35 31 00 64 2D
0941:09 82 00 83 20 31 36 35 18
0949:2C 34 36 2C 31 33 33 2C F0
0951:32 35 32 2C 31 36 35 2C CB
0959:34 33 2C 31 33 33 2C 32 DB
0961:35 33 00 88 09 8C 00 83 61
0969:20 31 36 35 2C 34 34 2C B8
0971:31 33 33 2C 32 35 34 2C 0D
0979:37 36 2C 31 39 38 2C 33 83
0981:2C 32 32 34 2C 32 00 AB 95
0989:09 96 00 83 20 32 30 38 60
0991:2C 31 39 2C 31 36 35 2C E8
0999:34 37 2C 31 33 33 2C 32 1D
09A1:35 31 2C 31 36 35 2C 34 46
09A9:38 00 CF 09 A0 00 83 20 8E
09B1:31 33 33 2C 32 35 32 2C 49
09B9:31 36 35 2C 34 35 2C 31 5B
09C1:33 33 2C 32 35 33 2C 31 E2
09C9:36 35 2C 34 36 00 F3 09 AF
09D1:AA 00 83 20 31 33 33 2C 94
09D9:32 35 34 2C 37 36 2C 31 B7
09E1:39 38 2C 33 2C 32 32 34 1A
09E9:2C 33 2C 32 30 38 2C 31 73
09F1:39 00 17 0A B4 00 83 20 F0
09F9:31 36 35 2C 34 39 2C 31 AB
0A01:33 33 2C 32 35 31 2C 31 1C
0A09:36 35 2C 35 30 2C 31 33 26
0A11:33 2C 32 35 32 00 3B 0A 75
0A19:BE 00 83 20 31 36 35 2C F7
0A21:34 37 2C 31 33 33 2C 32 A6
0A29:35 33 2C 31 36 35 2C 34 50
0A31:38 2C 31 33 33 2C 32 35 A9
0A39:34 00 5E 0A C8 00 83 20 41
0A41:37 36 2C 31 39 38 2C 33 4D
0A49:2C 32 32 34 2C 34 2C 32 46
0A51:30 38 2C 31 39 2C 31 36 37
0A59:35 2C 35 35 00 82 0A D2 FD
    
```

```

0A61:00 83 20 31 33 33 2C 32 5E
0A69:35 31 2C 31 36 35 2C 35 11
0A71:36 2C 31 33 33 2C 32 35 E8
0A79:32 2C 31 36 35 2C 35 31 31
0A81:00 A6 0A DC 00 83 20 31 CD
0A89:33 33 2C 32 35 33 2C 31 AC
0A91:36 35 2C 35 32 2C 31 33 BE
0A99:33 2C 32 35 34 2C 37 36 E2
0AA1:2C 31 39 38 00 CB 0A E6 EC
0AA9:00 83 20 33 2C 32 32 34 98
0AB1:2C 35 2C 20 32 30 38 2C 9F
0AB9:34 31 2C 31 36 35 2C 35 E0
0AC1:35 2C 31 33 33 2C 32 35 B8
0AC9:31 00 EF 0A F0 00 83 20 C3
0AD1:31 36 35 2C 35 36 2C 31 81
0AD9:33 33 2C 32 35 32 2C 31 F8
0AE1:36 35 2C 34 33 2C 31 33 07
0AE9:33 2C 32 35 33 00 13 0B 07
0AF1:FA 00 83 20 31 36 35 2C EE
0AF9:34 34 2C 31 33 33 2C 32 BE
0B01:35 34 2C 33 32 2C 32 32 50
0B09:38 2C 33 2C 31 36 35 2C 68
0B11:34 00 38 0B 04 01 83 20 44
0B19:31 36 34 2C 33 2C 33 32 81
0B21:2C 31 34 35 2C 31 37 39 41
0B29:2C 33 32 2C 34 33 2C 31 23
0B31:38 38 2C 32 30 31 00 5D BD
0B39:0B 0E 01 83 20 32 35 35 1A
0B41:2C 32 30 38 2C 37 2C 31 4B
0B49:36 39 2C 32 34 32 2C 31 65
0B51:36 30 2C 33 2C 33 32 2C 06
0B59:31 30 33 00 80 0B 18 01 DB
0B61:83 20 31 38 34 2C 39 36 E5
0B69:2C 31 36 32 2C 31 34 2C 86
0B71:31 30 38 2C 30 2C 33 2C BA
0B79:35 36 2C 31 36 35 00 A4 7B
0B81:0B 22 01 83 20 32 35 31 63
0B89:2C 32 32 39 2C 32 35 33 E3
0B91:2C 31 33 33 2C 33 2C 31 5B
0B99:36 35 2C 32 35 32 2C 32 BD
0BA1:32 39 00 C7 0B 2C 01 83 2A
0BA9:20 32 35 34 2C 31 33 33 06
0BB1:2C 34 2C 39 36 2C 31 34 FC
0BB9:34 2C 31 32 37 2C 32 35 42
0BC1:35 2C 30 2C 30 00 00 00 C7
    
```

Louis Giglio is a 64 programmer who lives in Odenton, Maryland. □

MULTI-SCREEN 64

By Bryan Flick

We've all seen those programs that use raster interrupts to put text and bitmap graphics onscreen at the same time or let you have 16 instead of the normal 8 sprites. But they've always restricted where you could put the text or sprites.

Wouldn't it be great if we could print text anywhere on the screen with a bitmap backdrop to add some other effects? Wouldn't it be nice to line up 16 sprites in a row for large moving titles? *Multi-Screen 64* allows you to do just this and more.

Multi-Screen does this by using two

shadow registers. These shadow registers are each 47 bytes long and are arranged exactly like the VIC chip.

Now, suppose you want text and a bitmap screen on at the same time. You would first turn on one set of registers to the text screen and the second set to the bitmap screen. Both appear on the screen simultaneously! Not really, but it appears that way. Every $1/60$ second, one set of shadow registers is copied into the VIC chip. During the next $1/60$ second, the other set of shadow registers is copied in. This happens so fast that they appear to be onscreen at the same time.

Typing It In

Multi-Screen 64 is written entirely in machine language. To enter this short program without errors, use *MLX*, our machine language editor, to type it in. See "Typing Aids" elsewhere in this section. When *MLX* prompts, respond with the following values.

Starting address: C000

Ending address: C067

When you've finished typing, be sure to save a copy of the program before exiting *MLX*.

Turn your computer off and on, or press your reset button, before loading *Multi-Screen 64*. Load it with the ,8,1 extension. When you get a READY prompt, type NEW. This won't erase *Multi-Screen*; it'll just fix some pointers used by BASIC. Now type SYS 49152 to enable *Multi-Screen*.

How to Use

Your 64 or 128 in 64 mode is now set up so you can easily take advantage of these extra features in your own programs. To make it easier to use these features, the first line of your program should always be the following.

10 V1=53153: V2=53201

V1 is the variable that points to the first set of shadow registers. V2 points to the second set. The *Multi-Screen* shadow registers work exactly like the VIC chip, but you must poke different memory values. Use the Offset Table printed here for help regarding these locations in the shadow registers.

A Border Shuffle

Now let's write a simple demonstration. Suppose you want a black border. According to the table, the offset to change the border color is 32. This means that you must poke the figure at the start of the shadow registers plus 32.

To get a black border (color 0), type POKE V1+32,0. The border will change colors, but it won't be black. This is because you didn't change the second set of shadow registers. *Multi-Screen* is now flipping between a black border and the usual light blue border 60 times a second. This happens so fast that the two colors appear to blend together, making one unique color. While most color combinations flicker too much to be useful, a couple (such as black and dark gray, and red and purple) are quite stable. To make the border black, you must also change the second set of shadow registers. Do this by typing POKE V2+33,0. The border is now black.

Text and Graphics

For our second demonstration, we'll mix text and hi-res graphics. According to the *64 Programmer's Reference Guide*, the following lines will turn the bitmap screen on at memory location 8192. POKE 53265,PEEK(53265) OR 32 enables hi-res mode, and POKE 53272,PEEK(53272) OR 8 puts hi-res at 8192.

To find out where to poke our registers, subtract each number after POKE and PEEK by 53248. Doing this gives us 17 for the first POKE (53265-53248=17) and 24 for the second (53272-53248=24). This means that 17 is the register to poke to enable the hi-res screen and register 24 puts the bitmap screen at 8192. The table verifies this. So to enable hi-res mode at that location, type the following.

POKE V1+17,PEEK(V1+17) OR 32
POKE V1+24,PEEK(V1+24) OR 8

Now a bitmap and text screen are on simultaneously. You can type as you would with the normal screen editor, and you can perform hi-res functions as you would normally. For instance, to clear the hi-res screen, type FOR I=8192 TO 16191:POKE I,0:NEXT. If

you have trouble seeing your cursor and text, type PRINT CHR\$(5) to set the text color to white. Note that all characters have different background colors. This is because the hi-res screen is getting its color data from the text screen. You can change this with the following two lines.

**POKE V1+24,(PEEK(V1+24) AND 15) OR 48
FOR I=3072 TO 4071:POKE I,16:NEXT**

Now the bitmap is getting its color data from location 3072. This completes the effect of the two screens being on simultaneously. To see a design on the hi-res screen, enter lines 50-130 from page 126 of the *Programmer's Reference Guide*.

You'll notice that this interesting backdrop won't be erased by pressing the Clr/Home key. Try typing something or listing the program. You'll notice that the backdrop does not move. It becomes apparent that you can do some effects that would be impossible without *Multi-Screen*. You can even have a multicolored bitmap screen on with a regular text screen. POKE 53270, PEEK (53270) OR 16 turns on multicolor mode. Again, subtract the number after POKE and PEEK by 53248, to get 22. Now, POKE V1+22,PEEK(V1+22) OR 16 makes the hi-res screen turn to multicolored hi-res. These examples show how powerful *Multi-Screen* is. For more features and programming tips, see the demonstration programs.

Different Banks

You can also switch to different video banks. The VIC-II chip can only access 16K at a time, so if you have a hi-res screen that's not in the current bank, you must switch banks. Do this with the following line.

POKE V1-1,(PEEK(V1-1) AND 252) OR x, where x is a number from 0 to 3 which changes banks according to the following table.

X Bank VIC Chip Range

3	0	00000-16383
2	1	16384-32767
1	2	32768-49151
0	3	49152-65536

So if you have a bitmap screen at loca-

tion 40960, you'd type POKE V1-1,(PEEK(V1-1) AND 252) OR 2 to switch to video bank 1, since 40960 lies between 32768 and 49151. The VIC chip is usually in bank 0. If you would like to change the bank for the second set of shadow registers (the above sets the first set of registers), substitute V2 for V1.

Demonstration Programs

Included are three programs to type in and examine. These demonstrations are written entirely in BASIC. To avoid typing errors, enter them with *The Automatic Proofreader*. See "Typing Aids."

Demo 1 mixes hi-res and text graphics, *Demo 2* puts 16 sprites onscreen, and *Demo 3* shows how two colors can be mixed to form unique combinations. Press 1 in the final demo to step through the choices for the first color, and 2 for the second color. Press Q to quit.

I recommend that you examine these three programs to pick up several programming tricks. They are fairly short and easy to understand.

How It Works

As I said before, *Multi-Screen 64* works by flipping between two separate screens. It does this 60 times a second using an IRQ (interrupt). A variable is used to determine which screen is currently being displayed; then it flips. Then a new set of shadow registers is copied in. All this happens before you can blink. Since it happens so quickly, your eye retains both images.

Offset Table

- 0 - Sprite 0 X Coordinate
- 1 - Sprite 0 Y Coordinate
- 2 - Sprite 1 X Coordinate
- 3 - Sprite 1 Y Coordinate
- 4 - Sprite 2 X Coordinate
- 5 - Sprite 2 Y Coordinate
- 6 - Sprite 3 X Coordinate
- 7 - Sprite 3 Y Coordinate
- 8 - Sprite 4 X Coordinate
- 9 - Sprite 4 Y Coordinate
- 10 - Sprite 5 X Coordinate
- 11 - Sprite 5 Y Coordinate
- 12 - Sprite 6 X Coordinate
- 13 - Sprite 6 Y Coordinate
- 14 - Sprite 7 X Coordinate
- 15 - Sprite 7 Y Coordinate

- 16 - Sprites 0-7 X Most Significant Bit
- 17 - Control Register 1
- 18 - Not Available
- 19 - Not Available
- 20 - Not Available
- 21 - Sprite Enable
- 22 - Control Register 2
- 23 - Sprites 0-7 Y Expansion
- 24 - Memory Control
- 25 - Not Available
- 26 - Not Available
- 27 - Sprite Background Priority
- 28 - Sprites 0-7 MCM
- 29 - Sprites 0-7 X Expansion
- 30 - Not Available
- 31 - Not Available
- 32 - Border Color
- 33 - Background Color
- 34 - Background Color 1
- 35 - Background Color 2
- 36 - Background Color 3
- 37 - Sprite Multicolor Register 0
- 38 - Sprite Multicolor Register 1
- 39 - Sprite 0 Color
- 40 - Sprite 1 Color
- 41 - Sprite 2 Color
- 42 - Sprite 3 Color
- 43 - Sprite 4 Color
- 44 - Sprite 5 Color
- 45 - Sprite 6 Color
- 46 - Sprite 7 Color

MULTI-SCREEN 64

```
C000:AD 00 DD 8D A0 CF 8D D0 1D
C008:CF A2 2E BD 00 D0 9D A1 DB
C010:CF 9D D1 CF CA 10 F4 A9 42
C018:00 8D 60 C0 78 A9 29 8D 5F
C020:14 03 A9 C0 8D 15 03 58 CC
C028:60 AD 60 C0 D0 19 AD A0 44
C030:CF 8D 00 DD A2 2E BD A1 C5
C038:CF 9D 00 D0 CA 10 F7 A9 46
C040:01 8D 60 C0 4C 31 EA AD 68
C048:D0 CF 8D 00 DD A2 2E BD 6B
C050:D1 CF 9D 00 D0 CA 10 F7 2C
C058:A9 00 8D 60 C0 4C 31 EA EA
C060:00 00 00 00 00 00 00 00 E1
```

DEMO 1

```
FQ 5 COPYRIGHT 1992 - COMPUTE
    {SPACE}PUBLICATIONS INTL
    {SPACE}LTD - ALL RIGHTS R
    ESERVED
PP 10 SYS 49152
BJ 20 V1=53153:V2=53201
MG 30 POKE V1+32,0:POKE V1+33,
    0
RA 40 POKE V2+32,0:POKE V2+33,
    0
QA 50 POKE V1+17,PEEK(V1+17) 0
R 32
EA 60 POKE V1+24,PEEK(V1+24) 0
R 8
```

PROGRAMS

```
FS 70 POKE V1+24,(PEEK(V1+24)
{SPACE}AND 15) OR 48
QX 80 FOR I=3072 TO 4071:POKE
{SPACE}I,48:NEXT
AB 90 FOR I=8192 TO 16191:POKE
I,0:NEXT
GK 100 FOR X=0 TO 319 STEP .5
SK 110 Y=INT(90+80*SIN(X/10))
PS 120 CH%=X/8:RO%=Y/8
FB 130 LN=Y AND 7
SX 140 BY=8192+RO%*320+CH%*8+L
N
KM 150 BI=7-(X AND 7)
JP 160 POKE BY,PEEK(BY) OR 2↑B
I
SQ 170 NEXT
SJ 180 PRINT CHR$(147);
KG 190 FOR I=0 TO 100:C=I AND
{SPACE}31
CA 192 POKE 646,C
DH 195 IF C>=16 THEN PRINT CHR
$(18);
MR 200 PRINT "THIS IS LINE #";
I
PS 210 NEXT
CD 220 END
```

DEMO 2

```
FQ 5 COPYRIGHT 1992 - COMPUTE
{SPACE}PUBLICATIONS INTL
{SPACE}LTD - ALL RIGHTS R
ESERVED
PP 10 SYS 49152
BJ 20 V1=53153:V2=53201
JK 30 FOR I=832 TO 894:POKE I,
255:NEXT
BG 40 POKE V1+32,0:POKE V1+33,
0
JB 50 POKE V2+32,0:POKE V2+33,
0
QD 55 POKE V1+21,255
PC 56 POKE V2+21,255
JH 60 FOR I=0 TO 7:POKE 2040+I
,13
MP 70 POKE V1+39+I,I+2:POKE V2
+39+I,I+2
AK 80 NEXT
GG 90 POKE V1+29,0:POKE V2+29,
0
MD 95 POKE V1+23,0:POKE V2+23,
0
HH 100 POKE V1+28,0:POKE V2+28
,0
EM 110 FOR I=0 TO 15:X=24+I*20
:Y=128
AK 120 GOSUB 1000
SK 130 NEXT
CM 140 PRINT CHR$(5);CHR$(147)
;TAB(8);"YOU NOW HAVE 1
6 SPRITES,"
GD 150 PRINT TAB(10);"ON-SCREE
N, AT ONCE!!"
MX 160 END
HS 1000 A=0:J=I:IF J>=8 THEN A
=48
DK 1010 J=J AND 7
AJ 1020 POKE V1+A+J*2,X AND 25
5
HA 1030 B=PEEK(V1+A+16):C=2↑J
FS 1040 IF X>=256 THEN 1060
```

```
CF 1050 POKE V1+A+16,B AND (25
5-C):GOTO 1070
DM 1060 POKE V1+A+16,B OR C
RR 1070 POKE V1+A+J*2+1,Y
XF 1080 RETURN
```

DEMO 3

```
FQ 5 COPYRIGHT 1992 - COMPUTE
{SPACE}PUBLICATIONS INTL
{SPACE}LTD - ALL RIGHTS R
ESERVED
PP 10 SYS 49152
BJ 20 V1=53153:V2=53201
PJ 30 C1=0
MK 40 C2=0
MP 100 PRINT CHR$(5);CHR$(147)
;
JB 110 PRINT "1ST COLOR=";C1
HR 120 PRINT "2ND COLOR=";C2
RX 122 PRINT
XJ 123 PRINT "PRESS 1 TO INCRE
MENT 1ST COLOR"
XA 124 PRINT "PRESS 2 TO INCRE
MENT 2ND COLOR"
EP 125 PRINT "PRESS Q TO QUIT"
ES 130 POKE V1+32,C1:POKE V1+3
3,C1
XE 140 POKE V2+32,C2:POKE V2+3
3,C2
QB 150 GET A$
JF 160 IF A$="1" THEN C1=C1+1
{SPACE}AND 15:GOTO 100
SK 170 IF A$="2" THEN C2=C2+1
{SPACE}AND 15:GOTO 100
RQ 175 IF A$="Q" THEN END
XX 180 GOTO 150
```

Bryan Flick lives in Stroudsburg, Pennsylvania.

PADLOCK

By Albert and Emil Heyrovsky
If you have programs that you would like to keep private, then *Padlock* for the 64 is just the utility for you. This utility encodes programs with a given code word. If someone doesn't know that word, the program is impossible to run. You gain access to the file *only* after entering the correct word. There is no other way to unlock the coded information, so you'd better remember the password.

Typing It In

Padlock is written entirely in machine language, but it loads and runs like a BASIC program. Use *MLX*, our machine language entry program, to type it in. When *MLX* prompts, respond with the following values.

Starting address: 0801
Ending address: 0ED0

After you've entered the program, remember to save a copy before exiting *MLX*.

Locking Your Files

When you run *Padlock*, you'll see several prompts.

Source: This is the name of the file you wish to encode. Make a note of its name before you run *Padlock*, since the program has no provisions for reading a directory.

Destination: This is the new name for the encoded version. For maximum security, be sure to delete the unencoded version of your file after you make the coded copy.

SYS \$: This is the SYS address in hexadecimal notation with which to run your program. If your program is in BASIC or if it is a machine language program that runs from BASIC, enter A496. Other common SYS addresses include 49152 (\$C000), 828 (\$33C), 32768 (\$8000), and 24576 (\$6000).

\$0001: Enter the value at address \$0001. This value will be 37 in hex unless you have reconfigured the computer's memory locations.

Code Word: This is your secret word (up to 20 characters in length) that is needed to activate the encoded version of your program. You are strongly advised to write down the password or keep an unencoded version of your file hidden safely away as a backup. If you forget the password, the file is inaccessible. If you enter the wrong password, the data will be incorrectly decoded. If you make a mistake, you'll have to reload the file in order to type in the correct word.

Padlock and your source program don't have to be on the same disk. When you run *Padlock*, you'll be prompted to insert source and destination disks. Press Return at the prompts. Load the encoded file as you would any BASIC program. You'll be asked for a password when you run it.

How It Works

The encoding system employed in *Padlock* uses the code word that you supply to perform an exclusive OR (EOR) function on a byte-by-byte basis with the data in the program. It also performs another EOR function with the sum of the ASCII values of the code

word. This sum is increased with every new byte to take the encoding process even further. When decoding, the EOR process works identically, but this time in reverse. Commercial and military encrypting machines use variations of this logical procedure to encode and decode messages when security is required.

PADLOCK

