

THINGS TO DO WITH YOUR

TI-99/4A COMPUTER



JERRY WILLIS, MERL MILLER, &
D. LaMONT JOHNSON

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THINGS TO DO WITH YOUR TI-99/4A COMPUTER

by

Jerry Willis

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CHAPTER ONE

Here's Your TI-99/4A Computer

This book is written for computer novices who want to use a Texas Instruments TI-99/4A home computer. The TI-99/4A computer is a useful product, but it doesn't work automatically. If you have listened to Bill Cosby on all those TV ads, you might have the wrong idea about what computers are and how they can be used. Bill makes it sound as if the only thing you need do is purchase the computer, bring it home, plug it in, and stand back while it balances your checkbook, entertains your family, educates your children, and brings you a tall, cool one during the ball game on TV.

You can use your computer to help with personal finances, to play games, or to help your children learn school-related skills. (We have yet to find a computer that can bring us a beer during the ball game, but at the rate new things happen in the computer industry, one may be just around the corner.)

But buying the computer is only the first step. Getting it to do what you want involves more than just plugging it in. This book deals with how to make your computer do useful things for you. Reading it will also help you decide if you really want

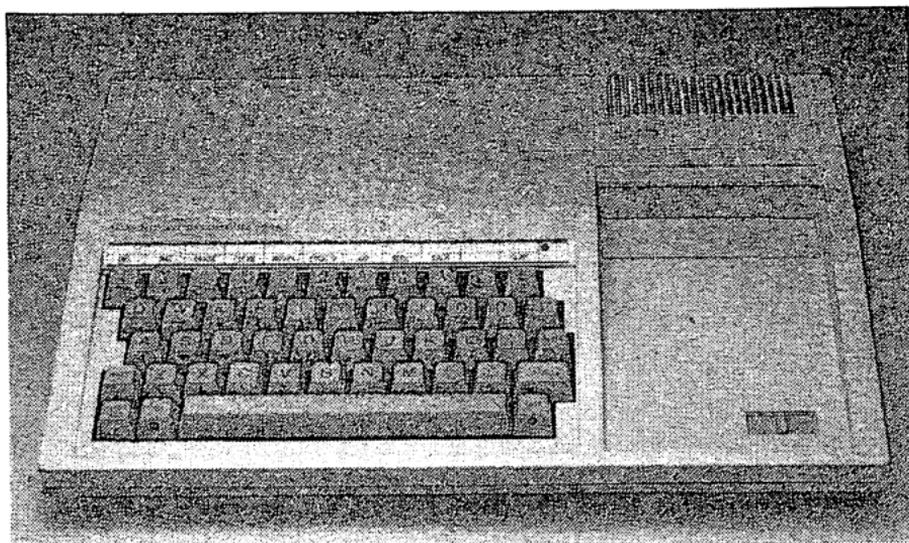


Fig. 1.1 The TI-99/4A Computer

to buy a computer. This is just one book in a series of short books on popular models. If you are shopping for a computer, you may want to read books on several of the computers that interest you. Reading a few books before buying may save you some money and provide information that will let you select the best computer for your particular needs.

Actually, the computer is just like any other machine or tool. The person using it determines how it is used and its power. Contrary to popular belief, computers really aren't intelligent machines that can take the place of humans. There is no more chance that computers will take over than there is that washing machines will rule the world. If you buy a computer for the home, the worst that could happen is that you may waste some of your time or money if you use the computer unwisely. Wise use of the computer doesn't mean, however, that every owner learns the same things and uses the computer in the same way. You could learn a great deal of higher mathematics, for example, but you certainly don't have to. You need to know many basic physics concepts in order to understand the internal workings of your automobile, but you don't have to know any physics at all to drive to the store.

In other words, you can use and enjoy your computer on many different levels. You may choose to regard your computer as you do any other appliance and simply use it as a labor-saving device. Or you may become fascinated with the internal workings and continue studying and learning about computers for the rest of your life.

This introductory book is intended to help you use a computer as an appliance. The good news is that you aren't going to have to learn much about hardware, software, bits, bytes, ROM's, RAM's and other computer things. The bad news is that you will have to learn a little jargon. You have to know a little jargon to drive your car. Most of us learned the terms, concepts, and principles needed to drive a car as we were growing up. By the time we were teenagers, the automobile had become a commonplace necessity for most families. Common terms like ignition, premium gas, gas pedal and brake were jargon when the automobile was first introduced. Today terms associated with the automobile are taken for granted because most of us grew up with cars. The same point could also be made for telephones. Most children learn telephone jargon as they grow up.

The same thing will be true with computers. The next generation may well take a computer on the dining table or in the recreation room for granted. Kids may take terms like RAM and ROM for granted, because they grew up with them, and they understand how to use computers. Unfortunately, we are part of a transitional generation. We didn't grow up with computers, but they are inexpensive and useful technology today. We are automobile literate and telephone literate, but we aren't computer literate. We'll try to help you solve this problem in three ways. First, as we introduce each computer term, we define it. Second, at the end of this chapter there is a little introduction to computer terms. It is not a glossary but it will give you a little background. Third, there is a glossary in the back of the book. Let's start with the two most important terms, hardware and software.

HARDWARE AND SOFTWARE

Before we get into specifics, it is important that you understand these two computer terms. *Hardware* may conjure up visions of eggbeaters or pipe fittings, but it really refers to any piece of computer equipment. The computer itself is a piece of hardware. So are other accessories such as printers or disk drives (See Chapter Ten).

Software refers to the programs that make your computer do specific tasks. As we already mentioned, the media often makes it seem easy to make a computer do what you want it to. Television programs and movies often show people making a computer perform simply by talking to it. As you may have already discovered, your computer isn't that friendly yet. (Actually, we talk to our computers all the time, usually when they don't do what we want, and what we say is often x-rated!) Communicating with a computer today usually involves typing instructions on its keyboard or transferring information stored electronically on a *cassette* or *disk* into the electronic memory of the computer. The instructions a computer follows when it performs a particular task are called software. It takes software to make hardware useful.

A comparison of stereo equipment and records may make the relationship between hardware and software a little clearer. The computer itself is a piece of hardware and is like a stereo. By itself, the stereo cannot create music. The computer can't do anything by itself, either. A computer program is like a cassette or record containing music. When the cassette is put in the stereo, the usefulness of the stereo becomes obvious. When a program is put into a computer, the computer also begins to be useful. Just as your stereo will play hard rock, Italian opera, and country music, your computer can play a video game, help you learn a new language, or balance your checkbook. Just insert the correct cassette (or software).

The comparison, however, stops there. A stereo with a cassette deck will play most of the commercially available cassettes, but computer programs are written for specific computer systems. A program written for the Apple computer, for example, cannot be used on your Texas Instruments computer without modification. Shopping for computer software is more difficult than shopping for a new music cassette because software is developed for specific computers.

“Talking” to Your Computer

You may have heard that you will have to learn to *program* the computer before it will do anything useful. It is true your computer can't do anything until it gets a program written in a computer language it understands, but you don't have to do it.

Computer languages can take weeks or months to learn. Programs (software) that do complicated and useful things take time to write. Writing computer programs is an interesting hobby (or profession) that thousands of people enjoy. You may decide that you want to learn to write programs in a language like BASIC (Beginners All-purpose Symbolic Instruction Code). We'll talk more about BASIC and other computer languages in Chapter Nine. Programming doesn't appeal to everyone who uses a computer, however. Fewer than ten percent of the people who own small or personal computers today spend much of their time writing programs. This means the great majority of people do not write their own software. Instead, they buy software someone else has written. This is what we discuss in this book. This is a software book for the TI-99/4A computer. We'll tell you what software is available to do a variety of things, where to get the software, and the strengths and weaknesses we see in the software.

Learning to Use the Hardware

This is not a book on how to set up your computer hardware. The only hardware we talk about is hardware you need to run the software we talk about. There are some explanations and photos of selected hardware. We'll start with the *console*. When you buy a TI-99/4A, this is the part you buy. The whole thing is covered in greater detail in Chapter Ten.

The Monitor

The computer console contains the parts that do the actual processing. But there must also be a way for you to see the results of any job your computer does. The results are displayed on a screen that looks like a TV. Such a screen is called a *monitor*. You can, in fact, use a color TV as a monitor, or you can purchase the Texas Instruments ten-inch color monitor. If you use the Texas Instruments monitor, it comes with a cable that plugs into the video and audio output.

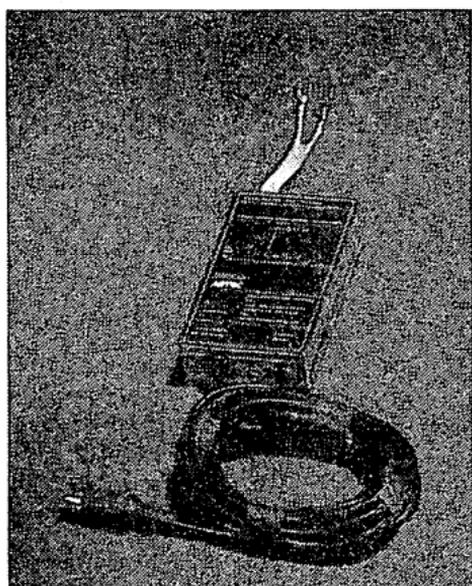


Fig. 1.2 The TI-900 Video Modulator

If you decide to use a color television set as the monitor, you will need to purchase the TI-900 Video Modulator. The modulator comes with installation instructions and the computer interface cable shown in Figure 1.2. The computer interface cable is plugged into the video and audio output.

Getting Programs Into Your Computer

Programs (software) to make the computer do something can be put into the computer in four ways:

- Programs can be typed in using the computer keyboard.
- Programs can be put in (*loaded*) by buying a *command* module and putting it in the slot on the computer console. Figure 1.3 shows a module being inserted in the computer.



Fig. 1.3 Command Module being inserted into the computer

Unless you purchase additional hardware besides the TI-99/4A console, these are the only ways to get a program into your computer, but

- If you purchase a cassette player/recorder, you can load programs into the computer from audio cassette tapes. You

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can write your own programs and store them on cassette or purchase cassettes with programs already stored on them. You can use any good standard cassette recorder, but it should have the following features: volume control, tone control, microphone jack, remote jack, earphone or external speaker jack, and digital tape counter. If you decide to use a cassette recorder with your computer, you will need to purchase a cassette interface cable from your Texas Instruments dealer. One end of this cable will connect to the cassette recorder and the other end to the computer console.

- If you purchase additional hardware, you can also load programs into the computer from floppy disk. A floppy disk stores data electronically on a thin platter of mylar or plastic that has a magnetic coating on it. The platter, which is about the size of a 45 RPM record, is sealed inside a protective cover. Figure 1.4 shows a floppy disk.

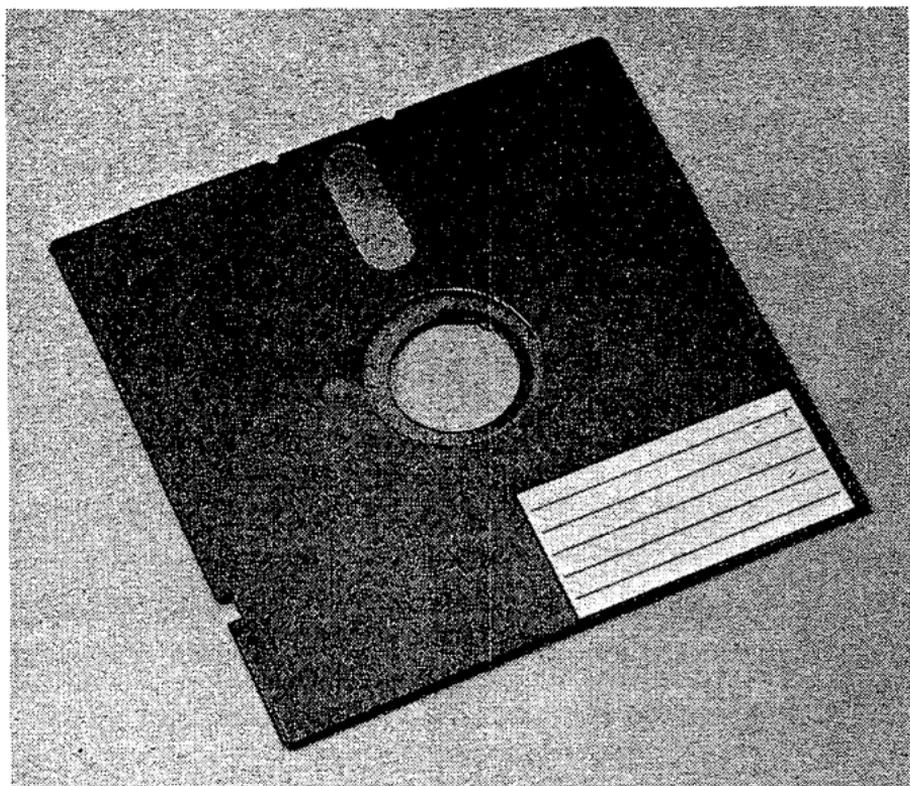


Fig. 1.4 Floppy Disk

To use programs stored on floppy disks, you will need one or more disk drives. A disk drive is a piece of hardware that *reads* programs stored on floppy disks and *writes* material on the disk. When we say that the drive *reads* the disk, we mean that information from the disk is transferred from the disk to the memory of the computer. *Writing* is taking information from the memory of the computer and storing it on the disk.

You may write and store a program on a disk or purchase a floppy disk with the computer program already written for your computer. The disk is inserted into the disk drive and the program on the disk is then loaded into the computer. (Disk drives, floppy disks, and other accessories, are explained in Chapter Ten.)

Cassette and disk operation have both advantages and disadvantages. The main disadvantage of using a cassette is that storing and loading information is slow. The advantage of cassettes is cost. A cassette recorder can be purchased for about fifty dollars, and cassette tapes cost only a dollar or two each. Disk drives cost several hundred dollars, and disks cost three to five dollars each. The issue is between you and your bank account. We will say, however, that few people are satisfied with cassette use for long. Disk drives are fast, and they are very reliable.

WHAT CAN YOU DO WITH IT?

Even if you never write a computer program of your own, you can choose from thousands of *canned* programs (programs written and sold by someone else) that are available. This book is devoted to reviewing and evaluating some of those commercial programs. They are discussed in the following categories:

Chapter Two. Games—Almost everyone knows that a computer can be used to play games. You can zap invaders from space with your laser ray, play soccer, or hunt the willy Whumpus through a maze of caverns, tunnels and perils. The TI-99/

4A has excellent *graphics*, and programmers make full use of the computer's color graphics potential to create great graphics displays for hundreds of TI video games.

Chapter Three. Arts and Crafts—You can turn the television screen into an electronic canvas and use the TI to create all sorts of color pictures and figures. With TI *Logo*, a special computer *language*, creating color graphics is easy because the language has a special feature called *turtle graphics*. The turtle is a small triangle that can be moved around on the screen. As the turtle moves, it draws in color. The TI computer also has a built-in sound synthesizer that lets you use the computer as a programmable electronic piano or sound effects generator. You can create your own music or sound effects in languages like BASIC or Logo, and there are a number of programs that help you create music.

Chapter Four. Education—Use your TI-99/4A and the TI Speech Synthesizer to improve your child's spelling with a program that actually spells words aloud. Or provide your child with computer math games for grades one through nine. Figures of speech, and word meanings in context can be taught with a reading program available for the TI. Learn touch typing with a program that also measures and improves typing speed and selects the right exercises to correct each typist's weak areas. There are hundreds of very good educational programs for both adults and children.

Chapter Five. Home Finance—Use the computer to create, maintain and use a computer-based filing system, or to keep a home inventory for insurance purposes. Keep car maintenance, medical and dental records, and develop a complete list of birthdays, anniversaries and other important occasions. Or get help in making decisions about loans, home and car buying, personal savings, leasing vs. buying, and much more.

Chapter Six. Telecommunications—With the TI home computer, you can tie into the entire TEXNET Information Service using your own home phone line. TEXNET and other information utilities offer electronic shopping, trading and bartering, financial market news, tax information, airline schedules and reservations, electronic mail, home and leisure time informa-

tion, law news, career information, statistics, dining guides, movie reviews, etc. TEXNET also has a TI software exchange for hundreds of free programs, a TI music and sound library, TI graphics library, a software directory, and other information. In addition to TEXNET, TI owners can subscribe to the Dow Jones News/Retrieval Service. This will give you information on business and general news, sports, and weather.

Chapter Seven. Word Processing—You can use your TI-99/4A as a word processor to write, edit, store and print out all sorts of documents. You can produce letters, notes, fiction, or anything else much faster and more easily with word processing than with traditional typewriting. With word processing, the major advantage is that you may edit your work on the screen before you print it on paper. You can say goodbye forever to messy corrections and to cut-and-paste rough drafts. Even major changes that involve moving large blocks of text can be done in seconds. You'll know that if a revision doesn't work well, you can change it again just as quickly and easily. Therefore, you won't hesitate to try out new, and sometimes better, ways of making a point. The TI-99/4A word processing programs are not as good as some programs for other computers, but even mediocre word processing saves time compared with traditional typewriting!

Chapter Eight. Business—Use your computer for a variety of business applications, such as stock analysis, spreadsheets, lease/purchase decisions and more.

Chapter Nine. Programming—In case you think you might want to learn how to write your own programs, we discuss the pros and cons of learning programming and present some simple examples of BASIC, LOGO, Pascal, and Assembly Languages.

Chapter Ten. Peripherals—The final chapter in the book deals with the accessories you can buy for the TI-99/4A. We talk about disk drives, printers, extra memory, expansion boards, and more.

OH, NO, JARGON!

It's not as bad as all that. We're just going to give you little guided tour of jargon. You've already learned that the main

component of the TI computer system (the box with the keyboard in it) is also called the console. The console plugs into a monitor. The monitor is usually your TV set, but it can also be a piece of hardware designed just for your computer. All of this electronic stuff is called hardware and is important. It's nothing, however, without software. Software is instructions the computer follows to do something. A set of instructions that tell the computer to perform a particular task—sing, play a game, keep track of inventory, teach long division—is called a program. You can either buy programs written by someone else (*canned software*) or you can write them yourself. If you write your own programs, you are programming the computer. This is a popular hobby, and thousands of people earn their livelihood as programmers. You don't have to write a single program for your computer to use it. There are plenty of canned programs for the TI computer.

Programs, whether they be canned or written by yourself, will need to be stored somewhere when they are not in use. When you want the computer to follow the instructions in a particular piece of software, you tell the computer to load that program into its memory. If the program is stored on a cassette tape, the computer can read the electronic codes stored on the tape and copy those codes into its electronic *memory*. If it is on a disk, the computer will read the codes stored on the magnetic surface of the disk. When the computer is told to *execute* or *run* a program, it looks at the codes in its memory and does whatever those codes tell it to do. The memory where the codes for your cassette program is stored is called *RAM*. RAM is random access memory, which can be used for storing programs (e.g., instructions) as well as any data the computer may need (such as your name, your answer to a math problem on the screen, the number of blue widgets in inventory). Another type of memory is called ROM. ROM is short for read only memory. This type of memory has instructions installed in it at the factory. It cannot be changed. If you buy a game cartridge for the TI, what you are really buying is one or two ROM circuits in which the instructions for the game have been permanently stored. When you plug the ROM cartridge into

the slot on the TI, the computer can read the instructions stored in the ROM. TI calls the ROM cartridges for its computer *Command Modules*. Both RAM and ROM memory is usually measured in K. K is an abbreviation for the 1024. That means 1K of RAM is really 1024 units of RAM. 1K is enough memory to hold 1024 separate characters or about a half a standard page of typed material. Each unit of memory large enough to hold the code for one character is balled a *byte*. One byte of memory can hold the code for one character. One *kilobyte* is 1024 bytes, but most people just say 1K instead of one kilobyte. Some programs will list the amount of RAM needed to run them. A program that calls for 24 K of RAM won't run on a computer with only 16K of RAM.

The last thing we'll look at and the first thing you'll usually look at when you turn your computer on is the screen. A screen is just what you think it is. Sometimes computer people call it a *CRT* or a *video display*. If you type a letter in on the keyboard, it will be shown on the screen. This is an *alpha-numeric display* because it is made up of letters and numbers. If your three-year-old writes on the screen with a crayon you have a mess. If you tell the computer to draw a picture of an ocean with a ship riding at anchor on a blue sky summer day, you have a graphics display since what you see on the screen is composed of special graphics characters. Very good graphics displays that show fine detail are made up of tiny dots of color called *picture elements* or *pixels*. The TI computer can create high-quality pictures made up of thousands of tiny multicolored pixels. Graphics of this type are called *high-resolution* or *HI-RES* graphics.

As new words are used in the following chapters, we will try to define them the first time they are used. Remember, too, that the glossary at the end of the book lists several hundred computer terms and defines them for you.



CHAPTER TWO

Games and Entertainment

OK, so you finally made the big decision. You signed your life away to the finance company and brought home your TI-99/4A computer with all the accessories. You've astounded your friends (and appeased your spouse, or tried to) by demonstrating how it can analyze real estate investments, improve Junior's spelling, and store your favorite recipe for chocolate-covered cabbage. That's all very nice, but now that the friends have gone home and everyone except you is in bed, it's time to get down to business. Time to put your computer through its paces. Time for what you *really* bought your TI for: playing computer games!

COMPUTER GAMING IS VERY POPULAR

While it's true that computers can be useful for a rapidly growing variety of tasks in the home, it's also a fact that they

are *most* often used for game-playing. One indication of this is the fact that nearly half of TI's software brochure is devoted to games.

That's not hard to understand when you consider the popularity of arcade games that cost a quarter to play. They're everywhere you go these days: grocery stores, convenience markets, restaurants, malls, you name it. There are several computers that can run games strikingly similar to these arcade games, and the TI-99/4A is one of them. Some experienced gamers even prefer some of TI's better games (such as Parsec) over the coin-operated arcade games. The fact that home computer games are becoming so good is quite an accomplishment, especially when you realize that arcade games often cost \$3800 and use a screen that is custom-designed for a single use!

THE TI IS AN EXCELLENT COMPUTER FOR GAMES

The primary reason for TI's good performance in computer gaming is that the hardware has features that attract good game programmers. This is due primarily to the TI-99/4A's ability to produce high-quality pictures (called "graphics" by programmers). Anyone who has played the arcade-like games knows that much of their appeal lies in colorful, imaginative graphics.

Another reason the TI-99/4A is good for games is that sophisticated sounds can be included. The voice synthesizer, for example, is one of the best made for the home market.

TYPES OF GAMES FOR THE TI-99/4A

When we first planned this chapter, we thought it would be easy to organize our discussion around several distinct cate-

gories of games. We even came up with a categorization system. We have since found out that the categories are not as clear-cut as we originally thought. As gaming gets more sophisticated, the divisions between categories become more blurred. Nevertheless, we will discuss computer gaming on the TI-99/4A in the following categories: action games; fantasy games; simulation games; card games, Las Vegas-style games, board games; and sports games.

Action Games

The most popular of all computer games are the action games. Most people are familiar with these games because most arcade games are action games. There are hundreds (maybe even thousands) of action games you can play on the TI computer. (Some people have criticized the violence in some games because they fear it could lead to increased violence in real life. That may or may not be true. We simply do not have the evidence to determine what effect playing action games might have on children.)

Actually, there are several subtypes of action games. The most popular type pits your spaceship/missile base/tank/etc., against hordes of attacking enemy ships/creatures/tanks/etc. One of Texas Instruments' technical representatives in the Consumer Relations Department, Michael Archuleta, tells us that insiders refer to these games as *Bang, Bang, Shoot 'Em Up* games. That certainly sums it up, because zapping alien spaceships or blasting asteroids is what these games are all about. In other types of action games, you guide race cars around a track or direct Munch Man around a maze while he's pursued by Hoonos. The intricate graphics and sound capabilities of the TI computer make it especially well-suited for action games.

Mike took us for a tour of the Texas Instruments facility in Lubbock, Texas, and showed us TI hardware and software we wanted to see. Besides being knowledgeable and friendly, Mike is a real expert at one of the most popular of all the TI *Bang, Bang Shoot 'Em Up* action games: *Parsec*.

Parsec

Parsec is a one-player action game available for \$39.95 from TI. The game uses advanced high-resolution (clear and distinct) graphics and speech that sounds like a human voice (if you have the TI speech synthesizer). The object of Parsec is to maneuver your lone ship through wave after wave of attacking nasties who try to blast or ram you into oblivion. You are armed with a laser (use it sparingly, or it will overheat). You use your laser to destroy the attackers and pile up points. You must do all this without crashing into the planet. You are periodically required to fly into, and then out of, a refueling tunnel with stalactites and stalagmites that you'd better dodge. Figure 2.1 shows a screen from Parsec.

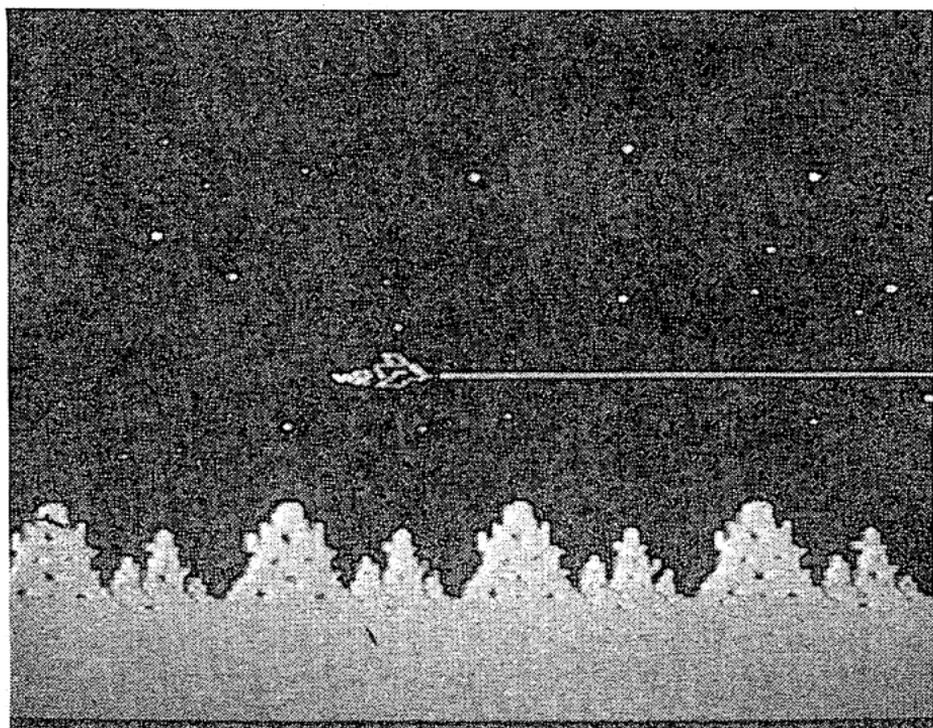


Fig. 2.1 Parsec

You may change the responsiveness of the flying controls on your craft at any time by choosing one of three lift levels.

Changing the lift level changes the sensitivity of your craft's flying controls. (You will most often use level three, the most sensitive level, but level one is best for the refueling tunnel and level two is essential for the asteroid belt.)

You begin the game with four ships in reserve. You use them one at a time until all are destroyed. If you can accumulate a total of 5000 points, you get an additional ship. You get another one at each additional 10,000 point increment.

You can control your craft by using the arrow keys. You can fire the laser with the period, the Y or the Q keys. It is also possible to forego the keyboard entirely and buy joysticks to play games. Chapter Ten describes different types of joysticks.

Interestingly, action game buffs like Mike at TI prefer the keyboard for most games, Parsec included. The joysticks have two drawbacks. One is that the game responds slightly more slowly to joysticks than it does to keys. Another is that you may find your hands cramping after long sessions of game playing. Most action game players who use joysticks find that their scores level off at a certain point. To advance beyond that point, they are forced to return to the keyboard.

As Parsec begins, the first wave of attackers appear. They look like large-winged jets and are called *Swoopers*. They come in a variety of colors, drop down from the top of the screen, and get faster and faster as the game continues. Swoopers have no cannon but can ram you if you don't destroy them.

The Swoopers are followed by *Urbites*. The Urbites are shaped like tiny bullets and fire two cannons at a time. The next wave are craft called *LTF's*. The LTF's are like Swoopers except they are more aggressive. They are followed by *Dramites*. Dramites look like Urbites but are more persistent in their efforts to find and ram you. After Dramites are *Saucers*, which have the added advantage of coming up at you from behind. Last are the *Bynites*. This last group is the most aggressive of all the attackers who try to ram you.

An asteroid belt is next. The tumbling asteroids are so large and so numerous that you must blast your way through them. Overheating of your laser can be a real hazard here. If you

successfully negotiate the asteroid belt, level one is completed. Level two is identical to level one except that your enemies must now each be hit twice before they are destroyed. On level three they must be hit three times. Killer satellites will appear after you negotiate the asteroid belt in level four. They enter the screen from all directions and fire frequently.

Throughout the game, the speech synthesizer causes a female voice to chime in with such things as "Good shot, pilot," "Enemy ships attacking," and "Refueling tunnel ahead." Jim Dramis, the TI programmer who designed and programmed the game, says the object was to have a female on-board computer warning you of things to come. He adds that another reason for making the voice sound female was that he had been warned that it was impossible to make the speech synthesizer sound like a female. (Parsec fans will enjoy the interview with Jim in the January 1983 issue of *99'er Home Computer Magazine*.)

If your hands cramp or you feel an overpowering urge for a dish of leftover candied cauliflower, you can freeze the game, have your snack, and take up later where you left off. That pause feature is a nice touch. On the negative side, some Parsec devotees feel it should be possible to enter the game at advanced levels since the beginning of the game is boring for experts.

Part of Parsec's appeal is that it can be enjoyed by beginner and expert alike. Beginners are lucky to score 1000 to 1500 points, while advanced players sometimes break 100,000. Parsec is similar to the *Defender* game that's so popular in arcades. It is fast, colorful and noisy, and it's likely to keep your interest for weeks or months as you develop flying and firing skills. It is an excellent example of an action game.

TI Invaders

TI Invaders is another one-player action game, available from TI for \$39.95. Your world is under attack by a fleet of enemies. You command a mobile missile base and must destroy the attackers. At the beginning of the game, the fleet is eleven creatures wide and five deep. The fleet begins to march toward

you, firing as it comes. You have periodic chances to hit control ships of different colors that pass overhead. As in the Parsec game, destroying one fleet moves the player on to more challenging levels: Experts may break 25,000 on this game.

TI Invaders is an extremely popular action game for the TI-99/4A. It is a challenging, colorful game that provides many hours of enjoyment. Figure 2.2 shows a typical screen display from TI Invaders.

