The Very Simple,

AMAZINGLY

STRAIGHTFORWARD,

Low-Stress Computer Buyer's Workbook

BY NICK BARAN AND SARAH HERBOLD

PC WORLD

Contents

Illustrations by Gordon Studer

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Picking Out Your PC

CHAPTER THREE

NOW THAT YOU KNOW SOME OF THE WAYS YOU MIGHT USE YOUR PC, YOU'RE BETTER prepared to think about what kind of PC is right for you. In this chapter we'll look at such issues as performance, memory, disk storage capacity, and monitors to help you decide what PC to buy.

Computer hardware may seem like a complicated subject. On one hand, though, you don't have to know much about hardware to use your PC successfully. Millions of PC users have no idea how much memory their computer has, or what their monitor's display resolution is, or even what kind of processor is inside their computer. They simply follow familiar procedures to get their tasks done and leave the technical details to the office computer expert.

Glossary

CPU

The central processing unit is a microprocessor chip that controls your PC's operations. It has a certain architecture (386 or 486) and clock speed (8 to 66 MHz).

RAM

Random access memory is your computer's short-term memory. It holds data as you work on your PC. RAM is measured in megabytes (MB).

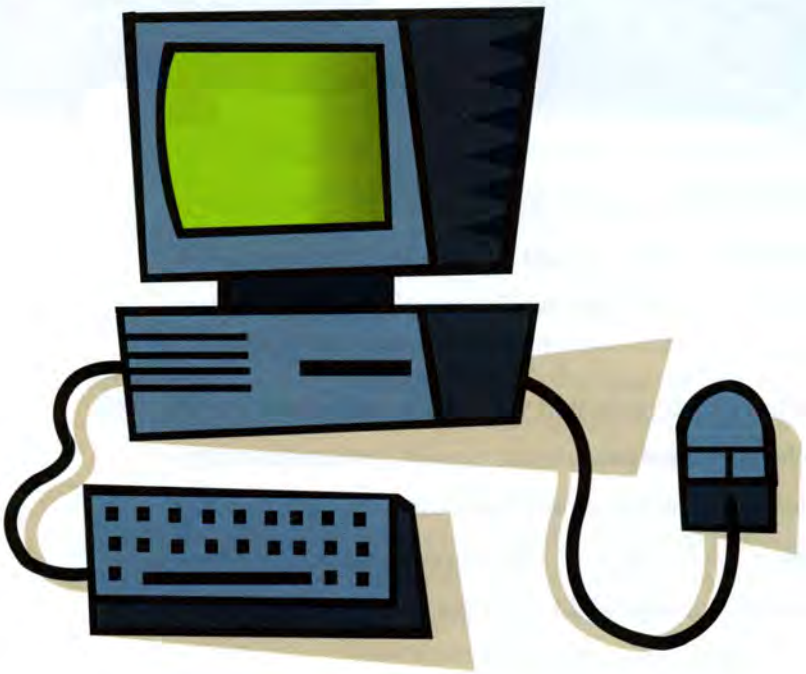
hard disk

The hard disk is a permanent storage device inside your computer that saves both the data you create and your software programs. Its capacity is measured in megabytes (MB).

On the other hand, when you're buying a PC, you need to know something about the fundamentals of computer hardware. Luckily, the essential things you need to understand in order to make an intelligent decision about what to buy are not difficult.

A basic desktop computer system consists of six main parts: three inside the computer and three that sit outside the main unit. The most essential internal component, the computer's "brain," is its **central processing unit** (**CPU**). The CPU is a microprocessor chip, a small silicon wafer about the size of an after-dinner mint, that processes information electronically. Computers also contain additional chips that give them "memory." A PC has two kinds of memory, which are analogous to short- and long-term memory. The second important internal element, **random access memory** (**RAM**), is the amount of memory your computer has when it is turned on. RAM is like short-term memory: Your computer uses it to "think" and "remember" when it's actually working on a project.

Your PC also contains a memory storage device, called a **hard disk**, for retaining information that you want to save once your machine is turned off. The hard disk is your computer's long-term memory.