```

0801:0B 08 C7 07 9E 32 30 36 56
0809:31 00 00 00 A9 36 85 01 E3
0811:A2 00 8E 20 D0 8E 21 D0 1A
0819:86 9D A9 C1 8D 18 03 A9 A1
0821:FE 8D 19 03 BD DF 09 9D 84
0829:00 CB E8 D0 F7 EE 27 08 28
0831:EE 2A 08 AD 2A 08 C9 D0 F4
0839:D0 EA BD 54 08 9D 00 01 21
0841:E8 E0 17 D0 F5 A0 03 B9 DF
0849:27 0A 20 16 E7 88 D0 F7 CF
0851:4C 00 01 B9 6B 08 99 0D FE
0859:08 C8 D0 F7 B9 6B 09 99 60
0861:D0 09 C8 C0 D1 D0 F5 4C 69
0869:5D CB A2 00 86 7B 86 FD 9C
0871:8E 20 D0 8E 21 D0 A9 C1 35
0879:8D 18 03 A9 FE 8D 19 03 B4
0881:A2 22 BD A9 09 20 16 E7 9A
0889:CA 10 F7 20 42 F1 C9 0D 7E
0891:D0 04 A4 FD D0 3F C9 14 AA
0899:D0 0B A4 D3 C0 0B F0 EB A6
08A1:C6 FD 20 16 E7 20 66 08 8E
08A9:A0 15 C4 FD D0 05 C6 FD ED
08B1:4C 2E 08 20 16 E7 A4 D3 E3
08B9:A9 01 91 F3 A9 3C 91 D1 83
08C1:4C 2E 08 C9 A0 B0 0B C9 C8
08C9:80 B0 04 C9 20 B0 03 A9 D6
08D1:00 6E E6 FD 60 20 9D 09 7E
08D9:A9 DE 85 FB A9 09 85 FC 60
08E1:A0 00 A6 FD 98 18 7D 5A 71
08E9:04 CA D0 FA 85 FE A9 36 2A
08F1:85 01 A6 FD B1 FB 8D AC FE
08F9:04 5D 5A 04 45 FE E6 FE E1
0901:91 FB A5 FB C9 00 D0 06 45
0909:A5 FC C9 00 F0 0B E6 FB E3
0911:D0 02 E6 FC CA D0 DD F0 FE
0919:D9 A9 20 8D AC 04 A0 7F 95
0921:B9 1D 09 9D 00 01 88 10 37
0929:F7 A9 DE 85 FB A9 09 85 F3
0931:FC A9 00 85 2D A9 00 85 1A
0939:2E A0 00 AD D9 08 C9 09 F0
0941:90 35 D0 07 AD D5 08 C9 12
0949:DE 90 2C 38 AD A8 08 E9 02
0951:DE 8D 67 01 AD AE 08 E9 55
0959:09 18 6D D9 08 8D 6D 01 93
0961:18 AD 67 01 6D D5 08 8D 48
0969:67 01 90 03 EE 6D 01 A9 8A
0971:49 8D 01 01 8D 08 01 4C 96
0979:00 01 20 7F 01 B1 FB 91 20
0981:2D 20 7F 01 E6 2D D0 02 C1
0989:E6 2E A5 FB C9 00 D0 2A 29
0991:A5 FC C9 00 D0 24 E6 01 D4
0999:20 59 A6 20 33 A5 BA A9 38
09A1:73 9D 01 01 A9 A4 9D 02 22
09A9:01 A9 09 20 16 E7 A9 47 B4
09B1:8D 18 03 A9 00 85 01 4C EF
09B9:00 00 E6 FB D0 BC E6 FC AC

```

```

09C1:38 B0 B7 38 AD 13 01 E5 38
09C9:FB 85 FB AD 19 01 E5 FC 2B
09D1:85 FC 18 A5 FB 69 DE 85 0C
09D9:FB A5 FC 69 09 85 FC 38 1A
09E1:A9 00 E5 2D 85 2D A9 00 8C
09E9:E5 2E 85 2E 18 A5 2D 69 29
09F1:00 85 2D A5 2E 69 00 85 02
09F9:2E 60 A2 10 BD CD 09 20 E7
0A01:16 E7 CA 10 F7 60 9E 20 13
0A09:3A 44 52 4F 57 20 45 44 94
0A11:4F C3 00 0D 0D 4D 45 54 0B
0A19:53 59 D3 20 59 54 49 52 AA
0A21:55 43 45 D3 00 93 05 08 F6
0A29:0E 09 D0 0D 05 2E 2E 64
0A31:47 4E 49 44 4F 43 45 C4 C0
0A39:99 11 0D A9 93 20 16 E7 CB
0A41:A9 0D 20 16 E7 A9 09 85 50
0A49:D3 A9 03 85 D6 20 6C E5 60
0A51:A2 00 BD E0 CE C9 FF F0 0B
0A59:1A C9 0D F0 06 20 16 E7 62
0A61:E8 D0 EF A9 05 85 D3 E6 83
0A69:D6 8A 48 20 6C E5 68 AA 0D
0A71:E8 D0 DF A2 04 A9 00 95 B0
0A79:FB CA 10 FB E8 86 02 BD 23
0A81:D6 CE 85 D3 8A 0A 18 69 B8
0A89:08 85 D6 20 6C E5 20 42 5D
0A91:F1 C9 0D D0 08 A6 02 48 E6
0A99:B5 FB D0 39 68 C9 14 D0 98
0AA1:10 A6 02 A5 D3 DD D6 CE 94
0AA9:F0 07 D6 FB A9 14 20 16 86
0AB1:E7 20 03 CC 48 A6 02 B5 85
0AB9:FB DD DB CE D0 06 D6 FB F3
0AC1:68 4C B0 CB 68 20 16 E7 C7
0AC9:A4 D3 A9 01 91 F3 A9 3C 56
0AD1:91 D1 4C B0 CB 68 20 16 0E
0AD9:E7 E8 E0 05 D0 9F 4C 3B 61
0AE1:CC A6 02 E0 04 F0 04 E0 21
0AE9:02 B0 14 C9 A0 B0 0B C9 F1
0AF1:80 B0 04 C9 20 B0 03 A9 03
0AF9:00 60 A6 02 F6 FB 60 C9 4D
0B01:30 90 F4 C9 3A 90 F3 C9 54
0B09:41 90 EC C9 47 90 EB C9 3C
0B11:C1 90 E4 C9 C7 B0 E0 90 B8
0B19:E1 A9 00 A6 FF 18 7D 8F DF
0B21:06 CA D0 FA 85 97 A6 FD 8C
0B29:BD E9 05 20 A5 CC 95 4B 12
0B31:CA D0 F5 A6 FE BD 3A 06 73
0B39:20 A5 CC 95 26 CA D0 F5 AF
0B41:A6 FD B5 4B A8 CA D0 04 AB
0B49:8A E8 D0 02 B5 4B 20 B5 E9
0B51:CC 95 4B CA D0 EC A6 ED CE
0B59:E0 03 B0 0A A5 4C 85 4B 0C
0B61:A9 00 85 4C F0 04 B5 4A 0F
0B69:85 4B A6 FE E0 02 D0 0C 96
0B71:A5 27 A4 28 20 B5 CC 85 32
0B79:26 4C C0 CC A4 27 84 26 8B
0B81:4C C0 CC C9 1B 90 09 C9 1B
0B89:41 90 02 69 08 29 0F 60 9E
0B91:69 09 60 0A 0A 0A 85 5D
0B99:02 98 18 65 02 60 20 62 64
0BA1:CE 20 FA CD 90 03 4C 5D E9
0BA9:CB 20 EF CD A6 FB BD 4C 75
0BB1:05 20 A8 CE 9D EF CF CA 6B
0BB9:D0 F4 20 0C CE 20 42 F1 A7
0BC1:F0 FB 20 EF CD A5 FB A2 F1
0BC9:F0 A0 CF 20 F9 FD A2 08 91
0BD1:A0 00 20 00 FE 20 4A F3 3D
0BD9:90 06 20 BE CD 4C 9D CE 53
0BE1:20 3F CE A9 00 A2 DE A0 35
0BE9:09 20 9E F4 90 06 20 BE 4B

```

```

0BF1:CD 4C 9D CE A9 DE 85 FA 71
0BF9:A9 09 85 FB A0 00 A6 AE 98
0C01:D0 02 C6 AF C6 AE A6 FF 14
0C09:B1 FA 5D 8F 06 45 97 E6 B8
0C11:97 91 FA A5 FA C5 AE D0 30
0C19:09 A5 FB C5 AF D0 03 4C 0E
0C21:4F CD E6 FA D0 02 E6 FB 39
0C29:CA D0 DD F0 D9 20 29 CE 16
0C31:20 42 F1 F0 FB 20 EF CD 45
0C39:A6 FC BD A1 05 20 A8 CE 7E
0C41:9D EF CF CA D0 F4 A5 FC 6D
0C49:A2 F0 A0 CF 20 F9 FD A2 87

```

Albert and Emil Heyrovsky live in Prague, Czechoslovakia. □

TRIBLOX

By Mark Neri

TriBlox is a highly addictive game of falling blocks for the 64. In this arcade-style game, you must rotate and position groups of blocks to get three blocks of the same color in a row.

Entering the Program

TriBlox is written entirely in machine language, but it can be loaded and run like a BASIC program. To type in the program, use *MLX*, our machine language entry program. See "Typing Aids" elsewhere in this section. When *MLX* asks for the starting and ending addresses, respond with the following values.

Starting address: 0801

Ending address: 0E80

When you are finished typing, be sure to save a copy of the program before exiting *MLX*.

Playing the Game

After you load and run *TriBlox*, you'll see a bin in the center of your monitor's screen. This is the area where the game is played. To the left of the screen is your score and the level-selection meter.

To begin a game, move the joystick left or right to select which level you want to play. A black needle on the yellow meter indicates which level is currently selected. When the needle is positioned toward the left, the game plays slower. As you move it to the right, game speed increases. Once you have selected a level, press the joystick button to begin play.

When the game begins, groups of three blocks, stacked vertically, will

PROGRAMS

drop from the top of the screen. Each block in the group has its own color. Pressing the joystick button will rotate the colors in a group of blocks. Moving the joystick left or right will move the blocks from side to side. Pulling down on the joystick will cause the blocks to fall more quickly.

A group of blocks will stop falling when it encounters either the bottom of the bin or another block. The object of the game is to get three matching blocks in a row, either vertically, horizontally, or diagonally. When you align three blocks of the same color, those blocks will disappear, and the blocks above them will drop down.

You are awarded points for each block that you eliminate. The number of points depends on the difficulty level that you have selected. Faster levels earn more points per block. As you play the game for a while, your skill at maneuvering the blocks will increase. The computer takes note of this. After you eliminate a certain number of blocks, your level increases, and the blocks fall faster. When the blocks stack up to the top of the bin, the game is over. To play again, press the joystick button.

TRIBLOX

```
0801:0B 08 70 17 9E 32 34 30 6E
0809:37 00 00 00 20 20 20 20 96
0811:20 20 20 20 20 A0 C4 B9 06
0819:3C 08 99 F8 00 B9 FD 08 F6
0821:99 33 03 88 D0 F1 A0 09 4C
0829:B9 0C 08 99 FF 03 88 D0 A1
0831:F7 A9 EE 85 2D A9 13 85 99
0839:2E 4C 00 01 07 60 05 EE 36
0841:13 F3 0C B9 6E 09 99 E8 A8
0849:07 C8 D0 F7 EE 02 01 EE 19
0851:05 01 C6 F9 D0 ED A2 03 23
0859:20 34 03 F0 33 C9 07 D0 95
0861:16 A2 01 20 34 03 D0 0A A0
0869:A2 04 20 34 03 18 69 07 65
0871:10 05 A2 0A 20 34 03 85 1D
0879:A8 A5 A7 85 A9 A5 FE 85 FB
0881:F7 A5 FF 85 F8 20 6C 03 73
0889:A5 F8 85 FF A5 F7 85 FE 72
0891:E8 20 34 03 D0 1E A2 08 21
0899:20 34 03 A0 02 84 A8 85 2A
08A1:A6 18 A5 FC 65 A6 85 F7 58
08A9:A5 FD 65 A7 85 F8 20 6C EF
08B1:03 4C 13 01 E8 20 34 03 FB
08B9:D0 1C A0 03 84 A8 E8 20 36
08C1:34 03 F0 08 A2 08 20 34 F4
08C9:03 4C 5C 01 A2 0A 20 34 BB
08D1:03 E6 A7 4C 5C 01 E8 20 AF
08D9:34 03 D0 0A E8 20 34 03 B2
08E1:18 69 04 A8 D0 D6 E8 20 37
08E9:34 03 D0 0A A2 02 20 34 21
08F1:03 18 69 06 D0 ED A2 08 A2
```

```
08F9:20 34 03 D0 E6 A9 00 85 F7
0901:A7 A4 FB F0 0C 06 FA 2A 37
0909:26 A7 C6 FB CA D0 F2 A8 D8
0911:60 48 B1 FE 85 FA A9 08 FE
0919:85 FB 68 A4 FE D0 02 C6 4A
0921:FF C6 FE C0 E7 D0 DE A4 B5
0929:FF C0 07 D0 D8 A9 37 85 BA
0931:01 58 4C D0 08 A4 A8 F0 49
0939:22 A5 F7 38 E5 A8 B0 03 7E
0941:C6 F8 38 85 F7 A5 FC E5 8A
0949:A8 B0 02 C6 FD 85 FC B1 3A
0951:F7 88 91 FC 98 D0 F8 C4 42
0959:A9 F0 0A B1 F7 C6 FD C6 76
0961:F8 C6 A9 10 EC 60 78 E6 98
0969:01 4C 16 08 60 00 0B 08 73
0971:C7 07 9E 32 30 36 31 00 DC
0979:00 00 20 F3 0A E9 41 A2 EB
0981:1B 95 01 CA D0 FB C0 17 62
0989:16 85 15 20 76 5A 47 5E B6
0991:0B 2A 80 02 A9 08 33 85 3D
0999:68 58 21 A1 0E 67 48 A8 7B
09A1:05 A9 06 20 5F 09 BB 60 5A
09A9:85 86 42 24 74 61 A3 38 53
09B1:80 04 09 39 07 85 A8 76 CF
09B9:08 85 0A 4C 0A 0A 9A 26 0B
09C1:02 0A A8 02 6A 8B 81 08 19
09C9:06 07 26 CC 07 03 18 65 0C
09D1:07 18 69 10 85 E1 1D 08 91
09D9:69 64 08 A5 0A F0 0E A5 EA
09E1:38 45 03 C0 C0 09 83 44 F7
09E9:09 34 7B A0 00 54 05 A0 03
09F1:28 D0 15 A5 06 90 04 07 CA
09F9:20 BF 0A E4 6C 70 C0 F7 33
0A01:05 C6 16 4C 04 09 00 57 6C
0A09:8D 00 1A 69 44 27 1A 91 42
0A11:4F 1D 91 77 1D 91 C6 1C 96
0A19:91 08 79 56 1C A5 16 A9 D9
0A21:20 A0 29 0A 5E 12 A0 51 01
0A29:D0 15 14 A4 79 D1 07 D0 A9
0A31:06 E6 03 C0 89 16 61 10 E5
0A39:02 D0 48 03 00 0F A4 2E 73
0A41:C9 00 D0 6E 17 F0 17 A5 8B
0A49:04 A6 05 A4 06 85 05 86 CA
0A51:06 84 C0 39 18 68 17 4C 12
0A59:2F 99 01 85 17 A0 78 B1 C1
0A61:0D F0 20 F0 C0 19 46 02 26
0A69:83 F4 0B 4C 59 09 C6 15 34
0A71:D0 0F A9 10 38 E5 0F 85 E4
0A79:15 E6 02 A5 02 C9 14 B0 7C
0A81:03 4C 5C 08 20 F6 09 4C 71
0A89:25 08 8D 78 D1 11 9E FF 7B
0A91:8D 0E C3 0E 0F D4 A9 80 E8
0A99:8D 12 D4 8D 18 D4 AD 1B F6
0AA1:D4 29 07 C9 08 B0 F7 B0 8B
0AA9:E7 E3 09 91 37 10 A2 04 28
0AB1:A9 97 6C 0E 0D 4C 5F F1 39
0AB9:B7 BD DA 45 0B BD DE 09 DE
0AC1:85 C0 C0 1F 90 C9 66 B0 CE
0AC9:1E C9 60 90 1A 27 FC 01 DC
0AD1:0A 14 A4 0C D1 11 D0 0E C7
0AD9:A9 01 2A 3E A4 B0 40 03 01
0AE1:A0 50 91 56 10 C6 11 C6 76
0AE9:84 82 11 C9 44 0A 08 0E 08
0AF1:C6 14 12 C9 03 D0 C6 CA 01
0AF9:D0 AB 60 29 51 79 78 02 63
0B01:52 A2 A0 A9 00 AA A7 5D EE
0B09:C0 40 04 C1 44 C2 40 22 FB
0B11:C3 E8 D0 F1 60 20 7C 09 02
0B19:A5 10 8D 67 F0 76 A0 27 F7
0B21:A9 C0 B0 07 08 C1 0C 64 86
```

```
0B29:14 C0 E4 C3 36 3C B1 0D 65
0B31:29 01 D0 14 7C 0B 3F 21 27
0B39:34 0A 9C 48 20 9E 0B 68 7D
0B41:A8 5E DC F0 1B 94 18 11 5A
0B49:72 4C 81 A1 12 A5 0D CB 03
0B51:C8 0D A5 0E CB 0E 4C 13 E6
0B59:0A 28 13 C9 D8 F0 14 A9 D9
0B61:20 58 A5 13 8F E6 A0 0F EB
0B69:FE 14 E9 E8 14 4C 53 0A 52
0B71:88 C0 FF D0 8F 4C F6 09 AD
0B79:60 A2 00 8E 21 D0 8E 20 DA
0B81:D0 BD 1E 0C 0F 06 7E 01 84
0B89:05 18 0D 74 04 BD 12 0E 5A
0B91:81 17 05 BD 0C 0F 78 06 3E
0B99:BD 06 10 9D 00 C1 05 00 FC
0BA1:52 FA D8 BD FA 11 9D F4 E2
0BA9:D9 BD F4 12 9D EE DA E8 23
0BB1:E0 FB D0 CB 60 A0 9D A0 6F
0BB9:10 FB AD 11 D0 30 FB 60 3D
0BC1:A9 0F E3 1E A9 04 59 20 FE
0BC9:A9 D8 14 A2 16 A0 08 B1 8C
0BD1:11 38 E9 5E 91 13 82 7C FB
0BD9:F6 A5 11 C6 18 28 85 11 E0
0BE1:85 13 A5 12 80 2F 12 37 71
0BE9:B5 D4 85 14 56 DD 60 78 65
0BF1:A9 03 A2 2E A9 38 8D 76 94
0BF9:A9 D0 8D 61 0F A2 08 14 08
0C01:B9 00 D0 99 00 38 88 0D A8
0C09:7C EE 08 0B EE 0B 0B 82 09
0C11:15 EE A2 31 BD 2D 0B 9D 2D
0C19:FF 3A 88 CB F7 A9 07 85 87
0C21:01 58 A9 1E 8D 18 D0 60 B5
0C29:29 1F DB E7 E7 DB C1 8D 57
0C31:22 00 02 AB D5 E8 00 04 AB
0C39:8A 00 A5 39 A5 C3 C3 A5 48
0C41:28 0F 99 BD AA 01 BD 99 AE
0C49:FF FF C3 0D BD BD C3 FF 17
0C51:A9 D0 29 68 CB 20 B4 0A 70
0C59:AE DC 04 05 04 D0 06 53 93
0C61:00 0C C6 61 08 D0 08 E8 66
0C69:98 0C F0 02 3A 26 8A 11 9F
0C71:01 60 4C 62 0B A2 0D A9 78
0C79:A0 9D 07 06 6C 39 FA A6 6F
0C81:18 A9 C2 9D 08 06 60 17 72
0C89:F1 14 30 01 C9 0A 90 03 50
0C91:D0 1B 06 F8 18 65 1A 85 39
0C99:1A A5 1B E2 05 1B A5 1C B5
0CAL:69 00 85 1C D8 20 D4 0B DC
0CA9:E6 19 A5 19 C9 3F D0 0B B9
0CB1:A5 18 C9 D0 F0 05 E6 18 2E
0CB9:20 8C 0B F5 0E 3F 03 A0 70
0CC1:00 B5 19 48 38 4A 4A 80 EE
0CC9:12 E6 68 29 0F 18 69 30 20
0CD1:99 1B 05 28 E3 10 E5 60 36
0CD9:A2 0A BD 14 0C C0 09 05 39
0CE1:A9 01 9D 9F D9 CA D0 F2 4B
0CE9:88 1B D0 F9 AD 00 DC 29 17
0CF1:10 F0 F9 4C 10 08 07 01 02
0CF9:0D 6C F4 6A 0F 16 05 12 E5
0D01:3C 89 F2 78 0A F2 38 88 96
0D09:C9 E3 3D D4 E3 B8 C3 13 92
0D11:03 0F 12 05 F7 3D C6 E3 29
0D19:1B 25 8F F7 72 E6 02 3B E9
0D21:04 8A 00 30 30 BA C0 C5 96
0D29:E3 2A 15 8F BB 12 72 43 A9
0D31:6E BF 6F 90 3C 8A 5B 3C 68
0D39:EE 4E 71 43 7D FC 4C EE 28
0D41:0C 05 16 05 0C 3D 59 F1 AF
0D49:70 81 5F F1 78 2A F1 6B C2
0D51:39 71 91 E3 38 0A E2 10 94
```