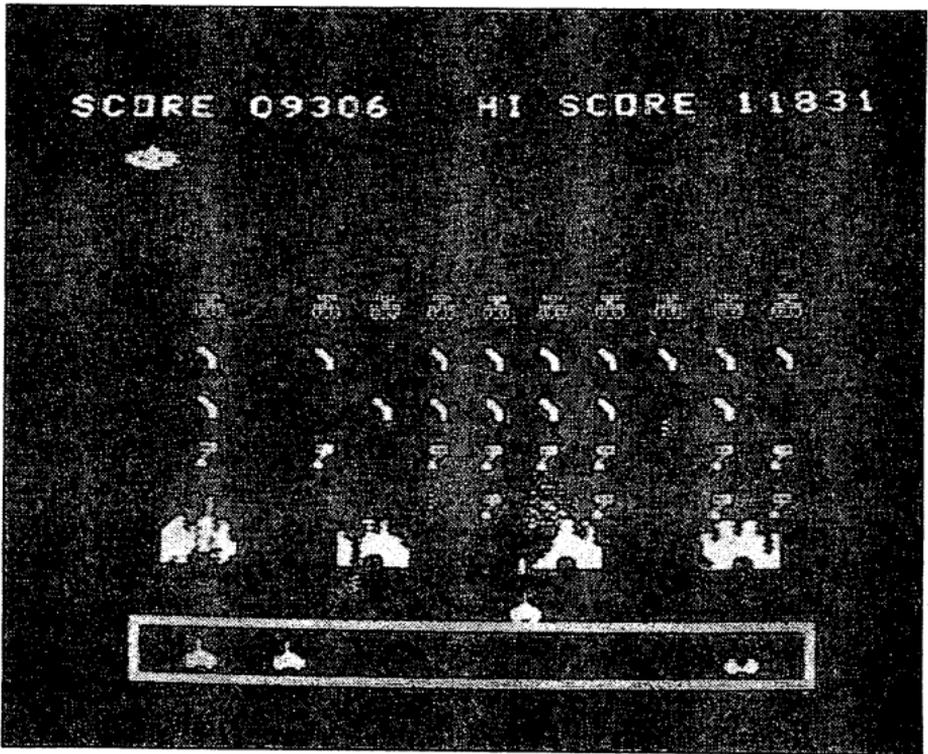


Fig. 2.2 TI Invaders

Death Drones

Death Drones is an action game that, unlike the first two we reviewed, is written in TI BASIC or Extended BASIC. It is available on cassette or diskette from Moonbeam Software for \$14.95.

In Death Drones, you are in charge of a city of the future, complete with nuclear power plant. The Death Drones attack your city one at a time while you try to shoot them out of your air space. If you miss and the Drone gets you, a bomb is dropped on your nuclear power plant. When the plant takes six hits, it and your city blow up spectacularly, and you have lost. If you manage to gain 1000 points by blasting pesky Drones, your plant is rebuilt and attacked again.

Death Drones is a difficult game to master. It is challenging and inexpensive, and while it isn't as technically polished as Parsec, it is fun. Death Drones is typical of the growing batch of good action games being written by non-TI programmers.

Astrostorm

Astrostorm is a free game written in TI BASIC and published in the June 1983 issue of *Compute* magazine. This game is typical of the free games printed in computer magazines. There's a catch, of course—in order to get the game free, you have to type in the entire program (approximately seventy-five lines). This is time-consuming. If you make errors, either the game won't run or it won't run the way it is supposed to. Nevertheless, there is satisfaction in getting an enjoyable game for nothing, even if it takes some effort.

Astrostorm positions your space ship in the middle of a field of moving asteroids. Your task is to negotiate the ship across the field twelve times. The asteroids move from the bottom of the screen. You can move your spaceship horizontally by using the LESS THAN (<) and the GREATER THAN (>) keys. At the beginning of the game you can choose how close to the bottom of the screen you want the ship to be. The farther down

on the screen you put your ship, the faster your reactions must be to avoid crashing into an asteroid. You can change the amount of time you have to play based on how good you are at playing the game.

This game lacks the sophisticated graphics and sound effects you get from expensive games written by experts. On the other hand, it's fun for a short while, and it has the added attraction of being free.

This isn't a hardware book, but you may be interested in a small dose of technical information about why your TI can do such a good job of displaying those ferocious Urbites, Hoonos, and assorted goblins, wizards, and rogues. If you're not interested and want to get right to the reviews of specific game programs, you might want to skip ahead to that section.

CHIPS, SPRITES, VOICES, AND COMPUTER GAMES

Your TI-99/4A uses a special silicon chip to control what you see on the screen. This chip (the TMS9918A) is called the Video Display Processor. This amazing little chip can display up to twenty-eight high-resolution graphics characters called *sprites*. These sprites (enemy ships, monsters, and so on) can use sixteen different colors, and can be made to move smoothly across the screen in any direction and at any speed. Most important of all, the sprites will continue to move without any additional instructions from the computer program until their speed or direction is changed. And you can change their speed and direction quite easily, without taking the attention of the central processing unit. That's good, because in fast, complicated games, the central processing unit needs to stay busy with other aspects of the game. If it had to deal continually with sprite movement, the game would be slower and less complex (and consequently less fun). This feature enables programmers to write sophisticated and interesting game programs for the TI-99/4A.

Even the older TI-99/4 had sprite capability but only if programs were written in difficult machine language (see Chapter Nine on Programming). When the TI-99/4A replaced the 99/4, the sprite capabilities were made available to programmers who write in the easier-to-learn BASIC language. Because of this, more and more programmers began to write games for the TI computer.

Other attractive hardware features include the unit's sound-generator chip. This chip gives the computer the ability to produce sophisticated sound through the display monitor or through a television set. The computer can also play music and produce a large variety of other sound effects. We've already mentioned that the speech synthesizer is one of the best in the home computer market. It can produce three voices, each covering five octaves and a fourth voice for special effects. The voices are surprisingly realistic for computerized speech and often cause first-time users to do a double-take.

Munch Man

Munch Man is a TI action game similar to the popular Pac Man arcade game. It is available as a command module from Texas Instruments for \$39.95. Unlike the arcade game, however, as you guide Munch Man around the maze, he leaves chain links behind him. The object of the game is to cover the maze completely with chain links before the four pursuing "Hoonos" eat Munch Man. Players begin the game with two Munch men in reserve and earn one more each time they earn 10,000 points. Figure 2.3 shows a screen from Munch Man.

Scattered around the maze are *power dots* (in the shape of the state of Texas or the letters TI) that can be eaten by Munch Man. After eating a power dot, Munch Man can, for a brief time, eat a Hoono. The game gets faster as you play and move into more difficult levels. At the twentieth level, the maze becomes invisible. Negotiating an invisible maze may seem next to impossible to you, but Mike at TI tells us there's a member of the TI User's Group who is blind and who does very well at Munch Man! He has apparently learned to react

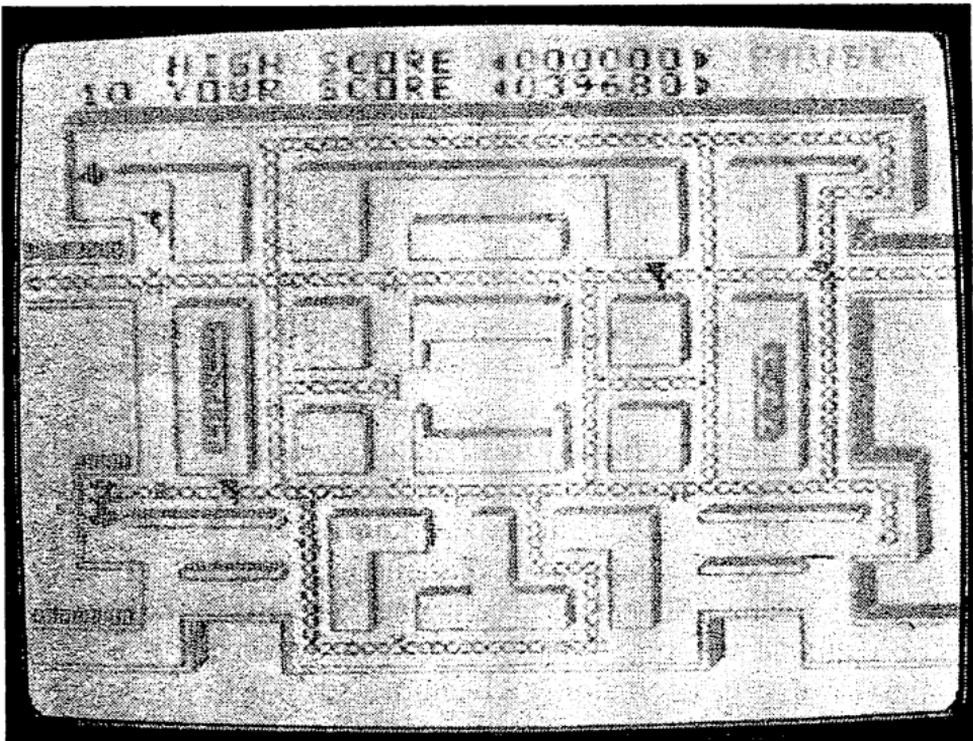


Fig. 2.3 Munch Man

to small differences in the game sounds that are characteristic of certain game conditions. This game doesn't use the speech synthesizer, but it does use music and other sounds.

An interesting feature of Munch Man is the *cheat mode*. By using this mode, you can put yourself on any level of the game with any number of men in reserve.

Munch Man is a fine action game that should appeal to anyone who likes maze games. Some people have suggested that Munch Man and other maze games are more desirable for children than the *Bang, Bang Shoot 'Em Up* games since they are less violent.

Fantasy Games

Fantasy or adventure games seem to be getting more popular. They were probably inspired by the popular Dungeons

and Dragons game. Dungeons and Dragons was originally a loosely structured game played entirely without a computer. The game became popular on college campuses in the late seventies. It soon spread to high schools and even elementary schools.

Fantasy or adventure games usually don't depend on fast action, laser guns, or attacking space ships for their appeal. Instead, they depend on the story line and require thoughtful strategy and imaginative problem-solving. Wizards, trolls, and other magical beings are the characters in these games. A fantasy game is more likely to appeal to older children or adults.

Most of the early fantasy or adventure games were text-only games. These games used no graphics, and the player actually read the entire game, selecting certain options as the game went on. TI still sells this type of game in its Adventure series by Scott Adams' Adventure International. These text-only games are available for most microcomputers and consist of eleven tapes or diskettes containing adventures such as Pirate Adventure, Adventureland, Mystery Fun House, Ghost Town, and others. The series is still popular and has its devoted followers. The pace of these games is so slow a complete game can take hours, days, or even weeks to complete. An interesting feature of most of these games is that you can save them on cassette or disk at any point. Later, you can enter the game where you left off.

A good example of this type of game is Pyramid of Doom. It is available from Texas Instruments on cassette or diskette for \$29.95.

You will need the Adventure Command Module to play this game, as well as all the others in the series. That module sells for \$49.95 and includes the Pirate's Adventure game.

Recently, another type of fantasy or adventure game has emerged. This type still relies on magic, demons, and wizards, but also uses detailed graphics and sound. A good example of this variation is Texas Instruments' new series of adventures. The command cartridge is called Tunnels of Doom. It includes two adventures on tape or diskette and sells for \$59.95. The two games are Quest of the King and a much simpler game called Pennies and Prizes.

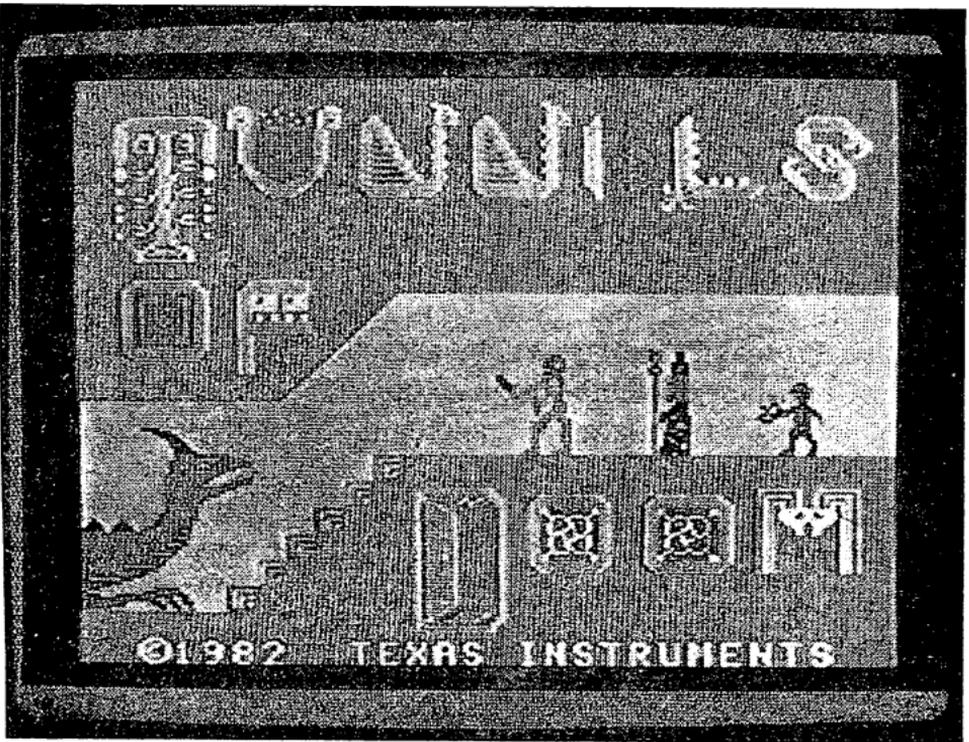


Fig. 2.4 Tunnels of Doom

Quest of the King

One to four people can play this graphics-based adventure game. Each player begins the game with 150 gold pieces that are used to buy weapons, food, armor, and other things. After each player is equipped, the game begins. The quest is to locate the orb of power and rescue the king. The king is being held prisoner in an air-tight room on one of the ten levels of the dungeon. You and the other rescuers are working against the clock. There's the constant danger that you may run out of food and starve or meet death by some other means before you find the king.

As the game begins, you are walking down a hall with doors on both sides. You use the arrow keys to advance, turn, or enter a room. The graphics are terrific at this point, and the illusion of progressing down a hall is downright awesome.

When you enter a room, the graphics present an overhead view. Each room contains treasure guarded by a magical creature. You can either fight the creature in hopes of winning the treasure, or you can turn tail and run. If you decide to fight, the game takes on some of the aspects of the *Bang, Bang Shoot 'Em Up* games.

Treasure consists of such things as gold, weapons, armor, or articles of magic such as potions, lanterns, or wands. There are various living statues that you can bribe to find out how to use the magical items. Vaults and chests hold special treasures, but their contents may backfire and do you more harm than good. By finding maps scattered throughout the dungeon, you can go deeper into the dungeon.

The screen periodically reports how many wounds you have sustained, and these wounds must not exceed your *hit points*. The hit points indicate how many wounds you can take before being killed. There are ways you can switch from one weapon to another or check for the presence of secret rooms. Doing this means you have less time to rescue the King and the Orb.

This is a complex game with seemingly endless situations and problems. The manual is fairly good but is hard to understand in places. You may find yourself thumbing through it frequently. The full game can take eight to ten hours or even longer. As with the Scott Adams Adventure Series, you can save this game on diskette or cassette and complete it later. The game is a little like bridge: the best way to learn it is to play with someone who already knows how.

This type of graphics-based fantasy game may signal a trend for popular adult computer games. These games depend more on strategy and logic and less on fine muscle coordination and quick reactions. We suspect, however, that future games will continue to merge some of the aspects of action games with fantasy games. Fantasy games will probably continue to appeal mostly to older children and adults, because they make you think logically. Of all the games we reviewed for this book, this was our favorite.

Pennies and Prizes

Pennies and Prizes is the other game included with the Tunnels of Doom cartridge and is a much simpler game. There are no monsters or traps of any kind. This game is really more a logic and guessing game than anything else.

You are searching for eight objects in a dungeon that may be varied from one to four levels. Pennies found along the way can bring additional wealth, and the game is over when all eight objects are found.

This is a good introduction to the Tunnels of Doom cartridge, and children will probably enjoy it. The game is too simple to hold the attention of adults for long.

The Pharaoh's Tomb

Pharaoh's Tomb is a fantasy-adventure game for advanced players. It is written in Extended BASIC and is available on cassette (\$14.95) or on diskette (\$17.95) from Miller's Graphics. The object of the game is to accumulate treasure while avoiding a host of hazards such as trap doors and ghosts. When you collect ten treasures, you move to the next level of difficulty and get another player to move through the mazes.

Pharaoh's Tomb uses graphics a great deal. You get an overhead view of the Tomb, along with sophisticated sound effects. This is a hard game to master and occupies experienced players for long periods of time.

Simulation Games

Simulation games are designed to mirror real-life or fantasy experiences, like flying an airplane or running a large corporation. Some computerized simulations actually do prepare people for the real experience. Flight simulators used by the Air Force or NASA have done this for years. Others are purely

for fun. The simulations discussed in this chapter are the fun kind.

For some reason, TI does not provide much of this type of software. However, some good simulation games are available from other companies.

Dow-4 Gazelle

Dow-4 Gazelle is a flight simulator written in TI BASIC and available for \$30.00 on cassette from John T. Dow. You need joysticks to use this program. Dow-4 Gazelle makes you the pilot of a single-engine plane. You must study a thirty-page manual before you can start. You must take off at night, fly the plane to its destination, and land it safely. The console and instruments are displayed on the screen, and there is a banner showing your direction and the distance of the destination. After the basic simulation, you can increase the difficulty by varying the wind, making the controls more sensitive, trying landings on shorter fields, and so on. If you crash, the sound effects include a siren. The screen informs you of the cause of the crash. If you land successfully, you will be rewarded with a short tune.

Dow-4 Gazelle cannot teach you to be a pilot, but it can supply adults and older children with hours of fun at various levels of difficulty.

Aeronaut

Aeronaut is a hot-air-ballooning simulation game written in Extended BASIC by Simulsoft Computer Software. It is available on cassette for \$19.95.

Like Gazelle, Aeronaut displays the flight instruments on the screen. In addition to traditional instruments, one instrument tells you how fast you are rising or falling, while another gives the temperature of the air in the balloon.

Controls (on the keyboard) permit you to turn on the propane burner or release air to descend quickly. The object of the game is to make a flight and land properly (descend slower than 800

feet per minute). The trip must be made without crashing into mountains or becoming entangled in electrical power lines.

This program seems to have been written to give you a taste of hot-air ballooning. It is also good entertainment. The idea is unusual, and the program is amusing for older children and adults.

Card Games, Las Vegas Style Games, and Board Games

These are common types of computer games. Some give you the opportunity to play a particular game, while others teach you how to play. Many do both. TI markets three programs, Bridge Bidding I, II, and III, that provide training and practice at bidding. Written by bridge experts Robert Hammon and Robert Wolff, each of the programs is available at \$29.95 for diskette and \$24.95 for cassette.

Another Texas Instruments program, Blackjack and Poker, is available as a command module for \$24.95. Extended BASIC is required to run the program. Up to four players can play either blackjack or poker. Developed by Milton Bradley, the program is recommended for ages ten and up.

Draw Poker is a one-player game from Texas Instruments. It sells for \$29.95 on diskette and \$24.95 on cassette. Your hand is dealt with all five cards showing. The computer hand is dealt face down. You may bet, raise, call, fold, or discard. Both you and the computer begin the game with \$5,000. Play continues until one of you is broke.

Blackjack from Hall Software is available on cassette. Up to four players can play, and Las Vegas rules are used.

Challenge Poker is a cassette game from Pewterware for \$19.95. You can play against the computer, or you can challenge up to three friends. Points are accumulated by drawing different hands.

Casino Pack from Futura Software (\$21.95 on diskette, \$19.95 on cassette) bring you various Las Vegas games such as slot machine, craps, and blackjack.

Sports Games

There are many sports games available for the TI computer. These games are suitable for both children and adults, but they do assume you already know the rules of each game.

Indoor Soccer

Indoor Soccer is a TI command module and is available from Texas Instruments with a suggested retail price of \$29.95. You can use either joysticks or the keyboard. The program provides high-resolution graphics and extensive sound effects.

This program is state of the art and is a good example of what can be accomplished with home computers. The human player controls only one player on the team. You can change

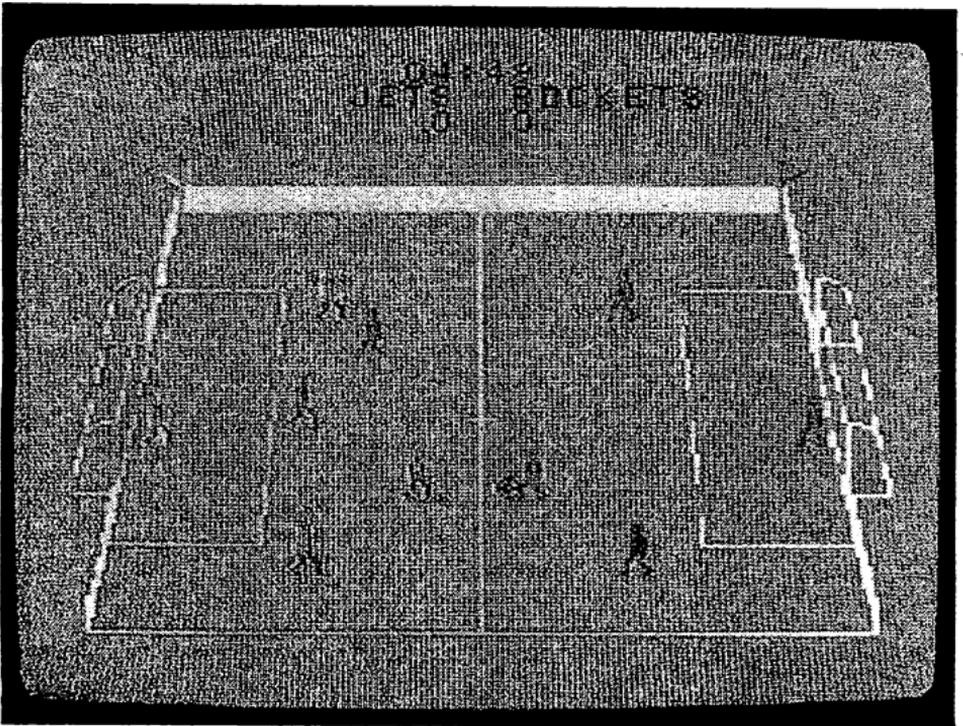


Fig. 2.6 Indoor Soccer

which player you control, though. Players can do all the standard soccer maneuvers, including passing, intercepting, tackling, and blocking. You can make free kicks, goal kicks, and penalty kicks, and timeouts can be called. The sound effects are great and the graphics superior. A unique feature of this game is that you can request an instant replay after a goal is scored.

WHERE TO LOOK FOR SOFTWARE

Probably the best way to find good new game software is to read some of the computer magazines. These magazines carry advertisements and reviews for many games. One of the best magazines for TI owners to subscribe to is *99'er Home Computer Magazine*, published monthly by Emerald Valley Publishing Company. Subscriptions are available for \$25 per year. This magazine carries regular reviews of game programs for the TI-99/4A computer. Other magazines that may be of interest to TI owners are *Compute*, *Creative Computing*, and *Computers and Electronics*. All three are available on well-stocked newsstands.

Local sources of software for the TI computer include some computer stores, video equipment stores, Sears, some department stores, and many discount stores, such as K-Mart.

CHAPTER THREE

Arts and Crafts

If you look closely at the video games on display down at the computer store, two things are likely to stand out: the quality of the animated color graphics and the sound effects. To many people the creators of video game programs are much like magicians. How can they create such startling visual and sound effects on a computer that costs less than \$100? We aren't going to tell you that in a weekend of study you can create a video game that will sell millions of copies. That task requires a considerable amount of knowledge about how computers operate, as well as some creative and artistic genius that most of us just don't have. Many of the creators of video games, however, began by buying a computer and learning how it operates. They did not necessarily have formal training or college degrees in computer science or engineering.

Creating video games is not the only way you can take advantage of the TI-99/4A's graphics and sound effects. Several programs let you create color pictures or musical tunes yourself. Many of the better programs for the TI-99/4A depend heavily on the computer's ability to generate color graphics and sound. With this computer, you can create color graphics

and sound or music that are as good as any produced by other computers in the same price range. When the occasion calls for it, the TI-99/4A can display print material in upper and lower case. It can talk through a speech synthesizer. It can put all sorts of color pictures, figures, and charts on its screen. And it can do a decent job of creating lots of sound effects and music through the speaker of your television or monitor.

Computers like the TI-99/4A are used in the areas of music and art in two different ways:

- To create music and graphics. The computer and its peripherals serve as a musical instrument for budding musicians and as a drawing pad for artists.
- As a teaching machine. The computer can actually teach you some of the basic information you need to create music or color graphics.

This computer won't take the place of your baby grand piano or your electric organ. And you won't be able to press a button and get an instant Picasso to hang on your wall. It probably won't take the place of music or art lessons either, but there are many things you can do with the computer in the areas of art and music that are fun and educational.

GRAPHIC ART

The TI-99/4A you take home from the store is a powerful graphics machine. Its screen is divided into three parts. There is a border, a display area, and the characters that appear in the display area. The TI-99/4A lets you change the color of the display area and the characters that are displayed on a blue background. It is easy to tell the TI-99/4A to adjust the screen to your particular tastes.

Standard TI-99/4A display features also include a way of creating graphics symbols. These symbols are the same size as regular letters and numbers, and they can be typed just like an A or 3 by pressing the correct keys on the keyboard. You

can use these symbols to create relatively crude pictures on the screen in much the same way you may have created a Christmas tree image on a typewriter by typing lines and lines of X's and I's in the pattern of a tree. The TI-99/4A creates these color graphics by dividing the screen into twenty-four lines of thirty-two characters.

High-Resolution Graphics

The great graphics you see in TI video games don't use that format, however. They take advantage of the computer's ability to generate *high-resolution* color graphics. *Hi-Res* graphics don't deal with the screen as a set of 768 squares (twenty-four lines of thirty-two characters). In the normal, low-resolution display mode, the computer tells the video display what to show in each of those 768 little squares. A particular square may have a capital A, a comma, or a graphic symbol like a heart in it. What the computer is actually displaying on the screen is a set of dots. Each character square on the TI-99/4A is eight dots wide and eight dots deep. If you look carefully at the information on the TI-99/4A's screen, you can probably see that letters and characters aren't really solid images. Instead, they are made up of patterns of closely spaced dots. The computer creates all its low-resolution graphics and characters by sending patterns of dots to the screen. Each of the 768 possible locations on the screen can display anything from a square where all of the sixty-four dots (eight rows of eight dots) are off (a blank square) to a square where all sixty-four dots are on (a solid square). By turning some of the dots on and some off, the computer can create patterns for all sorts of letters and graphic symbols.

The disadvantage of low-resolution graphics is that you must deal with sixty-four dots at a time. With high-resolution graphics, each dot on the screen can be controlled independently. That is, if the picture you are creating calls for one particular dot in a square to be turned on, high resolution lets you turn that one on and leave the other three off. High-resolution graphics thus let you individually control 49,152 dots on the screen

(64 dots in 768 squares). You can create some surprisingly detailed pictures with that many dots. You can turn each one on or off and control the color of each dot individually.

High-resolution graphics on a standard TI-99/4A are possible, but this isn't easy because of the way you must write programs to control each dot. If you need to control 49,152 different dots, there must be a lot of memory in the computer to store the instructions. You can buy software that makes the job of creating color graphics easier and more fun. The standard TI BASIC has too few keywords for creating color graphics, but TI Extended BASIC has quite a few keywords for this purpose. We recommend that you consider buying the Extended BASIC program, even though it costs more, if you want to do a lot with color graphics.

You may be thinking that a picture made up of dots on the screen can't really be that good. Remember that the image you see when you watch a regular television program is really a pattern of dots. Television displays are made up of even more individual dots that the TI-99/4A can control, but the principle is still the same. When we look at a bunch of dots, our minds do their best to see them as a meaningful whole, as a picture.

When Extended BASIC is added to the computer, the TI-99/4A has another powerful graphics feature—sprite graphics. A sprite is a special graphics character that can be much larger than standard characters. A sprite could be an extra-large letter or number; a video game piece such as a tank, airplane, or crawly creature; or whatever you wish. Extended BASIC will let you create up to twenty-eight different sprites. You can give each sprite a different color and move each one independently. You can even change the size of a sprite with the MAGNIFY keyword. That means you can make an object look as if it's getting closer and closer by making it appear larger and larger on the screen.

When Texas Instruments designed this computer, the company paid special attention to graphics. The first versions of the Model 99 computer, however, were specifically designed to prevent owners from writing programs that took advantage of all those color graphics features. We understand TI tried to design computers in such a way that only TI programmers,

and programmers cooperating with TI, could write high-resolution color graphics programs. TI hoped to keep most of the market for programs to themselves with this strategy. We feel the policy poorly served both the company and the people who bought the computer. First, TI could not possibly create and market all the programs TI owners want to buy. Second, purposely designing a computer so owners could not create the same quality of graphics as the TI programmers is a self-serving, restrictive business policy that should not be accepted or encouraged. The response to TI's approach was extremely negative. When TI introduced its Extended BASIC, it gave owners more access to the color graphics features of the computer and appeared to be making a concerted effort to compensate for earlier mistakes.

More recently, just before the company announced it had lost millions in its computer operation, TI appeared to be returning to its earlier, more restrictive approach. In the summer of 1983, TI announced it was considering a modification of the TI-99/4A that would prevent video games written by other companies from running on their computer. TI could do this by placing instructions that control high-resolution graphics in a *read only memory* chip that would be installed in the video game cartridge instead of in the computer. If the *graphics read only memory* (GROM) were removed from the computer, other companies would have to pay a license fee to add those instructions to their hi-res video games. TI, however, announced it does not plan to license the GROM rights to other companies. That would mean Texas Instruments would be the only supplier of hi-res video games for the TI-99/4A. No other computer company we know of has even considered such a policy, and no single company is likely to be able to provide such a range of programs that everything you might want to buy is available from that one source. We feel that, if TI actually does this, it is enough of a disservice to the buying public that people should seriously reconsider the purchase of a TI-99/4A.

As this chapter was written, TI had not modified the computer to prevent other companies from selling video games for it. In addition, both the Extended BASIC language and the version of Logo that runs on the TI-99/4A have many keywords

that let you create your own color graphics. Several other companies also sell programs that help you create hi-res graphics on the computer. Republic Software, for example, has a \$20 program called Utilities 1 that makes it easy to create hi-res color pictures and figures. The magazine *99'er Home Computer Magazine* regularly publishes articles on high resolution graphics. The May 1983 issue, for example, includes an article by W.K. Balthrop on "Graphic Presentation of Extended BASIC."

THE SOUND OF MUSIC (AND SPEECH) ON THE TI-99/4A

Any sound, musical or otherwise, has several characteristics:

- *Pitch* is determined by the frequency (cycles per second) of the sound. We hear cycles or waves created by vibrations in the air. These are measured in cycles per second, or Hertz. The typical human can hear sounds between twenty and 15,000 cycles, or Hertz. Notes on a piano or any other musical instrument are organized by pitch. The sound created by a piano is organized into several *octaves*. A piano has slightly more than an eight octave range, from deep or bass sounds to high pitched notes. An octave is a group of sounds rather than a single sound. An octave, for example, might begin with the C note and progress up through notes D,E,F,G,A, and B. The next note ends that octave and begins the next highest octave. Composers and musicians have created a complicated system of naming sounds of different pitch and duration, but the primary difference between one note on a piano and another is pitch (the frequency, or Hertz, of the sound).

- *Amplitude or loudness* of the sound. We experience this as variations in the volume of the sound.