```

0D59:28 02 A0 A0 E8 6E C5 4B FD
0D61:E7 24 CA E3 EE C9 E3 7D F3
0D69:C5 E3 E4 C3 6D E7 A4 43 CF
0D71:39 39 F2 55 43 72 49 92 33
0D79:93 23 8F 81 42 9C 93 24 FF
0D81:43 43 43 BF 93 24 0F A9 67
0D89:82 A9 38 39 F1 28 01 88 A4
0D91:39 02 E0 69 6B 43 73 0F D9
0D99:E9 C4 6A 20 4E AF A9 4D FA
0DA1:20 AE 93 55 4B 20 4A 49 F7
0DA9:DC 8F 12 6A 4E AF 85 0A 45
0DB1:4D 74 2F 93 0E 0F 8C 0D 81
0DB9:8F 82 38 04 77 77 77 3A 46
0DC1:83 39 04 8A 00 20 20 3A 10
0DC9:89 F2 78 0A F2 38 88 C9 68
0DD1:03 3F 03 E6 39 25 8F 93 1D
0DD9:0D 8F E3 1C 03 9F 94 0B 67
0DE1:8F F7 1A 8F 93 0D 8F A7 95
0DE9:1B 8F 00 40 81 93 3B D8 23
0DF1:E7 38 49 F1 18 04 04 A8 D7
0DF9:9E C6 3C 4E 6A 3C 4A 8A E4
0E01:E3 25 8F 00 05 05 05 33 C3
0E09:B9 23 01 01 01 C0 4E 66 09
0E11:3C EE 92 3C 4E 2A 3C 0A BA
0E19:E2 78 DC 50 84 93 11 8F 89
0E21:00 06 06 06 3B 89 F2 38 FD
0E29:49 F2 00 C2 C5 E3 24 C4 9D
0E31:23 07 07 07 C0 9E 2E 3D 0C
0E39:06 32 4E 92 3C 02 02 02 C7
0E41:02 EC E4 C8 E3 29 C6 43 57
0E49:21 0E 8E 39 0C 32 4C 00 A0
0E51:E5 C4 83 A1 80 BA F0 D8 C5
0E59:C8 10 03 03 A8 50 52 3C D5
0E61:38 32 3C 18 36 3C 32 36 6C
0E69:00 7C 0A E2 10 0E 0E 0E F6
0E71:E8 0A E2 10 28 02 00 00 2B
0E79:00 39 00 00 00 00 00 00 E3

```

avoid typing errors, enter it with *The Automatic Proofreader*. See "Typing Aids" elsewhere in this section. Be sure to save a copy of the program before exiting *Proofreader*.

The second part of *Synthesizer* is a machine language routine. To enter it, use *MLX*, our machine language entry program. See "Typing Aids" again. When *MLX* prompts, respond with the following values.

Starting address: C000
Ending address: C6C7

Be sure to save this program with the name SYNTH ML before exiting *MLX*. The main program automatically loads this file, and it looks for that name.

Making Sounds

To edit the settings, use the joystick to move the musical note sprite to the desired setting on the screen; then press and hold the fire button. Move the joystick up or down to change the setting.

Modes

Synthesizer has four keyboard modes: Polyphonic, Solo, Bi-Voice, and Tri-Voice. To select a keyboard mode, simply press the space bar. The first keyboard mode, Poly, uses all three voices played in succession to make chords. This keyboard mode can be used to mimic instruments that can play more than one note at a time, such as the piano or organ.

The second keyboard mode, Solo, uses only Voice 1 and can be used to simulate instruments that can play only one note at a time, such as the flute or trumpet.

The third mode, Bi-Voice, combines Voices 1 and 2 and slightly offsets the frequency of Voice 2 to give a rich, deep choir effect. The last mode, Tri-Voice, is the same as Bi-Voice except that it uses all three voices and slightly offsets the frequencies of Voices 2 and 3, producing an even richer, deeper choir effect.

Voices

The SID chip has three voices. Their different settings are displayed in three vertical rows in the middle of the screen. The first setting in each voice is the waveform. While normal pro-

grams for the SID chip have only the four basic waveforms (Triangle, Sawtooth, Pulse, and Noise), *Synthesizer* adds another four waveforms. These additional waveforms are actually combinations of the original four.

Waveforms

Synthesizer starts with the first two basic waveforms, Triangle and Sawtooth, and then combines these two in the third. *Synthesizer* labels this new waveform as TrSa.

The fourth waveform is the normal Pulse waveform and the fifth is a combination of the Pulse and Triangle waveforms. This new waveform created by *Synthesizer* is labeled PuTr.

The sixth waveform is a combination of the Pulse and Sawtooth waveforms and is labeled PuSa. The seventh waveform is a combination of the Pulse, Triangle, and Sawtooth waveforms. This last combination is labeled PuTS.

Finally, the eighth waveform is the normal Noise waveform. By combining different waveforms, complex sound effects can be created.

Pulse Rate

The next setting on each voice is pulse rate. Holding the fire button down and pushing either up or down will change the value of this setting by 20. To fine-tune this setting, move the joystick to the right; this will increase the pulse rate value by 1.

Octaves

In addition to all the normal functions of each voice, there is also an Octave function displayed at the bottom of each voice. This function can have values from -5 to 7, giving each voice more than a seven-octave range. The lower octave numbers are merely there so that the user can slow down the frequencies enough to hear how complex some of the waveforms really are. For example, set the octave to -5 and the waveform to PuTr for a fascinating breakdown of this waveform.

Equal Voices

For ease of editing the three voices, an extra keyboard function has been added. Pressing the Equal (=) key will equalize all three voices by whatever voice the cursor is positioned on.

Mark Neri, the author of *Castalia* (May 1991), lives in Longwood, Florida. □

SYNTHESIZER

By Todd Piltingsrud

Synthesizer was designed for those who simply enjoy experimenting with the 64's sophisticated SID chip. Since *Synthesizer* displays the SID chip as it appears to the computer, the serious user can also use the program to design complex sound effects for use in other programs.

Synthesizer is a full-function SID chip editor that is operated with a mock-up of a real keyboard, which is composed of the upper two rows of the 64's keyboard. This keyboard appears at the top of your screen when the program is run. A joystick in port 2 controls the movement of the cursor.

Entering the Program

Synthesizer is a two-part program. The main part is written in BASIC. To help

PROGRAMS

Filter

The next feature is Filter, found at the bottom left of the screen. To use the filter, you must first turn it on. To do this, move the cursor to the voices setting and hold the fire button down until the desired voices have been selected for filtering. After selecting the voices to be filtered, choose a cutoff frequency, mode, or resonance setting to hear the desired effect.

Modulation

The last feature is Modulation, located on the bottom right of the screen. Modulation is similar to the Vibrato or Sweep functions found on other programs and can be used to create similar effects.

The Modulation feature uses the waveform and frequency settings of Voice 3 to produce a value which is then put into any three locations in the SID chip that the user chooses. The waveform controls the mode of this interesting feature.

Setting the waveform of Voice 3 to Triangle will cause the modulator to produce a value which oscillates from 0 to 255 and back again. This is useful for creating vibrato effects.

When the waveform setting is set to Sawtooth, the value starts from 0 and goes up to 255 and then starts back at 0 again. This is useful for creating sweep effects.

When the waveform is set to Pulse, the value switches immediately between 0 and 255.

Finally, when the waveform is set to Noise, the Modulation feature generates random numbers between the values of 0 and 255.

Frequency

The frequency setting is actually the frequency setting of Voice 3. This figure determines the speed at which the Modulation feature generates its numbers. Holding down the fire button and pressing up or down with this setting will increase or decrease the value by 100. To fine-tune this setting, simply press the joystick right or left; this will increase or decrease the frequency value by 1.

When using this feature, the user may want to turn off Voice 3 to silence any unwanted sounds that the voice

Sound effects for Synthesizer.

	Explosion	Bell	Flute	Synth1	Airplane	Synth2	Synth3
Kybrd	Tri	Solo	Solo	Tri	Bi	Poly	Poly
Voices	=	1	1	=	1&2 3 *	=	=
Wave	Noiz	Tria	Tria	Sawt	Puls	Tria	Tria
Puls	•	•	•	•	•	•	•
Ring	off	on	off	off	off	on	off
Sync	off	off	off	off	off	off	off
Attk	0	0	4	2	15	•	0
Dcay	15	12	0	0	0	•	15
Sust	0	0	15	15	15	•	0
RelS	15	12	5	4	15	•	0
Octv	2	3	6	2	1	•	3
Filter	on	off	off	off	on	off	on
Cutoff	1460	•	•	•	1380	•	1420
Voices	1 2 3	none	none	none	1 2	none	1 2 3
Mode	Lp	•	•	•	Lp	•	Lp
Res	15	•	•	•	15	•	15
Modulat	off	on	on	off	on	off	off
Freq	•	4000	100	•	100	•	•
Add1	25	25	0	25	2	25	25
Add2	25	25	25	25	9	25	25
Add3	25	25	25	25	25	25	25

- * Turn voice 3 off.
- = All voices the same.
- Not applicable.

may produce. To do this, press the f1 key. This key turns the output of Voice 3 on and off.

Solo and Bi-Voice

The Solo and Bi-Voice keyboard modes were designed specifically with the use of the modulator in mind. Since these modes do not use Voice 3, using them will not interfere with the output of the modulator.

Modulation Demo

For an example of the power of the Modulation feature, use the space bar to set the keyboard mode to either Solo or Bi-Voice. Then set the waveform setting of Voice 1 to Triangle and press the Equal key. Next, move the cursor to the frequency setting of the modulator and set it to about 60. Then set the first address to 0 and the second to 7; these are the low frequency settings of Voices 1 and 2. Now, press a key on the *Synthesizer* keyboard. The modulator is putting new values into the low frequency settings of Voices 1

and 2, causing a vibrato effect.

To turn the modulator off, simply set all three addresses to 25; this is a value outside the SID chip's range and has no effect on the chip's output.

Use the list of sound effects for *Synthesizer* printed above to experiment and learn more about one of the 64's most complex and fascinating features: the SID chip.

SYNTHESIZER

```

RP 1 COPYRIGHT 1992 - COMPUTE
    {SPACE}PUBLICATIONS INT'L
    {SPACE}LTD - ALL RIGHTS R
    ESERVED
GA 5 IFPEEK(49152)<>169THENPOK
    E53265,0:LOAD"SYNTH ML",8
    ,1
AP 10 SYS49152:KB$(0)="POLY":K
    B$(1)="SOLO":KB$(2)="BI-
    VOICE":KB$(3)="TRI-VOICE
    "
GB 13 WV$(1)="TRIA":WV$(2)="SA
    WT":WV$(3)="TRSA":WV$(4)
    ="PULS":WV$(5)="PUTR"
QK 14 WV$(6)="PUSA":WV$(7)="PU
    TS":WV$(8)="NOIZ":XP=14:
    YP=7
  
```

```

HA 15 DIMK(76),M(31):FORT=1TO2
4:READA,B:K(B)=A:NEXT:PO
KE53248,125:POKE53249,90
JJ 20 S=54272:M(5)=15:M(4)=17:
M(25)=4:KB=197:M(3)=5:M(
24)=31:M(23)=240:M(22)=2
00
FD 25 M(28)=25:M(29)=25:M(30)=
25:B=24:B$="={CLR}{F1}"
:FORT=STOS+24:POKET,0:NE
XTT
FK 27 FORT=0TO2:POKE49248+T*3,
M(28)+T:NEXT
PJ 30 POKES+22,M(22):POKES+24,
M(24):POKE53264,0:GOSUB3
20:POKE53265,27
JH 35 DATA 8583,62,9094,31,963
4,68,10207,32,10814,50,1
1457,63,12139,34,12860,6
5
PH 40 DATA 13625,35,14435,70,1
5294,36,16203,66,17167,5
4,18188,38,19269,60
FC 45 DATA 20415,29,21629,61,2
2915,45,24278,26,25721,2
3,27251,73,28871,75,3058
8,0
HE 50 DATA 32407,1
MS 55 REM ** WHICH KEYBOARD MO
DE? **
FD 60 IFM(31)=1THEN125
RR 70 IFM(31)=2THEN230
MJ 75 IFM(31)=3THEN175
HB 80 IFPEEK(56320)<>127THEN43
0
PP 85 GETA$:IFAS$=""THEN80
QB 90 IFASC(A$)>95ORASC(A$)<19
THEN280
HR 95 F=K(ASC(A$)-19)/M(25+V/7
):IFF=0THEN280
MX 100 H=INT(F/256):L=F-(256*H
)
BR 105 POKES+4+V,M(V+4)AND254:
POKES+V,L:POKES+1+V,H
SP 110 POKES+4+V,M(V+4)ORL:V=0
+7:IFV=21THENV=0
GR 115 GOTO00
AX 120 REM ** SOLO **
MA 125 GETA$:IFPEEK(56320)<>12
7THEN430
DP 130 IFAS$=""THEN155
PE 135 IFASC(A$)>95ORASC(A$)<1
9THEN280
FM 140 F=K(ASC(A$)-19)/M(25):I
FF=0THEN280
SP 145 H=INT(F/256):L=F-(256*H
)
KF 150 POKES,L:POKES+1,H:POKES
+4,M(4)
GA 155 IFPEEK(KB)<>64THEN125
MP 160 IFPEEK(KB)=64THENPOKES+
4,M(4)AND254
PA 165 GOTO125
QR 170 REM ** TRI-VOICE **
GD 175 GETA$:IFPEEK(56320)<>12
7THEN430
FG 180 IFAS$=""THEN210
SJ 185 IFASC(A$)>95ORASC(A$)<1
9THEN280
SA 190 FORV=0TO14STEP7:F=K(ASC
(A$)-19)/M(25+V/7):IFF=
0THEN280
CD 195 H=INT(F/256):L=F-(256*H
):IFL-14<0THENL=L+14
RM 200 POKES+1+V,H:POKES+V,L-V
:NEXT:V=0
CH 205 FORV=0TO14STEP7:POKES+4
+V,M(V+4)ORL:NEXT:V=0
MM 210 IFPEEK(KB)<>64THEN175
CA 215 IFPEEK(KB)=64THENFORV=0
TO14STEP7:POKES+4+V,M(V
+4)AND254:NEXT:V=0
RF 220 GOTO175
AD 225 REM ** BI-VOICE **
HF 230 GETA$:IFPEEK(56320)<>12
7THEN430
AX 235 IFAS$=""THEN260
KM 240 IFASC(A$)>95ORASC(A$)<1
9THEN280
PG 245 FORV=0TO7STEP7:F=K(ASC
(A$)-19)/M(25+V/7):IFF=0
THEN280
FS 250 H=INT(F/256):L=F-(256*H
):IFL<7THENL=L+7
GQ 255 POKES+V,L-V:POKES+1+V,H
:NEXT:V=0:POKES+4,M(4)O
RL:POKES+11,M(11)ORL
HB 260 IFPEEK(KB)<>64THENGOTO2
30
GQ 265 IFPEEK(KB)=64THENFORV=0
TO14STEP7:POKES+4+V,M(V
+4)AND254:NEXT:V=0
XE 270 GOTO230
CJ 275 REM ** KB MODE, EQUALIZ
E, RUN **
FF 280 FORT=1TO4:IFAS<>MID$(B$
,T,1)THENNEXT:GOTO60
CS 281 ONTGO295,288,287,282
FQ 282 PRINT "{HOME}{2 DOWN}"
EJ 283 SYS50078,128,M(24),24:M
(24)=PEEK(780)
DX 284 IFM(24)AND128THENPRINTT
AB(29)"{?}OFF":GOTO60
GQ 285 PRINTTAB(29)"{3 SPACES}
":GOTO60
QC 287 RUN
AJ 288 GOSUB320:GOTO60
BA 290 REM ** KEYBOARD MODE **
JB 295 FORV=0TO14STEP7:POKES+4
+V,M(V+4)AND254:NEXT:V=
0:M(31)=M(31)+1
MP 300 POKES+14,M(14):POKES+15
,M(15):IFM(31)=4THENM(3
1)=0
FM 305 PRINT "{HOME}{2 DOWN}
{WHT}"TAB(20)KBS(M(31))
"{5 SPACES}":GOTO60
PC 315 REM ** EQUALIZE VOICES
{SPACE}**
BG 320 FORV=0TO14STEP7:M(V+2)=
M(E+2):M(V+3)=M(E+3):M(
V+4)=M(E+4):M(V+5)=M(E+
5)
MP 323 M(V+6)=M(E+6):M(25+V/7)
=M(25+E/7)
MK 325 POKES+2+V,M(E+2):POKES+
3+V,M(E+3):POKES+5+V,M(
E+5):POKES+6+V,M(E+6)
DH 326 POKES+4+V,M(E+4):NEXT
XB 327 REM ** PRINT VALUES **
CK 330 PRINT "{HOME}{2 DOWN}
{WHT}"TAB(20)KBS(M(31))
HD 335 FORV=0TO14STEP7:T=7+V/7
*13:PRINT "{RED}{HOME}
{5 DOWN}"
EH 337 PRINTTAB(T+1)WVS((M(E+4
)AND240)/16)
FS 340 PRINTTAB(T)"{5 SPACES}
{5 LEFT}"M(E+2)+M(E+3)*
256"{PUR}"
ED 345 IF(M(E+4)AND4)=0THENPRI
NTTAB(T)"OFF":GOTO350
QR 347 PRINTTAB(T)"ON"
RD 350 IF(M(E+4)AND2)=0THENPRI
NTTAB(T)"OFF":GOTO360
AR 355 PRINTTAB(T)"ON"
BX 360 PRINT "{3}"TAB(T)(M(E+5)
AND240)/16"{LEFT}"
CR 365 PRINTTAB(T)(M(E+5)AND15"
{LEFT}"
JE 370 PRINTTAB(T)(M(E+6)AND24
0)/16"{LEFT}"
DP 375 PRINTTAB(T)M(E+6)AND15"
{LEFT}"
XJ 380 PRINT "{BLU}"TAB(T)6-(LO
G(M(E/7+25)))/LOG(2):NE
XT:V=0
RP 385 PRINT "{CYN}{3 DOWN}"TAB
(14)M(21)+M(22)*8"{YEL}
"TAB(31)M(14)+M(15)*256
PS 390 IFM(23)AND1THENPRINTTAB
(15)"{CYN}1{UP}"
MB 392 IFM(23)AND2THENPRINTTAB
(17)"{CYN}2{UP}"
JK 394 IFM(23)AND4THENPRINTTAB
(19)"{CYN}3{UP}"
KM 395 PRINT "{YEL}"TAB(31)M(28
)
QE 400 IFM(24)AND16THENPRINTTA
B(15)"{CYN}LP{UP}"
SE 401 IFM(24)AND64THENPRINTTA
B(18)"{CYN}HP{UP}"
HA 402 IFM(24)AND32THENPRINTTA
B(21)"{CYN}BP{UP}"
JP 405 PRINT "{YEL}"TAB(31)M(29
)
JM 410 PRINT "{CYN}"TAB(14)(M(2
3)AND240)/16"{YEL}"TAB(
31)M(30)
JC 415 PRINT "{CYN}"TAB(14)M(24
)AND15
KA 420 RETURN
DX 425 REM{2 SPACES}** MOVE, V
OICES **
GQ 430 IFYP>16THEN570
JQ 435 POKE53248,13+XP*8:POKE5
3249,34+YP*8
BP 440 J=PEEK(56320):IFJ=127TH
EN60
BA 443 IF(JAND16)=0THEN634
EA 445 IF(JAND1)=0ANDYP<>7THEN
YP=YP-1
GA 500 IF(JAND2)=0THENYP=YP+1:
IFYP=16THENYP=19:GOTO57
0
BD 550 IF(JAND4)=0ANDE<>0THENE
=E-7:XP=XP-13
BC 555 IF(JAND8)=0ANDE<>14THEN
E=E+7:XP=XP+13
KF 560 IFXP<>40ANDXP<>8THENPOK
E53264,0:XP=14+E/7*13

```

PROGRAMS

```

KS 561 IFXP=40THENPOKE53264,1:
XP=8
BM 562 GOTO435
JS 563 REM ** FILTER AND MOD *
*
AM 570 IFXP<>8THEN600
KC 571 REM ** MODULATION **
AB 572 IFYP=23THENYP=22
RF 573 POKE53248,13+XP*8:POKE5
3249,34+YP*8
PC 574 J=PEEK(56320):IFJ=127TH
EN60
SS 575 IF(JAND16)=0THEN634
JP 576 IF(JAND1)=0THENYP=YP-1:
IFYP=18THENXP=14+E/7*13
:YP=15:GOTO560
GK 580 IF(JAND2)=0ANDYP<>22THE
NYP=YP+1
MP 585 IF(JAND4)=0THEN600
KX 595 GOTO573
KD 597 REM ** FILTER **
CX 600 XP=26:POKE53264,0
HM 605 POKE53248,13+XP*8:POKE5
3249,34+YP*8
GA 607 J=PEEK(56320):IFJ=127TH
EN60
DR 608 IF(JAND16)=0THEN634
EH 610 IF(JAND1)=0THENYP=YP-1:
IFYP=18THENXP=14+13*E/7
:YP=15:GOTO560
MR 615 IF(JAND2)=0ANDYP<>23THE
NYP=YP+1
JD 620 IF(JAND8)=0THENPOKE5326
4,1:XP=8:GOTO572
DR 630 GOTO605
JF 633 REM ** COMPUTE **
HR 634 POKE214,YP-2:IFYP>16THE
N655
CG 640 REM ** COMPUTE, VOICES
{SPACE}**
AE 645 ONYP-6GOTO685,720,745,7
47,770,805,773,810,850
GC 650 REM ** COMPUTE, FILTER
{SPACE}OR MOD **
MF 655 IFXP=8THEN675
HB 660 REM ** COMPUTE, FILTER
{SPACE}**
PR 665 ONYP-18GOTO880,915,960,
995,997
FF 670 REM ** COMPUTE, MODULAT
ION **
EP 675 ONYP-18GOTO1035,1080,10
81,1082
JM 680 REM ** WAVEFORM **
FB 685 PRINT"{RED}"
DQ 690 J=PEEK(56320):IF(JAND1)
=0AND(M(E+4)AND128)=0TH
ENM(E+4)=M(E+4)+16
KG 695 IF(JAND2)=0AND(M(E+4)AN
D240)>16THENM(E+4)=M(E+
4)-16
AM 700 PRINTTAB(8+13*E/7)WVS(I
NT(M(E+4)/16))"{UP}":PO
KES+E+4,M(E+4)AND254
XB 705 IFJ=127THEN60
JF 710 GOTO690
FF 715 REM ** PULSE **
SQ 720 P=M(E+2)+M(E+3)*256:PRI
NT"{RED}"
MP 724 J=PEEK(56320):IF(JAND1)
=0ANDP<4076THENP=P+20
GX 725 IF(JAND2)=0ANDP>19THENP
=P-20
MX 727 IF(JAND8)=0ANDP<4095THE
NP=P+1
CE 730 PRINTTAB(7+13*E/7)P"
{LEFT}{UP}":POKES+E+2,
PAND255:POKES+E+3,INT(P
/256)
EX 735 IFJ=127THENM(E+2)=PAND2
55:M(E+3)=INT(P/256):GO
TO60
RE 740 GOTO724
SK 743 REM ** RING OR SYNC **
FA 745 PRINT"{PUR}":EO=4:GOTO7
50
JF 747 PRINT"{PUR}":EO=2
XR 750 SYS50078,EO,M(E+4),E+4:
M(E+4)=PEEK(780):POKES+
E+4,M(E+4)AND254
RX 755 IF(M(E+4)ANDEO)=0THENPR
INTTAB(8+13*E/7)"OFF
{UP}":GOTO760
KH 757 PRINTTAB(8+13*E/7)"ON
{UP}"
RF 760 GOTO600
GQ 765 REM ** A,S **
HK 770 PRINT"{3}":EO=5:GOTO774
AP 773 PRINT"{3}":EO=6
KR 774 P=(M(E+EO)AND240)/16
FS 775 J=PEEK(56320):IF(JAND1)
=0ANDP<>15THENP=P+1
HK 780 IF(JAND2)=0ANDP<>0THENP
=P-1
SA 785 PRINTTAB(7+13*E/7)P"
{LEFT}{UP}":POKES+E+EO
,(M(E+EO)AND15)+P*16
XA 790 IFJ=127THENM(E+EO)=(M(E
+EO)AND15)+P*16:GOTO600
EX 795 GOTO775
XX 800 REM ** D,R **
SR 805 PRINT"{3}":EO=5:GOTO815
XJ 810 PRINT"{3}":EO=6
JM 815 P=M(E+EO)AND15
JX 820 J=PEEK(56320):IF(JAND1)
=0ANDP<>15THENP=P+1
KF 825 IF(JAND2)=0ANDP<>0THENP
=P-1
PG 830 PRINTTAB(7+13*E/7)P"
{LEFT}{UP}":POKES+E+EO
,(M(E+EO)AND240)+P
EE 835 IFJ=127THENM(E+EO)=(M(E
+EO)AND240)+P:GOTO600
CP 840 GOTO820
QK 845 REM ** OCTAVE **
HJ 850 PRINT"{BLU}":P=6-(LOG(M
(E/7+25))/LOG(2))
SR 855 J=PEEK(56320):IF(JAND1)
=0ANDP<>7THENP=P+1
BJ 856 IF(JAND2)=0ANDP<>-5THEN
P=P-1
QP 860 PRINTTAB(7+13*E/7)P"
{UP}"
SD 865 IFJ=127THENM(E/7+25)=2↑
(6-P):GOTO600
CA 870 GOTO855
CS 875 REM ** CUTOFF FREQ **
GB 880 PRINT"{CYN}":P=M(21)+M(
22)*8
XP 885 J=PEEK(56320):IF(JAND1)
=0ANDP<2028THENP=P+20
CF 890 IF(JAND2)=0ANDP>19THENP
=P-20
PD 893 IF(JAND8)=0ANDP<2047THE
NP=P+1
GK 895 PRINTTAB(14)P"{LEFT}
{UP}"
KF 897 M(21)=PAND7:M(22)=INT(P
/8):POKES+21,M(21):POKE
S+22,M(22)
FR 900 IFJ=127THEN600
CE 905 GOTO885
HA 910 REM ** VOICES **
DF 915 PRINTTAB(15)"{CYN}
{DOWN}{5 SPACES}{UP}":P
=M(23)AND7
XS 920 P=P+1:POKES+23,(M(23)AN
D248)+P:IFP=8THENP=0
JB 930 IFPAND1THENPRINTTAB(15)
"{CYN}1{UP}"
QJ 935 IFPAND2THENPRINTTAB(17)
"{CYN}2{UP}"
DR 940 IFPAND4THENPRINTTAB(19)
"{CYN}3{UP}"
JF 950 M(23)=(M(23)AND248)+P:G
OTO600
XF 955 REM ** MODE **
QK 960 PRINTTAB(15)"{CYN}
{DOWN}{8 SPACES}{UP}":P
=M(24)AND112
KS 965 P=P+16:IFP=128THENP=0
GP 967 POKES+24,(M(24)AND143)+
P
BC 970 IFPAND16THENPRINTTAB(15)
)"{CYN}LP{UP}"
AA 975 IFPAND32THENPRINTTAB(18)
)"{CYN}BP{UP}"
FE 980 IFPAND64THENPRINTTAB(21)
)"{CYN}HP{UP}"
GJ 985 M(24)=(M(24)AND143)+P:G
OTO600
DQ 990 REM ** RESONANCE, VOLUM
E **
PD 995 EO=23:A=15:SI=16:P=(M(E
O)AND240)/16:GOTO998
KH 997 EO=24:A=240:SI=1:P=M(EO)
AND15
SH 998 PRINT"{CYN}"
CK 1000 J=PEEK(56320):IF(JAND1)
=0ANDP<>15THENP=P+1
AS 1005 IF(JAND2)=0ANDP<>0THEN
P=P-1
DS 1010 PRINTTAB(14)P"{LEFT}
{UP}":POKES+EO,(M(EO)A
NDA)+P*SI
HA 1020 IFJ=127THENM(EO)=(M(EO)
ANDA)+P*SI:GOTO600
DX 1025 GOTO1000
EK 1030 REM ** MODULATION FREQ
**
RA 1035 PRINT"{YEL}":P=M(14)+M
(15)*256
GG 1040 J=PEEK(56320):IF(JAND1)
=0ANDP<65436THENP=P+1
00
EQ 1045 IF(JAND2)=0ANDP>99THEN
P=P-100
FF 1047 IF(JAND4)=0ANDP>0THENP
=P-1
QR 1050 IF(JAND8)=0ANDP<65535T
HENP=P+1
BC 1055 PRINTTAB(31)P"{LEFT}

```



```

      {2 SPACES}{UP}"
AB 1060 M(15)=INT(P/256):M(14)
      =P-INT(P/256)*256:POKE
      S+14,M(14):POKES+15,M(
      15)
AK 1065 IFJ=127THEN60
QC 1070 GOTOL040
DC 1075 REM ** ADD1,2,3 **
DB 1080 EO=0:GOTO1085
SG 1081 EO=1:GOTO1085
FM 1082 EO=2
SC 1085 PRINT"{YEL}":P=M(28+EO
      )
RS 1090 J=PEEK(56320):IF(JAND1
      )=0ANDP<25THENP=P+1
ED 1095 IF(JAND2)=0ANDP>0THENP
      =P-1
XG 1100 PRINTTAB(31)P"{LEFT}
      {UP}"
ME 1115 IFJ=127THENM(28+EO)=P:
      POKE49248+EO*3,P:GOTO6
      0
AJ 1120 GOTOL090

```

SYNTH ML

```

C000:A9 00 8D 20 D0 8D 21 D0 D9
C008:A0 6B A9 C0 84 FB 85 FC 12
C010:A0 00 B1 FB F0 0A 20 16 DD
C018:E7 C8 D0 F6 E6 FC D0 F2 09
C020:A9 40 8D 8A 02 78 A9 5C 82
C028:8D 14 03 A9 C0 8D 15 03 D9
C030:58 A0 3F B9 5E C3 99 40 FE
C038:03 88 10 F7 A9 01 8D 15 60
C040:D0 8D 27 D0 A9 0D 8D F8 15
C048:07 A9 00 8D 1B D0 A0 18 06
C050:B9 D9 00 09 80 99 D9 00 D3
C058:88 10 F5 60 AD 1B D4 8D F7
C060:19 D4 8D 19 D4 8D 19 D4 CA
C068:4C 31 EA 08 0E 93 05 20 23
C070:20 20 20 20 A7 12 20 1D F2
C078:20 1D 20 DD 20 1D 20 1D 06
C080:20 1D 20 DD 20 1D 20 1D 0E
C088:20 DD 20 1D 20 1D 20 1D 3A
C090:20 92 A5 0D 20 20 20 20 2E
C098:20 A7 12 51 DD 57 DD 45 B8
C0A0:DD 52 DD 54 DD 59 DD 55 0C
C0A8:DD 49 DD 4F DD 50 DD 40 48
C0B0:DD 2A DD 5E DD C4 92 A5 1A
C0B8:0D 20 20 20 20 20 20 B0
C0C0:20 20 20 CB 45 59 42 4F 7E
C0C8:41 52 44 3A 0D 0D 9A 20 9D
C0D0:20 20 D6 4F 49 43 45 31 4D
C0D8:20 20 20 20 20 20 D6 11
C0E0:4F 49 43 45 32 20 20 20 8B
C0E8:20 20 20 20 D6 4F 49 43 52
C0F0:45 33 0D C0 C0 C0 C0 DA
C0F8:C0 C0 C0 C0 C0 C0 C0 7A
C100:C0 C0 C0 C0 C0 C0 C0 83
C108:C0 C0 C0 C0 C0 C0 C0 8B
C110:C0 C0 C0 C0 C0 C0 C0 93
C118:C0 C0 C0 1C 20 20 20 D7 9F
C120:41 56 45 20 20 20 20 66
C128:20 20 20 D7 41 56 45 7F
C130:20 20 20 20 20 20 20 B3
C138:20 D7 41 56 45 0D 20 20 0E
C140:20 D0 55 4C 53 20 20 20 F2
C148:20 20 20 20 20 20 D0 55 62
C150:4C 53 20 20 20 20 20 B6
C158:20 20 20 D0 55 4C 53 0D 94

```

```

C160:9C 20 20 20 D2 49 4E 47 DF
C168:20 20 20 20 20 20 20 EB
C170:20 D2 49 4E 47 20 20 20 E1
C178:20 20 20 20 20 20 D2 49 8A
C180:4E 47 0D 20 20 20 D3 59 23
C188:4E 43 20 20 20 20 20 EB
C190:20 20 20 D3 59 4E 43 20 18
C198:20 20 20 20 20 20 20 1C
C1A0:D3 59 4E 43 0D 20 20 20 AB
C1A8:96 C1 54 54 4B 20 20 20 F2
C1B0:20 20 20 20 20 20 C1 54 AB
C1B8:54 4B 20 20 20 20 20 21
C1C0:20 20 20 C1 54 54 4B 0D 14
C1C8:20 20 20 C4 43 41 59 20 A6
C1D0:20 20 20 20 20 20 20 54
C1D8:C4 43 41 59 20 20 20 20 2F
C1E0:20 20 20 20 20 C4 43 41 5E
C1E8:59 0D 20 20 20 D3 55 53 B0
C1F0:54 20 20 20 20 20 20 8E
C1F8:20 20 D3 55 53 54 20 20 B0
C200:20 20 20 20 20 20 D3 39
C208:55 53 54 0D 20 20 20 D2 FC
C210:45 4C 53 20 20 20 20 99
C218:20 20 20 20 D2 45 4C 53 53
C220:20 20 20 20 20 20 20 A5
C228:20 D2 45 4C 53 0D 20 20 0F
C230:20 1F CF 43 54 56 20 20 18
C238:20 20 20 20 20 20 CF 6D
C240:43 54 56 20 20 20 20 2B
C248:20 20 20 20 CF 43 54 56 76
C250:0D 9A C0 C0 C0 C0 C0 72
C258:C0 C0 C0 C0 C0 C0 C0 DD
C260:C0 C0 C0 C0 C0 C0 C0 E5
C268:C0 C0 C0 C0 C0 C0 C0 ED
C270:C0 C0 C0 C0 C0 C0 C0 F5
C278:C0 C0 9F 20 20 20 C6 49 DC
C280:4C 54 45 52 20 20 20 20 F0
C288:20 20 20 20 20 20 20 0E
C290:20 20 20 20 20 20 9E CD C0
C298:4F 44 55 4C 41 54 49 4F 83
C2A0:4E 0D 9F 20 20 20 C0 C0 4A
C2A8:C0 C0 C0 C0 20 20 20 C4
C2B0:20 20 20 20 20 20 20 36
C2B8:20 20 20 20 20 20 9E C0 DB
C2C0:C0 C0 C0 C0 C0 C0 C0 46
C2C8:C0 0D 9F 20 20 20 C3 55 46
C2D0:54 4F 46 46 20 C6 52 45 87
C2D8:51 20 20 20 20 20 20 F6
C2E0:20 20 20 20 20 20 9E C6 0A
C2E8:52 45 51 0D 9F 20 20 20 C1
C2F0:D6 4F 49 43 45 53 20 20 EA
C2F8:20 20 20 20 20 20 20 7E
C300:20 20 20 20 20 20 20 87
C308:9E C1 44 44 31 0D 9F 20 39
C310:20 20 CD 4F 44 45 20 20 F5
C318:20 20 20 20 20 20 20 9F
C320:20 20 20 20 20 20 20 A7
C328:20 20 9E C1 44 44 32 0D 5C
C330:9F 20 20 20 D2 45 53 4F 37
C338:4E 41 4E 43 45 20 20 20 40
C340:20 20 20 20 20 20 20 C7
C348:20 20 20 20 9E C1 44 44 B6
C350:33 0D 9F 20 20 D6 4F 29
C358:4C 55 4D 45 13 00 0C 00 0A
C360:00 0F 00 00 0F 80 00 0D 33
C368:80 00 0D 00 00 0C 00 00 02
C370:0C 00 00 00 00 00 00 00 D6
C378:00 0C 00 00 7C 00 00 FC E3
C380:00 00 FC 00 00 78 00 00 89
C388:00 00 00 00 00 00 00 10

```

```

C390:00 00 00 00 00 00 00 18
C398:00 00 00 00 00 00 20 FD 5E
C3A0:AE 20 9E B7 8E B7 C3 20 D1
C3A8:FD AE 20 9E B7 8A 48 20 61
C3B0:FD AE 20 9E B7 68 49 00 C2
C3B8:9D 00 D4 60 00 00 00 00 AF

```

Todd Piltingsrud is a music major at Concordia College in Morehead, Minnesota. He always wanted a good synthesizer program, so he wrote his own. □

LISA

By Bruce M. Bowden

Little Isometric Artist, better known as *LISA*, is a way to draw three-dimensional diagrams which can be rotated and saved for future viewing on your 64's high-resolution screen.

To begin, *LISA* requires a set of vertices (corner points) and information about which of these points are to be connected to form a screen image. When the wire-frame image is drawn, you'll have the option of rotating it, seeing what it looks like at various angles, and saving the image as a straight bitmap, which may be loaded into *The Print Shop* and other drawing programs for further manipulation.

3-D Coordinates

LISA uses a mathematical description of an object that consists of three coordinate lines or axes. These lines intersect with each other at one point, called the origin. Each line or axis is at right angles, or perpendicular, to the other two. The axes, typically labeled x, y, and z, are lines with distance values on them, relative to the origin, which has a distance of 0. Negative values are on one side of the origin, and positive values are on the other.

To imagine the coordinate system and how *LISA* uses it, pretend that you're standing near the corner of a room, with a wall to your left and a wall in front. The point of intersection of the two walls and the floor is the origin, or zero point, of our system model. The edge where the front wall meets the floor models the positive part of the x-axis. The edge where both walls meet models the positive part of the y-axis. And the edge where the left wall and floor meet models the positive part of the z-axis. Remember that there are al-

so negative parts to each axis, extending off in the opposite directions from the origin. Actual three-dimensional coordinate systems can then be abstracted from the model and applied as follows.

If you want to describe where a point is located in the room, simply give its distance from the origin along the three axes. The directions might be two feet from the origin in the x direction, then five feet in the y direction (up from the floor), and then four feet in the z direction (parallel to the left wall). The coordinates of this point, using a scale in feet, could be represented by 2, 5, and 4.

In general, then, once a convenient origin and axes have been created, any figure which can be specified as points connected by lines is easy to describe. Just figure how far across (x), how far up (y), and how far out (z) each of the points is. (I'm sure you'll remember all about Cartesian coordinates from high school math classes.)

Entering the Program

LISA is a two-part program, with one part written in BASIC and the other in machine language. To help avoid typing errors, use *The Automatic Proofreader* to enter the main program; see "Typing Aids" elsewhere in this section. Be sure to save a copy of the program when you've finished typing.

The second part of the program is a graphics package written entirely in machine language, so use *MLX*, our machine language entry program, to type it in. When prompted by *MLX*, respond with the values given below.

Starting address: C000

Ending address: C6C7

The main program automatically loads the machine language program, so be sure to save this second program with the name *LISA.ML*. Make sure that both programs are on the same disk. When you load and run *LISA*, it will set up arrays and variables before displaying the menu screen. Each option on the menu has a letter in parentheses that shows which key must be pressed to make that selection. We'll explain each of the options, but out of the order in which they appear onscreen.

Options

Option G chooses the graphics screen. If pressed before any graphics have been drawn, it will probably display garbage. Press any other key to return to the text screen.

Option D selects the demonstration figure. Press D, and after a moment's delay for generating data, the graphics screen will appear, and a design will be drawn. This demo design resembles a flying saucer or igloo with an open hatchway. Because this figure has a symmetrical shape, the hatchway serves as a reference when rotating the figure.

Whenever a calculated drawing (one which isn't simply a picture file that has been loaded) is being displayed, press either cursor key to rotate the drawing. After a moment's delay for recalculation, the object will be redrawn in its new position. Pressing any other key will return you to the text screen and main menu.

Option S saves the figure. Make sure your disk has at least 32 free blocks in order to save the picture. Because the demo picture is the first saved, its name is *SLIDE00*. Subsequent saves will result in *SLIDE01*, *SLIDE02*, and so on. After the save operation, you'll be returned to the text screen.

Option N is for creating a new figure. For demonstration purposes, let's draw a cube. A cube has eight corners (vertexes) and twelve edges. Our cube will measure $1 \times 1 \times 1$ and have point 1 at the origin.

Draw a Cube

If you haven't done so already, load and run the program and then press N. When asked how many points you are entering, enter 8 and press Return. Now the program goes through and asks for the x , y , and z values for each of the points. The first point will be at the origin, so its coordinates are 0, 0, 0. Enter a 0 at each request.

The program now moves on to point 2. Remember that the numbers which you use to label each point are arbitrary. What matters is how the points are connected when we supply the edge data. When I sketched out my diagram of a cube before entering the data into the program, I labeled the

point with the coordinates 1, 0, 0 as point 2. So enter 1 for x , 0 for y , and 0 for z . Now continue through with the following coordinates.

Point 3: 1, 1, 0
Point 4: 0, 1, 0
Point 5: 0, 0, 1
Point 6: 1, 0, 1
Point 7: 1, 1, 1
Point 8: 0, 1, 1

After these points have been entered, you'll be asked how many edges there are. Since a cube has 12 edges, reply by entering 12. According to the scheme by which I've numbered my points, point 1 is connected to point 5. So when asked for the starting point for edge 1, enter 1; then enter 5 for the ending point. (See the accompanying figure.)

Notice that the edge number is arbitrary, too. For example, I could just as easily have responded that edge 1 is the edge which connects point 7 to point 8. The edge number simply shows the order in which each edge will be drawn.

If I indicate that point 1 is connected to point 5 by responding to the onscreen prompts, the remaining edges are as follows.

Edge 2: 2, 6
Edge 3: 3, 7
Edge 4: 4, 8
Edge 5: 1, 2
Edge 6: 2, 3
Edge 7: 3, 4
Edge 8: 4, 1
Edge 9: 5, 6
Edge 10: 6, 7
Edge 11: 7, 8
Edge 12: 8, 5

With the edge data entered, some scaling and centering calculations are done, and the figure appears on the screen. Because of the initial point of view, the figure looks more like a hexagon than a cube. The cubical shape will become apparent when you use the cursor keys to rotate the shape.

In this example we had three edges of the cube against the three axes, and each was of unit size, but our drawing could've been anywhere in space and

of any size. The program will shift and scale the data so that the figure always fits and is centered upon the screen.

Other Options

Option E will allow you to edit the data you've entered.

Option A allows you to set the number of radians (there are pi radians per 180 degrees) by which the figure can be turned each time. The default value is a twelfth of a rotation. Enter a negative number to abort. The program will take the input and modify it so that a rotation is completed in a whole number of turns. For example, enter 2, and you'll be informed that the program will be using three steps per rotation. Press any key to return to the main menu.

Option M will let you make a slide-show set of your figure with rotation. If you followed the steps in option A above, now place a blank disk in the disk drive and press M. You'll be notified how many blocks the slides will take—96 in this case. Press a key and watch the different views being drawn and saved. Because SLIDE00 was saved earlier, the slide numbers will be 01 through 03.

Option L will load a saved picture. If you saved the demo figure earlier, press L now to reload it. You'll be prompted for the name of the picture. Enter SLIDE00, and the graphics screen will appear so that you can watch the picture load. You'll then be returned to the main menu.

Finally, option H is used for calling up a quick reference screen whenever you need help.

To quit the program, merely press the Run/Stop key.

Additional Notes

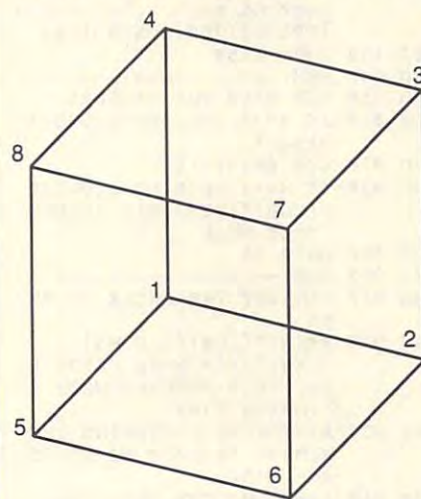
LISA was written with clear programming in mind. The BASIC code is well documented to help programmers use LISA routines in their own projects. In addition, the machine language program is a package of useful routines for high-resolution graphics: go to the graphics screen, clear the graphics screen, draw a line, return to text mode, save the graphic, load the graphic. These routines have SYS addresses referenced in the BASIC remarks.

To change the text screen colors,

change line 40 so that new color values are being poked into border and background addresses 53280 and 53281. To change the graphic screen colors, add a line to the program, following the part where the machine code has been loaded, which pokes the background color value into address 49173 and the drawing color into address 49174. The line might look like the following.

25 POKE 49173, color1 :POKE 49174, color2

The color values are the standard Commodore colors, ranging from 0 to 15.



LISA

```
GD 10 REM COPYRIGHT 1991 - COMPUTE PUBLICATIONS INTL LTD - ALL RIGHTS RESERVED
QF 20 IF DK=0 THEN DK=1:LOAD"LIBRARY.ML",8,1
PP 30 Y=INT(32768/256):X=INT((32768/256-Y)*256+.5):POKE 55,X:POKE 56,Y:CLR
FC 40 DIM PT(300,2),LN(300,2),RP(300,3):POKE 53280,6:POKE 53281,6:PRINT "{CLR}"
RR 50 PI=3.14159265:NP=1:NL=1:CS=SQR(3)/2:SN=.5:AN=PI/6:MD=0:PC=0
BJ 60 :
KP 70 IF MD=1 THEN MD=0:SYS 49152+6:REM TEXT MODE
SF 80 PRINT "{CLR}{WHT}{N}":A$="LISA - LITTLE ISOMETRIC ARTIST":GOSUB 1760:PRINT "{CYN}"
MX 90 PRINT:A$="COPYRIGHT 1991
```