- *Duration* is the amount of time the sound is made. There are symbols that tell the musician exactly how much time to play each note in a composition.

- *The envelope* of the sound is the variation of loudness over the period it can be heard. Different sounds have different *attack* and *delay* patterns. Some reach their maximum loudness gradually and then trail off. Others begin at maximum loudness and stop abruptly. The pattern of changes in volume of tone help determine the *timbre*.

- *Timbre* is a musician's term for the complexity of the sound. Some sounds are pure tones, which means they have only one pitch. Others have a major tone at a particular frequency and many harmonic, or secondary, sounds. This is part of what gives each musical instrument its own personality.

The TI-99/4A has a good music and sound synthesis system. It is a *four-voice* system, which means it is capable of generating up to four separate sounds at once. The TI-99/4A can control the sounds it generates through the CALL SOUND keyword. This keyword is one of the many keywords the computer understands when it is controlled by the BASIC language in its memory. The pitch, duration, and loudness of sounds are controlled by a set of three or more numbers that follow CALL SOUND. The attack/decay pattern and the timbre of the sound are only crudely controllable on the TI computer. Three of the voices let you generate relatively pure sounds that sound like musical notes. The fourth voice generates sounds with a different timbre and attack/decay envelope pattern. This fourth voice is good for generating sound effects like the sounds of battle in a space game.

Some of the programs that help you take advantage of the computer's sound synthesis features are described below:

Music Maker Module

With this program you can compose and play music on the computer without actually writing a program in BASIC or Logo. It is a \$40 cartridge that plugs into the slot on your computer. The Music Maker module allows you to write music on the computer screen and then tell the computer to play it

back to you. The program lets you control the note to be played and the volume. Up to three different notes can be played at once.

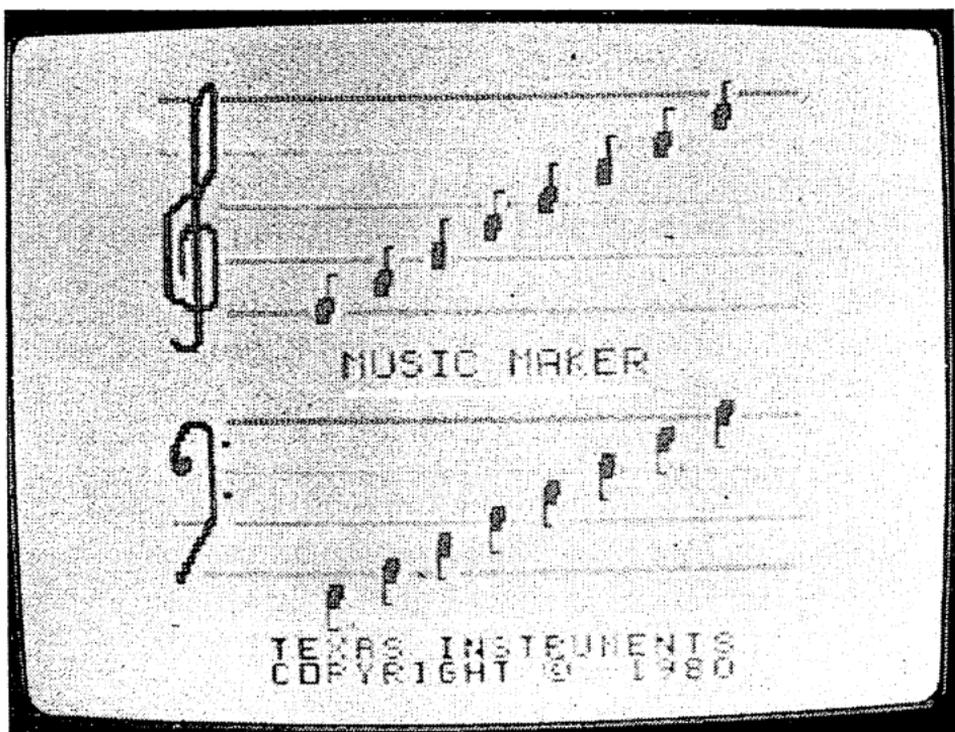


Fig. 3.1 Music Maker

Music Maker can be used in two different modes. One mode lets you create music without learning music notation. The other mode is for people who can sit down and enter notes in standard music notation. In the standard notation mode, the keys on the computer become notes instead of letters and numbers. The screen displays a musical staff. If you press the key for a middle C note, for example, the computer will put the notation for that note on the staff. As you create your masterpiece, each note (each key on the keyboard) is placed on the electric sheet of music on the screen. At any point you can tell the computer to play what you've created. After you hear the music, you can edit or change it as much as you want. You can add, change, or delete notes; you can change the

volume of each note and the tempo or speed at which the tune is played. When you're satisfied with your composition, you can save it on a disk or cassette. That means you can load it back into the computer days, even years, later and play it again. You could compose a whole set of Christmas carols and play them during the holidays each year.

The computer can also be used to teach about music. Here are three programs that can help you learn about music fundamentals:

Music Skills Trainer

This TI program costs \$29.95 on diskette and \$24.95 on cassette. It is written in TI BASIC and is available on cassette or disk. The program provides drill on four different fundamentals:

- *Pitch.* Can you recognize the difference between one note and another? This program gives you training in pitch recognition. It plays a note and asks you to identify it. As you learn how to distinguish between different notes, you move on to more and more difficult levels of identification.

- *Interval Recognition.* Another music fundamental is the ability to recognize the interval between notes. That is, how far apart on the musical scale are two notes? This program provides practice on interval recognition at several levels of difficulty.

- *Chord Recognition.* If you were a piano player, your right hand would generally play the melody of a composition. The left hand would play the harmony. The melody gives the music its identity and its personality. The harmony is the background. Harmony is usually repetitive and provides the beat of the music. Both the harmony and the melody are made up of chords. Chords are sets of individual notes that are all played at the same time. A chord of harmony, for example, might be three different notes played at once. While you were playing that chord of harmony, you might also have to keep your right hand busy playing a *broken chord* of melody. That

chord might have the same three notes in it, but they would not be played all at the same time. In the broken chord, the notes are played one after the other.

There are many commonly used chords in music. The C chord, for example, may be found in hundreds of compositions. Learning to recognize these chords when they are played is an important part of musical training. This program gives you practice in recognizing many of the commonly used chords.

- *Phrase Recall.* This program develops your ability to remember a sequence of up to nine different notes. The computer will randomly select the notes and ask you to identify each of the notes after they have been played. As with the other drill programs, this one has several levels of difficulty.

- *Note Whiz and Pitch Master.* These programs are available from Meca, Inc. They are \$29.95 a disk or cassette. Of the two, Note Whiz is probably the one that will be of most interest to beginning music lovers. Pitch Master deals with more complicated musical concepts.

Note Whiz is designed to sharpen your skill at rapid note reading. As notes appear at different locations on the musical clefs displayed on the screen, you must identify the notes. (A standard music staff is made up of two sets of five lines. Each set of five lines is a clef. The top clef is the treble clef; the bottom clef is the bass clef.) If you accurately identify the notes within the time limit, Note Whiz rewards you with a tune (computer generated music).

The Pitch Master program is designed to strengthen your musical ear and to improve your ability to memorize note sequence. You tell the computer what type of melodies you want to hear, and it will generate a melody and ask you to identify the notes used in the melody. This program uses some good color graphics to display note patterns on the screen.

There are many exciting ways to use the computer as a musical instrument and as an artist's canvas. If you want to learn more about programming in several computer languages that will help you create your own art and graphics, you'll find more information in Chapter Nine.

The TI-99/4A as Teacher

Our society is turning into a *learning* society; the knowledge we have in our heads and the information tools we have at our disposal determine, to a great extent, the success or failure of what we do. With that in mind, many families have purchased computers to help with learning.

Computers can serve as information tools (that topic is covered in the telecommunications chapter), and they can be a topic of study in themselves. There are even programs that let you learn how to use the computer more effectively:

Many people who purchase a home computer hope it will help their children do better in school. Computers *can* be valuable learning tools for children as well as adults, and that is the subject of this chapter.

How can computers help people learn things? First, computers can help by making it quicker and easier to learn things in time-tested ways. In other words, computers can help us continue to learn in ways we know will work.

For example, we have known for many years that one of the most powerful ways to learn is through repetition. Com-

puters have the ability to provide good, methodical repetition for as long as it's needed, And computers can do that without losing patience and making the learner feel stupid.

Computers can also give good feedback and encouragement. We know it is a good teaching technique to provide reinforcement as soon as possible after a learner gives a correct answer. A computer can immediately reward a correct answer with a smiling face or three minutes of an exciting computer game. The computer can also give you feedback on why an answer is incorrect and help you learn the specific information or skill that will enable you to learn difficult concepts or skills.

These are examples of standard learning methods. There is nothing really new about these techniques. The computer is only a new *means* for applying traditional methods. If you are a teacher or a parent, using the computer to automate these standard learning methods can give you more time to help children with more creative aspects of learning. The computer releases you from the frustrating task of drilling children on spelling or multiplication or a variety of other repetitive tasks.

We think educators and programmers should continue to work on producing and improving standard uses of computers in learning. We also believe, however, that it is more important to use computers in nontraditional ways. We think that the computer can be used for new and better ways of teaching and learning. We call such uses *innovative educational computing*.

The future development of innovative uses is particularly important if computers are to earn their keep in schools. When schools purchase computers, they use them solely to aid learning, and they must use them efficiently in order to justify the costs. For parents who use a computer for many uses, this may not be as important. If the computer is used for entertainment, balancing the family checkbook, and for word processing, it doesn't have to prove itself solely as a teaching machine. Nevertheless, we feel that it is important to be aware of the differences between standard and innovative educational uses.

Texas Instruments has produced a large number of educational programs, most on command modules so that they can be used by those who have only the basic hardware. In addition,

TI has attempted to avoid a common criticism of educational software, that it fails to use good principles of education. That happens because good computer programmers usually know little or nothing about teaching. TI generally arranges for large companies who specialize in educational materials to design the lessons that are then converted into computer programs. Scott, Foresman and Company; Addison Wesley; Scholastic Incorporated; Milliken; and the Minnesota Educational Computer Consortium are examples of organizations that have participated in developing TI software. This makes it more likely (but does not guarantee) that educational programs will be educationally sound. TI also tends to develop their programs in series rather than as individual programs. The series concept helps prevent educational software from being a large number of isolated, one-shot offerings that are lacking in continuity. One weakness, though, of TI's approach is that they do not encourage other suppliers to develop software for the TI-99/4A. This significantly reduces the amount of software available and may even reduce the quality of what can be purchased.

We'll talk about software that uses both the standard and innovative educational approaches.

STANDARD USES

Drill and Practice and Tutorial Programs

The simplest type of computer use in education is drill and practice. Drill and practice programs don't really teach you anything; they just give you practice in something you learned in some other way. A common drill and practice program is one that gives the student practice in using basic math skills.

A tutorial program does more than just give you practice on something you already know. It actually teaches.

At present, drill and practice programs are much easier to find than tutorial programs, but the following math program combines some of the elements of each:

Addition/Subtraction 1

Addition/Subtraction 1 is a Texas Instruments' command module with a suggested retail price of \$39.95. This is a drill and practice program with some tutorial functions. The program takes advantage of the things the TI computer does well: graphics and speech synthesis. (The speech synthesizer is optional and is really not essential for this program.) Since this program comes as a command module, you can run it using only the console and monitor. The program is intended for children who are developing math skills at the first grade level.

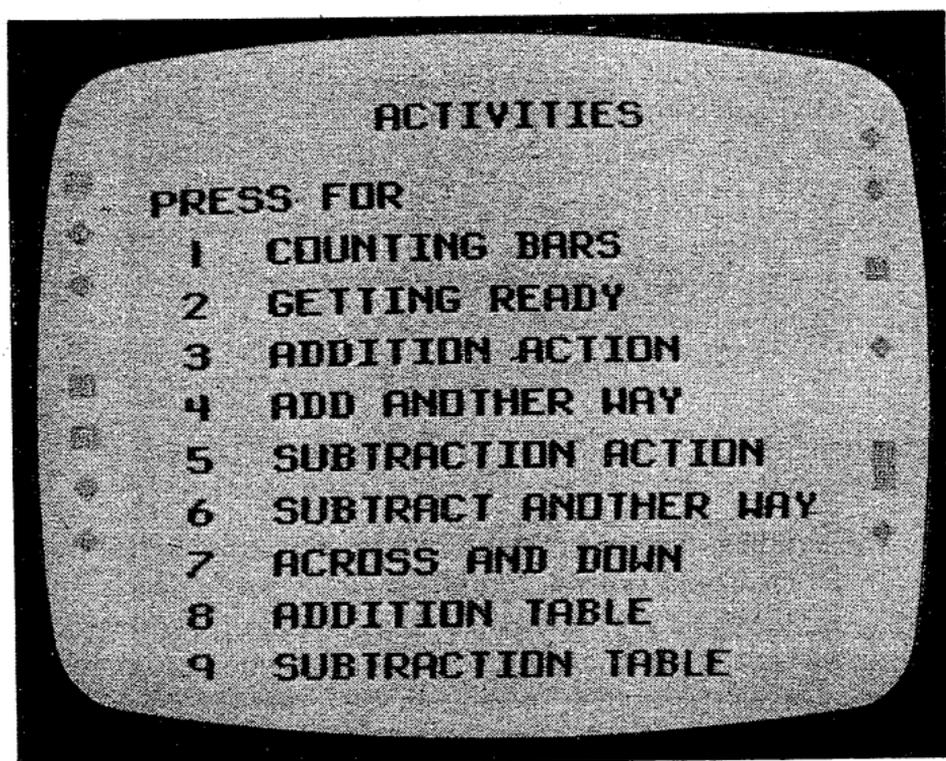


Fig. 4.1 The menu of Addition/Subtraction 1

The program was developed in conjunction with Scott, Foresman and Co., a large publisher of school textbooks.

The program begins with an impressive musical fanfare and an intricate graphic display of a rocket blasting off. (At least the sound effects and graphics are impressive *at first*. They are repeated so often they eventually become downright irritating!) The main menu then displays the choices shown in Figure 4.1.

When you make a selection (number 1-Counting Bars, for example), the rocket and music appear again. Then a number line labeled from 0 to 9 is displayed on the screen. Nine small colored rectangles (bars) are displayed above the nine, eight bars are displayed above the eight, and so on. The bars appear one at a time, and each is accompanied by a musical tone. Next, the numbers disappear, and the words *Your Turn* appear on the screen (and on the speech synthesizer, if you have one). Now a flashing box appears below one of the points on the number line, and you type the number you believe goes there. If the response is correct, the fanfare sounds and a fancy graphic appears. If the answer is wrong, it is X'ed out on the screen, and you get to try again. If the answer is wrong again, it is again X'ed. The program then provides an auditory (if the speech synthesizer is attached) and visual answer to the problem. For example, if the correct number is four, several numbers appear next to colored bars and a musical tone accompanies the appearance of each number. Then a large number 4 appears in the proper box below the number line. This is a good example of how a tutorial function can be combined with drill and practice.

When this section is completed, the program moves automatically to activity #2, Getting Ready. After the usual music, the rocket graphic and sound effects, the screen displays a large square containing six small elephants. The words *How Many?* appear below the box as in Figure 4.2.

Then, one at a time, the elephants turn black, and a number appears next to each elephant as it is counted. As the last elephant is counted, the sixth moves down and is placed under the words *How Many?* and *six* is spelled below the number. If there is a speech synthesizer, it reads everything as it is

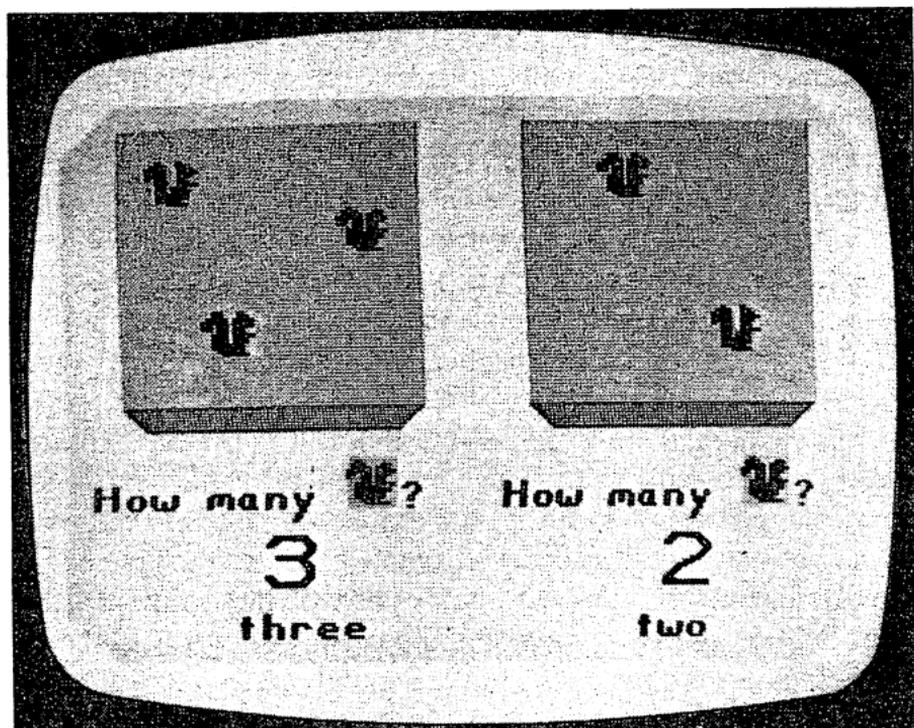


Fig. 4.2 How Many? from Addition/Subtraction 1

displayed. That's handy for children who are poor readers or who haven't learned how to read.

Activity #3 is Addition Action. A sample problem shows how the activity works. It starts with a square with four fish in it. The number 4 appears below the box. Then three more fish appear to the right of the box with + 3 below them. The computer displays: $4 + 3 =$. As an answer, the three fish move into the box with the other four and a 7 completes the equation. At the bottom of the screen, $4 + 3 = 7$ is displayed. After this initial tutorial section, the computer presents an actual problem. If you type in the correct answer, you will get the usual sounds and graphics as a reward. If the answer is incorrect, you get to try again. If your answer is wrong again, the animals in the box turn black, and a number appears one at a time next to each animal. After all are counted, the final number moves down into place in the equation as in Figure 4.3.

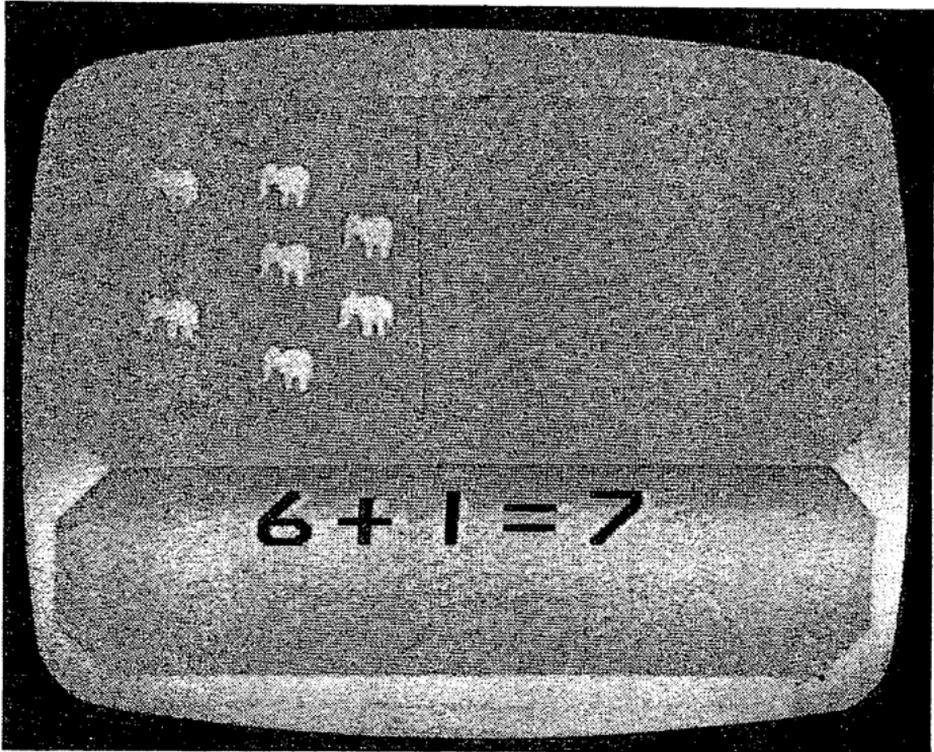


Fig. 4.3 Addition Action from Addition/Subtraction 1

Add Another Way is Activity #4 and is an exercise that demonstrates how to add both horizontally:

$$4 + 1 = 5$$

and vertically:

$$\begin{array}{r} 4 \\ +1 \\ \hline 5 \end{array}$$

The program starts by moving the numbers, one at a time, from the horizontal equation into the vertical problem. This is followed with a drill on the concept.

The format in activities #5 and #6 is similar to activities #3 and #4, except that you learn subtraction instead of addition.

Activity #7, Across and Down, presents a three-way grid as shown in Figure 4.4. You fill in the grid by adding in every direction.

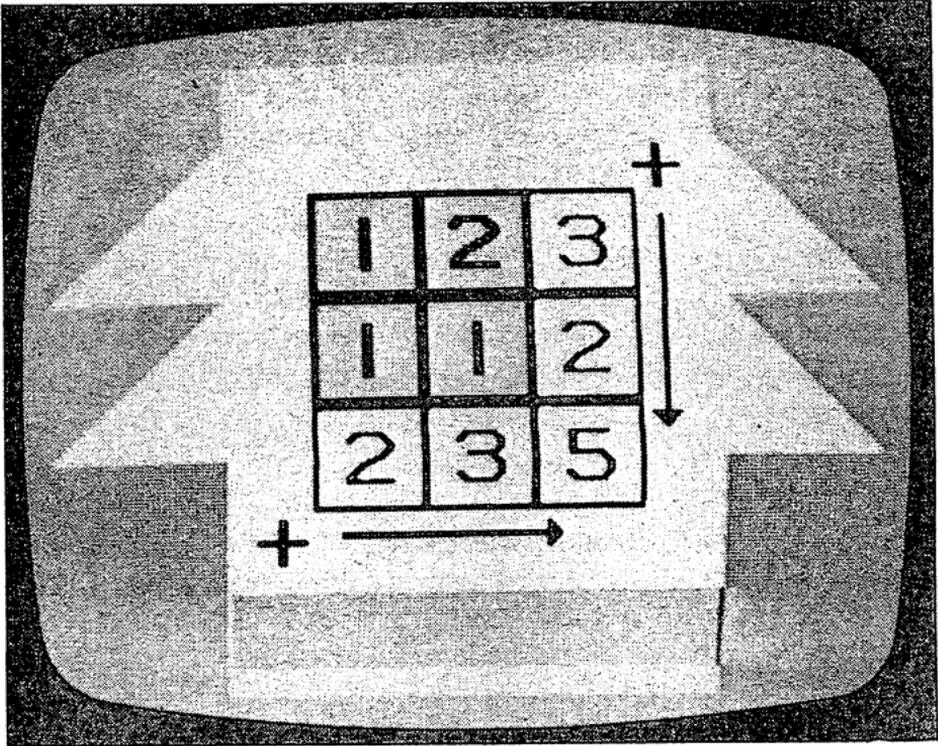


Fig. 4.4 Across and Down from Addition/Subtraction 1

Activity #8 presents an addition grid consisting of the numbers 0 to 9 displayed both horizontally and vertically. The program selects a vertical and a horizontal number by shading the row and column. The object is to fill in the sum where the two shadings meet. When a problem is correctly answered, a "smiley face" appears in the answer block. When an answer is incorrect, the problem and correct answer are displayed in the lower right corner of the screen. Figure 4.5 shows that several correct answers were entered and the answer to $3 + 0$ is 3.

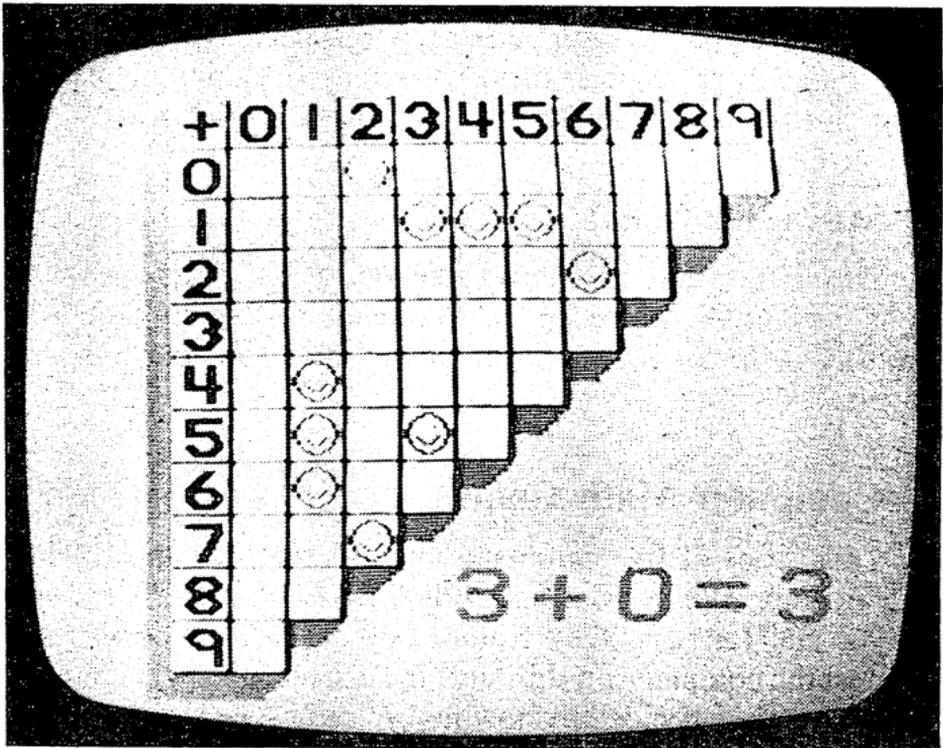


Fig. 4.5 Addition Grid from Addition/Subtraction 1

Activity # 9 is similar to #8 except that it deals with subtraction. The program is well written and uses color graphics, sound effects, and speech synthesis to good advantage. The music and graphics are somewhat overdone and become tedious after a while, but perhaps that would not be true for a child. Although primarily a drill and practice program, it does provide a little tutoring at the beginning of each exercise. The program responds quickly when you type in the answers. Accidental key presses during the program do not crash the program or have any effect whatsoever.

Addition/Subtraction 2

The second command module in the series developed with Scott, Foresman and Co. also sells for \$39.95. It is similar to Addition/Subtraction 1 except that it deals with math skills at

the second grade level. Like the first module in the series, it uses color graphics, sound effects, and speech synthesis. The irritating rocket graphic display is replaced by an equally irritating (to adults, at least) airplane graphic.

Multiplication 1

This is the third command module in the series and also sells for \$39.95. It is designed to provide instruction and drill (mostly drill) in multiplication at the third and fourth grade levels.

Computer Math Games

This series of five command modules was developed with the Addison Wesley Co. and sells for \$39.95 each. They are clever and fun, and they feature tasks such as a horse race against the computer. In this race, the distance the horse moves on each turn is decided by how fast you can type in the correct answer to an addition problem. The graphics and sound effects are excellent.

Arcademics

This is a series of six command modules that combine some of the characteristics of arcade action games with drill and practice. The series was developed by TI in conjunction with the DLM company. Dragon Mix, Alligator Mix, Alien Addition, Demolition Division, Minus Mission, and Meteor Multiplication are command modules that sell for \$39.95 each and are a creative blend of education and gaming. For example, in Meteor Multiplication, you are given a multiplication problem, and your task is to blast the asteroid containing the correct answer. Figure 4.6 shows a screen display from Meteor Multiplication. Kids like the graphics and the sound effects.

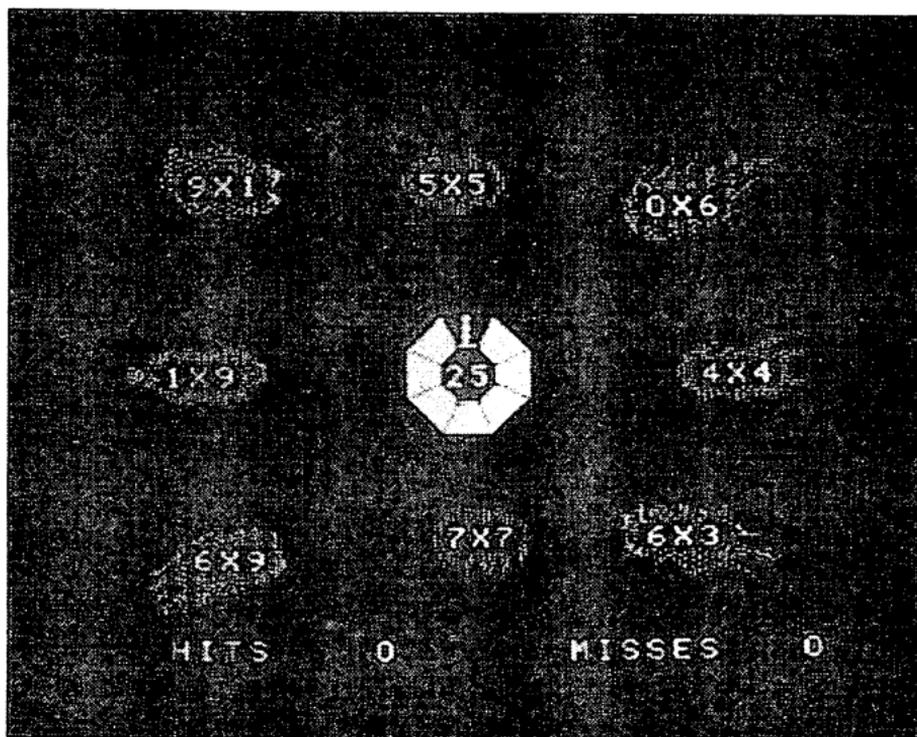


Fig. 4.6 Meteor Multiplication

Touch Typing Tutor

This \$29.95 TI command module should help anyone who would like to learn to type. The program has three parts: lessons, diagnostics, and games. The lessons section helps you learn the key. A review comes after every two lessons. The diagnostics section analyzes your typing skills, provides practice in weak areas, and measures your typing speed. The program measures speed on individual letters and guides you to appropriate practice. The game section uses graphics and sound effects to motivate you to increase your typing speed. You may choose any of eight levels of difficulty.

Spell Writer

TI has made three of its Speak & Spell packages available for use on the TI-99/4A. The program sells for \$29.95 on disk

and \$24.95 on cassette. You need both the Terminal Emulator II package and Speech Synthesizer to use the program, however (See Chapter Ten). With Spell Writer, you can design spelling lessons, play a word game, and use a file transfer program to make additional copies of word lists. Using this unique program, you can put in any word you want, and the speech synthesizer pronounces it. For example, the program drills you by pronouncing a word you have entered in Spell Writer. You type in the way you think it is spelled, and the computer voice reads what you have entered. There are no graphics in this program.

PLATO Programs

In a joint marketing venture, Control Data Corporation (CDC) and Texas Instruments have agreed to make available a comprehensive series of PLATO education command modules. PLATO began at the Computer Education Research Laboratory at the University of Illinois in Urbana. It was originally operated on a large central computer that could be accessed through telephone lines or microwave transmission. Hundreds of PLATO terminals are scattered around the country, most of them in public schools and universities. There is PLATO software to teach everything from simple addition and subtraction to how to fly the space shuttle. The PLATO Courseware Library for the TI-99/4A is divided into Basic Skills and High School Skills. The Basic Skills portion is for children who need challenges or additional learning material in math, reading, or grammar at grade levels three through eight. High School Skills are advertised as being for young adults who need challenges or more work in subjects usually presented in grades nine to twelve, and for older adults who want to brush up on their skills or prepare for the GED exam.

PLATO on the TI-99/4A will require the PLATO Command Module (\$49.95), any one of 108 *packages* including a diskette (\$49.95 each), TI Memory Expansion, and TI Disk Memory System. The programs include instruction in reading, as well

as math and language arts, such as poetry and literature. You can also get physics, chemistry, earth sciences, and biology, and material in the social sciences, such as geography, economics, behavioral science, political science, and history.

The PLATO software was announced and advertised when this was written, but it was not available. PLATO software for larger computers varies in quality from excellent to awful. We suspect the material they select for conversion to the TI computer will be some of the better programs.

PLATO will obviously be very expensive if you buy the entire series. Schools, libraries, and user's groups will probably be the most frequent volume purchasers, although many families may buy specific programs that can be used by one or more family members. More than twenty years of research have gone into the original PLATO programs. That should help assure a minimum level of quality in the TI PLATO software.

Teach Yourself Extended BASIC

This tutorial cassette (\$14.95) or diskette (\$19.95) is designed to help you to learn TI Extended BASIC. It includes seven chapters of tutorial lessons. In addition to the programs, you need the Extended BASIC (module, \$99.95). This program is designed for adults.

Other TI Educational Programs

Almost half of the TI Software catalog is devoted to educational programs of one sort or another. We can't mention all of them in this book, but a few you may be interested in are Early Reading (module, \$39.95), Beginning Grammar (module, \$39.95), and Speak & Math (disk, \$29.95; cassette, \$24.95). Consult the TI catalog for others.

INNOVATIVE USES

Innovative educational uses, you may recall, are those that provide new and better ways of teaching and learning. Innovative uses include teaching programming, simulations, and using word processing to improve writing skills.

LOGO

Logo is a computer language written especially for children by Seymour Papert. Papert is an MIT computer scientist who studied child development for five years with the famous child psychologist, Jean Piaget. Papert and his colleagues developed Logo, based on Piaget's ideas of how children think and learn. Papert suggests that if educational computing is to be of value, children must program the computer, rather than the computer programming children.

Logo makes it possible for children to actually program the computer to create complex graphics. Children are able to begin doing this after only a five to ten minute introduction to Logo commands! Papert believes that Logo can change the quality of children's thinking. While enjoying Logo, children learn mathematical and geometric concepts quite easily. We believe Logo holds great promise for educating children, and we recommend its use both at home and at school.

Although Logo will do other things besides create graphics, many people believe it is the graphics capabilities that are most important. Logo can be learned and used at many different levels of complexity.

Logo graphics revolve around a *turtle*. The turtle, shown in Figure 4.7, is a triangular shaped object on the screen that is guided around the display with a series of commands. As the turtle moves, it leaves a line in its path. You can create complex designs by moving the turtle this way.

Even if Papert is overly optimistic about changing the quality of children's thought, there are other things to recommend Logo. Many children dislike school because they associate it with failure. Logo gives the child successful control of a complex instrument—the computer—at school. Logo can motivate children to learn mathematical and geometric concepts in order to move the turtle efficiently. Errors are obvious right away, and the computer is nonjudgmental. This is particularly good with children who are sensitive to adult criticism. Logo can also be used to encourage children to work together as they attempt to solve Logo problems in groups.

A version of Logo is available for use on most computers. One of the major advantages of TI Logo is that, in addition to the turtle, it permits the creation of intricate, colorful moving graphics called "sprites." Figure 4.8 shows a screen display of sprites. (The tumbling asteroids in the Parsec game were created with TI Logo.) TI is producing an updated version of Logo called Logo II, which will do everything the original TI Logo does and more. In Logo II you will be able to program music and larger sprites. There are other improvements as well. Logo requires extra computer memory. Logo II will sell for around \$130.00. For more information on Logo, see Chapter Nine.

Simulations

Simulations let learners take roles in imaginary environments that have their own set of rules. Simulation programs are difficult to write, however, and good ones are scarce. We have already discussed several simulation programs in the chapter on computer games (Chapter Two). Some others include Hang Glider Pilot, available on cassette for \$19.95 from Maple Leaf Micro Ware; Winging It (another flight simulator), on cassette only for \$15.00 from Not Polyoptics; and Crime and Punishment (a courtroom simulation) available on cassette for \$12.50 from Decision-Making Systems Ltd.

Children and Word Processing

Another educational computer use we classify as innovative is the use of word processing programs to teach writing. If you want to improve writing or mechanical skills such as grammar, spelling, and punctuation, you can profit from word processing. Word processing makes the mechanics of revising a letter or manuscript easier than manual editing, and it encourages experimentation. Children who are working on their writing skills often find they must devote much of their energy and attention to the physical task of writing with a pencil. It's less work to write a story using a word processor, so children can concentrate on composing and organizing their creation. And since the computer lets them change and edit material without creating a mess, it is easier for children to see the effects of each change they make.

See the chapter on word processing for more information on this application.

We're just beginning to tap the educational potential of the home computer. You can have fun with it and learn something, too.

Home Finance, Record Keeping and Health Care

Chapters Two, Three, and Four in this book discuss a variety of ways the TI-99/4A can be used at home: amusing the family with games, encouraging the Picasso and Bach in the family with art and music, and teaching the kids math. In this chapter, we discuss using the TI-99/4A for keeping track of where the paycheck disappears, through checkbook programs, and we talk about record keeping and health-related uses.

Most people buy a home computer for some specific reason, such as word processing or telecommunications, but usually not specifically for the uses described in this chapter. After they have it for a while, they get more comfortable with it and more familiar with its potential. Their new awareness of what the computer can do leads many owners to look at the possibility of using the computer for home and personal uses.

If you were purchasing a computer mainly for home financial or record-keeping uses, or for health-related uses, you probably would *not* choose a Texas Instruments computer. There is not a lot of software for the TI along this line, compared with other home computers (the Apple, for instance).

But, since you've purchased the TI, there is some useful software in this area that you should know about.

The magazine *Interface Age* led the way in describing home applications of the microcomputer. Their December 1977 issue has two articles by Francis Ascolillo on a Household Finance System. The program gives a typical family an overview of their spending and earning patterns. It can print out monthly and yearly spending patterns and predicted trends. The same issue has a personal accounts payable program by Kevin Redden. You can keep track of bills as they come in, payments made, and other information. For example, you can keep track of time between receipt and payment, minimum payment due, total amount owed on each account, and interest paid on each account. These BASIC programs can be adapted for your TI computer (see Chapter Nine on Programming), or you may purchase similar programs written especially for the TI-99/4A.

99'er Home Computer Magazine, a publication devoted to the TI-99/4A, is another excellent source of programs in the home finance and record keeping area. You can type these programs in yourself and use them free (or for the cost of the magazine). If you don't have the time or the know-how to type in the programs, the magazine makes selected programs from past issues available on cassette tape. Programs featured each month are found in an ad near the end of the issue. Cassettes sell for \$12 each to subscribers, \$20 each for non-subscribers, plus \$1 for shipping and handling. Each tape contains from four to six programs. Most often, the programs featured are game programs, but there are several good programs for home finance, record keeping, or health care uses.

USING YOUR COMPUTER FOR FINANCIAL USES IN THE HOME

A growing number of TI programs are available that help home computer owners with personal financial decisions. These

programs can help with budget control, financial planning, checkbook balancing, analysis of loan options, and filing income tax forms. One of these programs is called Home Financial Decisions.

Home Financial Decisions

Home Financial Decisions is available as a command module from Texas Instruments and carries a suggested retail price of \$29.95. The program is designed to help families with decisions about loans, savings, the purchase of homes and cars.

The loans section of this program will help you determine:

- The amount you can borrow, based on the size of monthly payments you can afford, number of monthly payments, and annual interest rate.
- The size of monthly payments, based on the amount borrowed, number of payments, and annual interest rate.
- The number of payments, based on amount borrowed, size of monthly payments you can afford, and annual interest rate.
- The size of the down payment, based on purchase price, size of monthly payments you can afford, number of monthly payments, and annual interest rate.
- The early payoff amount of a loan, based on the amount borrowed, annual interest rate, number of payments you have made, and size of monthly payments.

As a test, we ran this part of the program and indicated that we wanted payments of \$58.00 per month for forty-eight months at an annual interest rate of twenty percent. The program informed us that we could borrow \$1905.99 and that the total interest paid on the loan would be \$878.01.

The residence section of the program can help with decisions about buying a house: whether to choose house A or B, whether to buy or rent, whether you should remain in your present home or buy a new one, whether you should remain in your

present home or rent, and whether you should refinance your existing mortgage.

We ran a quick test on the *Buy a House* segment and indicated we were considering a house priced at \$93,000 with \$20,000 down and a thirty-year mortgage at fifteen percent interest. We gave the annual percent increase in market value as two percent, the annual property tax as \$400, and the annual insurance cost as \$250, with five months from date of closing to the end of the year. The program informed us we could expect a total monthly payment of \$977.20, which included property taxes of \$33.33, insurance premium of \$20.83, and P and I (principle and interest) of \$923.04.

The section of the program that deals with auto financial decisions includes car-buying options: buying car A or B, leasing or buying a car, keeping your present car or buying a new one, keeping your present car or leasing a new one, and information on amount needed for early payoff.

The savings portion lets you plan future amounts in account: the size of deposits to reach a certain goal; the time period needed to reach a certain goal; and the amount needed in a savings account to permit a series of specified regular withdrawals for loan payments, retirement, and so on.

We found this program easy to use and well documented. The manual includes a glossary of terms. Perhaps what's most helpful is that it does a good job of explaining such financial terminology as *appreciation*, *equity*, and so on. The section on home purchases should be updated to allow for *creative financing* options such as variable interest rates, but that isn't a serious drawback. In each section, you can press a key to review the previous screen, start over in the same section, or return the computer to the selection list for that category or for the overall program.

We think this program could prove useful to many families from time to time, and we recommend it highly.

Other Home Financial Programs

TI sells several other programs for the TI-99/4A designed to help you make financial decisions. Here is a representative sample of these programs with a short description:

Household Budget Management (\$39.95) is available as a command module. It is designed to help balance your budget. It can be used to set up a complete, itemized budget consistent with your income or to help you find out why you run out of cash five days before payday each month. The program can produce some interesting graphs and tables that help you understand what is happening to your money.

Securities Analysis (\$54.95) is also available as a command module and is designed to help you with personal investment decisions. It provides stock analysis and other services important to investors.

Personal Real Estate is a command module priced at \$69.95. It helps you evaluate alternative real estate investments. It can also help you learn the principles of real estate investment.

Personal Financial Aids is available on disk (\$19.95) or on cassette (\$14.95). It helps you understand and figure amortization schedules, depreciation, and mortgage analysis.

Checkbook Manager (diskette, \$19.95) from Texas Instruments does exactly what you expect. It gives you a method of record-keeping that includes balancing your checking account. It also helps you determine how much you are spending in predetermined categories.

1040A Tax Pack is available in TI BASIC for \$24.95 or in Extended BASIC on disk or cassette for \$29.95 from CompuTech Distributing. This program is designed to lead you step-by-step through preparation of your IRS income tax form 1040A.

Several home financial programs for TI computers are sold by SA2 Software, including Monthly Budget Master and Income Tax Planner. Both are available in TI BASIC or Extended

BASIC on cassette for \$12 each or \$18 for both (add \$2 for diskette versions).

Home Budget is available from B & B Graphics for \$10 on cassette and \$12.50 on diskette.

Newspaper Route, at \$12.95 (cassette only), helps anyone manage a newspaper route. The program keeps a list of customers, amount due from each, and total amount due. It also maintains a record of charges and payments for each collection period. A good program for showing the kids how the computer can be useful for something besides zapping aliens! The program is available from Software for the Home.

Several other companies publish good home financial software. Try Eastbench Software Products, Tyte Innovative Software, Ehninger Associates, Inc., and The 99/4(A) Program Exchange.

THE TI-99/4A AS A RECORD KEEPER

There are many record-keeping functions that you can perform at home with your microcomputer. You can keep track of everything from recipes to tax records to bartending instructions. One program intended for general record-keeping purposes is called Personal Record Keeping.

Personal Record Keeping

Personal Record Keeping is available from Texas Instruments as a command module. Suggested retail price is \$49.95. The program is a computer-based filing system for the home. It's meant to give you a fast, easy way to create, maintain, and use your own customized files. Because it's a general record-keeper, you can tailor it to fit your own needs. It can be used for recipes, tax records, shopping lists, Christmas card lists, and for many other purposes.

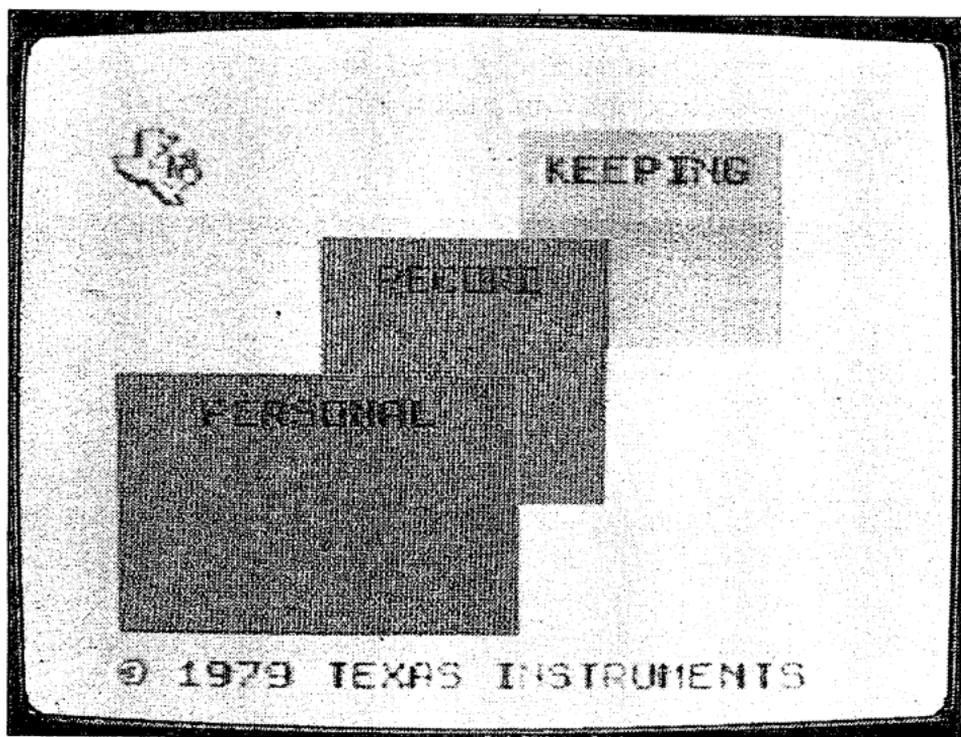


Fig. 5.1 Personal Record Keeping

This well-documented program lets you organize and set up customized files, as well as update and rearrange existing files. It lets you display selected lists of file data, analyze relationships between items, and evaluate simple statistics. If you have a printer, you can print out copies of files or selected data from them. The program also has the ability to put lists in alphabetical order. In addition, the Texas Instruments Statistics Command Module (\$44.95) is compatible with Personal Record Keeping.

At the beginning of the program, you are asked to enter the date and indicate whether a printer will be used. You are then asked to indicate whether you need to create a file or to load a file. We found one small problem with the program. There's a considerable delay after you press a key before the computer responds. Nothing major, but it would take some getting used to.

When you first set up a file, you press *1* for *Create a file*. Then the computer asks you to name the file. The file name can be no more than nine characters long, so you'll need to be creative to come up with a short but descriptive title.

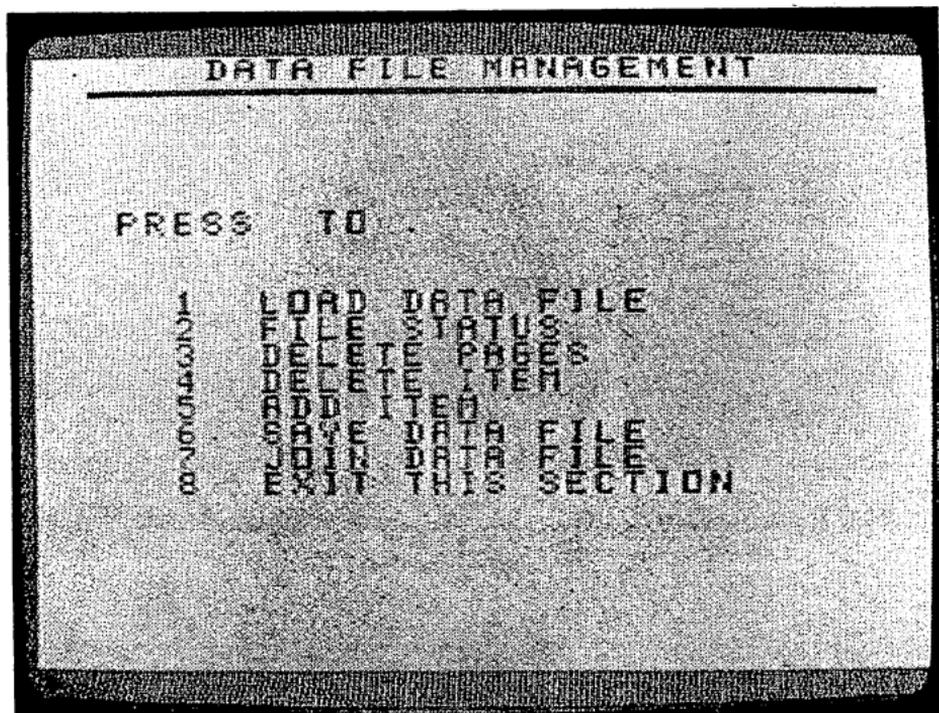


Fig. 5.2 Data File Management menu from Personal Record Keeping

The next step involves planning the file structure. According to the manual, the program organizes information into groups called *pages*. It suggests you think of the file as a book having numbered pages, with a set of categories listed in the same order on each page. The categories are called *items*, and each page is one full set of item categories. Sound confusing? Keep reading. Let's say, for example, that you create a file for your recipes. All information relating to one recipe makes up one page in the recipe file. The next step is to decide what categories

you want to include in the file. Each category must be given a name. The program asks you for the name and the item type. In your recipe file, you might choose categories such as *Calorie content*, *Fiber content*, or *Type of dish*. The program reviews the file structure you have set up, gives you an opportunity to change it, and finally displays the main menu. (No pun intended. *Menu* is a computer term for a list of choices presented to you by the computer.)

To begin entering data into the file system, press 2 for *Add pages*. The program prompts you for the information in each of the categories you previously set up. It continues to prompt you until all information is entered. For example, under the *Type of food* category, you might designate some recipes as *entree*, some as *dessert*, and so forth.

The program lets you change or correct data, delete or omit data, or rearrange the entire file. You can then choose to analyze your data by having the computer perform certain statistical operations, alphabetize the file, or display or print certain pages. If you want to double a recipe, or cut it down when the kids leave home, you can get the program to compute all the changes for you. You may want to display or print out certain subsets such as all dessert recipes or all meatless main dishes. Does someone in your family need a high fiber diet? You can call up all the recipes that are high in fiber. Each recipe can then be analyzed as well.

The program allows you to store data on diskette or cassette and retrieve it, or bring it back, at a later time. You can also transmit your data files over the phone. If you can talk Aunt Bessie into getting a TI-99/4A and the peripherals described in Chapter Ten on telecommunication, just think how much time you'll save getting her recipes into your file.

This is a useful program that is easy to learn. It's great for anyone who needs a modest home filing system and doesn't want to invest the time, effort, or money to purchase and learn to use TI's new Multiplan package from Microsoft. One weakness is that the manual gives no guidelines whatsoever as to how much information can be stored using the Personal Record Keeping program. This limitation is influenced by how many

pages are in a file, the number and length of items, and how much computer memory you have. Maybe that's why the manual gives no guidelines. They might turn out to be complex, but we feel some rules of thumb should be given.

Multiplan

Multiplan is a record-keeping program by the Microsoft Company. Multiplan is similar to VisiCalc and is described in Chapter Eight.

Tax/Investment Record Keeping

Tax/Investment Record Keeping is a Texas Instruments command module with a suggested retail price of \$69.95. It is similar to Personal Record Keeping, except it has a more specific purpose. It is a filing system intended just for organizing and recording tax and investment data. With this program, you can generate reports on your financial status and set up files for everything from simple record-keeping to full, double-entry bookkeeping. In addition, you can print out the entire transaction or any part of a transaction at any time.

This program probably is most useful to people who have a substantial net worth and some substantial investments (college professors like us need not apply!). It isn't as flexible as Personal Record Keeping, but for people who need such a program, it might be very useful.

OTHER RECORD-KEEPING PROGRAMS FOR YOUR TI-99/4A

Super Cataloger is a program that helps you keep track of files that are stored on diskettes. It is available on diskette from

J&KH Software for \$29.95. The program helps you keep track of up to 550 files located on up to sixty-three disks. You can then produce a sorted catalog on your printer. This program requires TI Extended BASIC, memory expansion, disk drive, and printer.



Fig. 5.3 . Super Cataloger

Name-It, a program for mailing lists, labels and files, is available for \$32.00 on cassette or for \$35.00 on diskette. The program lets you enter up to 250 names and addresses per diskette. You can have up to nine lines of information for each name and address (sometimes called a *record*). Each line can have twenty-eight characters. For example, you may have a mailing list that contains names of volunteers who drive elderly people to doctor appointments. Every month you must send a list of patients' names and appointments to the volunteers,

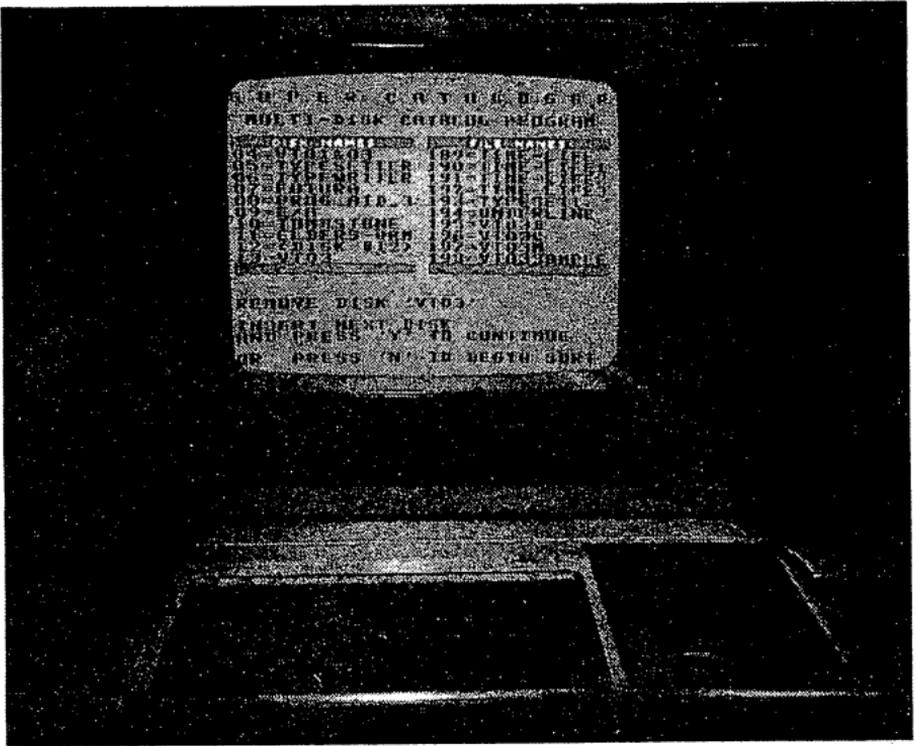


Fig. 5.4 Disk and File Names from Super Cataloger

indicating who is responsible for transporting each patient. Some of the volunteers may be able to drive only on Monday or Thursday and only on the northwest side of town. Others may be available only on Saturday and can drive anywhere within a fifty-mile range of the city. Because you can have up to nine lines of information and twenty-eight characters on each of the nine lines, you can include particular information about each person. In addition, Name-It can sort through these records in 100 seconds. If there is a change in appointment date and time, you can search through the mailing list and quickly find someone who can provide transportation for the new appointment. The main purpose of Name-It is as a mailing list. A form letter program is included that uses Name-It data in form letters typed with the word processing program called TI-Writer.

Other companies with record-keeping software for the TI-99/4A include: YCAN Systems, Inc., Microcomputers Corporation, and Destiny Computer Services.

USING THE TI-99/4A COMPUTER FOR HOME HEALTH CARE

Home health care is a promising new area for home computer use. Although there isn't a great deal of software available in this area, we expect the future to bring increased interest and, consequently, much more software related to home health care.

Physical Fitness

Physical Fitness is a Texas Instruments command module with a suggested retail price of \$29.95. Based on recommendations from the President's Council on Physical Fitness, this program helps you customize an exercise program for anyone thirteen years old and older.

Weight Control and Nutrition

Weight Control and Nutrition is also a Texas Instruments command module. For \$59.95 you have a complete nutritional guide. The program helps plan balanced weekly menus, taking food preferences into account. It also considers the desired weight and weight changes of each family member when suggesting menus. In order to take advantage of the program's features, disk or cassette storage is necessary.

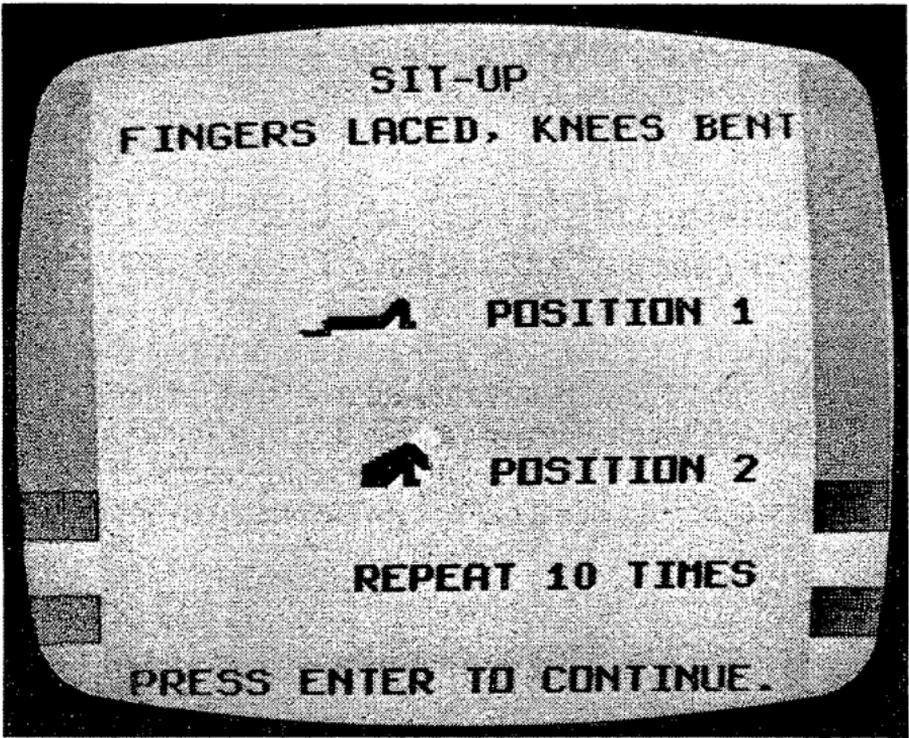


Fig. 5.5 Physical Fitness

TI TOLL-FREE HOT LINE TELEPHONE NUMBER

Texas Instruments has opened a new toll free telephone number to help with questions on software and peripherals. By dialing 1-800-858-4075, you can get advice on when and where TI materials can be purchased. This number is also used to place orders. However, if you use this number to order TI products, don't expect any great bargains. They charge the full retail price plus an extra fee for shipping and handling. The line is open during weekday business hours only.

There are lots of home uses for your TI-99/4A computer. In the next chapter, you'll discover how to connect with larger information systems.



CHAPTER SIX

Telecommunications

In the hit movie *War Games*, a teenage boy with a computer in his bedroom shows off to a prospective girlfriend by making reservations for the two of them for a flight to Paris. The movie was as much science fiction as fact, but thousands of people make travel and vacation plans with their home computer today. Imagine touching a few keys on your TI-99/4A computer and reserving a room in Boston or a car in Los Angeles at any hour of the day or night. With this service, a student can get access to a government publication at home at 2:00 a.m. for a paper that's due at 8:00 a.m. How about being able to link into the latest newswire or stock report at the same time the editor of your newspaper does? How would you like to read movie reviews or pro-football statistics on your computer screen? Imagine the excitement of immediately announcing a new baby to your friends all over the country by typing the message in on your computer. Even frantic activities like Christmas shopping can benefit from work on the computer. You can review products on your television screen and then make your final

decisions and place your orders. These are some of the things you can do with telecommunications.

Most people are aware of the video games you can play on personal computers. Most also know that those desktop marvels that play Pac-Man, Frogger, and Fast Eddie can do an honest day's work as word processors, accounting machines, and educational tools. The subject of this chapter, however, is not so well known. Telecomputing involves connecting your home computer to other computers over standard phone lines. Your computer becomes a link to hundreds, perhaps thousands, of other computers that have been programmed to provide various services. You can sit back in your easy chair, get a comfortable grip on the TI-99/4A's keyboard, and do everything from pay bills to read weather reports for Colorado ski resorts.

Telecomputing is, in fact, one of the fastest growing areas of personal computer use. Many TI-99/4A owners regularly use their computer to talk to other computers. To begin telecomputing, you must connect your computer to a special device called a *modem*. Then you connect the modem to your phone line. You dial another computer's number, and when it *answers*, you *talk* to the computer by typing on the keyboard of the TI-99/4A. The computer on the other end of the phone line responds to your requests by sending information that is displayed on the television or monitor screen.

Because telecommunications is a topic most people are not familiar with, we'll give a somewhat extended introduction to the topic in this chapter. We'll explain the concept of telecommunication, then give you some general examples of how telecommunications can be used. We will tell you about the different kinds of information you can get. Then we'll give some specific examples of services available to TI-99/4A owners. In the final section of the chapter, we'll tell you exactly what equipment and software you need to get started.

It is a little difficult to explain exactly what telecommunications is because there are so many aspects of the phenomenon and so many ways the home computer owner can take advantage of the services that are available. It is a little like trying to explain reading and talking. The skills of reading and talking

are really *tools* that, if you have them, let you do many different things—from reading the morning paper to decoding the assembly instructions that came with your son's Christmas bicycle. The ability to telecommunicate also gives you many options for acquiring and using information. Over the last century, the development of wireless communication technology, such as radio, television, and satellite transmission systems, has changed the way we get much of our information and the *type* of information we get. Today homes with cable television, for example, are able to tune to an *all-news* channel and get instant information on current news stories. Cable channels now available or in the planning stages will provide specific types of information in areas such as health and nutrition (Cable Health Network) and business news.