```
" :GOSUB 1760
AS 100 A$="COMPUTE PUBLICATIONS INTL, LTD":GOSUB 1760
GF 110 A$="ALL RIGHTS RESERVED":GOSUB 1760:PRINT:PRINT
KQ 120 A$="PLEASE CHOOSE":GOSUB 1760:PRINT
SS 130 A$="(N)EW FIGURE":GOSUB 1760:A$="(G)RAPHIC SCREEN":GOSUB 1760
FC 140 A$="(S)AVE PICTURE":GOSUB 1760:A$="(M)AKE SLIDE SET":GOSUB 1760
BH 150 A$="(L)OAD PICTURE":GOSUB 1760:A$="(M)AKE SLIDE SET":GOSUB 1760
JX 160 A$="(E)DIT":GOSUB 1760:A$="(H)ELP":GOSUB 1760:A$="(D)EMO":GOSUB 1760
BB 170 GET A$:IF A$="" THEN 170
XK 180 FL=0:B$="NGHDSAMEL"
RA 190 FOR X=1 TO LEN(B$):IF A$=MID$(B$,X,1) THEN FL=X
AM 200 NEXT:IF FL=0 THEN 170
KA 210 ON FL GOTO 230,570,630,810,850,910,1020,350,520
MR 220 REM -----
HG 230 REM INPUT A NEW FIGURE
CC 240 INPUT "{CLR}{DOWN}{CYN}HOW MANY POINTS ARE YOU ENTERING":NP
MF 250 FOR X=1 TO NP:PRINT "{CLR}{2 DOWN}":FOR Y=ASC("X") TO ASC("Z")
HE 260 PRINT"ENTER THE ";CHR$(Y);" VALUE FOR POINT";X;" : "
RB 270 INPUT RP(X,Y-ASC("W")):NEXT Y,X
HA 280 INPUT "{CLR}{DOWN}HOW MANY EDGES ARE YOU ENTERING":NL
RR 290 FOR X=1 TO NL:PRINT "{CLR}{2 DOWN}"
XX 300 PRINT"ENTER THE STARTING POINT FOR EDGE";X;" : {SPACE}":INPUT LN(X,1)
AS 310 PRINT"ENTER THE ENDING POINT FOR EDGE";X;" : " :INPUT LN(X,2)
BB 320 NEXT:PRINT "{YEL}":A$="CALCULATING...":GOSUB 1760:GOTO 1150
SG 330 REM -----
DH 340 REM EDIT THE DATA
XX 350 FOR X=1 TO NP:PRINT "{CLR}{2 DOWN}":FOR Y=ASC("X") TO ASC("Z")
BQ 360 PRINT"THE ";CHR$(Y);" VALUE FOR POINT";X;" : " :RP(X,Y-ASC("W")):NEXT Y
PE 370 PRINT:PRINT"REENTER THIS POINT? (Y/N)":GOSUB 1800
KA 380 IF A$<>"Y" THEN 420
SS 390 PRINT "{2 DOWN}":FOR Y=ASC("X") TO ASC("Z")
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PROGRAMS

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BQ 400 PRINT"ENTER THE ";CHR$(
Y);" VALUE FOR POINT";X
;": ";
PP 410 INPUT RP(X,Y-ASC("W")):
NEXT Y
CQ 420 NEXT X:FOR X=1 TO NL:PR
INT"{CLR}{2 DOWN}"
RJ 430 PRINT"THE STARTING POIN
T FOR EDGE";X;": ";LN(X
,1)
QE 440 PRINT"THE ENDING POINT
{SPACE}FOR EDGE";X;": "
;LN(X,2)
AX 450 PRINT:PRINT"REENTER THI
S EDGE? (Y/N)":GOSUB 18
00
QR 460 IF A$<>"Y" THEN 490
KQ 470 PRINT:PRINT"ENTER THE S
TARTING POINT FOR EDGE"
;X;": ":INPUT LN(X,1)
PR 480 PRINT:PRINT"ENTER THE E
NDING POINT FOR EDGE";X
;": ":INPUT LN(X,2)
RC 490 GOTO 320
EQ 500 REM -----
CF 510 REM LOAD THE PICTURE
HS 520 PRINT"{CLR}{2 DOWN}WHAT
IS THE NAME OF THE PIC
TURE?":INPUT A$
QC 530 X=LEN(A$):POKE 53050,X:
FOR Y=1 TO X:POKE 53050
+Y,ASC(MID$(A$,Y,1)):NE
XT
PA 540 IF MD=0 THEN MD=1:SYS 4
9152+3
FF 550 SYS 49152+18:PC=0:GOTO6
00
RH 560 REM -----
EQ 570 REM GO TO THE GRAPHIC S
CREEN
JJ 580 IF MD=0 THEN MD=1:SYS 4
9152+3:IF PC THEN 1500
SM 590 GOSUB 1800
MP 600 IF MD=1 THEN MD=0:PRINT
"{CLR}":SYS 49152+6:REM
TEXT MODE
HP 610 GOTO 70
JE 620 REM -----
QE 630 REM POST HELP SCREEN
MJ 640 PRINT"{CLR}{WHT}":A$="M
AIN MENU HELP":GOSUB 17
60:PRINT"{CYN}"
SC 650 A$="CREATE A NEW FIGURE
BY CHOOSING 'N' AT":GO
SUB 1760
AC 660 A$="THE MAIN MENU AND E
NTERING POINT AND":GOSU
B 1760
PK 670 A$="EDGE DATA WHEN PROM
PTED.":GOSUB 1760
GH 680 A$="IF A FIGURE EXISTS
{SPACE}ON THE GRAPHIC":
GOSUB 1760
XG 690 A$="SCREEN, IT WILL BE
{SPACE}DISPLAYED BY":GO
SUB 1760
CK 700 A$="PRESSING 'G' AT THE
MAIN MENU.":GOSUB 1760
KM 710 A$="CHOOSING 'D' AT THE
MAIN MENU WILL":GOSUB
{SPACE}1760
SD 720 A$="CAUSE A DEMO FIGURE
TO BE CREATED,":GOSUB
{SPACE}1760
QH 730 A$="WITH ALL THE NORMAL
FIGURE OPTIONS":GOSUB
{SPACE}1760
HP 740 A$="AFTERWARD.":GOSUB 1
760
XM 750 A$="THE (L)OAD AND (S)A
VE OPTIONS WORK":GOSUB
{SPACE}1760
AH 760 A$="WITH A HIGH-RESOLUT
ION IMAGE.":GOSUB 1760
SH 770 A$="THE SLIDE SET OPTIO
N SAVES A":GOSUB 1760
PR 780 A$="FULL ROTATION SEQUE
NCE.":GOSUB 1760:PRINT
QA 790 GOSUB 1790:GOTO 70
KB 800 REM -----
JP 810 REM RUN DEMO
FR 820 PRINT:PRINT"{YEL}":A$="
GETTING DATA...":GOSUB
{SPACE}1760:GOSUB 1640
FJ 830 GOTO 1150
KG 840 REM -----
FB 850 REM SAVE THE PICTURE
DR 860 IF MD=0 THEN MD=1:SYS 4
9152+3
KD 870 SYS 49152+15
SE 880 IF MD=1 THEN MD=0:PRINT
"{CLR}":SYS 49152+6:REM
TEXT MODE
MS 890 GOTO 70
CP 900 REM -----
SR 910 REM SET THE ANGLE OF TU
RN
AP 920 PRINT"{CLR}{2 DOWN}
{CYN}":A$="WHEN FIRST R
UN, THIS PROGRAM USES A
":GOSUB 1760
SS 930 A$="DEFAULT TURNING INC
REMENT OF 1/12 OF A":GO
SUB 1760
SE 940 A$="COMPLETE ROTATION.
{SPACE}PLEASE EITHER EN
TER":GOSUB 1760
FF 950 A$="A NEW INCREMENT (IN
RADIAN), OR A":GOSUB
{SPACE}1760
DX 960 A$="NEGATIVE VALUE TO A
BORT.":GOSUB 1760
PD 970 PRINT:INPUT"ANGLE";X:PR
INT:PRINT"{YEL}":IF X<0
THEN 70
PD 980 IF X>2*PI THEN A$="TOO
{SPACE}LARGE... USING D
EFAULT":GOSUB 1760:AN=P
I/6:GOTO 790
PX 990 X=INT(2*PI/X+.5):IF X<=
1 THEN X=2
FD 1000 AN=2*PI/X:A$="USING"+S
TR$(X)+" STEPS PER ROT
ATION":GOSUB 1760:GOTO
790
DP 1010 REM -----
MD 1020 REM MAKE THE SET OF SL
IDES
PA 1030 PRINT"{CLR}{2 DOWN}
{YEL}":IF PC THEN 1050
CR 1040 A$="THERE IS NO ENTERE
D FIGURE":GOSUB 1760:G
OTO 790
CE 1050 IF 2*PI/AN > 20 THEN A
N = 2*PI/20
GJ 1060 A$="THIS SLIDE SET WIL
L TAKE"+STR$(INT(2*PI/
AN+.5)*32)
BS 1070 A$=A$+" BLOCKS.":GOSUB
1760:GOSUB 1790
DQ 1080 SYS 49152+3:FOR SX=1 T
O 2*PI/AN
EE 1090 SYS 49152+15
HG 1100 GOSUB 1570:GOSUB 1180:
NEXT
QG 1110 IF MD=1 THEN MD=0:PRIN
T"{CLR}":SYS 49152+6:R
EM TEXT MODE
PA 1120 GOTO 70
ED 1130 REM -----
PA 1140 REM DRAWING THE FIGURE
SH 1150 GOSUB 1180:GOTO 1500
DR 1160 REM -----
GA 1170 REM CALCULATING THE GE
OMETRIC CENTER
QX 1180 AX=0:AY=0:AZ=0
DQ 1190 FOR X=1 TO NP:AX=AX+RP
(X,1):AY=AY+RP(X,2):AZ
=AZ+RP(X,3):NEXT
MA 1200 AX=AX/NP:AY=AY/NP:AZ=A
Z/NP
DQ 1210 :
AQ 1220 FOR X=1 TO NP:REM CONV
ERT TO ISOMETRIC IMAGE
EC 1230 PT(X,1)=(RP(X,2)-RP(X,
1)-AY+AX)*CS
GC 1240 PT(X,2)=RP(X,3)-AZ-SN*
(RP(X,2)+RP(X,1)-AX-AY
)
RA 1250 NEXT
RA 1260 :
EJ 1270 MAX=PT(1,1):MIN=MAX:RE
M INITIALIZE EXTREMA
SE 1280 FOR X=1 TO NP:FOR Y=1
{SPACE}TO 2
RF 1290 IF PT(X,Y)>MAX THEN MA
X=PT(X,Y)
CR 1300 IF PT(X,Y)<MIN THEN MI
N=PT(X,Y)
CQ 1310 NEXT Y,X
JR 1320 SR=199/(MAX-MIN):REM T
HE SCALE RATIO
RH 1330 AR=152/115:REM THE ASP
ECT RATIO
ES 1340 OS=160+MIN*SR*AR:REM X
-OFFSET TO CENTER THE
{SPACE}DRAWING
RA 1350 FOR X=1 TO NP:FOR Y=1
{SPACE}TO 2
GG 1360 PT(X,Y) = (PT(X,Y)-MIN
)*SR
PD 1370 NEXT Y,X
KP 1380 IF MD=0 THEN MD=1:SYS
{SPACE}49152+3:REM SWI
TCH TO THE GRAPHICS SC
REEN
SH 1390 SYS 49152+12:REM CLEAR
SCREEN
HD 1400 FOR X=1 TO NL
BM 1410 X1 = INT(PT(LN(X,1),1)

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*AR+OS+.5):Y1 = INT (PT
(LN(X,1),2)+.5)
AC 1420 X2 = INT (PT (LN(X,2),1)
*AR+OS+.5):Y2 = INT (PT
(LN(X,2),2)+.5)
JS 1430 V(2)=INT(X1/256):V(1)=
INT((X1/256-V(2))*256+
.5)
GM 1440 V(4)=INT(Y1/256):V(3)=
INT((Y1/256-V(4))*256+
.5)
AE 1450 V(6)=INT(X2/256):V(5)=
INT((X2/256-V(6))*256+
.5)
MD 1460 V(8)=INT(Y2/256):V(7)=
INT((Y2/256-V(8))*256+
.5)
FB 1470 FOR Y=0 TO 7:POKE 5300
0+Y,V(Y+1):NEXT
AQ 1480 PC=-1:SYS 49152+9:REM
{SPACE}DRAW THE LINE
XM 1490 NEXT:RETURN
DD 1500 GET A$:IF A$="" THEN 1
500
EX 1510 IF A$="{RIGHT}" THEN A
N = ABS(AN):GOSUB 1570
:GOSUB 1180:GOTO 1500
DB 1520 IF A$="{LEFT}" THEN AN
= -ABS(AN):GOSUB 1570
:GOSUB 1180:GOTO 1500
FJ 1530 IF MD=1 THEN MD=0:PRIN
T "{CLR}":SYS 49152+6:R
EM TEXT MODE
JR 1540 GOTO 70
DC 1550 :
QS 1560 REM ROTATING THE OBJEC
T
KC 1570 FOR X=1 TO NP
HH 1580 XX=RP(X,1):YY=RP(X,2)
CP 1590 RP(X,1)=XX*COS(AN)-YY*
SIN(AN)
FC 1600 RP(X,2)=XX*SIN(AN)+YY*
COS(AN)
QX 1610 NEXT:MD=1:RETURN
AG 1620 :
DM 1630 REM GENERATING DATA FO
R DEMO FIGURE
XF 1640 NP=1:NL=1:A=10:B=5
ME 1650 FOR TH=0 TO 3:FOR PH=0
TO 9:GOSUB 1710
FA 1660 LN(NL,1)=NP:LN(NL,2)=N
P+1:LN(NL+1,1)=NP:LN(N
L+1,2)=NP+10:NL=NL+2:N
P=NP+1
SE 1670 NEXT PH:NL=NL-1:LN(NL-
1,1)=NP-1:LN(NL-1,2)=N
P+9:NEXT TH
PQ 1680 TH=4:FOR PH=0 TO 9:GOS
UB 1710
QH 1690 LN(NL,1)=NP:LN(NL,2)=N
P+1:NL=NL+1:NP=NP+1:NE
XT PH
QK 1700 NP=NP-1:NL=NL-1:LN(NL,
1)=NP:LN(NL,2)=NP-9:RE
TURN
AK 1710 RP(NP,1)=A*COS(TH*PI/1
0)*COS(PH*PI/5)
SA 1720 RP(NP,2)=A*COS(TH*PI/1
0)*SIN(PH*PI/5)
GG 1730 RP(NP,3)=B*SIN(TH*PI/1
0):RETURN

```

```

AS 1740 :
HP 1750 REM CENTER PRINT
SA 1760 IF LEN(A$)<38 THEN FOR
LP=1 TO 20-LEN(A$)/2:
PRINT CHR$(32);:NEXT
CJ 1770 PRINTA$:RETURN
HB 1780 :
SX 1790 PRINT:PRINT "{YEL}":A$=
"PRESS ANY KEY":GOSUB
{SPACE}1760
DM 1800 GET A$:IF A$="" THEN 1
800
HD 1810 RETURN

```

LISA.ML

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C000:4C 7D C0 4C 21 C0 4C 5B E3
C008:C0 4C CE C0 4C 64 C0 4C A4
C010:54 C6 4C A0 C6 06 07 00 5D
C018:00 53 4C 49 44 45 30 30 54
C020:00 20 7D C0 AD 15 C0 8D 36
C028:20 D0 A2 84 86 FC A2 00 F7
C030:86 FB A0 00 AD 16 C0 0A 59
C038:0A 0A 0A E0 15 C0 91 FB 1E
C040:C8 A6 FC E0 87 F0 09 C0 50
C048:00 D0 F3 E6 FC 4C 3E C0 41
C050:8C 17 C0 AE 17 C0 E0 E8 47
C058:D0 E4 60 20 A7 C0 A9 93 B0
C060:20 D2 FF 60 A9 00 85 FB 01
C068:A9 A0 85 FC A9 00 A8 91 97
C070:FB C8 D0 FB E6 FC A6 FC 71
C078:E0 C0 90 F3 60 AD 11 D0 98
C080:09 20 09 10 8D 11 D0 AD B0
C088:16 D0 18 29 DF 8D 16 D0 11
C090:AD 18 D0 18 29 DF 09 08 B1
C098:8D 18 D0 18 AD 00 DD 29 D4
C0A0:FC 09 01 8D 00 DD 60 AD C1
C0A8:11 D0 18 29 DF 8D 11 D0 A4
C0B0:18 AD 18 D0 18 29 F0 09 0A
C0B8:06 8D 18 D0 18 AD 16 D0 25
C0C0:29 EF 8D 16 D0 AD 00 DD 01
C0C8:09 03 8D 00 DD 60 20 6E 60
C0D0:C1 18 AD 42 C6 8D 4E C6 E2
C0D8:AD 43 C6 8D 4F C6 AD 44 E8
C0E0:C6 8D 50 C6 AD 45 C6 8D 3D
C0E8:51 C6 20 B5 C5 C9 03 F0 70
C0F0:1B C9 05 F0 17 18 AD 47 DD
C0F8:C6 C9 00 D0 03 20 23 C1 FD
C100:20 6E C1 AD 46 C6 8D 4C F6
C108:C6 4C 41 C3 18 AD 46 C6 31
C110:C9 00 D0 03 20 23 C1 20 F3
C118:6E C1 AD 47 C6 8D 4D C6 3B
C120:4C C3 C1 AD 08 CF 8D 6C D4
C128:C1 AD 0C CF 8D 08 CF AD 50
C130:6C C1 8D 0C CF AD 09 CF E3
C138:8D 6C C1 AD 0D CF 8D 09 7C
C140:CF AD 6C C1 8D 0D CF AD AE
C148:0A CF 8D 6C C1 AD 0E CF ED
C150:8D 0A CF AD 6C C1 8D 0E 85
C158:CF AD 0B CF 8D 6C C1 AD DC
C160:0F CF 8D 0B CF AD 6C C1 91
C168:8D 0F CF 0B 00 00 AD 08 D9
C170:CF 8D 4E C6 AD 09 CF 8D 34
C178:4F C6 AD 0C CF 8D 50 C6 E7
C180:AD 0D CF 8D 51 C6 20 F7 CE
C188:C5 8D 46 C6 AD 52 C6 8D 59
C190:42 C6 AD 53 C6 8D 43 C6 8B
C198:AD 0A CF 8D 4E C6 AD 0B 3C
C1A0:CF 8D 4F C6 AD 0E CF 8D 98

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C1A8:50 C6 AD 0F CF 8D 51 C6 CA
C1B0:20 F7 C5 8D 47 C6 AD 52 D6
C1B8:C6 8D 44 C6 AD 53 C6 8D CD
C1C0:45 C6 60 18 AD 43 C6 6A 98
C1C8:8D 3E C3 AD 42 C6 6A 8D 85
C1D0:3D C3 18 A9 00 8D 3F C3 F9
C1D8:AD 46 C6 C9 00 D0 05 A9 31
C1E0:01 8D 3F C3 AD 08 CF 8D 27
C1E8:48 C6 AD 09 CF 8D 49 C6 96
C1F0:AD 0A CF 8D 4A C6 AD 0B 74
C1F8:CF 8D 4B C6 20 BF C4 AD D4
C200:48 C6 8D 4E C6 AD 49 C6 38
C208:8D 4F C6 AD 0C CF 8D 50 E6
C210:C6 AD 0D CF 8D 51 C6 20 62
C218:B5 C5 C9 05 D0 01 60 AD 6C
C220:3F C3 C9 00 F0 1B 18 AD 41
C228:3D C3 6D 44 C6 8D 3D C3 D9
C230:90 03 EE 3E C3 AD 3E C3 95
C238:6D 45 C6 8D 3E C3 4C A3 B4
C240:C2 AD 44 C6 8D 50 C6 AD 70
C248:45 C6 8D 51 C6 AD 3D C3 14
C250:8D 4E C6 AD 3E C3 8D 4F 4F
C258:C6 20 B5 C5 C9 03 F0 17 AF
C260:20 F7 C5 AD 52 C6 8D 3D 8D
C268:C3 AD 53 C6 8D 3E C3 A9 A8
C270:01 8D 3F C3 4C A3 C2 AD 22
C278:44 C6 8D 4E C6 AD 45 C6 A6
C280:8D 4F C6 AD 3D C3 8D 50 B8
C288:C6 AD 3E C3 8D 51 C6 20 40
C290:F7 C5 AD 52 C6 8D 3D C3 09
C298:AD 53 C6 8D 3E C3 A9 00 CF
C2A0:8D 3F C3 AD 3F C3 C9 01 AD
C2A8:F0 03 4C 2F C3 AD 4D C6 1A
C2B0:C9 00 F0 0B EE 4A C6 D0 E8
C2B8:13 EE 4B C6 4C CC C2 CE 43
C2C0:4A C6 AD 4A C6 C9 FF D0 A5
C2C8:03 CE 4B C6 AD 3F C3 CD 19
C2D0:46 C6 F0 1C 18 AD 3D C3 C0
C2D8:6D 42 C6 8D 3D C3 90 03 74
C2E0:EE 3E C3 18 AD 3E C3 6D C2
C2E8:43 C6 8D 3E C3 4C 2F C3 C8
C2F0:AD 3D C3 8D 50 C6 AD 3E 25
C2F8:C3 8D 51 C6 AD 42 C6 8D EB
C300:4E C6 AD 43 C6 8D 4F C6 1C
C308:20 F7 C5 8D 40 C3 AD 52 ED
C310:C6 8D 3D C3 AD 53 C6 8D 18
C318:3E C3 AD 40 C3 CD 3F C3 01
C320:F0 08 A9 00 8D 3F C3 4C 94
C328:2F C3 A9 01 8D 3F C3 EE 5D
C330:48 C6 D0 03 EE 49 C6 20 22
C338:BF C4 4C FF C1 00 00 00 68
C340:00 18 AD 45 C6 6A 8D BC 8F
C348:C4 AD 44 C6 6A 8D BB C4 58
C350:18 A9 00 8D BD C4 AD 47 CA
C358:C6 C9 00 D0 05 A9 01 8D 21
C360:BD C4 AD 08 CF 8D 48 C6 3A
C368:AD 09 CF 8D 49 C6 AD 0A A6
C370:CF 8D 4A C6 AD 0B CF 8D BF
C378:8D 6E 20 BF C4 AD 4A C6 8F
C380:8B 4E C6 AD 4B C6 8D 4F F5
C388:C6 AD 0E CF 8D 50 C6 AD 86
C390:0F CF 8D 51 C6 20 B5 C5 42
C398:C9 05 D0 01 60 AD BD C4 6A
C3A0:C9 00 F0 1B 18 AD BB C4 90
C3A8:6D 42 C6 8D BB C4 90 03 3E
C3B0:EE BC C4 AD BC C4 6D 43 69
C3B8:C6 8D BC C4 4C 21 C4 AD 09
C3C0:42 C6 8D 50 C6 AD 43 C6 0C
C3C8:8D 51 C6 AD BB C4 8D 4E 7C
C3D0:C6 AD BC C4 8D 4F C6 20 62

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PROGRAMS

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C3D8:B5 C5 C9 03 F0 17 20 F7 32
C3E0:C5 AD 52 C6 8D BB C4 AD FF
C3E8:53 C6 8D BC C4 A9 01 8D A5
C3F0:BD C4 C4 21 C4 AD 42 C6 4C
C3F8:8D 4E C6 AD 43 C6 8D 4F 2E
C400:C6 AD BB C4 8D 50 C6 AD 05
C408:BC C4 8D 51 C6 20 F7 C5 54
C410:AD 52 C6 8D BB C4 AD 53 56
C418:C6 8D BC C4 A9 00 8D BD 72
C420:C4 AD BD C4 C9 01 F0 03 B2
C428:4C AD C4 AD 4C C6 C9 00 C7
C430:F0 0B EE 48 C6 D0 13 EE E5
C438:49 C6 4C 4A C4 CE 48 C6 FE
C440:AD 48 C6 C9 FF D0 03 CE 40
C448:49 C6 AD BD C4 CD 47 C6 6C
C450:F0 1C 18 AD BB C4 6D 44 47
C458:C6 8D BB C4 90 03 EE BC 97
C460:C4 18 AD BC C4 6D 45 C6 01
C468:8D BC C4 4C AD C4 AD BB DC
C470:C4 8D 50 C6 AD BC C4 8D AD
C478:51 C6 AD 44 C6 8D 4E C6 26
C480:AD 45 C6 8D 4F C6 20 F7 B1
C488:5D 8D BE C4 AD 52 C6 8D 4E
C490:BB C4 AD 53 C6 8D BC C4 BE
C498:AD BE C4 CD BD C4 F0 08 09
C4A0:A9 00 8D BD C4 4C AD C4 04
C4A8:A9 01 8D BD C4 EE 4A C6 12
C4B0:D0 03 EE 4B C6 20 BF C4 F0
C4B8:4C 7D C3 00 00 00 18 58
C4C0:A5 01 29 FE 85 01 38 A9 BC
C4C8:C7 ED 4A C6 8D B4 C5 A9 DB
C4D0:00 8D B0 C5 A9 A0 8D B1 CC
C4D8:C5 AD B4 C5 4A 4A 8D 41
C4E0:B2 C5 A9 00 8D B3 C5 A2 D3
C4E8:06 18 AD B2 C5 2A 8D B2 01
C4F0:C5 AD B3 C5 2A 8D B3 C5 50
C4F8:CA D0 EE A2 05 18 AD B2 BA
C500:C5 6D B0 C5 8D B0 C5 90 87
C508:03 EE B1 C5 18 AD B3 C5 08
C510:6D B1 C5 8D B1 C5 CA D0 5B
C518:E4 AD 48 C6 8D B2 C5 AD 67
C520:49 C6 8D B3 C5 A2 03 18 C5
C528:AD B3 C5 6A 8D B3 C5 AD 4B
C530:B2 C5 6A 8D B2 C5 CA D0 BF
C538:EE A2 03 18 AD B2 C5 2A B3
C540:8D B2 C5 AD B3 C5 2A 8D 69
C548:B3 C5 CA D0 EE 18 AD B2 6B
C550:C5 6D B0 C5 8D B0 C5 90 D7
C558:03 EE B1 C5 18 AD B3 C5 58
C560:6D B1 C5 8D B1 C5 18 AD 23
C568:B4 C5 29 07 18 6D B0 C5 F2
C570:8D B0 C5 90 03 EE B1 C5 AD
C578:18 AD 48 C6 29 07 8D B2 24
C580:C5 A9 07 18 ED B2 C5 AA 2E
C588:18 A9 01 E0 00 F0 04 0A 8E
C590:CA D0 FC 8D B2 C5 AD B0 E6
C598:C5 85 FB AD B1 C5 85 FC 6F
C5A0:A0 00 B1 FB 0D B2 C5 91 C2
C5A8:FB A5 01 09 01 85 01 60 CC
C5B0:00 00 00 00 00 AD 4F C6 58
C5B8:CD 51 C6 F0 08 B0 03 A9 1A
C5C0:04 60 A9 03 60 AD 4E C6 E8
C5C8:CD 50 C6 F0 05 B0 F3 A9 B3
C5D0:04 60 A9 05 60 A9 00 8D 33
C5D8:53 C6 18 AD 4E C6 6D 50 56
C5E0:C6 8D 52 C6 90 03 EE 53 AB
C5E8:C6 18 AD 4F C6 6D 51 C6 DD
C5F0:6D 53 C6 8D 53 C6 60 20 50
C5F8:B5 C5 C9 03 F0 22 AD 51 F6
C600:C6 8D 53 C6 38 AD 50 C6 0B