Cable-based information systems all share one problem. You are a passive viewer who has no direct control over the material you view. Yes, you can tune to the channel that provides health and nutrition news, but it may or may not do a piece on the particular topic you want to hear about. Telecommunications will let you take a much more active role in the selection of information you want to learn about.

MAJOR TELECOMMUNICATIONS APPLICATIONS FOR HOME COMPUTERS

What Are Information Utilities?

When you go to your kitchen sink to get a glass of water, you simply turn on the tap and out flows the water. The water comes from some large reservoir of water stored at some distant location. A similar thing happens when you turn on the electric lights in your home or when you tune into your favorite cable television station. Water, electricity, and cable television ser-

vices are called utilities. A utility service becomes available to you in your home when you have the proper receiving equipment: the kitchen sink, the electric light or the television set. Telecommunications can be thought of as a large family of information utilities that can be brought into your home or office through your personal computer. We will use the term *information utilities* in a very broad sense to include any source of information that can be accessed by a computer connected to the phone line. Some computer writers use the term information utilities just to describe large systems that offer a wide variety of services. We like to think of an information utility as any kind of information service, large or small, local or national. In other words, we think of anyone who is offering information that can be received by a personal computer over the telephone lines as offering an information utility.

Starting with this definition of an information utility, we can say that lots of information utilities are now offered and that many more will become available in the near future. In order to receive such a service, you will need the right equipment, you will need to make the appropriate connections, and in most cases, you will need to pay a utility fee. However, some of these services are free. We'll give you more detail on how all this works later. For now let's look at some of the many utility services available for your computer.

Local Area Networks and Computer Bulletin Boards

There are hundreds of local computer *networks* now operating in this country, many using regular phone lines for communications. They're run by universities and colleges, by computer clubs, amateur radio clubs, and special interest groups. Members of the sponsoring organization (or, in some cases, anyone who knows the phone number) interact with the network's computer. Some systems limit use to reading the local electronic bulletin board; others let you use a large computer system's power from the comfort of your home.

A typical local area network will be sponsored by a computer club. The club will pay for a phone line that is connected to a computer owned by the club. When you call, the computer answers the phone electronically and will often ask what information you would like to have transmitted to your computer. There may be options such as reading the latest issue of the club's newsletter, browsing through want ads for used equipment, or looking at material written by other TI-99/4A owners about new products or problems. The type of network and the services offered vary greatly from one locale to another. Local computer stores and computer clubs are usually aware of the networks operating in the area and what they offer. Many local networks are the electronic equivalent of the bulletin board down at the laundromat or at the factory. Notices of events, want ads, offers of free puppies or kittens, and descriptions of new computer equipment are commonly found on local networks.

National Networks and Bulletin Boards

In addition to local computer bulletin boards, several national systems (some with toll-free numbers) are available for the cost of the phone call. National bulletin boards are generally intended for a special audience, and some charge for their use. For example, HEX (Handicapped Education Exchange) can be reached by dialing (301) 593-7033. Individuals and organizations use it to exchange information on how technology can be used to help the handicapped. There are also national networks for owners of a particular brand of computer. We'll describe some of the Texas Instruments networks in a later section of this chapter.

If you would like to get information on most of the operating computer bulletin board systems (CBBS), there is an appropriately electronic way to do it. Novation, one of the larger manufacturers of modems, has a bulletin board of its own that provides information to callers on the hundreds of free CBBSs across the country. When you have your TI-99/4A set up for

telecomputing, you can dial (213) 881-6880. When Novation's computer answers the phone, you will probably need to hit the RETURN key on your TI-99/4A once or twice, and the Novation computer should send the following message to your computer:

LOGON PLEASE

Most systems have some method of signing onto the system. In this case, all you need to do is type CAT (Novation makes CAT modems) and press RETURN. You are then given access to this CBBS, which has a list of hundreds of other CBBSs, organized by the area codes of their phone numbers. The system has many other services, such as games you can play (remember that the call is long distance for most people and could get expensive).

Recreational Games

Both CompuServe and The Source, telecomputing *department stores* that are discussed later in this chapter, have provisions for playing games. Dial their numbers, type in your personal identification code, then play any of over 100 different games. Most of these games are the adventure or strategy type with few or no graphics. It is difficult to transmit graphics quickly over phone lines and almost impossible, without lots of specialized software, to transmit usable graphics to all the different models of personal computers on the market today.

Downloading Programs

Several networks sell programs by *downloading* them to your computer and billing the cost to a credit card. Some services even let you try the program first; if you like it, the program is yours for a small fee. Before you can download programs, you must buy a special program that lets you store

the programs you buy on a cassette or disk. In addition, most of the programs available today are for older, more established computers such as the Apple II and the TRS-80. In the future, it may be possible to dial up several services and buy TI-99/4A software over the phone.

Data Bases

A data base is simply a batch of information stored in the memory of a computer. If you need to know the current price of Texas Instruments stock or the time of the next plane to Orlando, this information—and much more—is available from data bases that make up one of the many information utilities that are accessible by computer. Both Source and CompuServe have such information stored in extensive data bases. A doctor can check on a recommended treatment for a new disease, a farmer can get predictions on the wheat crop in South America, a consumer can check discount prices on a dishwasher or color television.

Some writers predict that these large computerized information utilities, with their huge data bases, will replace traditional sources of news and information, such as newspapers and television newscasts. We doubt that. Newspapers are sources of general information that is professionally packaged and conveniently presented. We think information utilities are likely to be added to our existing sources of information rather than replacing them.

The reason for our view is that information utilities are not that easy to access; it takes some effort to get information from them. In addition, they are not very convenient sources of general information. The morning paper or the nightly news gives us that. What information utilities do best is provide us with access to specific information. Suppose you are a member of a local group that was formed to fight for modifications in local laws governing waste disposal near the subdivision where you live. One task the group must accomplish is to write a booklet on the problem, to be distributed to citizens and local

officials. You want the paper to be technically accurate and you want to be able to include information on what has happened in other areas that faced a similar problem.

It would be possible to gather the background information you need by going to the library and searching through the relevant indexes for magazine articles and books on the topic. A hand search, however, would probably take days of hard work at the library. And because of the time it takes to do the search, it is not likely to be as comprehensive as it should be. An alternative is a computerized search through one of the data bases available from an information utility called DIALOG (described later). A DIALOG search will provide you with a list of articles (with abstracts or summaries of the articles) and books on the topics you're interested in. A DIALOG search would take less than an hour and would be more comprehensive than a search in a library. Even a DIALOG search, however, is unlikely to point you to recent news stories on the topic. You can get those stories through one of the general information utilities like The Source or CompuServe. And if you want a summary of all the federal court cases relevant to the particular type of pollution issue you are concerned with? There is a data base that will provide that for you. A data base may contain millions of references to books, articles, and technical papers; it can be searched electronically by telling the computer to look for references with information about a particular topic. When you use a computer to find the information you need, you reduce the time it takes and improve the quality of the search.

There are hundreds of these data bases available through information utilities today. Professionals in almost every field can use one or two data bases of particular interest to them. You can use your TI-99/4A to find information on new metallurgical patents, federal court cases, space games, college scholarships, and much more.

Banking and Shopping

Several banks, led by the troubled United American Bank of Knoxville, have systems that let customers transfer funds

and pay bills by computer. Dial the bank's number, type in your account number, then type in the instructions on how much to pay whom. Chemical Bank of New York even has provisions for making purchases like airline tickets, which are mailed to you and debited to your account. Some experts foresee *banking by computer* as a commonplace activity in the future. At present it is limited to a few areas where it is being test marketed and to people who use information utilities, such as CompuServe, that have banking facilities.

Shopping by computer has caught the public's eye. There are several shopping services that let you order items that are charged to your credit card and mailed to your home or office. Both Source and CompuServe have shopping services that will be discussed later. In addition, many services provide consumer information of various types. You can get movie and book reviews, for example, from many sources.

Electronic Mail and Teleconferencing

Electronic mail means different things to different people. A large corporation may have computers that store messages written in the Dallas office to staff in the Chicago office. Late at night the Dallas computer automatically calls up the Chicago computer and transmits the messages. When the recipient of a message arrives at work the next day, a flashing light on the computer console on his or her desk indicates there is a message waiting in the computer's memory. That is electronic mail.

Public access electronic mail involves typing a message in on your keyboard. That message is sent to a company that handles electronic mail. It transmits the message to the city where the recipient lives. The message may then be printed out and delivered by the Post Office the next day. In the future the recipient may have a home computer that is always connected to the phone line. Messages may be transmitted directly to the home and printed out on a printer attached to the computer.

That is in the future. Today, a form of electronic mail is possible through the information utilities. Each person who has

an account with a utility such as The Source has a user number that can serve as an electronic address. If you need to send a report to a friend or colleague who lives across the country, you could transmit the report (which you did on a word processor) from your copy on a disk or cassette through the computer to The Source. When your friend next uses The Source, it would tell him or her that a message is waiting. The report would then be transmitted from The Source to your friend, who could transfer it from the computer's memory to a disk or cassette.

MAJOR INFORMATION UTILITIES

Currently there are two established national general-purpose information utilities: The Source and CompuServe. Both can be used by anyone with a small computer, a credit card (so they can bill you monthly), and a telephone. Calls to the two major networks are local calls in many major cities because you are connected to them through special electronic communication networks—usually Telenet or Tymnet.

The Source

The Source is a service of Source Telecomputing Corporation. If you want to sign up with The Source, you can do so through the mail or at many computer stores. As with cable television, there is an initial hookup charge of \$100. After that, The Source charges \$7.75 per hour of use during non-business hours. Late night use is less, \$5.75, and access during office hours is \$20.75. There is a minimum monthly charge of \$10, whether you use the system or not. The phone call to The Source is a local one in over 300 cities.

Few people will want every service offered by The Source, now a subsidiary of Reader's Digest, but it's nice to know they're there. Here are some of the most interesting services:

- *UPI News Service.* This is the broadest category of services offered by The Source. Here you will find general news stories and information in many areas, including business, economic, weather, commodity, federal and feature news reports. You can get the latest news before it is printed in the local paper. News stories can be on your computer screen within minutes after they are released. By using a *keyword* search, you can select news items on a particular topic.

- *Electronic Mail.* In addition to the method of electronic mail described earlier, it is possible to dial a toll-free number and dictate a letter over the phone. Your letter will be put in the electronic mail file and will be available to the recipient the next time that person signs on. Special interest groups can also use the electronic mail feature by placing information in a sort of electronic bulletin board that can be read by subscribers with similar interests. There is also an electronic equivalent of junk mail. You can type in a letter or report and tell the system to send it to as many Source subscribers as you wish.

- *Electronic Travel Service.* In addition to making your own airline and hotel reservations, you can get restaurant rating guides and view international airline schedules. You have access to worldwide airline flight information, which is updated every two weeks. If you were going to visit either New York or Washington D.C., you could get listings of services ranging from fur rental to babysitting before you left home. One part of this service, the Travel Club, can be used just like a travel agency. You can wrap up all of your travel plans by asking the Travel Club to order tickets and make reservations.

- *Educational Applications.* The Source has quite a few programs that provide drill exercises on a variety of topics of interest to both school children and adults. You can call on these programs to help your children learn how to count, learn the alphabet and the decimal system, and much more. Programs to teach spelling, math, foreign language and science are available. In addition, there is a directory of financial support possibilities for college students and a job service that lets you type in your resume so prospective employers can review it. There is also a jobs-available listing.

- *Consumer Aids*. You can view informative articles on how to reduce energy costs and save gasoline. You can get assistance in choosing the right wines or the right vitamins. One part of this service, *Comp-U-Store*, amounts to an electronic super market. You can review items and prices on the computer screen and place your order from the computer keyboard. Then there is *TradeNet*, which is a barter service. With *TradeNet*, you can trade for trips, professional advice on a range of subjects, and items of almost any description. The service also has restaurant guides and reviews for most large cities, and a movie review section.

- *Sports News*. Up-to-the-minute news on sports, team standings, sports trivia and sports records are available. Scores on a national, international, and statewide level are available.

- *Financial Service*. Business and financial forecasts from professional economists and security analysts are up-dated weekly.

- *Portfolio Management*. You will have access to a system that will help you create and maintain your personal investment portfolio. By simply entering a file name that contains your stocks, you can receive an up-to-date report on each stock on your computer screen.

- *Legi-Slate*. You can track bills referred out of Congressional Committees and get lists of members of Congress by state, party, committee, and subcommittee. This service is up-dated weekly.

- *Commodity News Service, Inc.* This service allows you to track price movements in commodities futures markets and provides market commentary and commodity news.

- *Computing Services*. You can write and run programs in a variety of languages including BASIC, COBOL, Pascal, and FORTRAN, among others. The Source also makes available quite a few canned programs of their own. Many are free; some involve a small extra charge. They include games, business software, and software for special applications, such as statistical analysis of large amounts of data. You cannot buy these programs and run them without being connected to the service. In essence you *rent* them by connecting to The Source by phone and typing in the name of the program you want to use.

• *Data Bases.* A service likely to be used by many subscribers is access to some of the many data bases available from The Source. One of the more popular data bases is the United Press International (UPI) wire service. It is possible to tell The Source to put the UPI output on the screen, then watch the news scroll by a line at a time. However, that is an inefficient way of finding the news you're interested in. From your computer you can tell the UPI data base exactly what type of news you want to read. If you want information on what is happening in the latest crisis country, you can do so by typing in the name of the country. All of the recent stories filed with UPI about that country will be displayed. It is easy to get in-depth reports on any subject you are interested in. Best of all, you can have up-to-date information any time you want it. The UPI data base is only one of a large number of data bases available on The Source. It takes some effort to learn how to use them effectively, but the effort is well worth it.

Many of the data bases available on the system are oriented toward a particular topic. A person interested in the stock market, for example, can get detailed news and background information that is relevant to the companies he or she is interested in. There are data bases on commodities, stocks, bonds, precious metals, and more. There is, for example, an electronic version of the magazine *U.S. News and World Report*, as well as abstracts of articles from magazines like *Forbes* and *Harvard Business Review*.

TEXNET—A Special Service of The Source for TI Owners

Texnet is a special edition of The Source that was specifically designed to work with the TI-99/4A computer. Since this computer has a relatively small display capacity, its use on some information utilities will be less than satisfactory, because the display does not fit the way the utility formats information for transmission. For example, if the utility expects

to send data to a computer that puts eighty characters on a line and can display twenty-four lines at once, the data may look garbled or confused because the TI computer cannot use that format.

When you have the Texnet service, data from The Source is formatted for the TI-99/4A. You also have access to all the normal services of The Source, plus some additional special services:

- *TI Software Exchange*—More than 100 programs are available in this service, and the number is increasing. These programs are free. You pay for the time used to get the program downloaded to your computer, but there is no cost for the program itself.

- *TI User Group*—This is a nationwide listing of people who have TI computers and are interested in communicating with other TI computer users.

- *TI Logo Exchange*—People who are interested in writing and using Logo programs can exchange ideas with other people who are working with Logo. Several Logo programs are available at no cost.

Michael Archuleta, the Texas Instruments technical representative who told us about games for the TI-99/4A, gave us an impressive Cook's tour of Texnet. With the TI-99/4A powered up, the Terminal Emulator II Command Module cartridge in place, and the telephone in the modem, Mike was ready to dial into Texnet.

After he had dialed the correct telephone number and typed in some identifying information, a menu of services appeared on the computer screen. Mike's first menu selection resulted in a brief show-and-tell program designed to demonstrate Texnet and explain to the new owner what it could do. Two things were impressive: the color and detail on the screen were sharp and clear, because The Source was transmitting data in a format specifically designed to take advantage of the computer's features, and the voice synthesizer plugged into the side of the computer actually read every word on the screen—it sounded

like a computer talking but was clear enough to understand. TI's software for telecommunications allows you to use the speech synthesizer module so you can hear as well as see the information sent to your computer.

Next, Mike called for some information on one of TI's latest educational projects called Plato. A report on what Plato is and its present state of development appeared on the screen. Then Mike demonstrated another feature of the system by having the computer print the report out. We next went to the *interactive* mode of Texnet and were asked if we wanted to *chat*. That feature lets you communicate with other TI owners who are also connected to Texnet at that time. Since we didn't have time to chat, we moved on, but Mike assured us that we could have carried on a conversation with someone elsewhere in the country by typing messages back and forth.

One of the most interesting demonstrations was when Mike asked for a service called Logo Exchange. This service allows you to share Logo programs and ideas. We saw a menu of Logo programs on the screen, and Mike selected one called BANNER. It took about fifteen minutes for BANNER to download to our computer. Once the program had been transmitted to our machine, Mike was able to run it. BANNER turned out to be a flashy show-and-tell program that has an animated balloonist who travels through the air, with fluffy white clouds and bright red airplanes passing by on a background of blue sky. The animation was well done and even had a three dimensional effect. Next, Mike saved the program on disk so it could be used again later or incorporated in another Logo program.

If you decide to try telecommunications yourself, we recommend Texnet. You can sign up for Texnet at a local Texnet dealer, or you can write to Texnet Information Service.

CompuServe

The major competitor to The Source is CompuServe Information Service, now a subsidiary of H & R Block. There are

many similarities between the two major information utilities and some differences. CompuServe has an initiation fee of around \$30 and charges \$5 per hour during non-business hours. CompuServe is not available during normal working hours, since the company that runs this service uses its computers to serve commercial customers during that time. The connecting call is a local one in over 300 cities.

CompuServe offers services similar to those of The Source. Instead of UPI, CompuServe uses the Associated Press news-wire, and it has electronic editions of papers such as the *St. Louis Post-Dispatch*. There are also electronic editions of popular magazines such as *Computers and Electronics*, *Better Homes and Gardens*, and *Popular Science*.

CompuServe offers information on topics as diverse as home repair, personal health, and recipes. Like The Source, it has book and movie reviews, as well as a sports information service. There is even a file of computer art that can be copied on your printer if you have one.

Like The Source, CompuServe has a number of financial data bases you can use to investigate and track the performance of stocks and commodities. There is also a way of doing electronic banking on CompuServe through a bank in Boston or Knoxville. The service also has an electronically searchable version of the *World Book Encyclopedia* on line, a program that helps you select a college, and a service called *refundle bundle* for coupon clippers.

CompuServe sign-up kits are available from several sources, including Radio Shack stores, and from CompuServe. The base fee is \$20, but most people buy at least \$10 worth of manuals to help them learn how to use CompuServe. A CompuServe Starter Kit, which includes manuals and several hours of time, is \$40.

Both CompuServe and The Source add new services regularly, and both offer value for the money you pay.

OTHER INFORMATION UTILITIES

In addition to the general-purpose information supermarkets, there are many specialized services that offer a more limited range. What they lack in breadth, however, is more than offset by their depth.

Knowledge Index

This is a special, low-priced version of the giant DIALOG Information Service that has a huge computer complex containing millions of references on every imaginable subject. Because of the high cost of the DIALOG service, it was used primarily by professionals at libraries, universities and research centers. DIALOG lets you search for information on any of thousands of different topics. Instead of going to the library and searching through references, books and magazines, the computer does the searching and gathers the information for you. *Knowledge Index* costs \$35 for the initial sign up. With this initial fee you get two hours of search time. After that, it will cost \$24 an hour to use the system. To join the system you can call 800-528-6050, extension 415.

Dow Jones

You can join this service for an initial fee of \$50. There is no monthly fee, but you are charged for the time you use the system. This charge varies depending on which part of the service you are using.

Money DOS

This is a free service you can use by dialing a phone number after your computer is ready to telecommunicate. Money DOS is a bulletin board on financial investments. The person who gives the advice and runs the bulletin board is J. M. Keynes, a senior vice president of investments for a member firm of the New York Stock Exchange. You can contact the bulletin board by dialing (305) 655-2340 during the week and on weekends by dialing (305) 655-3389. With your TI-99/4A computer set up for telecommunications, you can receive Mr. Keynes' latest advice, and if you have a printer, you can have it printed out for later reference.

The Encyclopedia Britannica

This gives you the full text of the Britannica 3 encyclopedia and covers the ten-volume Micropedia, which contains important facts in capsule form. Other special editions such as Book of the Year are also included.

GETTING ON LINE

Does one or more of the possibilities in telecommunications arouse your interest? Would you like to use your TI-99/4A to connect yourself to a bulletin board or information utility?

Preparing the TI-99/4A for Telecomputing

In addition to the computer and a monitor or television, you will need the following:

- A telephone line that can be connected to the modem. Some modems are *direct connect* models that you plug into a phone jack as if it were another phone, and some are *acoustic* models that require a standard telephone so you can place the handset in rubber cups on the modem. Direct connect models are preferred because there is less interference.

- An RS-232 serial interface. There are several ways of adding a serial interface to this computer. They are explained in Chapter Ten.

- A modem (sometimes called a *telephone coupler*). Again, modems are discussed in Chapter Ten.

- Telecommunications software. There are many different programs that let you convert your computer to a telecommunications device. One of the simplest ways to do that with the TI-99/4A is to buy the TI Terminal Emulator II Command Module. This cartridge contains all the software you need to use the computer as a telecommunications device. A device that lets you communicate with other computers is often called a *terminal*. This program converts the computer to a terminal.

In addition to the items noted above, there are two optional but very useful pieces of equipment. A printer will let you get printed copies of information sent to you from the information utilities, as well as printed listings of any programs you may download. A speech synthesizer will let you hear as well as see the information coming in.

Telecommunications may not be one of the ways you planned to use your computer, but in an age when timely access to information is more and more important, we feel telecommunications will take more and more time in the life of a home computer.



Word Processing

WHAT IS WORD PROCESSING?

If you are the kind of person who writes things, this is the chapter for you. In this chapter we talk about using the TI-99/4A as a word processor. Just what is a word processor, and why would anyone want one? Generally, when you think about what a computer can do, you think about handling numbers. You probably imagine computers adding, subtracting, multiplying, and dividing numbers to determine this month's phone bill. This so-called "number crunching" (manipulating, printing, and storing numbers) is one function of a computer. The TI-99/4A is capable of doing similar work with words. When computers are used to accept, manipulate, store, and print words, this work is called *word processing*.

Word Processing Lets You Customize

Word processing is a giant step beyond typewriting. The invention of the typewriter permanently changed (and simplified) the task of writing. Word processing is now changing (and simplifying) writing again. Word processing is far superior to typewriting in many ways.

In typewriting, the first step in producing a document is usually composing a rough draft that is typed on paper. In business, this usually means a secretary is the typist. The typist then gives the writer the rough draft. The writer marks any changes to be made and gives it back to the typist. The typist produces another copy on paper, complete with the writer's corrections, and again gives it to the writer. This cycle can be repeated over and over again until the writer is satisfied with the document, or until the typist goes into cardiac arrest, whichever comes first.

The really time-consuming part of this whole process is that even small revisions such as correcting spelling errors usually mean the entire document must be retyped. (This sometimes starts a vicious cycle because typists often correct one error, only to find that they have made another someplace else in the document.)

Word Processing Makes Revisions Easy

Word processing makes it easy to revise a document by doing away with some of the steps that are necessary in traditional typing. After typing the material in the computer, the typist stores the document on a floppy disk or cassette. A simple command causes the document to be printed out on paper. The writer marks any revisions and gives the marked rough draft back to the typist. The typist can then make the changes desired by the writer. If a word is spelled wrong, the change is easy

to make. Usually corrections are made by putting the cursor on the incorrect word and typing over it. In addition, whole words, phrases, or paragraphs can be deleted by pressing a key or two. Inserting words or longer passages is equally easy. Sentences, paragraphs, or even pages can be moved around in the text by typing in a few simple commands. All these changes can be made without retyping the manuscript! The typist can store the revised document and give a command to get another copy on paper. Most of the time, even complex changes can be made in a matter of just a few seconds or minutes.

Word Processing Makes It Easy to Produce Copies

Since the document is stored on disk or cassette, it can be printed as many times as you want. This can be very helpful when you want to send a lot of people the same letter. We've all received form letters like that at Christmas time. They usually begin Dear Friend/s and then go on to tell us fascinating stories about Susie's braces and Fred's little league team.

With a word processor, you can produce these little Christmas messages without Aunt Mary or Cousin Gertrude ever suspecting they're numbers 597 and 598 on the list. After each letter is printed, you simply change the name in the salutation as it appears on the monitor screen. Then you print the letter again. Repeat this process until everyone on your list has his or her own personalized letter. You can even add a different paragraph at the end of each letter, customized for each of the people on your list. ("Thanks so much for the stuffed aardvark you sent last year; it's just what I always wanted and looks lovely in the den.") Many word processing programs can be instructed to stop at a specific point (after the word "Dear" for instance). This is your chance to type in unique material (such as names or addresses). Some word processing programs can even use names from a mailing list and continue printing copies until all the names (or as many as you want) have letters.

Word Processing Eliminates Tedious Typing

Any secretary can tell you how tedious it is to listen for the bell that signals that the text is getting dangerously close to the end of the line. Most word processing programs have a feature called wraparound that makes an end bell and a carriage return at the end of each line unnecessary. If a word is too long to fit on a line, the program takes that word and *wraps it around* to the beginning of the next line.

Another tedious typewriting task is centering headings or varying the margins in a document. With word processing, these tasks can be accomplished by typing simple codes into the document or making selections from a "menu." Many word processing programs can also "justify" text (make each line end exactly at the right margin), center a block of text on a page, or otherwise change the format of a document.

Word Processing Improves the Quality of Your Writing

When you know that even major changes can be made quickly and easily, you won't hesitate to try out a different, and sometimes better, way of expressing yourself. ("Thanks so much for the stuffed aardvark. It looks lovely in the den and had absolutely nothing to do with the divorce.") If the change isn't as good as the original, you can go back to the first version just as easily. Word processing encourages you to experiment and to refine until you're completely satisfied with a document.

Word Processing Is Becoming Popular

Over 350,000 word processors were being used by 1981. Approximately forty percent of all authors were using word

processing at that time. There are probably many more word processors in use by now.

THE TI-99/4A AS A WORD PROCESSOR

Talking about word processing and the TI computer is a little like one of those old good news, bad news jokes. The good news is that word processing is wonderful; the bad news is that the TI-99/4A isn't a good choice if word processing is your main reason for buying a computer.

Limited Screen Display Width

There are a couple of reasons why the TI is less than ideal for word processing. First and foremost is the size of the display. The screen cannot display enough characters on each line to make word processing easy. This means you cannot see an entire standard letter-width line all at one time. You are forced to look at only one part of the line because the whole line won't fit on the TI screen. Unfortunately, using a monitor with a bigger screen won't help. The fact that the TI-99/4A does not display many characters on a single line is an *electronic* limitation, not a limitation due to the size of the screen.

Non-Standard Keyboard

The keyboard on the TI-99/4A looks like a standard typewriter keyboard, but that's an illusion. It's actually several inches narrower than standard width. This means the keyboard has fewer keys than standard, and the keys are closer together. Having fewer keys means that you can type many standard typewriter characters only by holding down a special key called a function key.

The crowded keyboard means adult typists frequently make more errors when using word processing on the TI. Grown-up fingers are just too big. It's true that most people can, in time, become accustomed to the TI keyboard. Some people argue that since children frequently use the computer, the smaller keyboard is actually better. While that argument may be fine for justifying use of the computer with children, it doesn't convince us that the TI is a good computer for adults to use as a word processor.

Lack of Spelling and Grammar Checkers

One of the really useful things about word processing is that you can usually buy software that checks spelling and grammar mistakes. These programs automatically look for errors and even make suggestions to help improve your writing. These are valuable aids to writers, particularly to children or to adults who have trouble with spelling and grammar. To date, we have seen no spelling or grammar checkers to use with any of the four major word processing programs for the TI-99/4A.

What Programs Are Available?

There are four word processing programs that are often used with the TI-99/4A:

- TI-Writer/Word Processor (PHM 3111) by Texas Instruments.
- Direct Writer II from Dynamic Data & Devices.
- Word Processing by Futura Software, Inc.
- Textiger by the Textiger Company.

Space prevents us from presenting a complete review of each program. The TI-Writer/Word Processor (PHM 3111) by Texas Instruments is clearly the best of the word processing programs we have seen for the TI-99/4A. We will, therefore,

review this program fairly extensively and then provide a short summary of the other three.

TI-Writer

This word processing program carries a suggested retail price of \$99.95, though you can get it for considerably less. For example, Southern Audio Video Electronics, Inc., sells it for \$71.00.

TI-Writer requires the TI-99/4A computer, a monitor, the 32K Memory Expansion, at least one disk drive (two are more convenient), the disk controller card, the RS-232 Interface and any compatible printer (see Chapter Ten on peripherals).

TI-Writer comes in Texas Instrument's standard large three-ring binder and consists of the word processing command module, program diskette, plastic keyboard overlay strip (to identify what certain keys do), and 176-page program manual. The first thing you are likely to notice about this package is that the three-ring binder is difficult to use. It takes up far too much space, and the plastic doodad at the front that holds the command module makes it almost impossible to close the blasted thing. These binders look nice on the shelf but were never designed to be used.

TI-Writer has some advanced features but, in our opinion, these features do not compensate for the fact that the program can display only forty characters at a time on each line. This is a design problem in the computer itself. A line in TI-Writer can be up to eighty characters in width, but if you choose anything wider than forty characters, you can't see the entire line all at once. (Forty characters is far shorter than you want for most printed material.) To see the remainder of the line, TI-Writer uses three overlapping *windows* of forty columns each. The next window is displayed automatically as the cursor passes the right edge of the screen, or a *next window* command can be used. Obviously, you can only view one window at a time. After writing and editing a long document with TI-Writer, you will probably feel as if you've been watching the ball at a tennis match while seated at the net! You may prefer to set

the screen width to exactly one-half the width for the printout and forget about the windows. That's a poor solution, but we prefer it to eyeball tennis.

Another problem is that the program does not display true lower-case letters on the screen. (It will, of course, *print* true lower-case letters if your printer is capable of printing them.) Instead, lower-case letters appear as smaller upper-case letters.

Now that we've bad-mouthed this program right at the beginning, we need to point out some of its good points. The program allows you to choose five different combinations of background and character colors. This is a small point but can provide welcome relief after hours of staring at one color combination.

When you're typing in text, you'll see the menu of available functions constantly displayed at the top of the screen. This is convenient for beginners and saves endless thumbing through the manual. Figure 7.1 shows a screen display from TI-Writer.

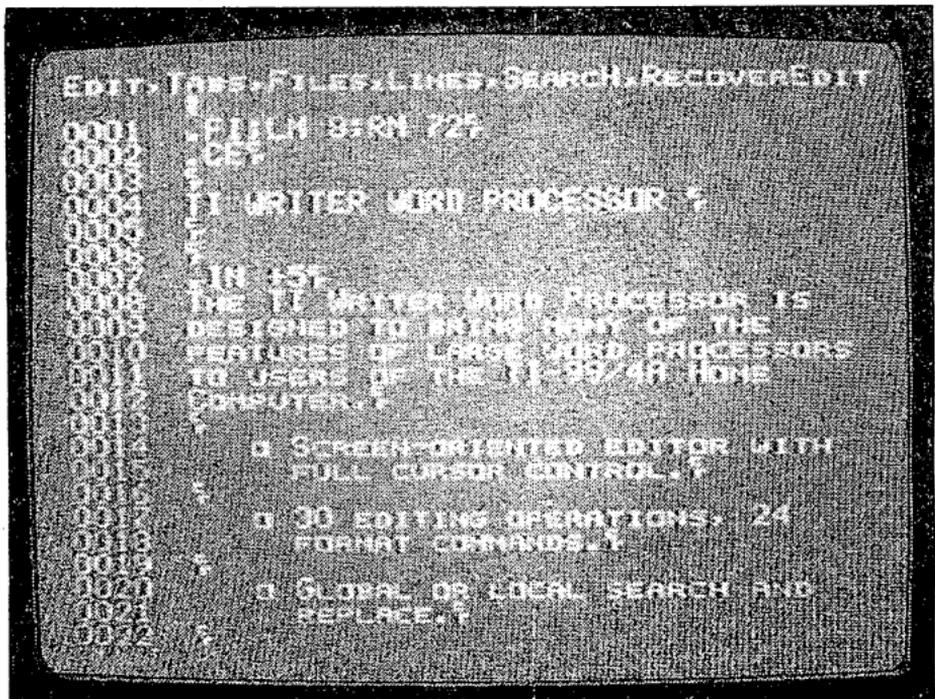


Fig. 7.1 TI-Writer

TI-Writer permits complex editing and formatting. Editing refers to making changes in your text. Formatting refers to telling the computer how to handle such things as margins, page length, and line spaces. TI-Writer lets you add or take out material. Other features include boldface printing, underlining, moving and copying text, and document reformatting.

TI-Writer also has an OOPS! function to give you a second chance in case you accidentally delete, type over, or blank out characters. You can press the OOPS! key and automatically get back what you wiped out, as long as you have not pushed any other key since you made the error. This is a handy feature.

Other handy features are TI-Writer's ability to merge two different documents or load or save only a part of a document. In addition, the program lets you make substitutions in the whole manuscript. For example, you may decide to replace every *will* with the word *may*. A single command can cause the substitution to be made throughout the document.

```

* TEXT FORMATTER *
ENTER INPUT FILENAME:
DSKI.FORMAT.DOC
ENTER PRINT DEVICENAME:
RS232.LF
USE MAILING LIST? N
WHAT PAGE(S)? <ALL>
NUMBER OF COPIES: 1
PAUSE AT END OF PAGE? Y

```

```

MARKING...
©1982 TEXAS INSTRUMENTS

```

Fig. 7.2 TI-Writer's Text Formatter

The formatting feature lets you give a command at the very beginning that tells the computer to indent paragraphs, print uniform right margins (justify text), and number pages. In addition, you can control margins, page length, indenting, and page numbering. If you want something printed on each page, such as *REPORT ONE*, the word processor has commands that cause it to be printed at the top or the bottom of pages. Centering and underlining can also be used.

Another good feature of TI-Writer is that it can create a mailing list and print mailing labels. In addition, TI-Writer can be used in conjunction with some other TI software, such as Multiplan and TI Extended BASIC. Unfortunately, however, TI-Writer cannot be used to create or edit TI Extended BASIC programs. This would be handy, especially for beginners who have not yet learned the TI Extended BASIC editing features.

In conclusion, we have found TI-Writer to be a surprisingly sophisticated word processing program. Editing and formatting features are good and the manual is written clearly, though poorly indexed. The main problems were mentioned early in this chapter: the narrow display and the non-standard keyboard. Both of these are the fault of the computer, however, not the word processing program. The absence of spelling and grammar checkers compatible with this program is surprising. Perhaps some will be available in the near future.

Direct Writer II

This word processing program is written in Extended BASIC and has a suggested retail price of \$66.00. It is available from Dynamic Data & Devices.

Direct Writer requires the TI-99/4A computer, program diskette, Extended BASIC command module, 32K memory expansion, at least one disk drive, and serial or parallel printer. The documentation on this program is scanty, and neither automatic word wraparound nor a mailing list capability is included. True lower-case letters are displayed, and this is a strength of the program.

Word Processing

Another Extended BASIC word processing program, priced at \$149.95 from Futura Software, Inc., Word Processing requires the same equipment as that listed for Direct Writer II. This word processing program seems overpriced to us, particularly since it lacks automatic word wraparound and the ability to move large blocks of text to new positions in the document. A mailing list capability is included, however.

Textiger

This Extended BASIC word processing program sells for \$59.95 and is from Textiger. Available on disk or cassette, Textiger runs with or without memory expansion. All you need is the TI-99/4A, the program disk or cassette, Extended BASIC command module, and a printer. The program lacks automatic word wraparound, the ability to move large blocks of text, and a mailing list capability. Documentation is scanty.

While your TI-99/4A may not be the best computer for word processing, we hope we've given you an idea of what word processing is all about.



Business Applications

There are two primary ways to use personal computers for business: in small business and for managerial tasks. The TI-99/4A is, unfortunately, not a good computer for most small businesses. There are, however, several good managerial uses for your TI-99/4A that we'll concentrate on in this chapter. Before we start, though, there are several things you should know about the TI as a business or managerial computer. First, you'll need quite a bit of extra equipment to run most managerial software. At the very least, you will probably need the TI expansion system, TI Extended BASIC, a disk drive, a printer and some extra memory. This means the cost of your system will be at least \$1000, probably more. Even after spending over \$1000 you will not have a good business computer. The TI is a good home and recreational computer, but it just can't be upgraded for business use. It wasn't intended for business. The poorly designed keyboard is a serious problem, for example. Most business programs use a lot of memory. As a result, they are pretty slow on a TI-99/4A, since it does not have fast memory access and data processing.

In addition, the TI-99/4A does not *effectively* use CP/M. CP/M is a popular operating system used on business computers. There are conversion circuits that let you use CP/M on many of the popular home computers, such as Atari, Commodore 64, Apple II, and the TI-99/4A. Advertisements for these extra, add-on circuits generally emphasize the fact that thousands of excellent business and managerial programs have been written to run on computers that use CP/M. Some of the ads imply that if you buy the CP/M board for your computer, you will be able to run all of those great CP/M programs. That simply is not true. CP/M is a *necessary* but not a *sufficient* requirement. Most of the good CP/M programs require lots of memory, are provided in disk formats that don't match the ones used on the home computers, and expect a screen display that is twenty-four lines of eighty characters. Even if you find CP/M programs that don't require more memory than the TI provides, that are available on TI compatible diskettes, and that will work with the TI screen format, you are still using a computer with a decidedly unbusinesslike keyboard. We don't think it's worth the effort. Spend your money on one of the excellent but inexpensive business computers, and let the TI do the things it does best.

We are not trying to discourage you from using the TI-99/4A in your job, but we do think you should be aware of its limitations. Don't buy this computer if your primary application is business. There are computers that will do the job faster and better for the price of an expanded TI-99/4A or less. However, if you buy TI-99/4A as a home computer, and you want to do a few managerial tasks on it, great. There are some helpful programs you can buy, and it is a good way to decide whether a computer would be useful in your work.

If you are a manager, you know the importance of information. If you can control and manage information better, you're likely to be a better manager. There are many different ways you can use the TI-99/4A to help you manage your business. We'll introduce you to some of the ways. One major business use of computers, telecommunications, is discussed in Chapter Six. We expect that telecommunications will be an

extremely important managerial tool in the future. It is already helping managers communicate better and faster. If you plan to use your computer for telecommunications, we strongly suggest that you read Chapter Six. Pay particular attention to the comments about *The Source*. *The Source* has an option called *Management Contents* that's well worth the price of admission. *Management Contents* helps you research most of the popular business magazines and can even give you short abstracts of articles you request. In one session, using *Management Contents* may be able to save you enough time to pay for both your TI-99/4A and *The Source* subscription.

Most of what you do as a manager is concerned with either planning or word processing. For a detailed description of word processing programs for the TI-99/4A, see Chapter Seven. The rest of this chapter discusses programs that help you with fast, accurate planning.

If you want to use a computer for planning, it is likely that your main concern is projections. You want the answer to questions such as "What will happen if sales increase by ten percent?" The answers to many questions that begin with "What if" can help you make decisions about the future.

The most useful managerial tool for small computers is probably the electronic spreadsheet. If you are doing it manually, a spreadsheet analysis is tedious work. Accountants and others who perform financial analyses have been using spreadsheets for a long time. A spreadsheet is simply a rectangular worksheet containing rows and columns of numbers. The simplest example of a spreadsheet is a column of numbers with a total. Now what happens when one of the numbers is changed? The total is wrong! If you are doing your work by hand, and you change several numbers, you may have to recalculate the entire column. The larger the number of rows and columns on the work sheet, the more complicated it becomes to change any one number. Imagine how many hours of work would be involved in changing and updating a complicated financial forecast.

An electronic spreadsheet simply does the same thing the hand-made spreadsheet does, only the computer does much of

the work. Most of what you have to do is to get the numbers and information into the spreadsheet. After that, simple commands tell the computer to rearrange the information in almost any way you want. For example, assume that you are a district sales manager for a large company. You have been asked to prepare a sales estimate for the next fiscal year that gives three different levels of performance. You supervise twenty-five sales representatives, your company has 350 products that range in price from \$3.95 to \$225, and you have nineteen different discount plans. The regional manager wants your sales estimate by next week, and you just found out about it today. Believe it or not, you could probably do that complicated sales analysis in an afternoon with an electronic spreadsheet.

Multiplan

You can avoid many of the manual calculations by using your TI-99/4A and an electronic spreadsheet called Multiplan. Spreadsheet programs are available for nearly all small computers and are in wide use. The first spreadsheet program for personal computers was VisiCalc (available from VisiCorp). This program became popular for business applications and has been adapted for many small computers. Multiplan offers all of the advantages of VisiCalc and a few extra. Multiplan is available for \$275 from Microsoft.

How does Multiplan do all this? The computer screen becomes a window that shows you a certain section of a giant spreadsheet made up of 255 rows and sixty-three columns. This window can be moved around simply by using the direction keys on the computer so you can view any portion of the spreadsheet you desire. The screen can even be split so that you can see two different parts of the spreadsheet at one time when you want to make comparisons. Not only can you see the different parts of the spreadsheet, but you can ask the computer to search for certain kinds of information, to do some calculations and to show you the result. You can also find out what is in any given portion of the worksheet at any given time.

Once you have entered a formula, you never have to enter it again. You can copy formulas, headings (or titles), and numbers into as many columns as you want. Using our sales estimate as an example, suppose you want to show what would happen if ten of the sales reps had a twenty-five percent increase, and all the others had a five percent decrease. All you have to do is tell the computer to multiply your first results by either twenty-five percent or minus five percent wherever appropriate. The computer performs all of the calculations.

Multiplan is a high quality software package. It has a good manual written in clear language. It uses little jargon and has step-by-step instructions. One thing that impressed us was that the manual puts you at ease right off by letting you know that it isn't necessary to read the whole thick book to get started. It points out that much of the learning comes as you use the program. We were able to get a good idea of how Multiplan works after just a few minutes of using the program.

The first part of the manual is a tutorial. It takes you through a practice session in which you actually set up a spreadsheet and do some calculations. The remainder of the manual is devoted to teaching you some of the finer points and more complicated procedures that can be done with Multiplan.

The Multiplan program itself is user-friendly. It has a Help key you can press at any time and get further instructions on the computer screen. Most of the program is menu driven, which means you are given a list of choices, and all you do is select the choice you want.

A program that does as much for you as Multiplan takes a while to learn, but if you have to do any kind of financial projections, it is well worth the effort to learn it. Even though you can get started quickly, it takes some practice before you can take full advantage of all of the things Multiplan can do.

Finance Management

Another program in the TI Business Aids Library is Finance Management (diskette, \$39.95). This is a planning program that helps project how much money will be needed to keep a

business going and how much capital costs will be. The program also helps with some other common business calculations such as depreciation, amortization, variable and grouped cash flows, and annuities. You must have the Extended BASIC command module to use this program.

Cash Management

Cash Management (diskette, \$39.95) is another TI program designed to help forecast the amount of cash available to your company. (TI Extended BASIC is also required for this program.) By estimating cash flow, you can make smarter managerial decisions. A maximum of six forecasts, with up to twelve periods per forecast, can be projected at any one time. Beginning and ending balances are maintained in each period for cash, receivables, investments, payables, and inventory. Twenty categories of data are available in each forecast—eighteen categories for expenses and income, one category for sales unit, and an automatically calculated gross margin category. If you have a printer, you may print any portion of a forecast.

Lease/Purchase Decisions

This TI program (diskette, \$69.95; cassette, \$59.95) is designed to help you determine whether an investment in any capital project will be economically beneficial to your business. It is an excellent example of an application that is difficult to do on a large computer and nearly impossible with a calculator, but is quite manageable on a personal computer. Lease/Purchase Decisions is actually three programs: Capital Investment Analysis Model, Lease-or-Buy Decision Model, and Lease Evaluation Model. You don't need to know anything about computers to use this program but you should have a little background in decision analysis. Here are some features of all three programs:

- The time span for your analysis can be up to thirty years.
- Lease payments, operating costs and gross revenue can vary from year to year.
- Up to six different methods of depreciation are possible.
- You can do both equivalent annual cash flow and sensitivity analysis.
- There are several different report formats, all of which can be printed.

Mailing List

Mailing list programs are available in many different versions by different companies. The Mailing List from TI (diskette, \$69.95) stores, alphabetizes, sorts, or searches for mailing list information. It handles names, addresses, telephone numbers, and other related mailing information. Another mailing list program is described in Chapter Five.

Although the TI-99/4A is not the best computer for business applications, it can help you make business and managerial decisions.



CHAPTER NINE

Programming

As you read this book, or any other book on computers, you will read about computer programs. Even before you read this book on computers, you'd probably heard the word *program* mentioned in relation to computers.

In this chapter you will learn what a computer program is and a little about how programs are written. You will not learn how to program; but you will learn what kind of programming you can do on your TI-99/4A computer. You will see how programming fits into the total picture of what you can do with your computer.

WHAT DOES PROGRAMMING HAVE TO DO WITH USING A COMPUTER?

Your TI-99/4A computer and every other computer can only do what it is told to do. The computer, with all its parts in

order, is still just a tool waiting to be used. Before it can do anything, it has to be told what to do. Not only does it have to be told what to do, but also how to do it. The process of telling the computer what to do and how to do it is called programming. Without a program, your computer is just a piece of junk.

What Is a Computer Program?

If you want another person in the room to pick up a book and bring it to you, you would have to give that person instructions to carry out your wish. You might say, "Please bring me that book." Or you might just point and grunt. As long as the other person understands what you want and is willing to help you, your instructions will be carried out. A computer program is really just a set of instructions. It is your way of telling the computer what to do. And as long as the computer is plugged into the wall, it is always willing to help you.

Where Do Computer Programs Come From?

When you use your TI-99/4A computer, there are several different programs working together. This explains why sometimes it seems that your computer has a mind of its own. After all, when you first turn the thing on, it begins asking you questions. That's because some programs are already built into the computer. These programs, or sets of instructions, were developed by the engineers at the factory where your computer was made and are built into the electronic circuitry of your computer. You have no control over these built-in programs. You cannot change them.

Most programs, however, are not built-in. Most owners buy all or almost all of the programs they use. In some cases, however, you may want to develop a set of instructions yourself. When you do this, you are *writing* your own program.

Who Writes Computer Programs?

Not long ago, only a few highly trained people had access to the equipment needed to write computer programs. Computers were multimillion-dollar machines that most of us never saw. This has changed. Millions of people now know how to write programs, and thousands more are learning every day. Even very young children are programming computers. No, this isn't because people have gotten smarter. It's because computers have become much easier to program, and the price is now low enough for a family to buy one.

Just as there are many different kinds of programs, there are also different levels of programming. Built-in programs are the most difficult. The people who developed the built-in programs for your computer are highly skilled. They understand electronics, and they know how computers work. Then there are applications programmers. Applications programmers don't have to know as much about the inner workings of the computer as the people who write the *system* or built-in software. But they make their living writing the kind of programs that make computers do the jobs that people want them to do. *Software* is another term for programs. Thanks to these applications programmers, you don't have to write programs yourself to get your computer to do the jobs you want it to do. You use programs they have already written.

Should You Learn to Program?

You can enjoy your TI-99/4A computer and have it do a lot of work for you without ever learning how to program. Most software that you buy comes with easy-to-follow instructions. However, there are many advantages in learning how to program. Here are some of them:

- *Added enjoyment.* It is fun and fulfilling to be able to give the computer your own instructions and have it understand and follow them.

- *Special uses.* Sometimes there just won't be any software available that does just what you want it to.

- *Understanding software.* A person who knows something about programming will often find it easier to select and use software.

- *Modifying software.* Sometimes a purchased program will come very close to what you want, but won't fit your needs exactly. If you have some programming skills, you may be able to modify the program to get it to do exactly what you want.

- *Selling software.* If you become a skilled programmer, you may develop programs that other people want to buy.

How Are Computer Programs Written?

As we said earlier, to get a computer to do something useful, you have to give the computer a set of instructions. You provide the instructions through a language the computer understands: a computer language. Computers are programmed in over 150 different computer languages.

Before you can program your computer, you need to learn a computer language. There are many books and learning aids available that can help you. Several languages are available for the TI-99/4A. You should know the differences between them so that you can decide which language would be best for you to learn.

How Much Do You Need to Know to Program Your Computer?

Learning a computer language is similar to learning a foreign language: it is a gradual process. If you were suddenly transported to a foreign country and didn't understand a word of the language, you would have a hard time communicating. However, in a short time you would be able to understand and use a few words of the new language. Through exposure and practice you would learn more new words and phrases until one day you found yourself fluent in the new language.

The same process applies to learning a computer language. You don't need to know very much to get started, but the more you practice and the longer you persist, the better you will get. For example, you can learn enough about programming your TI-99/4A computer in about ten minutes to tell it how to draw certain figures on the screen. With more study and practice, you can program your computer to do more complex things, such as playing a game or figuring out the monthly payment on a loan.

COMPUTER LANGUAGES

Why are there so many different computer languages? Computer languages are different from each other in several ways. Some are easier to learn than others, some are suited to only certain types of computing work, some are very fast while others operate much more slowly. We'll talk two of the major categories of computer languages: high-level languages and low-level languages.

High-Level and Low-Level Languages

A basic point to keep in mind as you learn about computer languages is that while there are over 150 different languages, computers actually understand only one. Does this sound confusing? We will explain.

Whether a language is considered high-level or low-level depends on how far it separates the programmer from the internal, electronic workings of the computer. The lowest level language is called machine language. When you program in machine language, you actually deal with the same set of codes and instructions that your computer does. Computers can only handle signals that are *on* and *off*. Generally we think of them as *ones* and *zeros*, but inside the computer it is working with patterns of on and off electrical signals. Different patterns tell the computer to do different things. Those patterns are thus the instructions the computer understands. Generally, when you work in machine language, the computer has some built-in software that lets you type in instructions in a number system called *hexadecimal* instead of in *binary*. Binary numbers are patterns of ones and zeros—those are the only two digits that can be used. The decimal number 12, for example, is written as 1100 as a binary number. Hexadecimal is a *base-16* number system and the decimal number 12 is written as C. Yes, hexadecimal numbers use letters as well as the symbols 0 through 9. To learn machine language, you need to learn at least two new number systems besides the decimal number system we are accustomed to, as well as the set of *machine language instructions* the computer understands. This *machine language* is the only language the basic computer understands. Every other language the computer *speaks* is actually translated into machine language by a program built into the computer.

Programming in machine language is difficult and tedious. There are no words or phrases involved in this language. Inside the computer it consists entirely of long series of 0's and 1's. Therefore, other languages have been developed that are much

easier for people to understand. These languages are made up of English or English-like words instead of just numbers. However, since the computer can only understand machine language, these other languages have to be translated into machine language before the computer can understand them. Sometimes the language a programmer uses is translated several times before it gets back to machine language. With these languages, the programmer is far removed from the circuits inside the computer. These other languages are called high-level languages.

Different Languages for Different Jobs

Some computer languages are general-purpose languages. Others are designed to do special jobs. For example, the programmer who writes educational programs is using the computer for a decidedly different purpose than the programmer who writes an accounting program. These two programmers may use different programming languages, because some are better for educational programming, while others are good for business programming. Specialized languages make programming for one type of job much easier than it would be if there were only one general-purpose programming language.

PROGRAMMING LANGUAGES FOR THE TI-99/4A

There are at least seven different programming languages available for the TI-99/4A computer. We'll tell you what these languages are, what hardware and software you need to use each language and how you get them into your computer. We'll discuss the advantages and disadvantages of each language, show you a simple example of what each language looks like and tell you some of the things you can do with each.

The BASIC Programming Language

BASIC stands for Beginner's All-purpose Symbolic Instruction Code. It is the most popular programming language in use today, especially with small computers like your TI-99/4A. A version of BASIC, called TI BASIC, is built into the TI-99/4A. When you turn on the computer, it is ready to be programmed in BASIC.

BASIC is a high-level general-purpose language. BASIC was developed for novice programmers who are not computer scientists or engineers. It is easy to learn and use. BASIC uses English and English-like words instead of numbers or letters. For example, if you want the computer to put a certain word on the computer screen, you tell it to *PRINT* that word. Or if you want the computer to add 3 and 2, you could tell it to "LET X = 3 + 2." If you then tell it PRINT X, the answer to the problem will be displayed on your screen.

Extended BASIC

In addition to the 150 or so different languages, there are also many different versions of each language. The different versions of a particular language are called dialects or versions. Just as there are many different French or English dialects, there are also many different dialects of BASIC. The BASIC used on the TI computer is different from the one used on other home computers. That is because different people designed the BASIC in each of the machines, and because the developers wanted to design a BASIC that would take advantage of the particular features of the computer for which it was written.

TI BASIC is a very simple BASIC. It lacks many powerful features that other dialects of BASIC have. Because of this, Texas Instruments markets a better version of BASIC called TI Extended BASIC. Unlike TI BASIC, Extended BASIC is

not built into the computer. To use Extended BASIC, you have to buy one of Texas Instruments' solid state software cartridges (\$99.95) and plug it into your computer. To get full benefit from this more powerful version of BASIC, you need to have the TI memory expansion system (see Chapter Ten on peripherals for a description of the memory expansion unit).

Pascal

Pascal is another high-level general-purpose language available for the TI-99/4A. Pascal has some advantages over BASIC, but it is more difficult to learn than BASIC. Consequently, it is not as popular. Pascal for the TI-99/4A is often listed as *UCSD Pascal*. UCSD stands for University of California at San Diégo, where this particular Pascal dialect was developed. Before you can use Pascal on your TI-99/4A, you need several things in addition to your computer. First, you need a disk software package. There are three disks in the Pascal package; it costs \$299.85. Then you need the memory expansion system, the disk drive system, and a component of the Pascal called the P-System.

Logo

Logo is a specialized (as opposed to general-purpose) high-level language designed especially for children. It is an interesting language, and it is easy to use. Texas Instruments was one of the first companies to develop this language for use with their small computers, and TI Logo is one of the better versions around. Logo is a very good *first* programming language for children and is considered by many to help children learn problem solving and math, and to develop spatial skills. TI is currently updating its version of Logo: the new version will be called TI Logo II.

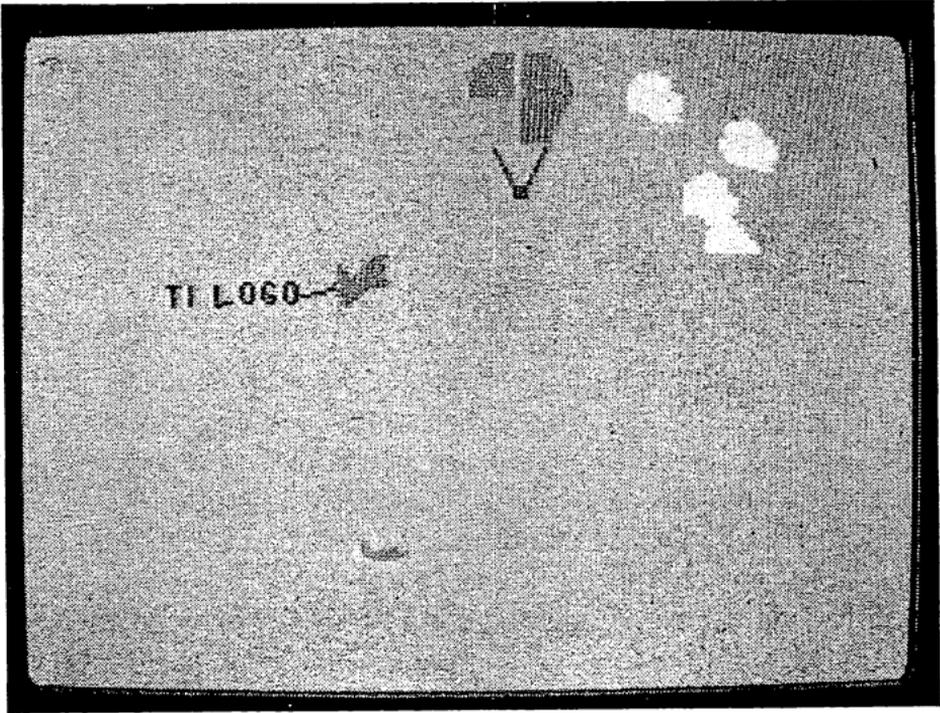


Fig. 9.1 TI Logo Sprites

TI Logo comes in a software cartridge that plugs into your computer; it costs \$129.95. In order to use Logo, you need to have the memory expansion system. You will probably also want to have a disk drive.

PILOT

PILOT stands for Programming Inquiry Learning Or Teaching. This is another specialized high-level language, and as the name suggests, it was designed to be used in education. TI's version of PILOT is available on either disk or cassette tape. Therefore, to use PILOT, you will need either a disk drive or a cassette tape recorder in addition to the appropriate software. The cost of the disk software packages is \$79.95.



Fig. 9.2 TI Logo

ASPIC

ASPIC stands for Amateur Special Purpose Instructional Code. It is a specialized, simple language for children. This type of language is sometimes called a *very-high-level* language because it is so easy for people to understand. ASPIC is actually built from BASIC. It helps children learn programming by eliminating the technical features of BASIC. It employs a logic that is more consistent with a child's way of thinking.

You can load ASPIC into your computer either by cassette tape, or by typing the program in yourself. If you type it in yourself, you then have to save it on either disk or tape. The

program is listed in the November 1982 issue of *99'er Home Computer Magazine*.

TMS990 Assembly Language

Assembly language is a low-level language that bridges the gap between machine language and higher level languages. It is much more difficult to learn than the high-level languages we just discussed, but it is not as difficult as machine language. Although you will probably never want to learn machine language, you might want to try your hand at assembly language programming.

Early computer professionals developed assembly language because programming in machine language was so difficult. Assembly language uses letters of the alphabet (instead of patterns of 1's and 0's) as codes for different instructions. The advantage of this to the programmer is that the program is much easier to understand, and the codes are much easier to remember and use.

Let's look at the difference between assembly language and machine language. The machine language code for telling the computer to add the number 2 to the number 3 looks like this:

11001110 00000011 11001110 00000010

In assembly language part of the program looks like this:

ACI 3

ACI 2

Although ACI 3 probably doesn't mean anything to you, to the programmer who knows assembly language it means:

Add the number 3 to the accumulator.

The accumulator is a place in the computer where numbers are *accumulated* or *added*. Likewise, ACI 2 means:

Add the number 2 to the accumulator.

ACI 3 would be much more likely to remind you that 3 was being sent to the number accumulator than 11001110 00000011.

Very few people have to program in machine language today. Usually the lowest-level language used is assembly lan-

guage. Assembly language is available for your TI-99/4A if you want to use it.

The TMS9900 assembly language is part of a software package called *Editor/Assembler*. This package costs about \$100. It comes in a large loose-leaf binder containing three items: a 470-page users manual, a solid-state software cartridge and two disks. To use this assembly language, you need to have two pieces of equipment in addition to your TI-99/4A computer. You need the TI memory expansion system and the TI disk memory system.

Assembly language programming is not for the beginning programmer. It is so difficult that you risk becoming discouraged before you ever get your computer to do anything. The TI Editor/Assembler manual even suggests that you should not try to use the package unless you have already had some experience with assembly language programming.

THINGS YOU CAN DO WITH TI-99/4A LANGUAGES

There are three types of programming you can do with the seven languages we just listed: high-level general-purpose programming, specialized programming for teaching and learning, and machine/assembly language programming. Let's take a look at some of the things you can do with these languages.

High-Level General-Purpose Programming

TI BASIC and TI Extended BASIC are part of the most popular programming language family. BASIC is popular for two reasons:

First, it is a general-purpose language. You can use it for almost any programming job.

Second, it is very easy to learn. If you have never learned

a programming language and want to start programming your TI-99/4A computer yourself, BASIC is the place to start.

The advantages of learning BASIC as your first language are:

- Every other brand of home computer can be programmed in BASIC. Even though the dialects are slightly different, you can easily adjust your programming skills to another computer.
- Since more programs are written in BASIC than any other language, you can adapt more programs for your own use than you can with any other language. Hundreds of BASIC programs that will run on the TI-99/4A have been published in computer magazines.
- Since it is one of the easiest languages to learn, you can do more with it in less time than with any other language.

To give you just an idea of what the different languages look like, we will show you the same simple computer program translated into different languages. The program is taken from an article by David G. Brader and Gary M. Kaplan in *99'er Home Computer Magazine* ("Chatting With Your Micro: Languages for the Home Computer," November, 1982). When the program is run in any of the languages, it generates approximately the following sequence of events:

The computer puts on the screen:

```
HI, I'M THE TI-99/4A
HOME COMPUTER
```

WHAT'S YOUR NAME?

You type your name; let's say Bob. The computer puts on the screen:

```
NICE TO MEET YOU, BOB
```

This is what our computer program looks like in TI BASIC:

```
10 PRINT "HI, I'M THE TI-99/4A HOME COMPUTER"
20 PRINT "WHAT IS YOUR NAME?"
```

```

30 INPUT N$
40 PRINT "NICE TO MEET YOU," ;N$
50 END

```

UCSD Pascal, while it is much easier to use than assembly or machine language, is more complicated than other high-level languages. However, Pascal has three advantages over other high-level languages:

- It is faster than other high-level languages. A program written in Pascal runs faster than the same program written in another high-level language.
- It has more structure than other high-level languages. It is easier for one programmer to understand and modify another programmer's work.
- The speed and power of Pascal make it a more efficient language for some complex business and scientific uses.

Our sample program written in UCSD Pascal looks like this:

```

BEGIN
WRITE (OUTPUT, 'HI, I'M THE TI-99/4A');
WRITE (OUTPUT, 'HOME COMPUTER. ');
WRITE (OUTPUT, 'WHAT IS YOUR NAME?');
READLN (INPUT, NAME);
WRITE (OUTPUT, 'NICE TO MEET YOU, ');
WRITE (OUTPUT, 'NAME');
END

```

Specialized Programming for Teaching and Learning

Enthusiasts of this group of languages often believe these languages are really suited to many general-purpose programming tasks. However, they are becoming popular primarily because they work so well in the classroom and are easy and quick to learn. Logo and PILOT are two of these languages.