```

```

C608:ED 4E C6 8D 52 C6 B0 03 E3
C610:CE 53 C6 38 AD 53 C6 ED 6C
C618:4F C6 8D 53 C6 A9 01 60 25
C620:AD 4F C6 8D 53 C6 38 AD DD
C628:4E C6 ED 50 C6 8D 52 C6 29
C630:B0 03 CE 53 C6 38 AD 53 AB
C638:C6 ED 51 C6 8D 53 C6 A9 2C
C640:00 60 00 00 00 00 00 E5
C648:00 00 00 00 00 00 00 D5
C650:00 00 00 00 A5 01 29 FE 60
C658:85 01 A9 19 85 FB A9 C0 DF
C660:85 FC A9 0F A2 08 A0 FF 8C
C668:20 BA FF A9 07 A6 FB A4 BE
C670:FC 20 BD FF A2 00 A9 A0 45
C678:85 FC A9 00 85 FB A9 FB A8
C680:A0 BF A2 40 20 D8 FF EE F9
C688:1F C0 AD 1F C0 C9 3A 90 AF
C690:08 A9 30 8D 1F C0 EE 1E 63
C698:C0 A5 01 09 01 85 01 60 21
C6A0:A9 3B 85 FB A9 CF 85 FC D6
C6A8:A9 0F A2 08 A0 00 20 BA A3
C6B0:FF AD 3A CF A6 FB A4 FC 59
C6B8:20 BD FF A9 00 A2 00 A0 8B
C6C0:A0 20 D5 FF 60 00 00 00 64

```

Bruce Bowden is one of *COMPUTE's* programmers. He can be reached on QuantumLink as GazetteBMB. □

BUG-SWATTER

The machine language listing for *Song Machine* (October 1991) contained several errors. In order to correct them, load and run *MLX* and respond with *Song Machine's* original starting and ending addresses. Then select Load File from the *MLX* menu and load the corrupted copy of *Song Machine*.

When the *MLX* Command Menu returns, select Enter Data. When prompted for a starting address, give the address listed below and then enter the first block of data. Press Return on an empty line to return to the Command Menu. Select Enter Data again for the second block of data, using its starting address. When both blocks of data have been entered, save the program with a new name before exiting *MLX*.

A similar problem occurred with *Add Check* (October 1991). It can be corrected in the same manner.

Starting address: 0C69

```

0C69:00 85 FE 18 A5 30 69 28 2D
0C71:85 30 A5 31 69 00 85 31 A7
0C79:18 A5 32 69 28 85 32 A5 45
0C81:33 69 00 85 33 E8 E0 0D F1
0C89:D0 A9 60 A2 00 A0 00 A9 D6
0C91:60 20 D2 FF C8 C0 28 D0 A6
0C99:F8 E8 E0 05 D0 EF 60 20 FB
0CA1:44 E5 A0 00 B9 76 93 20 58

```

```

0CA9:D2 FF C8 C0 1E D0 F5 60 D0
0CB1:8E EF 02 AE F3 03 E0 01 A6
0CB9:F0 52 AE D7 02 E0 01 B0 78
0CC1:11 AE D8 02 E0 01 B0 0A BF
0CC9:AE D9 02 E0 01 B0 03 4C 1B
0CD1:4D 84 A2 0F 8E 18 D4 4C C1
0CD9:52 84 A2 00 8E 18 D4 AE BD
0CE1:D7 02 E0 00 F0 2C CA 8E DE
0CE9:D7 02 E0 00 F0 24 AE D8 D8
0CF1:02 E0 00 F0 26 CA 8E D8 A4

```

Starting address: 19E1

```

19E1:91 8E 83 03 C8 C8 C8 C8 E4
19E9:C8 A2 00 B9 35 03 9D 89 3F
19F1:03 E8 C8 CC 34 03 B0 03 D7
19F9:4C 5E 91 8E 88 03 E0 04 1B
1A01:B0 C4 88 C0 00 F0 BF B9 D8
1A09:35 03 C9 56 D0 F4 C8 B9 DC
1A11:35 03 C9 31 F0 09 C9 32 5E
1A19:F0 20 C9 33 F0 37 60 AD 0D
1A21:A7 02 8D 7A 03 AD A8 02 25
1A29:8D 7B 03 AD A9 02 8D 7C 2B
1A31:03 AD AA 02 8D 7D 03 4C 7C
1A39:E0 91 AD AB 02 8D 7A 03 F0
1A41:AD AC 02 8D 7B 03 AD 8F 81
1A49:02 8D 7C 03 AD AE 02 8D 5B
1A51:7D 03 4C E0 91 AD AF 02 41
1A59:8D 7A 03 AD A0 02 8D 7B 52
1A61:03 AD B1 02 8D 7C 03 AD EA
1A69:B2 02 8D 7D 03 20 D8 8F DA
1A71:C9 0D F0 AA 18 AD 76 03 FD
1A79:6D F5 02 85 FB AD 77 03 03
1A81:6D F6 02 85 FC 18 AD 78 DE
1A89:03 6D F5 02 85 FD AD 79 72
1A91:03 6D F6 02 85 FE A0 00 0B
1A99:B9 84 03 99 7F 03 C8 CC 2C
1AA1:83 03 D0 F4 4C 1B 92 60 16
1AA9:AD 83 03 8D 7E 03 20 D8 E7
1AB1:8F C9 0D F0 F2 18 AD 76 9A
1AB9:03 6D F5 02 85 30 AD 77 69
1AC1:03 6D F6 02 85 31 18 AD A0
1AC9:78 03 6D F5 02 85 32 AD 40
1AD1:79 03 6D F6 02 85 33 A0 CD

```

ADD CHECK

Starting address: 0861

```

0861:34 03 AD 34 03 A2 35 A0 F2
0869:03 20 BD FF A9 02 A2 08 5D
0871:A0 02 20 BA FF 20 C0 FF 04
0879:A9 0D 20 D2 FF A2 0F 20 9B
0881:C6 FF 20 CF FF 20 D2 FF 1C
0889:20 CF FF 20 D2 FF C9 30 F9
0891:D0 0D 20 CF FF 20 D2 FF 74
0899:C9 0D F0 0B 4C 93 08 A9 09
08A1:FF 8D B2 02 4C 93 08 AD F9
08A9:B2 02 C9 FF F0 48 A2 02 BC
08B1:20 C6 FF 20 E4 FF 85 FB B3
08B9:85 FD 20 E4 FF 85 FC 85 F3
08C1:FE A9 00 8D BA 02 8D BB 49
08C9:02 A0 00 20 E4 FF 18 AD 0A
08D1:BA 02 69 01 8D BA 02 AD 06
08D9:BB 02 69 00 8D BB 02 18 EC
08E1:A5 FD 69 01 85 FD A5 FE EF
08E9:69 00 85 FE 20 07 FF C9 F8
08F1:00 D0 03 4C CC 08 A2 00 27
08F9:20 C6 FF A9 02 20 C3 FF 7E

```

REVIEWS

THE TERMINATOR

Not many games leave players with the desire to stalk the streets brandishing an AK-47 rifle. The cartoon violence in most action adventure games these days shows opponents disappearing in flashes of light or simply falling in a neat heap on stone floors. You don't find such effects in *The Terminator*.

Based on the relentless action film, *The Terminator* mirrors its 1984 namesake, offering a wealth of destructive potential. You can play either the killer cyborg from the future or the cunning tactical expert Kyle Reese, who must protect the Terminator's target, Sarah Conner, the mother of an unborn revolutionary.

Gun stores and army depots await in central Los Angeles. Pick up bulletproof jackets, automatic weapons, and even a Stinger missile—but mounting this offense (and defense) takes time—time in which your opponent might decide to end the conflict.

As the Terminator, strategy doesn't much concern you. Simply pick up your rifles and hunt down Sarah Conner. But even a twenty-first-century cyborg isn't indestructible. Reese will do everything he can to stop you—a lot rides on his success. And those LA police officers are no wimps.

When you zero in on civilians or law enforcement officers, a closeup of your hit appears onscreen. The wounded don't just fall; bullets knock them off their feet and force out blood. Bethesda claims these scenes were so popular early on that it now offers a separate disk with more of these closeups.

If you prefer strategy over pure violence, make Reese your choice. He'll need more time to plan and gather supplies, but the blows dealt de-

liver greater satisfaction than what you would get by playing a remorseless cyborg. Sarah Conner stands by your side when you begin. Protect her well. She can carry supplies if you become too weight-

through their eyes (if they can still see). Step into a weapons store or shooting range and a 256-color screen appears.

Kill or destroy one of your opponents and you'll be treated to full-screen action cine-



Everyone's favorite killer cyborg is back to wreak havoc in *The Terminator* from Bethesda Softworks.



On the leading edge costwise, the elegant and lightweight *Leading Technology 9800NB* runs at 20 MHz and uses a Cirrus Logic VGA controller.

ed down with weaponry and ammunition, and remember that she'll teach her unborn son the ways of a rebel.

Unlike other recent 3-D games, this product puts you in direct control of the characters. You see the world

through their eyes (if they can still see). Step into a weapons store or shooting range and a 256-color screen appears. Kill or destroy one of your opponents and you'll be treated to full-screen action cine-

matography. These great shots make up for the less than superb point-of-view game graphics in which characters sometimes disappear seemingly at will or walk through walls.

When you play the part of the Terminator, a heads-up display overlays your optical vision, providing accurate target acquisition information. Just be aware that the faster the pace, the slower the action. This means greater frustration in attack mode, so choose less detail even on a faster than average machine.

The Terminator sports impressive sound. In addition to providing sound card support, this game lends the internal speaker some respectability via Real Sound technology. Be sure to remove any TSR programs and use expanded memory. Otherwise, *The Terminator* is sluggish and prone to nondescript buzzes and graphical errors.

Even with the occasional annoying bugs, *The Terminator* offers magnificent detail in its graphics and movement options. There's nothing like taking a few shots at your target as you make a strategic withdrawal from the ever-present police force. Load that 9-mm Uzi and take aim. The fate of humanity rests on your shoulders.

JONATHAN BELL

IBM PC and compatibles (80286 or faster recommended); 640K RAM; EGA or VGA; requires hard drive; supports Ad Lib and Sound Blaster; joystick optional—\$54.95

Animated Combat Sequence Disk—\$24.95

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Circle Reader Service Number 324

LEADING TECHNOLOGY 9800NB

The steady stream of new 386SX notebooks is starting to look like the circus act where one clown after another spills out of a car. After a while, you lose count and

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they all begin to look alike.

To grab our attention these days, savvy notebook manufacturers have to offer one or more unique features or a substantially lower price. While the 9800NB has a few interesting features, its primary claim to fame is cost. Leading Technology computers are sold at highly competitive prices in many of the mass-market discount chains. But even if the price is right, should you buy it?

First, let's look at what's good about this machine. It runs at 20 MHz (many 386SX notebooks still run at 16 MHz), takes as much as 8MB of RAM (more than most), uses the Cirrus Logic VGA controller (still the best one for converting color to 32 shades of gray), gets a healthy 2-2½ hours on a battery charge with the built-in power-saving features, weighs only 6.6 pounds, includes an easy-to-use DOS shell, and can plug into an optional expansion chassis.

With these features, the 9800NB stands out from the crowd. In addition, if you care about looks, it has a stylish, almost machine-like appearance that's quite attractive.

Other features work well but are slightly flawed. The keyboard has a nice springy feel, although I didn't care for the reverse L placement of the arrow keys (other notebook computers use the more intuitive upside-down T shape.) And while the 40MB Seagate hard drive is reasonably fast, I couldn't get it to work with *Stacker 1.1*.

What doesn't work at all? Only one thing, although it could be a major problem for many notebook users. Because there's no provision for an internal modem and the 9800NB has only one serial port, you can't use a mouse and a modem at the

same time. That means you can't use *Windows* communications programs unless you use them with keyboard commands (good luck!).

On the other hand, if you don't think you'll be using your notebook to go online or you're happy with your current text-based communica-

of cereal in single-serving boxes, probably only two or three were kinds you really liked. This all brings us to *FastLynx LapPack*, "the complete software system for the laptop computer."

Packaged in a box large enough to hold a football, *FastLynx LapPack* offers ten

fer of information between desktop and laptop computers; and *Mergelt! Phonelist*, a well-designed phone-number-and-address database. You also get *FastLock*, which provides hard drive security by requiring a password to boot up, and *EZC Smart Cursor*, which (drum roll, please) allows you to change the shape of your cursor!

Obviously, some of *FastLynx LapPack's* programs are more valuable than others, and no bundle—even a package with this many programs—can possibly please all users.

For instance, *The Maximizer* would probably interest a business user who must keep in close contact with clients (besides an appointment calendar and stripped-down ledger function, it includes ready-made letters to be mailed for birthdays and anniversaries), but it would be of little use to just about anyone else.

The enclosed *CompuServe* starter kit will prove valuable to a telecommunications newcomer, but for someone already using *CompuServe* or someone without a modem, this part of the package isn't of much use.

Most of the *FastLynx LapPack* programs are easy to install, easy to learn, and quite efficient, however. Both *CO/Session*, which lets one PC control another via modem, and the previously mentioned *FastLynx* program make it easy for your laptop to interact with your desktop computer, and *Switch-It* allows for quick entrances and exits between programs—much like going back and forth between windows in a word processing program.

SitBack backs up your files automatically, and *FastJuice* provides the often



FastLynx LapPack includes ten programs for your laptop computer.

tions program, this shouldn't be a problem. To sum up, if you can find the 9800NB for a great price, this could be the notebook for you.

DAVID ENGLISH

Leading Technology 9800NB, 2MB of RAM, VGA screen, 20MB hard drive—\$2,249

LEADING TECHNOLOGY
10430 SW Fifth St.
Beaverton, OR 97005-3447
(503) 646-3424

Circle Reader Service Number 325

FASTLYNX LAPPACK

If you saw double features as a kid, you probably wouldn't have minded skipping one of the movies some of the time. If you bought sampler packs

software packages for a suggested price of \$299.95, which the Rupp Corporation claims would cost \$1,049.00 if purchased separately. Is it a bargain in a big box, then, or an overabundant bundle?

To begin with, it's hard to consider something with no word processor, spreadsheet, or full communications program "a complete software system."

On the other hand, *FastLynx LapPack's* ten programs generally work well, providing a variety of functions—though some are more useful than others.

The package includes *The Maximizer*, a contact management program for business professionals; *FastLynx*, which allows easy trans-

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Circle Reader Service Number 182

REVIEWS

indispensable service of monitoring your laptop's battery charge. Just weigh your needs before letting *FastLynx LapPack* substitute for careful software shopping.

So is *FastLynx LapPack* a ten-pack of your favorite Chocolate-Frosted Sugar Bombs or a disappointing medley of Bombs, Nutty Berries, and Nothing but Bran? Probably the medley, but maybe a boxful of favorites if you're lucky. Check the ingredients first. Then purchase with care.

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Circle Reader Service Number 326

PERSONAL COMPUTING FOR WOMEN

What's the advantage women have in learning to use a PC? "Women can type." If that line doesn't convince you not to buy this superfluous course in personal computing, keep reading. I'll convince you.

My first question is why a beginners' guide to PCs should be gender-specific. Author Maria Hoath's observations such as "When we start our cars we don't know how the gas gets to the engine" and questions like "Remember how befuddled you were when your VCR arrived?" tell all.

Women are innately computerphobic, she claims. Why? We're afraid we "might press the wrong key and erase everything."

When I finally got through the pages of endless male bashing, "case histories" of women who have actually used personal computers (imagine that), and "facts" that ironically emphasize Hoath's lack of confidence in her own gender, I was halfway through the book.

Nowhere does she list a single source of information to support her statements, and yet she offers strange assertions like "software is usually regional in its popularity—what people use in one state may be unknown in another state." Tell that to the manufacturers.

Unfortunately, Hoath devotes only 26 pages to what should have been the focus of her effort—personal computers. While not in-depth, her information is at least useful to a novice, but mysteriously enough, she deems that part of the book optional. Go figure.

In Maria Hoath's world, every boss is a condescending male, and every woman an aimless airhead, perplexed by the complex. "This is an awful lot of techy terms, isn't it?" I can almost see her wink. At \$9.95 for 152 pages of nothing, this book is an expensive joke.

JILL CHAMPION

Author: Maria Hoath 152 pages—\$9.95

WRITE BYTE PUBLISHING
P.O. Box 835
Alpharetta, GA 30201-9998
(404) 740-0659

Circle Reader Service Number 327

"TALKING" ONCE UPON A TIME . . . VOLUME III: JOURNEY THROUGH TIME

My nine-year-old daughter used *Once upon a Time* to write a book. What she didn't know was how much spelling, grammar, and linear logic she was learning in the process. *Once upon a Time* combines word-processing and drawing software in a unique educational experience that kids will think is nothing but fun. Volume III of *Once upon a Time* lets kids actually create books set in medieval times, in the Wild West, or in outer space—all on the PC. Volume I offers Farm Life, Down Main Street, and On Safari scenarios. The variety of stories and pictures that kids can actually create within each scenario is almost entirely up to them.

Referring to *Once upon a Time* as a drawing program is misleading. The child doesn't actually draw anything on the screen. Instead, he or she selects an appropriate background (four per scenario including a blank) and then places any number of picture elements, selected from an on screen list, anywhere on that background. The upper two-thirds of the screen is the child's selected background. The bottom third offers a list of commands that can be

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selected by simply moving a highlight bar. Backgrounds can be switched, for example, by simply highlighting the Background command and hitting the Return key. The Draw option allows the child to place a picture element directly on the background he or she has selected. The F1 key displays a list of all available picture elements for the selected scenario. In a flash of brilliance, the creators of *Once upon a Time* have set things up so that the child types in the name of each selected picture element before it will appear on the background. The child thus reads the list and learns the words. Each of the three scenarios allows selection from roughly two dozen different picture elements. In the Medieval Times scenario, for example, the child can put wizards, horses, knights, tables, and much more on backgrounds illustrating a castle's interior, hills and a distant village, or a blank or black screen. Using the computer's arrow keys, a child can place each selected element anywhere on a background. Highlighting the appropriate command at the bottom of the screen and typing in the element's name allows your child to flip, delete, or move elements.