Logo is extremely popular. Chapter Four discusses Logo as an educational tool, so we need not say much more about it here. Remember, this language is so easy to get started with that very young children can write a computer program after only a few minutes of instruction. If you have children who will use your TI-99/4A computer, Logo would be a good investment. Our simple, sample program looks like this in TI Logo:

```

TO GREET
CLEARSCREEN
PRINT (HI, I'M THE TI-99/4A)
PRINT (HOME COMPUTER)
PRINT (WHAT IS YOUR NAME?)
CALL READLINE "N
PRINT "HELLO,
PRINT :N
END

```

PILOT was created for a specific purpose: to help educators with no computer science background design effective computerized learning systems. Thousands of teachers have used PILOT to create many different types of programs for home and classroom use. These programs are called *computer assisted instruction* programs. PILOT lets people who are experienced teachers take advantage of the new computer technology without spending months learning to program the computer.

PILOT is a powerful language teachers can learn quickly. It is designed to make educational programs easy to write. With only a few hours of training, teachers can write programs that sound conversational. That is, the programs let the computer simulate a conversation between the students and someone teaching a concept or principle. The computer seems to understand what they say and can talk back to them. This is especially true of TI PILOT, since it takes advantage of TI's fine voice synthesizer and actually speaks to the students.

A TI PILOT version of our sample program looks like this:

D: R\$(15)
T: HI, I'M THE TI-99/4A
T: HOME COMPUTER
T: WHAT IS YOUR NAME?
A: R\$
T: HI THERE \$R\$
E:

The final high-level language we will look at is ASPIC. ASPIC is really just a hybrid dialect of BASIC. This means that the language itself is a program written in BASIC. ASPIC instructions are first translated into BASIC and then into machine language before the computer can respond to them. This makes ASPIC a very slow language.

There are some advantages of using ASPIC. First, it is cheap (you can just type in the whole language yourself and then store it on disk or tape). Second, it is so simple that small children and older beginners can program the TI-99/4A to do some fancy things with just a few simple instructions. Since our sample program looks almost the same in ASPIC as it does in BASIC, we will not list it.

Low-Level Programming

With the Editor/Assembler package, you can program your computer in assembly language. Remember, in this language you are only one step removed from the language the computer really understands: machine language. When you tell the computer to carry out the instructions you have given it in assembly language, a built-in program called an assembler translates your instructions into machine language, and the computer then carries them out.

Although programming in assembly language is complicated and tedious, it has several advantages. The greatest advantage is speed: the computer carries out the instructions quickly. Although your computer can do things rapidly compared with how you or I could do them, sometimes additional speed is

needed. Programs written in assembly language can do things much faster than programs written in high-level languages like BASIC.

A second advantage of using assembly language is that it allows you to get the computer to do some things you can't get it to do in other languages. In this language you have total control over the computer. The only limits are those set by the engineering of the computer. In high-level languages, you are confined not only to the engineering limits of the machine, but also by the limits of the language.

Because assembly language gives you total control over the computer, you can use the language in two different ways. First, when you need a program that would be impossible or very awkward to write in a high-level language, you can write the program in assembly language, using your Editor/Assembler package. Second, rather than writing a whole program in assembly language, you can write a short program that does just one special thing, then incorporate it into a BASIC or other high-level language program. The Editor/Assembler package allows you to use assembly language with either Extended BASIC or UCSD Pascal.

Now let's see what our sample program would look like if you were to write it using the Editor/Assembler package:

	REF	WMBW, INPUT
LINE1	TEXT	'HI, I AM THE TI-99/4A'
LINE2	TEXT	'HOME COMPUTER'
LINE3	TEXT	'WHAT'S YOUR NAME?'
BUFFER	BSS	32
LINE4	TEXT	'NICE TO MEET YOU,'
GREET	LI	R0,0
	LI	R1,LINE1
	LI	R2,32
	BLWP	@VMBW
	LI	R0,64
	LI	R1,LINE2
	BLWP	@VMBW

```
LI      R0,128
LI      R1,LINE3
BLWP   @VMBW
LI      R0,BUFFER
BLWP   @INPUT
LI      R0,256
LI      R1,LINE4
BLWP   @VMBW
LI      R0,288
LI      R1,BUFFER
BLWP   @VMBW
END     GREET
```

Computer languages, like computers, are tools. The question of which tool is best can be answered only when you know what job you need to do. Whether you use your computer just for fun or for work, you can do as much or as little of your own programming as you like.



Selecting and Buying Accessories for the TI-99/4A

The TI-99/4A is one of the least expensive full-function computers on the market today. In 1983 the price of the computer was around \$99 for much of the year. The price of this computer appeals to thousands of buyers each month, because most of us are used to thinking of computers as million-dollar devices instead of affordable machines that cost less than a hundred dollars. The low price, however, is just for the basic keyboard console. Most people who use their TI-99/4A regularly end up spending more money on accessories than they spend on the computer itself.

This pattern, spending more on accessories than on the basic machine, is difficult for many people to accept. We are accustomed to buying cars that cost thousands of dollars and selecting accessories for them that cost hundreds of dollars. A Ford Mustang may cost \$8000, and a stereo sound system for it may be \$450. A TI-99/4A, on the other hand, costs less than \$99, while a good printer that connects to it could cost over \$700. If we applied that ratio of base price to accessory cost

to the Mustang and its radio, the radio would cost \$56,000! The point is, the money you spend on the basic computer is often only a small percentage of the total cost of a computer system that can do the jobs you want it to do. The price of a good collection of video game cartridges can be more than the cost of the computer.

Some companies have taken advantage of the public's inexperience with buying computers and accessories. They have lowered the price of their basic computers to the point that they are unlikely to make any profit at all on each unit they sell. Once you buy their computer, however, you are locked into that company for accessories, which are priced so high the company makes a windfall profit on each item. Unfortunately, it is our opinion that TI has done just that. Their basic computer costs \$99, but the price of most accessories from TI are higher than similar products for several other computers. TI has even gone so far as to consider designing their computer so that no other company can create video game cartridges for it. They haven't actually done that yet, but it does show how far TI has considered going in order to capture as much profit as they can from their \$99 computer.

WHERE TO BUY ACCESSORIES?

Where should a new TI-99/4A owner buy his or her accessories? If you subscribe to magazines like *99'er Home Computer Magazine*, you will see ads for many mail-order companies with toll-free numbers. Call them up, give your VISA or MASTERCARD number, and they ship products to you by return mail. Prices for products through the mail are often ten to thirty-five percent lower than the price of comparable products available in local stores.

On the other hand, accessories for the TI computer are carried in many discount stores today. Often prices at a K-Mart or a regional discount store such as Fred Meyer will

also be below list on at least some accessories. Should you buy locally or through the mail?

We buy about half our computer accessories and software through the mail and half from local stores. In our opinion, beginners should seriously consider buying even more from local stores for several reasons. First, some stores have a salesperson who knows the products and can give advice, suggestions, and hints, not just take your money. A good store, however, can sometimes be hard to find. In some, the only thing the salesperson can do is point you in the direction of the rack with TI accessories and ask if that will be cash or credit card. Even with that type of store, it is usually easier to get an adjustment when you have a problem with a product. If the product doesn't work or the software doesn't load, the store will usually exchange it or refund the purchase price. A mail-order company will usually do the same thing, but you must return the product first. It can take several weeks to straighten out a problem, even if the mail-order supplier is cooperative.

There is one area, however, where mail-order suppliers generally have an advantage. Few local stores carry the variety of products that is available by mail. TEX-COMP, a Granada Hills, California, based supplier that bills itself as *Your Lubbock Connection* (the TI-99/4A was developed and manufactured in Lubbock, Texas), often has full-page ads that list over 100 items for the computer, most at discount prices. ELEK-TEK in Chicago is another big mail order company that has hundreds of TI programs and accessories. Sometimes the only source for a product you want will be a mail-order supplier.

Whether you buy from local stores or from mail-order companies, there are some hazards you should be aware of. Local stores often have salespeople who have little or no understanding of your computer. Instead of telling you they do not know the answer to a question, many of them will give you the answer they think is most likely to make the sale. We even had a TI factory representative tell us once that the TI-99/4A was software and hardware compatible with the IBM PC, a \$3000 computer! Even when we questioned the statement, he per-

sisted in explaining that the \$99 TI computer was IBM compatible. TI does have a very good business computer, the TI Professional, which costs about \$2600 and does use many of the same programs available for the IBM PC. The TI-99/4A, however, is not IBM compatible. If we go into a store where we are not sure of the salespeople, one technique that is handy is to ask a few questions we do know the answer to. If the salesperson answers them accurately and honestly, even if the answer may reduce the likelihood of a sale, we can put more confidence in the answers that person gives to other questions. This technique has produced some astounding answers in some stores.

The people who answer the phone at a mail-order supplier can also provide inaccurate information. Perhaps the best advice is to be very careful about making buying decisions on the basis of what a salesperson, especially one working on commission, tells you. We know that is a sweeping generalization that does a disservice to many fine salespeople who do an excellent job. However, they are a decided minority in this field. We feel a store that has such a staff is worth an extra ten to fifteen percent, since their knowledge and advice can save you much more than that.

A common problem with mail-order companies is the delays in shipping products. Think twice about ordering something that is not in stock. Many companies will tell you they are expecting a big shipment on Friday and will be glad to ship yours that afternoon. Big shipments are often late in this industry, because companies cannot keep up with demand. That Friday shipment may not get there for five or six Fridays. In addition, even if the shipment does arrive, there may be so many back orders that your order cannot be filled from that supply. It is not unusual for mail order suppliers to charge the cost of a product on your credit card the day you place the order and then take weeks, even months, to send that product to you. Again, we are painting a bleak picture with a wide brush. There are honest, responsive mail order suppliers who do everything they can to provide the customer with quick service. As with local suppliers, we feel that type of company

is worth a little extra cost because it saves you lots of frustration.

WHAT YOU GET AND WHAT YOU NEED

When you buy a TI-99/4A computer, you get one element of the computer system, the console or keyboard unit. The main circuit board is in the console along with some memory you can use for program and data storage. The keyboard is also on the console. A complete computer system consists of at least the following:

Basic processing system. This is on the circuit board in the console.

Memory. There is 16K of random access memory (RAM) in the console, which you can use for program and data storage. The console also has several thousand bytes of read only memory (ROM). The ROM in the console contains the instructions that let the TI speak BASIC. More RAM can be added by plugging in cards in the expansion box, and ROM is added by plugging cartridges into the slot on the console.

Output. The computer comes with everything you need to connect it to a television. It can then send information to you by displaying it on the screen of the television. The computer has several other output options, including a printer and a speech synthesizer.

Input. The keyboard lets you enter data and instructions in the computer. The computer can also accept information, or input, from game controllers (connection provided on the side of the computer), from speech recognition units, light pens, and other input devices that will be described later.

Storage. You need some way of storing information and programs when they are not in the memory of the computer. The console has all the circuits you need to use a cassette

recorder as a storage device. The cassette is optional; a faster and more reliable storage device is the disk drive. TI manufactures one for the TI that fits inside the expansion box.

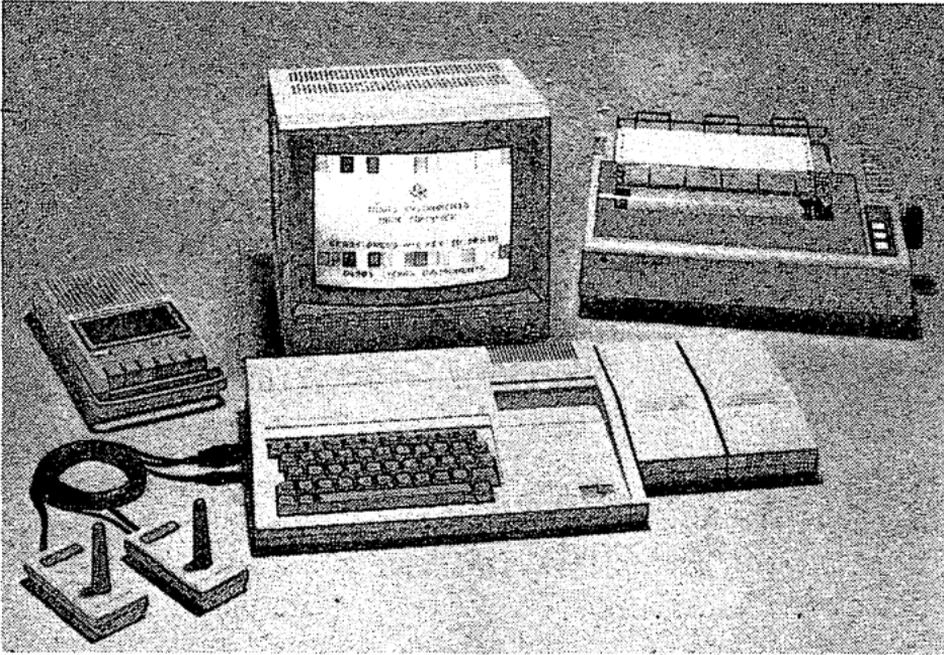


Fig. 10.1 . TI-99/4A computer system including: (from left to right) joysticks, cassette recorder, video monitor, impact printer, HEXBUS interface and speech synthesizer

Few people who buy the TI-99/4A stop with the console. Most need at least a few other items to have a complete system. In order to have the five components of a computer system listed above you would need the console, a color television, and a cassette recorder. Many systems also include extra memory and a printer. Disk drives are also popular accessories. If you add extra memory, a disk drive, or any of the special expansion cards that will be described below, you will need to buy a silver and black box TI calls the *peripheral expansion system*. This box lists for around \$250 but has been offered as part of several promotions by TI. At times you could buy three other accessories or TI software modules and get the peripheral expansion system free. The original version of this computer

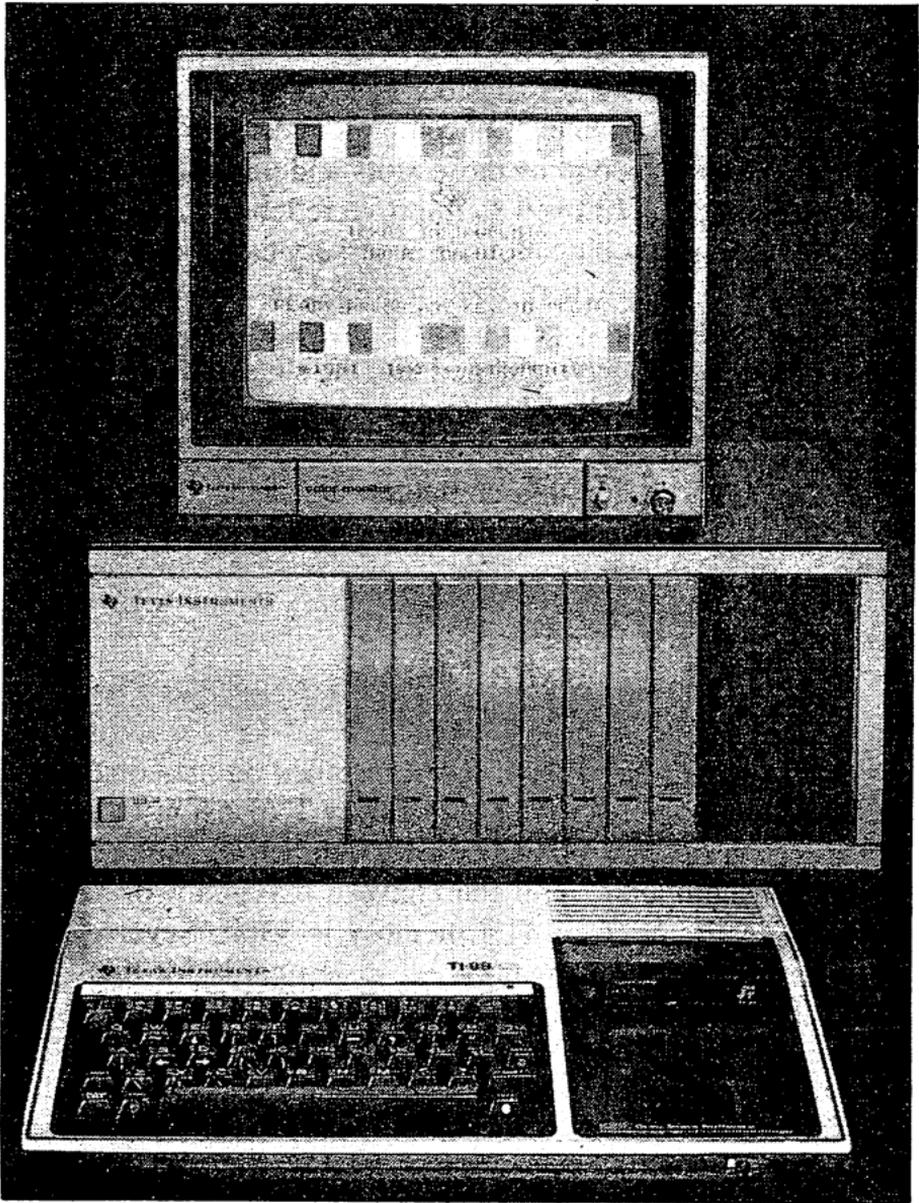


Fig. 10.2 TI-99/4 Peripheral Expansion System

used a daisy chain approach to adding accessories. That is, you could plug one accessory into the slot on the side of the computer, then plug another into the first, and so forth. Some owners ended up with a string of accessories several feet long. That made for a messy installation, and reliability was a prob-

lem. The current version lets you connect the console to the peripheral expansion system which is really a special, but empty, box. In that box is a set of slots with copper traces that are connected to the console. You can plug a memory card or disk controller card into one of those slots and add that peripheral to the computer. TI hoped to improve reliability and convenience by letting you plug all your accessory cards into this box, but at least a few owners have reported problems with poor connections. If your system behaves erratically, it may be that the accessories you have plugged into the slots in the expansion box need to be checked for proper seating. Reliable or not, you will have to buy an expansion box in order to use many of the accessories for this computer. In the next section we will review some of the accessories you might need. We will begin with extra memory.

Extra Memory

The TI-99/4A has 16K of RAM installed on the computer's main circuit board. TI sells a Memory Expansion Card that plugs into the expansion box. It adds another 32K to the memory of the computer. You thus have a maximum of 48K of RAM. The list price of TI's memory is \$300. Several other companies also make memory expansion cards for this computer. Foundation Company of Tiburon, California, for example, sells a 32K RAM card for \$150. Foundation even has a memory expansion for the TI that does not require you to buy the expansion box to install it. Many business programs will expect you to have all the memory the computer can handle. Word processing, accounting, and electronic spreadsheet software all need lots of memory. In addition, if you want to buy TI's version of Pascal, it can be used only in a system that has the extra 32K of memory added. Ordinary uses such as computer literacy and learning to program in BASIC can usually be done without extra memory. However, if you get serious about writing programs in a language such as BASIC, you will probably need extra memory to store longer programs.

You may also add all sorts of extra read only memory (ROM) to the TI without even thinking about it. All of the programs in a command module are actually stored in ROM chips inside the cartridge. When you plug in a command module, you are adding ROM to the system.

Output Options

In addition to the standard method of providing output through the video display, the computer can send information to a printer, plotter, or any of several other devices.

Televisions and Video Monitors

The video output from this computer can be sent to a standard television or to a monitor. Generally speaking, a monitor will provide the highest-quality display, since it was designed specifically for the job. TI sells a good ten-inch color monitor for around \$400, which is somewhat overpriced. The Commodore color monitor is \$100 less, several inches larger, and should work with the TI computer if you can get a properly wired cable to connect the computer to the monitor. Several other manufacturers also sell very good quality color monitors that will work nicely with the TI computer.

Printers and Printer Interfaces

One of the first things many computer owners like to add to their system is a printer. Printers let you get a *hard copy* (printed on paper) of information or data from the computer instead of a visual display. Video displays are useful and are preferred for many tasks, but there are times when only a hard copy will do. People buy printers because:

- Program listings and business reports are easier to read on paper than on the computer screen.
- When you have a program or a report printed on paper

(hard copy), you have protected yourself against losing it if there is a problem and you lose all the information in the computer's memory (this can happen when the power goes off) or you damage the cassette or disk where the information was stored.

- When you use the computer for word processing or to generate mailing labels, naturally you need a printer.

- If you want to make copies of charts, graphs, or illustrations that were created on the computer, you need a printer to make the hard copy. For that matter, you can make many more copies or overheads for meetings.

- If you want to share a program with someone else, the easiest thing to do is make a printed copy of the program and send it to your friend.

TI sells a printer for this computer, the TI Impact Printer. Its list price is \$750. This model is actually manufactured by Epson, a well-known Japanese manufacturer of printers and a division of the conglomerate that makes Seiko watches. TI's printer appears to be the Epson MX-80, which is one of the best-selling printers ever built. This printer, with the Epson label on it, is available for between \$450 and \$600 in most areas. TI showed good taste in selecting this printer. At least two other computer companies, Hewlett Packard and IBM, sell this model under their names. Epson recently retired the MX-80 and replaced it with an improved and faster version called the FX-80. Since the way these two printers interface with the computer is essentially the same, it should be possible to connect the FX-80 instead of the MX-80. For our money, we would buy the FX-80 instead of an MX-80, regardless of the name on the printer. You will need a special printer cable to connect it to the TI computer, but they generally cost less than \$35, which means you could save between \$100 and \$200 if you buy the Epson version instead of the TI version.

The Epson printer is only one of at least 150 different printers that can be used with the TI. Most compatible printers fall into one of two broad categories: dot matrix or daisy wheel. Dot matrix printers produce letters and shapes by pushing a

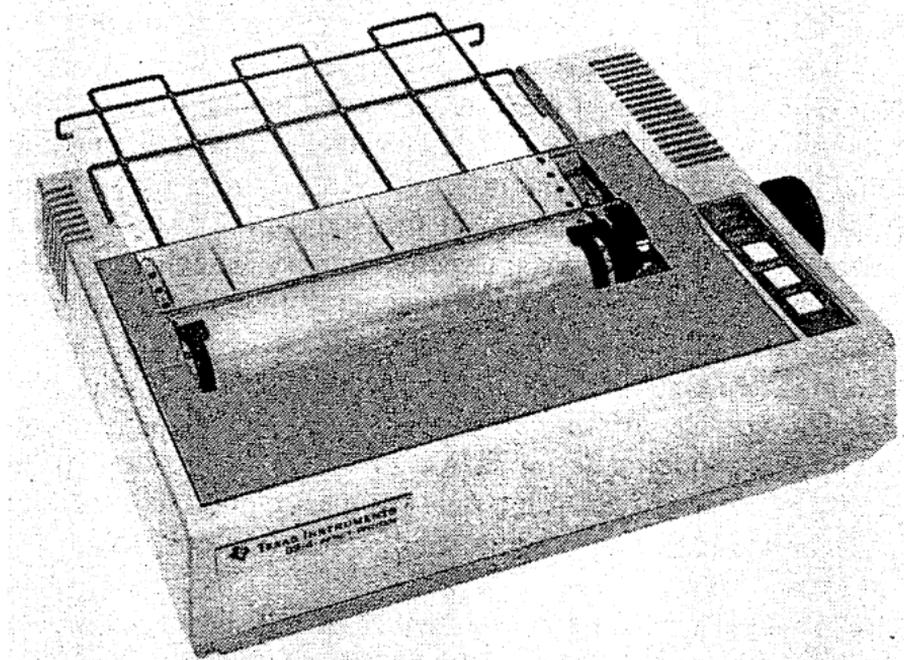


Fig. 10.3 TI-99/4 Impact Printer

matrix of tiny wires into a ribbon, which then strikes the paper. Each letter consists of a pattern of tiny ink dots on the paper. Printers vary in the number of dots they can use to create a character. Generally the quality of the print increases as the size of the individual dots decreases and the number of dots increases. A five-by-seven dot matrix (five rows of seven dots) gives you thirty-five individual dots to use, while the nine-by-nine matrix gives you eighty-one. The nine-by-nine matrix can produce characters that look very good. A printer with a five-by-seven matrix is cheaper to build, but the quality of print is not as good. A few of the dot matrix printers that are popular with TI-99/4A owners are the Gemini-10 (around \$300), the Prowriter (several models, prices begin around \$400), and the Okidata Microline series of printers (\$300 and up). Dot matrix printers generally provide acceptable to very good print quality and print at least eighty characters a second. Some print as many as 200 characters a second.

The other type of printer does not create characters out of

patterns of dots. These printers produce fully-formed characters in much the same way a typewriter does. Most of the printers in this category use the *daisy wheel* print mechanism. Print quality is high; in most cases it is as good as that produced by office typewriters. Today, the daisy wheel printers from Diablo and Qume (and the printers from NEC, which use a print thimble instead of a wheel) set the standard for quality and reliability. One of the least expensive daisy wheel printers is the Smith Corona TP-1, which is generally available for \$600 or less. It is slow, however, and prints at 12.5 characters a second. The Diablo 630 is another excellent daisy wheel printer that can operate at forty to fifty-five characters per second (cps). This model sells for \$2000 to \$3000. In general, print quality on daisy wheel printers is from very good to excellent while print speed ranges from snail's pace (ten cps) to almost fast (sixty cps).

No matter what printer you select, it will be necessary to *interface* the printer with the computer. Before you can successfully interface a printer with your TI-99/4A, three major obstacles must be overcome:

- The printer must accept data in the form the TI-99/4A transmits it. The computer and printer must have compatible interfaces.
- The cable between the computer and printer must have the proper connectors on each end and must be correctly wired.
- The code used by the TI-99/4A must be the same one used by the printer, OR a program must translate the codes for the printer.

Let's deal with the interface issue first. Printers generally come in two different flavors: serial and parallel. Serial printers accept data a bit at a time with each character code being made up of seven or eight bits. Parallel printers accept data eight bits at a time over eight separate data lines. The TI-99/4A has neither a parallel nor a serial interface built in, but you can buy either one as a card that plugs into the expansion box. We suggest you consider buying a serial printer and a serial inter-

face to connect it to the computer, since serial interfaces are also required to connect modems for telecommunications work. Some serial interfaces, however, are wired to operate with modems rather than printers. That means you will probably have to have a cable specially wired to use a printer, since printers and modems put some of their signals on different pins. The serial interface card from TI lists for \$180. Remember that you must have an expansion box, since it plugs into a slot on the box. If all you need is a printer or modem interface, several companies sell serial interfaces (also called RS-232 interfaces) for under \$100.

Parallel printers are often less expensive and easier to find. They are easily interfaced with the TI, if you connect the printer to the parallel interface card with the correct cable. Many TI dealers carry the cables that let you connect the computer to most popular parallel printers.

The third obstacle to be overcome when interfacing a printer with your computer is code compatibility. Fortunately, that is not likely to be a major problem. The TI computer assigns a special code to each letter, number, and symbol it can display. TI used the ASCII code (American Standard Code for Information Interchange), and that is the same one used by virtually all the printers you are likely to run across. That means you can probably get a printer up and running if you have the proper interface (serial and parallel) and a correctly wired cable.

Modems

Strictly speaking, a modem is an input and an output device but is included here because it requires the serial interface mentioned above. In addition, you will need a telecommunications program (TI sells one that comes in a command module), and a modem. Modems let you connect your computer to the telephone line. TI's model lists for \$200, which is a little high. A modem we consider an excellent buy for the TI is the Signalman Mark III. TEX-COMP has advertised this model for \$94, and it is advertised as TI-compatible. You still need the serial interface card, however.

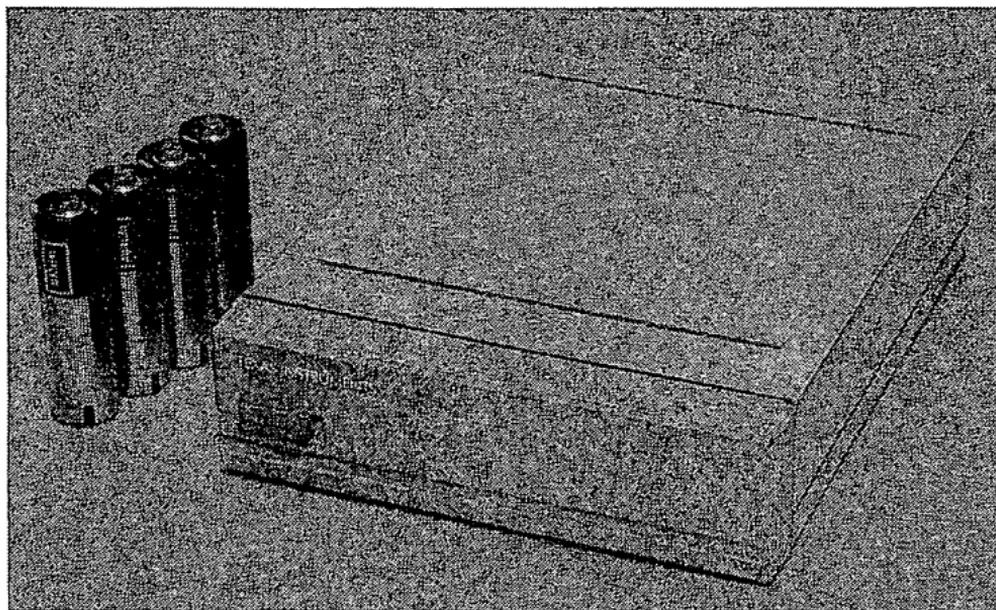


Fig. 10.4 TI Modem

Video Disk Output

This computer is also capable of controlling the operation of several types of video players. For around \$500, you can buy the controller card and cable needed to interface the computer with a Sony, Pioneer, or Panasonic video player. You could, for example, set up the computer to teach a biology lesson and illustrate the lesson with material stored on video cassette or video disk. As students answered the questions correctly or incorrectly, the computer could instruct the video player to select the next segment to be shown on the screen. Video player interfaces for computers are relatively new and untried, but TI is to be commended for developing this interface for their computer. It will allow many people to experiment with computer-controlled video lessons at a reasonable cost.

Speech Synthesizer Output

Scientists in the laboratories of Texas Instruments have developed some of the most sophisticated speech synthesis tech-

nology you can get today. The company was able to take advantage of that technology to create an inexpensive synthesizer (\$150) for the TI-99/4A. If you want to experiment with speech output, few computers let you do it as cheaply as TI. The company also has several pieces of software for speech enthusiasts. A number of games will *talk* to you as well as use the video display if the speech synthesizer is attached. Besides adding interest to video games, speech synthesizers can let young non-readers use the computer by giving vocal instructions, and it can allow visually impaired people to use a computer even if they cannot read material on the screen.