Most amazing, however, is the program's ability to actually speak the name of each picture element, crisply and clearly, through the computer's existing speaker. The child simply highlights a picture element on the on screen list and then hits F2, and its name is spoken. This, of course, makes *Once upon a Time* an even better reading and spelling aid than it might have otherwise been. It's certainly convenient, too, since you don't

need any additional hardware or software to perform this nearly miraculous feat.

When I said my daughter wrote a book, I wasn't kidding. *Once upon a Time* also has some attractive word-processing capabilities. They will at first seem limited, but this is a program for children ages 7-12. Kids that age don't want or need comprehensive features such as block move or search-and-

replace. They just want to write, and *Once upon a Time* lets them do just that.



Volume III of *Once Upon a Time* lets kids explore medieval time, the Wild West, outer space, and the universe of their own imaginations.

replace. They just want to write, and *Once upon a Time* lets them do just that.

No, my daughter didn't sell her book to a major publisher and make enough money to buy me a new car, but she was happy and busy for hours, writing her story and creating pictures to go with it, then coloring the final printed results. She learned a lot of new words and organizational skills in the process. Now she's bugging me to get off the computer and let her start on her next creation, and she hasn't caught on that she's learning while she creates. That's why I think *Once upon a Time* is one of the best examples of quality educational software

that I've seen in a long time.

ALAN R. BECHTOLD

IBM PC and compatibles; 384K RAM; CGA, EGA, MCGA, VGA, Tandy 16-color, or Hercules; joystick or mouse—\$49.95

Also available for Apple II series (non-talking)—49.95, Apple IIgs—\$59.95, and Macintosh—\$49.95

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Circle Reader Service Number 328

EPSON EQUITY 386SX/20 PLUS

When was the last time you were dazzled by a computer? In addition to power, speed, and a commitment to the needs of the average user, Epson's EQUITY 386SX/20 PLUS offers remarkable graphics based on Edsun's CEG anti-aliasing chip.

The power and speed come from the 20-MHz 386SX microprocessor, 2MB of fast zero-wait-state DRAM (Dynamic Random Access Memory), a 100MB hard drive (a 40MB drive is available), and a 32K SRAM (Static Random Access Memory) cache. For computation-inten-

sive applications, the cache optimizes system performance by holding oft-used instruction sequences, allowing the microprocessor to use them without any wait states. While the DRAM offers fast performance with its 80-ns rating, the SRAM wins the race with its blazing 25-ns rating.

If you need more speed, and especially if you plan to run *Windows*, I recommend adding more memory. This Epson allows you to expand RAM to 16MB maximum, 14MB on the system board alone with Single In-line Memory Modules (SIMMs).

You have room for three drives altogether, two mounted horizontally and one (unexposed, for a hard drive) mounted vertically. While Epson offers a choice of VGA monitors (monochrome, regular, and extended) and operating systems (MS-DOS 3.3, 4.01, and 5.0), I was surprised to find that you pay extra for them. Epson will, however, throw in *Microsoft Windows* software free with every purchase of the operating system for this computer, and Epson also gives you Bitstream's *Facelift*, a font-generation program for *Windows* that allows you to create scalable fonts for your printer and screen.

Epson's commitment to the needs of the computer user is apparent in its documentation and in the design of the computer. I give Epson an A for its excellent User's Guide, which offers attractive design, a multitude of illustrations, thoroughness, and readability. In addition to the usual information on set up and use of the computer, this manual covers safety, installation of options, system diagnostics, troubleshooting, and more. Throughout, Epson includes boxes with notes, cautions, and other information deserv-

ing special attention. There's also a glossary of computer terms at the end of the guide.

The first time you set the computer up, you'll need to run Epson's setup program, which defines your configuration. This is probably the only part of the guide you'll need to consult if you have some computer experience under your belt. If you need more guidance, Epson covers everything from finding an appropriate location for your computer to connecting system components and running through your options in the setup program. Your options include setting a password, enabling or disabling the cache, turning your speaker on or off, and setting the keyboard repeat rate.

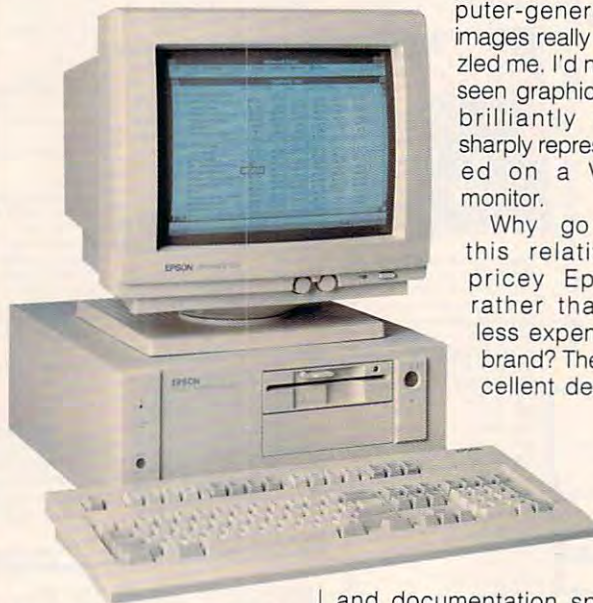
Access to the EQUITY system box couldn't be easier. Forget about screwdrivers—just turn a wheel lock, push in two releases on the back of the box, and tilt the top up and off. At six inches high, this box offers plenty of room for installation and adequate ventilation. If you need access to the right portion of the system board, you can easily lift out the drive bay/power supply subassembly—once again, without using a screwdriver.

This EQUITY gives you four full-size card slots—three 16-bit and one 8-bit. Because the video output, mouse port, serial port, parallel port, and video adapter port are integrated into the system board, you really don't need many slots.

On the front of the box, you'll find a power button on the right, out of the way of the keyboard but recessed to help you avoid hitting it accidentally. To the left you'll find a hard disk access light. Below it is a light to let you know when the computer is in turbo (20-MHz)

mode, and below that is a small, recessed reset button. Accidental reboots should be a thing of the past; you have to aim and deliberately try to hit this one.

The 101-key keyboard served my purposes well, and I didn't find anything remarkable to distinguish it



from most other keyboards.

The built-in VGA adapter with 512K of video memory supports up to 800 × 600 pixels in 16 colors or up to 640 × 480 pixels in 256 colors. With a CEG chip, however, you have an apparent resolution of at least 1563 × 1280, and that's with a standard VGA monitor. Here's how it works: The CEG chip uses a technique called anti-aliasing to blend colors between adjacent pixels, getting rid of the jagged edges typical of most displays. You see rounder curves and, according to Epson, you have access to a color palette of more than 700,000 shades.

There are now CEG display drivers for *Windows*, *PageMaker*, *Excel*, *Ami Pro*, and several other programs.

(For a current listing, contact Edsun Laboratories, Marketing Department, 564 Main Street, Waltham, Massachusetts 02154; 617-647-9300.)

I used the *Windows* CEG driver and was impressed with many of the features as well as the CEG screen blanker. A CEG demo with photographs and computer-generated images really dazzled me. I'd never seen graphics so brilliantly and sharply represented on a VGA monitor.

Why go for this relatively pricey Epson rather than a less expensive brand? The excellent design

and documentation speak well for the computer, and Epson has a reputation for durability and dependability. Also, you can bet that Epson will be around for some time. If you depend heavily on your computer and need that kind of reliability and reputation, this is a computer to consider. And if you want the marvels of the CEG chip now, this Epson is the way to go.

MIKE HUDNALL

Epson EQUITY 386SX/20 PLUS with 2MB RAM, 32K SRAM cache, 3½-inch 1.44MB drive, and 100MB drive—\$2,799

Super VGA monitor—\$635, DOS 3.3—\$95, DOS 4.01—\$125, DOS 5.0—\$155

EPSON AMERICA
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Torrance, CA 90509-2842
(800) 922-8911

Circle Reader Service Number 329

NEC GRAPHICS CDs

Where can a desktop publisher go in search of stock art? Where can you find useful black-and-white and color photographs, images, and clip art? NEC provides the answer to this question with its wide-ranging collection of graphics CDs that includes *Photo Gallery* (black-and-white photos), *Image Folio* (color photos), *Clip Art 3-D*, and *Image Gallery* (conventional clip art). *Type Gallery PS*, another product, provides attractive, professional typefaces.

Photo Gallery comes with a book illustrating each of the hundreds of professionally photographed images available through this program, categorized by content. The images are in TIF format with gray scale information, so they're easy to use with most desktop publishing and word processing programs that can import art.

Because this collection was designed for broad use, the art looks generic. However, you're virtually guaranteed that *something* here will meet your needs.

If you're generating a publication for personal use, for use within your company, or for nonprofit use, you can reproduce any of the images as often as you please. However, if you're publishing for profit, you'll have to pay UNIPHOTO Picture Agency, the photo service owning the copyright to the photographs, for use of the images above the cost of the CD product. (This also applies to the *Image Folio*, which contains color photos.) Color versions of many of the photos are available from UNIPHOTO.

One thing you should be aware of before purchasing this package is the graini-

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ness of gray scale images when they're reproduced on a laser printer. Photos are more appropriate for use in typeset documents, and laser printers are more appropriate for proofing photos prior to typesetting (making sure you're using the right photo in the right place, that the picture is right side up, and so on). If your final output is on a laser printer, you might be better off either using conventional vector clip art or using the photos for scanning purposes to create your own vector clip art.

I often use photographs in desktop publishing as raw material for scanning and tracing. A product like *Photo Gallery* reduces the need for scanning. By and large, however, the images aren't good candidates for tracing—they aren't usually high-contrast images with simple content. More often, black-and-white photography gets its power from complex shadings that defy all but the most gymnastic of scanning software. The images work with any graphics package that uses the TIF format.

Type Gallery PS allows you instant access to any 3 typeface families out of 116—a family is a collection of roman, bold, italic, and bold italic fonts—on the CD. Once you've accessed three, to access additional typeface families you have to pay NEC a premium (on top of the \$399 price of the product) between \$49 and \$249, depending on the size of the family. These typefaces must be used with a PostScript device.

Image Gallery offers a similar arrangement. For the price of the CD, you're allowed access to any 6 of the 20 categories of clip art provided on the disc. Additional categories (like Fashion and Food, containing an average

of 210 images each) will be unlocked for \$99 each.

Image Folio gives you access to over 4000 color images in "VGA resolution"—320 x 200 pixels. *Clip Art 3-D* comes with 2500 three-dimensional clip art images.

ROBERT BIXBY

IBM PC and compatibles; 640K RAM; EGA, VGA, or Hercules; hard disk; CD-ROM supporting ISO 9660 format; MS-DOS CD extensions

Clip Art 3-D, Image Folio, Image Gallery, Photo Gallery, Type Gallery PS—\$399 each

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(800) 366-3632

Circle Reader Service Number 330

PANASONIC KX-P1123 PRINTER

How do you choose the right printer? Price comes first on many lists and often determines the quality and number of features you'll get. If you can afford a price tag of \$400, you should take a look at Panasonic's new KX-P1123, a quality printer with a number of attractive features.

Just right for home, office, or school, this 24-pin printer offers multiple fonts, an easy-to-use push-button front panel, and simple installation.

Available fonts include Courier and Prestige in draft or LQ modes and proportional spacing and script modes. In addition, you can take advantage of the printer's bold, italic, double-height, double-width, and double-strike capabilities. Control centering attributes, set the margins, create three macros, or return to factory settings—all at the push of a button.

The KX-P1123 doesn't stop with an array of fonts.

This printer adapts well to fanfold paper as well as to single sheets and envelopes in a variety of sizes and weights.

Special features such as printing in landscape mode, creating macros to store different print formats, dumping the data in hex format, and designing and downloading custom characters make this printer worthy of your attention. Less spectacular but no less important are the paper park and perforation cut functions that avoid paper waste and advance the paper to the tear position.

The unit comes with a 10K buffer, but for an additional \$60, you can add a 32K buffer chip that comes with easy-to-follow instructions.

Even with all the extras, it only took me around 20 minutes to start printing in different fonts and producing quality forms from the command line and with *Express Publisher*. The easy-to-understand manual with all of its diagrams and explanations helped to speed things up. The KX-P1123 package also includes a maintenance and troubleshooting guide.

I spent most of the 20 minutes of installation time trying to load the fanfold paper. Of the three methods of paper installation, the rear-feeding method proved by far the hardest to conquer. Since the tractors roll during paper loading, precision positioning of the fanfold sheets took several attempts. The paper would catch on one tractor but not the other. Once it was installed properly, I had no further trouble with the paper.

Although not the fastest printer I've used, this Panasonic printer is no sloth either. Printing at 240 cps in draft mode and 53 cps in LQ mode might cause a few delays, but a print spooler could remedy that bottleneck.

The KX-P1123 prints bit-image graphics at 240 dpi. There were a few jaggies, but that's to be expected in any dot-matrix printout whether it's text or graphics.

Don't look for compatibility problems from this printer. The two emulation modes, Epson LQ-850 and IBM ProPrinter X24, should work with almost any software package.

With a two-year limited warranty and technical support and customer service departments a toll-free call away, the KX-P1123 belongs on every cost-conscious shopper's list of printers to evaluate.

JOYCE SIDES

Panasonic KX-P1123—\$369.95

PANASONIC COMMUNICATIONS & SYSTEMS
Computer Products Division
Two Panasonic Way
Secaucus, NJ 07094
(800) 742-8086

Circle Reader Service Number 331

TEENAGE MUTANT NINJA TURTLES WORLD TOUR— ELECTRIC CRAYON DELUXE

Circling the globe with the Ninja Turtles may not be everyone's idea of a great time, but most youngsters ages 3 and up will enjoy the trip. Each of the 30 pictures in this computer coloring book features the Turtles visiting a major tourist attraction and includes a description of the site.

Choose from 16 colors in EGA mode, and mix these for a total of 256 different shades. A mouse works best for clicking on a color and filling an area. Drawings may be erased and tried again. Completed masterpieces can be saved and printed in different formats.

*Les Manley in:
Lost in L.A.*

“SHE STOOD NAKED,

HER WET BODY BATHED IN BEVERLY

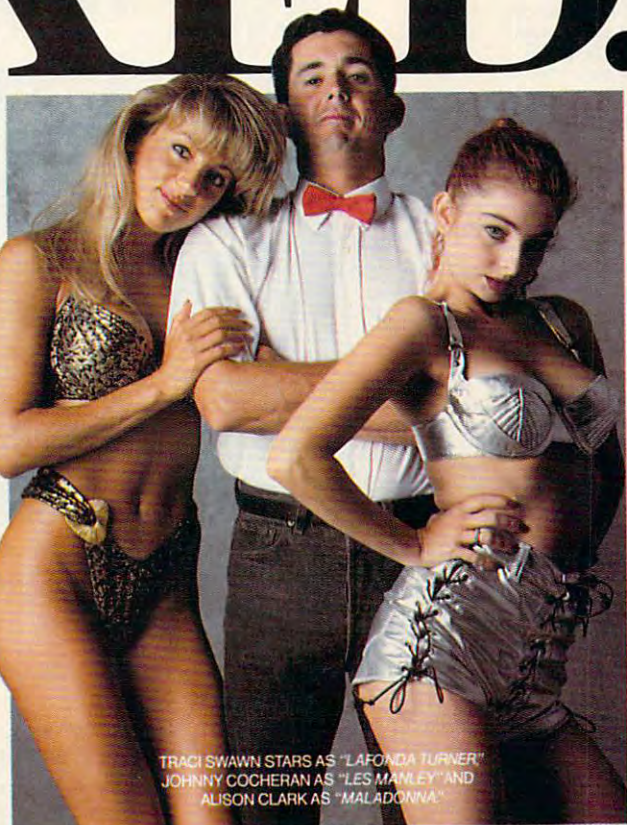
HILLS MOONLIGHT. THE STRANGER CREEPT
OUT FROM THE SHADOWS TOWARDS THE POOL. LIKE

THE STARLETS WHO HAD VAN-
ISHED BEFORE HER, SHE WAS
OBLIVIOUS TO HIS MENACING

PRESENCE. HER
SCREAM WAS NOT
HEARD! THE HIPPEST
STARS IN HOLLYWOOD
ARE BEING KIDNAPPED.
AND ONLY ONE MANLEY
CAN SOLVE THE CRIME
OF THE CENTURY. *LES
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LA LAND. MEET GOR-
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Cowabunga, dudes! For kids, this one's a hit!

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Circle Reader Service Number 332

FLOW CHARTING 3

Having drawn hundreds of system flow charts with a pencil and template in my auditing work, I found the prospect of computerizing this tedious task especially attractive. Happily, Patton and Patton's *Flow Charting 3* whips up a high-quality flow chart with only a little effort on your part.

The designers exercised commendable restraint in refraining from trying to be all things to all users with *Flow Charting 3*. Instead, they concentrated on the essentials, added only a few frills, and produced a workmanlike product that will do the basic job for almost anyone.

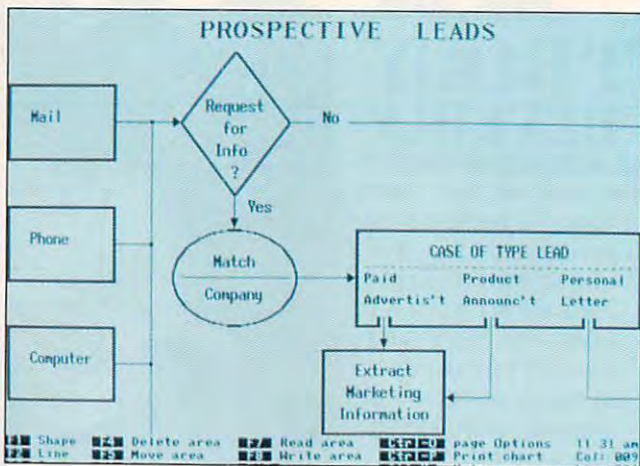
A keyboard-based program, *Flow Charting 3* uses function keys, Ctrl- and Alt-key combinations, and some clever, effective shortcut keys to handle its specialized tasks. You won't do any freehand work in this program, since it's optimized for standard flow charting. The mouse functions seem to be an afterthought, but for a few chores such as basic cursor repositioning, your hand automatically moves to the mouse.

Flow charts use a standard symbol set: rectangles for processes, diamonds for decisions, and so on. *Flow Charting 3* gives you 35 ba-

sic symbols, each coming in up to 12 sizes and shapes (tall or squat rectangles, for instance). Looking through the illustrations of each symbol in Appendix C, I couldn't imagine a flow charting function that Patton and Patton failed to include.

and direct approach. Upon finishing the tutorial, I felt ready to create virtually any flow chart.

With *Flow Charting 3*, you can quickly create a flow chart you'll be proud to present to any board of directors. And years from now,



Flow Charting 3 from Patton and Patton Software allows for simple or complex onscreen logic tracking.

Once you choose your symbols, you need to connect them with lines. Simple and direct, line drawing has provisions for arrowheads, multiline connectors, and bypasses. Lines—thin, thick, hollow, and dashed—require but a moment to add.

Ten text styles—normal, bold, wide, fat, tall, Greek, subscript, superscript, micro, and title—complete your chart. You don't have a wealth of possibilities to indulge your creative urges, but you can include everything needed in a good flow chart.

Flow Charting 3 supports about 75 printers, from 9-pin dot-matrix to laser. You can print flow charts in portrait or landscape orientation, and larger charts can be spread over up to six pages.

The manual's tutorial section impressed me particularly with its detailed advice

when you wonder how that program or process you designed works, you'll have a neatly printed flow chart to remind you at a glance.

RICHARD O. MANN

IBM PC and compatibles, 512K RAM, CGA, EGA, VGA, or Hercules; mouse optional—\$250

PATTON AND PATTON SOFTWARE
485 Cochrane Cir.
Morgan Hill, CA 95037
(408) 778-6557

Circle Reader Service Number 333

MACE EXPRESS RECOVERY

In spite of the many advances PCs have made over the years in the areas of power and reliability, they still have an Achilles heel: the disk drive.

Because of head crashes, mechanical wear and tear, or just plain rough handling, disks fail, leaving you unable

to boot from your hard drive or staring at the dreaded *File Not Found* message.

Now there's help. Fifth Generation Systems' *Mace Express Recovery* package, with its powerful utility *Emergency Room*, can detect and correct many drive-related problems.

This powerful program can correct such problems as damaged boot sectors, partitions, file allocation tables, and directories. It doesn't require any technical knowledge to use, and calling *Mace Recovery* easy-to-use is something of an understatement.

To check or repair a disk, simply type *ER*, indicate the drive you wish to repair, and the recovery proceeds automatically. In the unlikely event that the recovery fails, you can completely undo any changes that were made to the disk.

In such cases, Fifth Generation Systems' technical support line can probably offer advice on further steps you can take to successfully recover the disk.

Mace Recovery doesn't succumb to "feature-itis"; it performs one function, and it performs it well. Installing and using it couldn't be simpler; the manual tells you everything you need to know in just 21 pages. Owning *Mace Recovery* is like having an insurance policy for your PC; it's something you hope you never need, but if you do, it can be a lifesaver.

RICHARD RAPP

IBM PC and compatibles, 512K RAM; mouse optional—\$69

FIFTH GENERATION SYSTEMS
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(504) 291-7221

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To enter the Contests and become eligible for the Cash Prizes, fill out the following user registration form and mail it with a check or money order for \$10.00 (Ten Dollars) to Enigma Software, Inc. 5130 E. Charleston Blvd., Suite 5, Las Vegas, NV 89122.

REGISTER NOW! THE FIRST GAME IN THE SERIES WILL BE MAILED FEBRUARY 3, 1992 AND THE MONTHLY CASH PRIZES START THEN!

Return your entry PROMPTLY to secure your chance to enter the year end Contest for \$40,000 worth of CASH PRIZES!

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Hidden Treasure Registration Order Form CMJ-1

Name: _____

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Disk Size: _____ 5.25" _____ 3.5"

Mail Registration To: Enigma Software, Inc. 5130 E. Charleston Blvd. Suite 5 Las Vegas, NV 89122
Include \$10.00 Registration Fee Nevada Residents Add \$.70 Sales Tax (702) 452-1941

OFFICIAL RULES

1. To be eligible for entry and Cash Prizes in any of the first eleven Contests, each contestant must be a Registered User for that month's game series. To be eligible for the Grand Prize and the final contest, each contestant must be a Registered User for all of the previous eleven games, the final game in the "HIDDEN TREASURE" game series and sent in the correct solutions to each of the eleven games. To become a Registered User for any game in the series, the only requirement is to mail in the \$10 (Ten dollar) purchase price and the completed registration card for that series. Starting February 3, 1992, the first game in the "HIDDEN TREASURE" series will be mailed to all Registered Users whose registration card has been received by Enigma Software, Inc. as of January 31, 1992. Register Now... Each of the following monthly games in the series will be mailed on the first Friday of the corresponding month. Solutions must be postmarked no later than the last day of the month in which the series was released. The deadline closing date for each monthly contest is the last day of the month in which the series was released. Any solutions received after the deadline closing date will confirm eligibility for any of the Cash Prizes in the last series BUT NOT THE CURRENT MONTH'S CONTEST... Respond today... and good luck in all of the Contests!!!

2. There are 620 "Final Contest" Cash Prizes available to be won as follows: Grand Prize \$10,000; (1) First Prize \$5,000; (2) Second Prize \$1,000 each; (3) Third Prize \$500 each; (10) Fourth Prizes \$400 each; (100) Fifth Prizes \$200 each; (30) Sixth Prizes \$100 each; (50) Seventh Prizes \$50 each; (100) Eighth Prizes \$25 each; (400) Ninth Prizes \$10 each. The total CASH PRIZES for the final months contest is \$40,000. The first 620 (Six Hundred Twenty) solutions received at our office from Registered Program Users will be eligible for the final month's Cash Prizes totaling \$40,000. The first contestants to send in the correct solutions will determine the Winners. ***POSTMARK DETERMINES THE DATE*** In case of ties, winners will be selected in a random drawing for their eligible prize category and remaining contestants automatically go to the next available prize level i.e., if two contestants tie for first place, the random drawing will determine the winner and the remaining contestant will be a second place prize winner. UNCLAIMED PRIZES WILL NOT BE AWARDED.

3. There are 1,100 monthly Cash Prizes available to be won as follows: For each of the first eleven monthly contests there will be 100 (One Hundred) Cash Prizes awarded as follows: (1) First Prize \$400; (2) Second Prize \$200 each; (4) Third Prizes \$100 each; (11) Fourth Prizes \$20 each; (82) Fifth Prizes \$10 each. The total Cash Prizes for the eleven months is \$22,000. The first 100 (One Hundred) solutions received at our office from Registered Program Users will be eligible for the current month's Cash Prizes. The first contestants to send in the correct solutions will determine the Winners. ***POSTMARK DETERMINES THE DATE*** In case of ties, winners will be selected in a random drawing for their eligible prize category and remaining contestants automatically go to the next available prize level i.e., if two contestants tie for first place, the random drawing will determine the winner and the remaining contestant will be a second place winner. UNCLAIMED PRIZES WILL NOT BE AWARDED.

4. All prizes will be mailed to the Winners no later than the fifteenth day of the following month. All random drawings will be held by Layton & Layton, an independent Certified Public Accounting Firm, whose decision is final on all matters relating to these contests. Each Contest entry has an equal chance to win. The odds of winning depend on the number of entries received.

All game solutions must be received by the last day of the corresponding month. No responsibility assumed for lost, late, misdirected, incomplete, illegible, mutilated or postage-due mail. 5. No substitution or transfer of prizes permitted. Taxes are sole responsibility of winners. Limit one prize per household or family per month. 6. Winners may be asked to sign affidavits of eligibility, advertising and liability releases, which must be received by specified date or prize will be forfeited. By participating, winners agree to use of their names/voices/likenesses in publicity and advertising without additional compensation. 7. Contests are open to the Continental U.S. residents, except employees and immediate families of Enigma Software, Inc., J.V. Enterprises, Layton & Layton-CPA Firm, Diversified Systems group, Inc., their affiliates, subsidiaries, agencies and any printers and/or other suppliers or distributors of any elements of this game. Void in Alaska, Hawaii, Puerto Rico, U.S. Virgin Islands and wherever prohibited by law. 8. The names, cities and states of residence of prize winners will appear in a printed list. For list of monthly prize winners (available after the 15th of each month following the close date of the current series), send self-addressed, stamped #10 envelope and the words: Current Month's Winners List to Enigma Software, Inc., 5130 E. Charleston Blvd., Suite 5, Las Vegas, NV 89122. 9. If Game Disk is damaged in mailing, immediately call (702) 452-1941 and you will be given information on replacement of game disk or procedures for accessing through modem communications.

System Requirements:
IBM PCAT/386 Or 100% Compatible
384K RAM EGA/VGA Color Graphics

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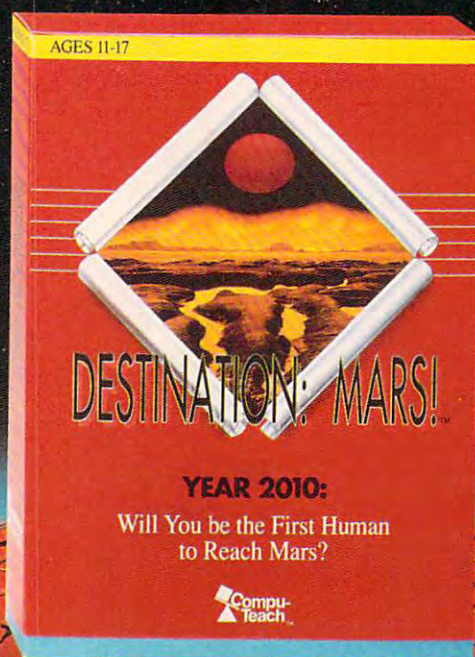
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DVORAK ON TYPING

Remember your high school typing class? These days, learning to type doesn't have to mean noisy typewriters and scowling teachers. Interplay's *Dvorak on Typing* fills in with an assortment of drills and a game. When Dvorak instructs, you can work against the clock or just type with no set limits on time.

Dvorak on Typing also offers the old tried and trues of traditional typing manuals—only better. For instance, during the Letters segment, the screen shows you which finger to use and where to find the key on the keyboard.

For a break from drills, you can play a game where you're a knight facing different foes. You'll have difficulty watching the game, though, since you must read and type in text from the bottom of the screen. This puts a bit of a damper on the fun, but you still log typing time.



Here's a twist on chivalry—control a knight by typing.

Features include a Reports option that displays your accuracy rating and words per minute for each session. You can also see your most recent "problem" keys. Another option activates a voice to offer encouragement.

Absolute beginners might still find a teacher's guidance helpful—as a matter of fact, this program would be great for the classroom. However, if you want to sharpen

your typing skills at home, *Dvorak* lends rote drills some computer clout.

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IBM PC and compatibles; 512K RAM for CGA, EGA, Tandy 16-color, or Hercules; 640K for MCGA or VGA; supports Ad Lib and Sound Blaster—\$49.95

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THUNDERSTRIKE

Defense industries and television networks control the world. The more exciting the military action on the tube, the better the ratings. Sound familiar? No, it's not a replay of the Persian Gulf War. It's *ThunderStrike*, an addictive arcade game set 247 years in the future.

ThunderStrike straps you into your choice of five futuristic fighter aircraft. You patrol a desolate landscape in an airborne arrowhead, on the lookout for enemy craft and drones capable of destroying your pyramid-shaped installations. As with most arcade games, it's much easier to kill than be killed, but the threat that your craft might be destroyed is real enough to give the game an edge.

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DEVELOPED BY **CORE DESIGN LIMITED**

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REVIEWS

whether your maneuvers and dogfights are exciting enough to draw in the viewers.

ThunderStrike is a compelling, highly playable game that suffers from only a few annoying aspects. Even if you install *ThunderStrike* on a hard drive, you still need its boot disk to start it up every time you play. Furthermore, the game provides no save feature, so each time you play you must start from scratch. Still, once the action begins, it's hard to quit. This compelling action earns *ThunderStrike* high marks.

EDDIE HUFFMAN

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HEBREW PLAY HOUSE/ MILK AND HONEY CHALLENGE/ MY ISRAELI ATLAS

A traditional Hebrew form of study in which two students learn by asking each other questions, *haver* has worked for centuries. Tekoa, publisher of *Havruta: A Jewish Encyclopedia*, continues this tradition of study by substituting your computer for a study partner.

The *Havruta* software series consists of several interactive lessons on Jewish life and culture, Israel, Hebrew language, Jewish history, and holidays. Each package offers lessons, games, and quizzes. Applications typically have file editors to enable parents and teachers to customize exercises for individual students. The Hebrew language programs require no special hardware.

Hebrew Play House teaches basic Hebrew vocabulary for items found in and around a typical home. Youngsters play several games, and in the process they learn to recognize and spell Hebrew words for furniture, pets, and kitchen utensils. Activities include construct-

ing images with clip art objects, entering Hebrew names for pictures (the program comes with a Hebrew keyboard chart), reconstructing an illustration by positioning its missing parts, and matching an object with its Hebrew name. Youngsters must be able to read Hebrew without vowels in order to play.

In another package—*Milk and Honey Challenge*—children (ages 10 and up) meet Israel and its people with help from 15 prepared study units. Topics include geography, history, culture, current events, famous personalities, Hebrew vocabulary (using transliterated English), and the Diaspora. A built-in editor lets teachers and parents prepare customized study materials.

The fast-paced activities encourage youngsters to memorize a series of facts. For example, *Order It* requires players to arrange events in correct chronological order, while *Match It* challenges contestants to link a specific item with its counterpart on a list. If players do not complete an activity before time runs out, the game starts over, and drill continues at a slower pace. In *Milk and Honey's* hangmanlike game called *The Menorah* (an eight-branch candelabrum), players must answer a question correctly before all eight candles burn out. The contestant with the most candles left at the end of the game wins.

Lots of fun, *Milk and Honey Challenge* helps kids learn by playing seven entertaining games. These activities motivate youngsters to work through lessons.

My Israeli Atlas, the final program reviewed, encourages people to visit Israel by computer. This enjoyable electronic geography package includes four colorful maps, several clip art images, and eight interactive games. It features 28 prepared study units organized into six major subject areas: Israel (general), Northern Part, Samaria (North Judea), Judea and Negev, Jerusalem Sites, and Places to Visit. Individual lessons focus on important cities and resort towns, historical sites, the old city of Jerusalem, biblical origins, and Israel's neighbors. Parents and teachers can create new lessons using the program's built-in lesson editor.

Youngsters select a unit for study and then choose an activity from the

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drill menu. Lively games let students become more familiar with the country's geography, important places, and English names for Hebrew locations. Challengers need not know Hebrew to play. *My Israeli Atlas* even includes a road map of modern Israel.

Don't let the early copyright dates of this series mislead you; Tekoa's Judaic computer encyclopedia still provides an imaginative supplement to conventional Jewish studies textbooks. While some users might find the CGA graphics a bit disappointing, *Havruta's* entertaining activities make it fun to learn difficult concepts.

CAROL HOLZBERG

IBM PC and compatibles; 128K RAM; CGA, EGA, MCGA, VGA, or Tandy 16-color—\$39.95 each

My Israeli Atlas also available for Apple II series and Apple IIGs—\$39.95

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Circle Reader Service Number 337

PULSTAR SXP

One-stop shopping—that's what I like best about this complete package, and that would be even more important if I were new to computing. The Pulstar hardware includes all the important pieces: a fair-sized hard drive, a modem, SuperVGA, high-density floppy drives, a mouse, a joystick port, and more.

My Pulstar odyssey began with a long installation of all the software. I prefer to have bundled software copied to the hard drive at the factory, a service that many manufacturers provide. With so many programs in the package—*Quattro Pro*, *Chessmaster 2100*, *DeluxePaint II*, *Publish-It!*, *Word for Word Professional*, and *Mavis Beacon Teaches Typing*, to name a few—installation takes time.

If you want to install the programs selectively, though, this is a more efficient approach. You get only what you want on the hard drive, saving room for data files.

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The installation program was easy to use, so there wasn't much to do but swap disks.

Without reasonable performance, all the attachments in the world wouldn't matter. But the Pulstar performed well above acceptable standards and even excelled in several respects. The 40MB hard drive seemed to outperform its 28-millisecond rating.

The video card and monitor combination outshone the video combo on my personal system. Video output was one of the best I've seen for a system in this price range.

I loved the crisp feel of the keyboard. The 2400-baud Hayes-compatible modem worked like a charm, too.

The issue of footprint size sometimes divides users into two camps. I like a big box that dissipates heat and lets you easily install cards. Some users with limited desk space think the smaller, the better. Consider the small and sleek Pulstar for your office if you

pitch your tent with the pro-downsizing crowd.

With a 386SX microprocessor running at 16 MHz, the Pulstar ran noticeably slower than the 386DX running at 25 MHz that I'm used to, but I didn't find the SX's performance a handicap. The system performed so well as an integrated unit that I never really noticed the lower clock speed. On almost every count, it kept up with me.

Should you consider this system for yourself? That depends. Those new to computing will get everything they need, and this system won't be obsolete next year. Furthermore, it will be some time before you're out buying software or hardware add-ons. If you want a reasonably priced system and don't need a speed demon, then the answer, once again, is yes. This computer performs admirably and will probably meet all of your needs. The only person who might look

elsewhere is someone who needs top performance. Not too many of us do, so this great package gets my vote for serious consideration.

RICK LEINECKER

Pulstar SXP—\$1,995

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HOW TO CHOOSE THE RIGHT COLLEGE

For many high-school students and their parents, the process of choosing a college frustrates instead of exhilarates. The College Knowledge Series from Education Information Systems offers welcome advice to help you make this important decision.

Of the three programs I've

used, *How to Choose the Right College* is the most useful in helping you pinpoint a college that meets specific needs. The program lists 4450 colleges with detailed information about each, such as majors offered, student body size, work opportunities, financial aid availability, intercollegiate sports programs, and lots more.

To narrow your choices, you enter information such as degree type, field of study, preferred location of college, and other student-specific data. You also enter your SAT or ACT scores.

Once you've entered your criteria, you search the database in one of several ways. Full Search lets you print or view a general report containing location, size, tuition, and application deadline. You can also get an ACT or SAT comparison list, a detailed report on each college that matches your criteria, or a report of colleges listed in descending or

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The Jaws of Cerberus*

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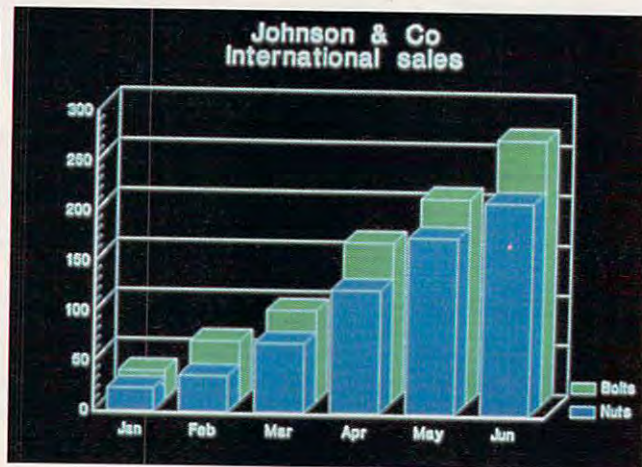
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der by tuition, student body size, or application due date.

Main menu choices include Overview of Colleges Today, Match Criteria to Database, State Search (colleges in a specified state), Personal Letter Writer, How to Finance College Education, and How to Evaluate Colleges.

One feature not fully developed is Major Fields of Study. The fields aren't broken down into specifics. For instance, the sciences major is broken down into 10 or 15 options such as Life Sciences and Biology, but not into a specific field like marine biology, even though over 1200 schools offer degree programs in biology or life sciences.

You shouldn't depend completely on a computer program to pick your college, but they often yield valuable aid. At \$79.95, the price tag is a little steep, but if you have the money to spare and you don't



Graph-in-the-Box Executive makes creating down-and-dirty business graphics as easy as pie charts.

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GRAPH-IN-THE-BOX EXECUTIVE

Creating simple charts and graphs with a personal computer doesn't necessarily prove to be as easy as it sounds. Hard-to-learn packages designed for creating presentation graphics—like *Microsoft PowerPoint* and *Aldus Persuasion*—are geared more toward the presentation professional and often come equipped with more power—and work—than most of us really need.

Those with more modest graphing needs will find *Graph-in-the-Box Executive* a good choice. A TSR (Terminate and Stay Resident) program that sits in RAM until you need it, *Graph-in-the-Box Executive* lets you pluck information from virtually any application and use that data in a chart or graph.

Say, for instance, while working in *WordPerfect*, that you want to convert a table of numbers into a bar chart. You summon *Graph-in-the-*

Box Executive by typing Alt-G, and then highlight the *WordPerfect* table using either the cursor keys or your mouse. A copy of the information then moves into *Graph-in-the-Box Executive's* data table, and from there you can convert the data into 15 types of charts, including bar, pie, scatter, and line charts and various combinations of those.

Graph-in-the-Box Executive's clear documentation simplifies virtually every task. Advanced users will really appreciate the program's technical reference documentation, which anticipates quite a number of problems you might expect to encounter with any type of graphics program, including this one—incompatibilities with other terminate-and-stay-resident programs and applications, for example.

Unfortunately, what you stand to gain in convenience with this program, you tend to lose in output quality. Graphs created with *Graph-in-the-Box Executive* lack the polished appeal of those created using more sophisticated software, even when you choose to print them on a laser printer. In addition, your output choices—printer and plotter—don't include creating slides.

If what you're after is mere down-and-dirty graph and chart creation, *Graph-in-the-Box Executive* should serve well as a useful—though somewhat limited—tool.

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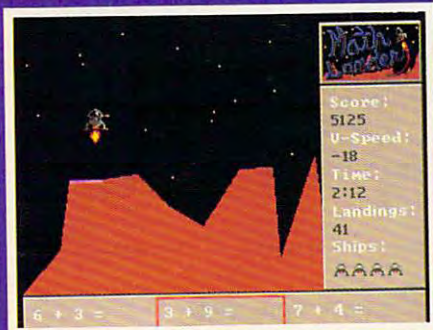
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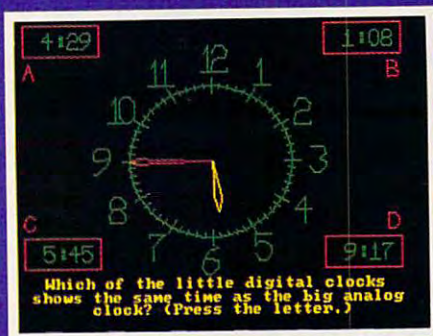
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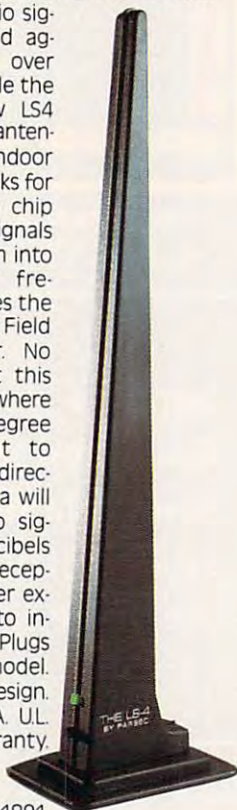
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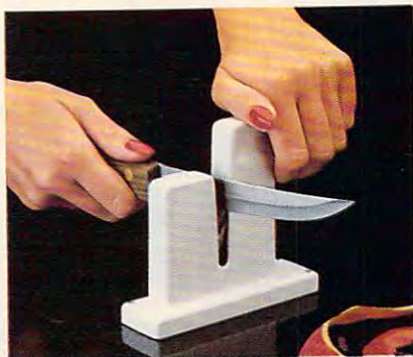
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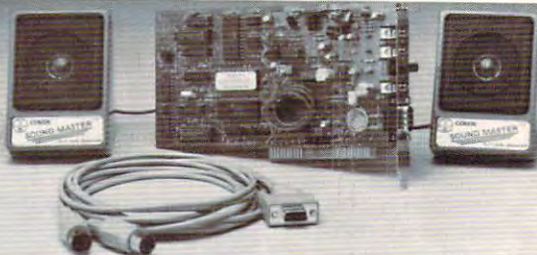
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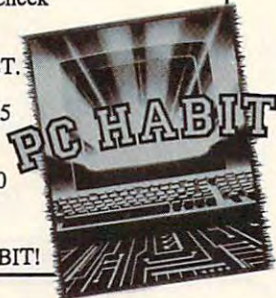
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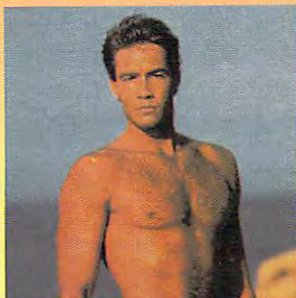
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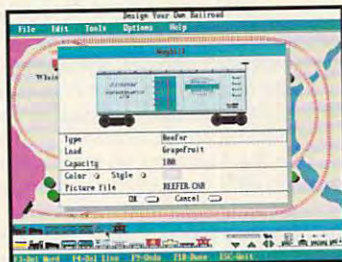


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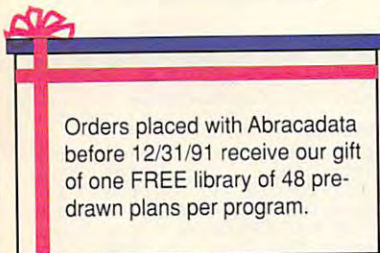
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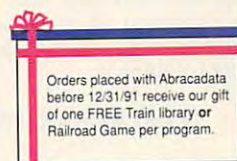


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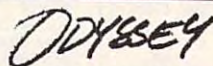
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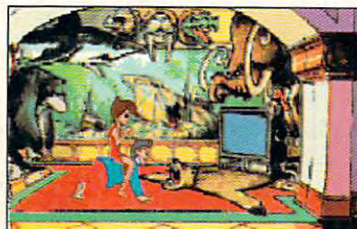
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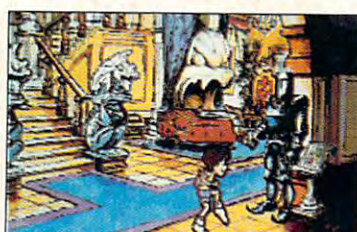
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