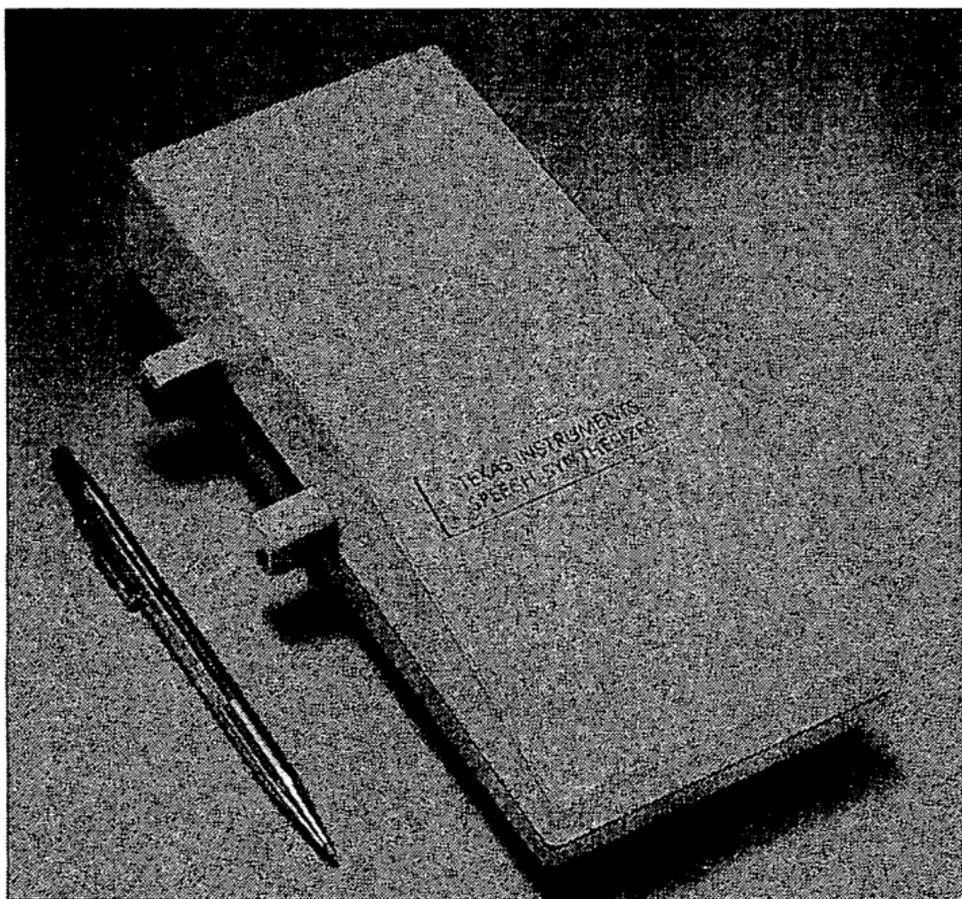


Fig. 10.5 TI Speech Synthesizer

Input Devices

In addition to the keyboard, this computer has a number of other input options.

Video Game Controllers

Educational and recreational applications often call for a means of input other than the keyboard. Many arcade games, for example, do not work well if you must press keys to control movement. TI sells a pair of relatively high quality joysticks for \$35. Several other companies also manufacture TI-compatible joysticks. You should be able to try out several different types before selecting the ones that suit your playing style.

Voice Recognition Unit

Several computers have accessories that let the computer *talk* to you in a mechanical or computer-like voice. That is speech synthesis. The opposite of that, speech recognition, is less common. A computer that has speech recognition can accept data and instructions that are spoken rather than typed in. You could, for example, say PRINT instead of typing the instruction in on the keyboard. TI, in cooperation with Milton Bradley, sells the MBX Expansion System for the TI-99/4A. This unit is a fascinating set of equipment. It includes a headset with a microphone, a sixty-four position membrane keypad, and a jazzed-up joystick. The unit sells for \$130; the joystick is another \$30. With this system connected to the computer, you can give it instructions orally instead of typing them in or moving the joystick. Milton Bradley has announced they have developed ten different games that use this technology. Six of the games are arcade-style recreational programs and four are educational games. Some of the games can be played without

the voice recognition unit; others require it. One game that requires it is Championship Baseball (\$60). The game uses animated players who move about on the video baseball field. You can control your players with voice commands, and the umpire calls balls and strikes. There is even some nice ballpark music. One of the educational games, Honey Hunt, lets children help a friendly bee find nectar in flowers and avoid spiders and dragonflies. Players can give the bee directions verbally and thus learn the meaning of directional words like *right* and *left*.



Fig. 10.6 MBX Expansion System

Mass Storage

One of the first things a new computer owner will need is a way of storing large amounts of information and programs outside the computer. Like most small computers, when you turn the TI-99/4A off, everything you have typed into the memory of the computer is lost. It isn't very practical to spend hours writing a program or doing word processing and then have to start all over the next morning because the computer was turned off. There must be a way of creating a permanent copy of the material for use later. Printers let you make a copy that humans can read. Mass storage devices let you make a copy the computer can read.

The cheapest method of adding mass storage to the TI computer is with a cassette recorder. The model TI sells is around \$70. You can use other brands of recorders with this computer, but we have never been able to get reliable cassette operation on most personal computers unless we used the recorder designed specifically for that model. So we suggest you consider using the TI cassette recorder if you plan to depend on cassettes for mass storage. There is only one good thing about cassette storage: it is cheap, particularly when compared with the other popular alternative, disk drives. If you write a program in BASIC and want to store it on a cassette, you can probably set yourself up with cassette storage for less than \$75, and that includes several cassettes. Saving data and programs on cassette and loading them back into the computer later is a slow process, however. Cassettes just don't work very fast. They aren't all that reliable either. Few small computers have truly dependable cassette systems.

The alternative to cassette storage is a disk drive. Disk drives let you store data and programs on five-and-a-quarter-inch platters of magnetized plastic that are inserted into the disk drive. The disks resemble 45 RPM phonograph records and are flexible, that's why they're called *floppy disks*. The biggest ad-



Fig. 10.7 TI Program Recorder

vantage of a disk drive over a cassette is speed of operation. A program that takes several minutes to load into the computer's memory from a cassette can be loaded in seconds from a disk. Disk systems are also much more reliable than cassette storage.

To use a disk on the TI-99/4A, you will need an accessory called the Disk Controller Card, which fits in the expansion box and costs \$250. Once you have the disk controller, you can attach one or more disk drives to the computer. The first two you add can be put inside the expansion box. TI's disk drive is \$500, which is one of the highest prices for a disk drive. The high price, however, does not mean it's a high-capacity drive. When the disk drives for almost every other personal computer have at least 140K of storage capacity on each disk (some have 500K!), the TI version has less than 100K. TI is charging far too much for a low-capacity disk drive. One company, Computer Peripherals Unlimited, adver-

tises TI-compatible disk drives for \$185 and another company, Software Support, sells drives for \$199.

Several other companies also sell sophisticated storage systems called *hard disk drives* for the TI. These systems use spinning platters of solid metal for data storage and have the ability to store five to twenty million characters of data. We have a difficult time, however, justifying the use of a peripheral that costs over \$2000 on a \$99 computer.

A mass storage system for the TI that's more appealing is the new Wafertape Digital Tape System announced by TI in 1983. The Wafertape system uses tiny, specially designed tape cassettes that are smaller than ordinary cassettes but manufactured to exacting standards. This system stores and retrieves data very quickly and seems to work reliably. A Wafertape system costs \$140, but it requires a new peripheral card called the HEXBUS Interface. The HEXBUS Interface is \$60 and lets you use the same set of accessories that the new TI CC-40 computer uses. In addition to the wafertape drive, there is a tiny printer/plotter that prints graphs and figures in four colors on narrow paper, a serial interface, and a parallel interface. All these peripherals work on the HEXBUS system developed by TI. The company claims this method of connecting the computer to peripherals results in a high reliability and very fast data transfer. Some critics see it as an attempt to design an interface system that other companies cannot copy, in order to capture more of the accessory market of their computers. We aren't sure which reason is closer to the truth, but TI has announced it will not license anyone else to use the HEXBUS technology on which TI holds the patent. The price of HEXBUS peripherals is very reasonable, however. The little plotter, for example, is \$200.

We hope the book has been helpful in introducing you to the field of personal computing and to the TI-99/4A. There is much more to learn, of course, but much of what you need to know to use the computer effectively has been covered in the last ten chapters. We hope you find many uses for the computer and spend many productive, enjoyable hours at the TI-99/4A's keyboard.

This concludes *Things To Do With Your TI-99/4A Computer*. We hope that you have enjoyed it and have learned some useful things. If you haven't bought a computer yet, you might want to read some of the other books in this series. Buying a computer can be either an enjoyable or frustrating experience. How much you enjoy your computer may depend on how much you find out about it before you buy it.

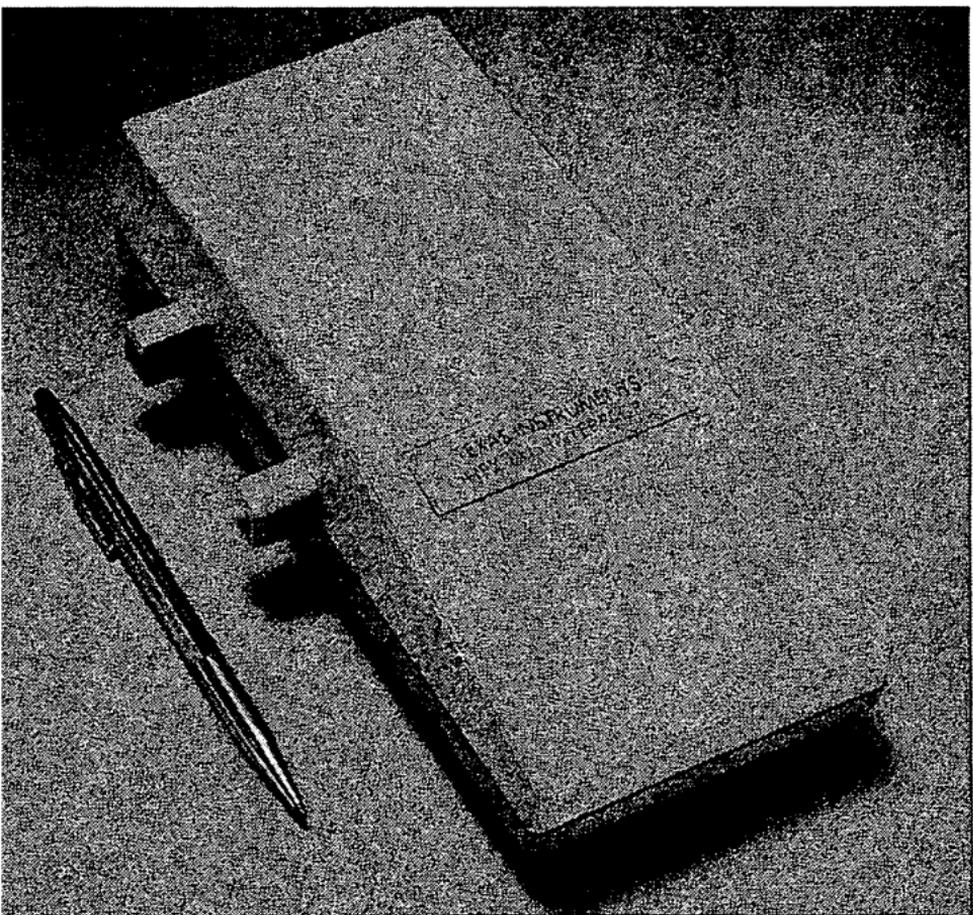


Fig. 10.8 TI HEXBUS Interface



Glossary

Alphanumeric: Information presented in both alphabetic and numeric form, for instance a mailing list. The numbers 0-9 and the letters A-Z or any combination.

Applications software: Programs designed to perform specific tasks. Applications software can be games, educational programs, or business programs.

Arithmetic expression: A group of letters, numbers and/or symbols that tell the computer to perform an arithmetic function. For example:

$2 + 2$

$2 * 2$

A22

$2/4$

2/A

$A * (2/B8)$

Arithmetic operator: A symbol that tells the computer to perform an arithmetic operation. The operators include + addition; - subtraction; * multiplication; / division; and \vee raise to a power.

ASCII: A simple code system that converts symbols and numbers into numbers the computer can understand. For instance, when you type a on the keyboard of your computer, the binary number 01100001 is sent to computer's central processing unit (CPU). The CPU then displays the letter a on the screen.

Assembly language: A low-level programming language that is much faster than a high-level language such as BASIC. Assembly language programs are extremely difficult to write. Here are two lines from an assembly language program:

```
LDA
MOV C,A
```

Audio track of cassette: A separate track of a program cassette that lets the computer play sound through your television speaker. This is an extremely useful feature for programs that need audio; e.g., a foreign language program.

BASIC: Beginner's All-purpose Symbolic Instruction Code. A high-level computer language designed for beginners. TI BASIC is a dialect of BASIC designed especially for the TI microcomputers. Here are three lines of program written in TI BASIC:

```
10 PRINT "HELLO HOW ARE YOU?"
20 INPUT A$
30 GOSUB 500
```

Baud: A unit of information transfer. In microcomputers, a baud is one bit per second.

Baud rate: The rate at which information is transferred. For instance, 300 baud is a transfer rate of 300 bits per second. The TI-99/4A is an 8 bit computer. This means that each character, space or symbol requires 8 bits. Therefore, a baud rate of 300 transfers only 37.5 characters per second. If you are sending a letter with each word approximately 6 characters long and you have one space between words, you can send about 5 words a second or 300 words a minute.

Binary number: A number system that uses only two digits, 0 and 1, to express all numeric values. See digital computer.

- Bit:** The basic unit of computer memory. It is short for binary digit and can have a value of either 1 or 0.
- Black box:** A piece of equipment that is viewed only in terms of its input and output.
- Boot:** The process of loading part or all of the disk operating system into the computer. This lets you load information from the disk or save information to the disk.
- Break:** To interrupt execution of a program. To break a program on the TI-99/4A, you have to press the function key and the 4 key at the same time.
- Buffer:** A temporary storage place used to hold data for further processing.
- Bug:** A problem that causes the computer to perform incorrectly or not at all.
- Bus:** A set of connection lines between various components of the computer. See TI Expansion Bus.
- Byte:** A group of eight bits usually treated as a unit. It takes one byte to store a unit of information (a letter, number, symbol, space, etc.). For instance the word *love* requires four bytes.
- CAI:** Computer-Aided Instruction
- Canned software:** One or more programs that are ready to run as is. These programs are available in books or magazines ready to type in and run or they are available on magnetic media. Common magnetic media used for TI software includes TI command modules, cassettes and diskettes.
- Cassette:** A small plastic cartridge that has magnetic tape inside. It has two reels. The tape on one reel is wound onto the other reel. Computer programs can be stored on a standard audio cassette.
- Cassette drive:** A standard tape recorder used to save (record) or load (retrieve) computer information.
- Cathode Ray Tube:** The picture tube of a television set or monitor. It is used to display computer output.
- Central processing unit:** This is the heart of the computer. It contains the circuits that control the execution of instructions.
- Chip:** A formed flake of silicon or other semiconductor material containing an integrated circuit.

Circuit: The complete path of an electric current. A computer circuit may have thousands of different elements; e.g., transistors, diodes, resistors, etc.

Circuit board: A plastic board that has hundreds or even thousands of different circuits.

Clock: An electronic circuit in a computer that is the source of timing and synchronizing signals.

Code: A system of symbols and rules for representing, transmitting and storing information.

Coding: The design of a computer program.

Command: An instruction that tells the computer to perform an operation immediately. The command *RUN*, for instance, tells the computer to immediately begin executing a program.

Command module: See TI Command Module.

Compiler: A computer program that translates high-level language statements into machine language.

Computer-Aided Instruction: The process of teaching by computer. This is a system of individualized instruction that uses a computer program as the learning medium.

Console: The keyboard and other devices that make up the control unit of a computer. The console of TI-99/4A computer is fully contained. It is complete computer ready to be connected to a television or monitor.

Control key: Pushing the computer's control key in conjunction with another key causes the computer to perform special functions. The TI-99/4A control keys can only be used in programs.

Controller: A device that can be attached directly to the computer or to an external mechanical device so that images on the screen can be moved around. A joystick is a controller.

CPU: Central Processing Unit.

CRT: Cathode Ray Tube.

Cursor: The little black blinking square on the screen that indicates where the next character will be displayed.

Daisy wheel printer: A printing machine whose print head has a number (usually 96) of radial arms or petals. Each petal

- has a type character on the end. Daisy wheel type is equal to or better than most typewriter type.
- Data:** All items of information a computer can process or generate—numbers, letters, symbols, facts, statements, etc.
- Data base:** The entire collection of data in a computer system that can be accessed at one time.
- Data base management system:** A program that organizes data in a computer's data storage (disks, etc.) so that several, or all, programs can have access to virtually any item, and yet a particular item need be keyed into the computer system only once.
- Data processing:** The process of converting data into machine readable form so the computer can work on it.
- Data transmission rate:** Baud rate.
- Debug:** To eliminate errors in a computer program or a computer.
- Decimal number system:** This is the number system you are familiar with, i.e., 0-9.
- Default:** See default value.
- Default value:** An assigned quantity for a device or program that is set by the manufacturer. For instance, a printer may have a default value that tells it to print everything in elite type. A default value in a program is usually the most common or safest answer. As another example, a word processing program may ask if you want to clear everything in memory. The safest answer is no, since it doesn't cause any harm if you hit the wrong key. In this example the program would have a default value of no.
- Desktop computer:** A complete computer system designed to fit on a desktop. The TI-99/4A is a desktop computer.
- Device:** Any piece of computer equipment.
- Digital:** A system that uses the numbers 0 and 1 to represent variables involved in calculation. This means that information can be represented by a series of offs (0) or ons (1). See bit.
- Digital computer:** A computer that uses a series of electronic offs and ons to represent information. These offs and ons

are converted to (or from) binary numbers. The TI-99/4A is a digital computer.

Directory: A list of all the files on a diskette.

Disc: Disk

Disk: A piece of flat rotating circular mylar that is coated with magnetic material. It is used to store computer information. See also hard disk and diskette.

Diskette: A flexible disk that is 5 1/4 inch in diameter (about the size of a 45 RPM record). It is the most common mass storage device. The TI-99/4A uses diskettes as the primary means for mass storage.

Disk drive: An electromechanical device that stores on or recalls information from a disk. A disk drive is a peripheral for the TI-99/4A.

Disk file: An organized collection of data stored on a disk.

Disk operating system: An operating system that lets the computer use one or more disk drives. See operating system.

Documentation: All of the available information about a particular computer, computer program or set of programs; e.g., how to turn on the computer, how to load programs, etc. For computer programs, the documentation should include such information as: what type of computer the program runs on, how much memory is needed and how to operate the program.

DOS: Disk Operating System

Dot matrix printer: A printer that forms characters as patterns of dots. The dots lie within a grid of definite dimensions, such as 5X7 dots.

Edit: To make changes on the screen in data or a program.

Electronic mail: Personal or other messages generated on computer and transmitted to another computer at a different location. The computers are connected via phone lines.

Execute: To operate a computer program or part of a computer program. The process a computer goes through when it analyzes instructions and acts on them.

Expansion bus: See TI Expansion Bus.

Expression: A combination of numbers, variables and operators that can be evaluated. The answer must be a single num-

ber or variable. For instance, $2 + 3 = 5$. It can't equal 7. Other expressions such as $A + B$, $A - 3$ or $A/B * 38$ must also have only one answer.

External memory: Mass storage.

Field: A unit of information that is part of a file. For instance, in the following mailing list file, NAME, ADDRESS, CITY, STATE and ZIP are all fields:

SAMPLE MAILING LIST

NAME _____

ADDRESS _____

CITY _____

STATE _____

ZIP _____

In the example above, both the information and title are part of a field. For instance, the field for Joe Jones is this: NAME Joe Jones.

File: An organized collection of related records. A payroll file has a complete payroll record for each employee.

Floppy disk: Diskette

Formatting: The process of electronically organizing a diskette so that information can be stored on it and retrieved from it.

FORTTRAN: FORMula TRANslation. A high-level computer language used for mathematical or engineering applications. Here are three lines from a FORTRAN program:

40 FORMAT (E14.7)

X = A + B * C / D - E

WRITE (6, 50) X

Function key: A key that tells the computer to perform a special function; e.g., *escape* tells the computer to leave the current program and free the computer for other uses. The TI-99/4A has a *Control* key that, when used with another key, performs specific operations. The key and what happens depends on the program. For example, pressing the Control key and the P key may start a printer in a word processing program while Control and P may have no meaning in an accounting program. In addition, the TI computer has a row of function keys across the

top of the keyboard. These keys also have uses that are particular to specific programs. The use of each function key should be explained in the documentation with the program.

Graphics: Pictures, line drawings, special characters, etc., that can be displayed on the screen or produced by a printer.

Hard copy: A copy of the computer's output printed on paper.

Hardware: The various physical components of a computer system; e.g., the computer itself, the printer, keyboard and monitor. Additional hardware for the TI might include the memory expansion box, a disk drive or a tape recorder.

High-level language: A computer language that uses simple English words to represent computer commands. For instance, the command PRINT "Hello" in BASIC tells the computer to print the word *Hello* on the screen.

Initialize: To set a program element or hardware device to an initial quantity (usually zero).

Input: To transfer data from the keyboard or a mass storage device into the computer's internal memory.

Input device: A device used to enter information into a computer. These are all input devices: keyboard, joystick, disk drive, cassette player.

Input-Output: The processing of entering data into a computer or taking it out.

Instruction: Properly coded information that causes the computer to perform certain operations.

Integrated circuit: A group of components that form a complete miniaturized electronic circuit. The circuit has a number of transistors plus associated circuits. These components are fabricated together on a single piece of semiconductor material.

Interactive: A computer system that responds immediately to user input.

Interface: A device that allows other devices to communicate with each other.

Inverse video: A process that shows dark text on a light background on your screen. Normally light text is shown on a dark background.

I/O: Input/Output

Jack: A plug socket on a computer.

Joystick controller: A two inch by two inch black box with a movable plastic stick on the top of it. It is used as an input device most often with computer games.

K: When used as a measure of computer memory K is an abbreviation for kilobyte or kilobytes. It is also an abbreviation for kilo.

Kilo: A prefix meaning 1000. In computer jargon it is used as an abbreviation for 1024

Kilobyte: 1024 bytes. Thus 4 kilobytes (abbreviated 4K) of memory is about 4000 bytes of memory. It is exactly 4096 bytes, but 4K is a convenient way to keep track of it. This means that if you have 4K of memory, you have space for 4096 characters, spaces, numbers and symbols in your computer.

Language: The means of communicating. The difference between computer language and human language is that a computer language allows humans to communicate with computers. The lowest level of language is machine language, the *pure* language of the computer. Machine language programs use 1's and 0's to represent the off's and on's in the computer. Machine language programs are the most difficult programs to write but they do not have the speed and action limitations of higher-level languages. Assembly language programs are also low-level languages but they use simple mnemonic statements as commands. High-level languages such as BASIC, FORTRAN and Logo, use Englishlike statements to tell the computer what to do. BASIC is the most common language because it is the simplest to use.

Load: The process of entering data or programs from an external device, such as a disk drive, into the computer. For instance, if you *load* a program into the computer it is available for use.

Line number: A number that defines each line of programming in a high-level language. Each line of the program begins with a line number. The computer executes the program in line number order starting with the lowest number.

Logic: A systematized interconnection of devices in a computer circuit that cause it to perform certain functions.

Logical operator: A symbol that tells the computer to make a comparison. These operators include \geq (greater than), \leq (less than), and $=$ (equals).

Logo: A high-level computer language that is often used with children. An easy to learn language, Logo allows colorful, detailed graphics to be drawn on the screen. Sprite graphics and turtle graphics are terms associated with Logo.

Loop: A series of programming instructions that repeat. The last instruction in the loop tells the computer to return to the first instruction. Intentional loops have some means of escape built into them. Unintentional loops, caused by programmer error, can only be stopped by pressing the break key or turning the computer off.

Low-level language: A computer language at the machine level (a pattern of pure binary coding). It is neither simple nor obvious for a human being to read, understand or use.

Machine language: The lowest-level language. It is a pattern of ones and zeros that the computer understands.

Mail merging: A program usually used with word processing that allows you to insert names and addresses into a group of documents. All you have to do is load the names and a sample of the document; everything else is automatic. For instance, suppose you want to send the same letter to 2000 people. Once you have created the mail list and the letter, the computer adds the name and address of the first person to an original copy of the letter. It can also address the person by name at several different places in the letter. It does the same thing for the second person on the list, the third, etc.

Mainframe computer: A large expensive computer generally used for data processing in large corporations, government installations, etc. Originally, the term referred to the extensive array of large rack and panel cabinets that held thousands of vacuum tubes in the early computers.

Mass storage: The files of computer data that are stored on media other than the computer's main memory. For ex-

ample, disks and cassettes are mass media devices.

Matrix printer: Dot matrix printer.

Mega: A prefix meaning one million.

Memory: The internal hardware in the computer that stores information for further use.

Menu: A display shown on the screen that gives you a list of options. You select an option by typing a letter or number and pressing the return key.

Microcomputer: A fully operational computer that uses a microprocessor as its CPU. Microcomputers are a new kind of computer. Whereas minicomputers are small scale versions of large computers, microcomputers are an outgrowth of semiconductor technology. Consequently, some microcomputers have features not found on either minicomputers or mainframe computers.

Microprocessor: A central processing unit contained on a single silicon chip.

Minidisk: Diskette

Minicomputer: A small computer based on large computer technology.

Mnemonic: A technique or symbol designed to aid the human memory. Its most common computer use is in assembly language programming. For instance, it is much easier to remember LDA (an assembly language term) than 004000 072.

Mnemonic code: A system of abbreviations designed to replace obscure, complex terms used in preparing assembly language programs.

Modeling: A partial simulation of real or possible situations.

Modem: A modulating and demodulating device that enables computers to communicate over telephone lines.

Monitor: A television set or cathode ray tube used to display computer information. In common usage, a monitor usually refers to a special device used exclusively for computer output. It can display a line 80 characters long and has at least 24 lines of text.

Mylar: A type of plastic that is the main component of floppy diskettes.

Nano: One billionth

Nanosecond: One billionth of a second. Modern computers operate in nanoseconds.

Numeric data: Data that consists entirely of numbers.

Operating system: A set of computer programs devoted to the operation of the computer itself. The operating system must be present in the computer before applications programs can be loaded or run.

OS: Operating system.

Output: Information or data transferred from the internal memory of the computer to some external device.

Output device: A device used to take information out of a computer. CRTs, mass storage devices (such as disk drives), and printers are all output devices.

Packaged software: Canned software.

Parallel: The performance of two or more operations or functions simultaneously. For instance, a parallel port accepts all eight bits of a byte at one time. Some computers are connected to the computer via the parallel port.

Pascal: A powerful high-level computer language for business and general use. Named for French mathematician and philosopher Blaise Pascal (1623–1662). Here are three lines from a Pascal program:

```
BEGIN
  READLN(I,HOURS)
  IF I = 1 THEN WORK := SUN
```

PC: Personal computer.

Peripheral: Any device that connects to a computer. Printers, joysticks and modems are peripherals.

Personal computer: Microcomputer.

PILOT: This is an easy to learn, high-level language designed for use by novice computer users. Primarily used for educational programs.

Pixel: A picture element that is one point on a screen. The size of the pixel depends on the computer graphics mode being used and the resolution capabilities of the screen.

Port: The location where Input/Output devices are connected to the computer. For example, a printer may be connected to computer with a cable at the parallel port. A modem may be connected at the serial port.

- Power supply:** A device, consisting of a transformer and other components, that converts household current (115 or 230 volt) to the voltage used by a computer.
- Powerful:** As used with computers, powerful means that a computer, a device or a program has a lot of features. Powerful is so *over used* in the computer industry that it really has no meaning.
- PRINT:** A command to the computer that tells it to display something on the screen or print it out on a printer.
- Printer:** A device for producing paper copies (hard copy) of the data output by a computer.
- Program:** An organized group of instructions that tells the computer what to do. The program must be in a language the computer understands.
- Prompt:** A symbol, usually a question mark, appearing on the screen that asks you to enter information.
- Qwerty:** An abbreviation used to indicate a standard typewriter-style keyboard. The first six letters in the third row of a standard keyboard are QWERTY.
- RAM:** Random Access Memory.
- Random Access Memory:** This is the read-write memory available for use in the computer. Through random access the computer can retrieve or send information instantly at any memory address.
- Read:** The act of taking data from a storage device, such as a diskette, and putting it in the computer's memory.
- Read Only Memory:** A random access memory device that contains permanently stored information. The contents of this memory are set during manufacture. A command module is a Read Only Memory. The contents of ROM is not erased when the power is turned off.
- Read/Write memory:** Computer memory that you can put data into or take data out of at any time.
- Record:** An organized block of data. For instance, the payroll information on one person.
- Resolution:** The number of points (or pixels) you can put on a television screen (or monitor) both vertically and horizontally. High resolution indicates a large number of pixels and, therefore, a sharper display.

Reverse video: Inverse video.

ROM: Read Only Memory.

SAVE: A command that tells the computer to store the contents of memory on some media, such as a diskette or cassette.

Screen: A CRT or television screen.

Semiconductor: A metal or other material (silicon, for example) with properties between those of conductors and insulators. Its electrical resistance can be changed by electricity, light, or heat.

Serial: A group of events that happen one at a time in sequence. For instance, a serial interface reads in a byte one bit at a time. Modems transmit data serially.

Silicon: a nonmetallic chemical element resembling carbon. It is used in the manufacture of transistors, solar cells, etc.

Software: The programs and data used to control a computer. Software is available in many forms. You can type the program in yourself, for instance, or you can have it transmitted to you over the telephone. You can also get it on cassette, diskette or common module.

Sprite graphics: Moving graphics that are produced by the language Logo.

System: All of the various hardware components that make the computer usable; e.g., the computer, printer, modem, keyboard, CRT and disk drive or cassette player.

Text editor: A computer program that allows you to change or modify the contents of memory. It can modify either data or programs.

TI Command Module: A preprogrammed ROM cartridge that can be inserted into the console of the TI-99/4A. Although the module can contain any software, it is primarily used for games.

TI Expansion Bus: See TI Expansion System

TI Expansion System: A large gray box that lets the TI-99/4A control disk drives and other devices. All extra memory is placed in the expansion system.

TI Extended BASIC: A version of the BASIC programming language that has more features than TI BASIC.

Turtle graphics: A small, triangular shape that is displayed in the language Logo. The *turtle* shows the direction of

lines for graphics. For example, if the instruction is to move north, then the turtle moves in the direction of the top of the screen.

User friendly: A computer system or software package that is easy for novice users to use and understand.

User's manual: A book or notebook that describes how to use a particular piece of equipment or software.

Value: A quantity that can assume any of a given set of values. For instance, assume A is a variable whose value is 1. If you add 3 to it, its value is 4.

Variable: A quantity that can assume any of a given set of values. For instance, assume A is a variable whose value is 1. If you add 3 to it, its value is 4.

Video display: The screen of your monitor or TV.

Volatile memory: As used with computers, volatile means that the memory loses its contents when the computer is turned off. That is, any information in volatile memory is lost when the computer is turned off.

Window: A portion of the CRT display devoted to a specific purpose.

Word: A minimum storage element in a computer memory and the smallest data element worked on by the CPU. Word sizes vary with the design of the computer, varying from eight bits to 12, 16, 32 or 64 bits.

Word processing: A special feature of a computer that allows you to manipulate text. See also word processor or text editor.

Word processor: A computer program that helps you manipulate text. You can write a document, insert or change words, paragraphs or pages, and then print the document.

Write: To store data on external media such as a disk or cassette. The expression *write to diskette* means that the information stored in the computer's memory is sent to the diskette where it is stored.

Write protect: When new material is written to a diskette, anything already on the disk may be erased. Write protect is a method of fixing the disk so that it can't be written on.



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