The CPU, RAM, and hard disk are the internal components you need to know about. Each one comes in different "sizes," or capacities. Now let's look at these components one by one. First let's talk about the center of all computing activity, the CPU.

The CPU

A computer divides information into electronic bits. A single letter or character contains 8 bits of information. A basic measure of a computer's power is the number of bits its CPU can "compute," or process, simultaneously. The original PC microprocessor, which was invented at Intel and used in IBM's first personal computers, could process 8 bits of data at a time. It was called the 8088 processor, and it was invented in 1978. In 1982, Intel developed a 16-bit microprocessor, called the 80286, which was used in the IBM PC AT model. Millions of 80286 machines are still in use today (though they are considerably faster than the original).

The 80286 was followed by the 80386 microprocessor in 1986. (For the sake of simplicity, these processors and the computers that use them are referred to by their last three digits: 286, 386, and 486.) The 386 can process 32 bits of data at a time. It is available in two versions: the DX and the SX. The DX transmits 32 bits of data at a time to other components of a PC system (such as the hard disk or video monitor), along a pathway called a "bus." The SX transmits only 16 bits of data at a time on the bus. This makes it somewhat slower than the DX, but the performance difference is noticeable only in high-performance applications such as graphics and scientific programs.

The 386 processor was followed in 1989 by the 486, which is similar to the 386 except that it is about twice as fast. The 486 also comes in DX and SX versions. The DX includes mathematical functions directly on the chip that in 386 and earlier chips used to be available only on a separate chip, called a math coprocessor. Like the 486DX, the 486SX is a full 32-bit processor, but it lacks the math coprocessor functions of the DX. These functions are needed only for very sophisticated graphics or design projects, however. If you plan to stick to standard business applications, you can save money and buy a 486SX-based system.

PC CPU performance comparison

This table shows the clock speed, bit-processing, and bus bit-transferring capacities of the CPUs used in current and earlier PCs. It also indicates whether each CPU includes a math coprocessor.

CPU	Clock speed	Processing bandwidth	Bus bandwidth	Built-in math coprocessor
486DX2	50–66*	32	32	yes
486DX	33–50	32	32	yes
486SX	20–33	32	32	no
386DX	25–33	32	32	no
386SX	16–25	32	16	no
286	8–12	16	16	no
88	4–8	8	8	no

The bandwidth is the number of bits of data that can be processed simultaneously.
A math coprocessor performs calculations involving decimals.
* The DX2 CPU doubles processing speed for some operations.

Besides the number of bits processed at once, CPU microprocessors can also be differentiated by how long they take to complete one cycle of instructions. A CPU's **clock speed** is measured in millions of cycles per second (or megahertz, MHz). The 386 and 486 processors come in a variety of clock speeds, currently ranging from 16 MHz, typical of laptop and notebook computers, to up to 50 MHz on desktop PCs. "Clock-doubled" 486 processors, which use a 33-MHz processor, can double their speed to 66 MHz for some operations. They are called 486DX2 microprocessors.

All this boils down to something quite simple: The faster the CPU, the faster your work gets done—and the higher the price. Besides costing more, though, high-speed processors also generate more heat (which may require extra fans and ventilation) and need special high-speed circuitry so that other components of the system (such as memory and the video system) can keep up. If you decide to buy a high-speed 486 system (such as a 486DX-50), make sure you buy it from a well-known manufacturer that has proven expertise in designing high-speed systems. You can get burned (no pun intended) buying a cheap model advertising 50-MHz or higher clock speeds if components in the system other than the CPU are inadequate to the demands of a high-speed processor.

So what CPU should you buy? Unless you are counting every dollar, we recommend a 486-based system for a desktop PC. Although you can save a few hundred dollars on a 386, for that amount you can get a 486 that's twice as fast. The price difference is small compared to the difference in capability. In addition, most major PC manufacturers will soon be making only 486 desktop models. If you're buying a notebook PC, however, 386 models are still substantially cheaper than 486 models—although the price gap is narrowing.

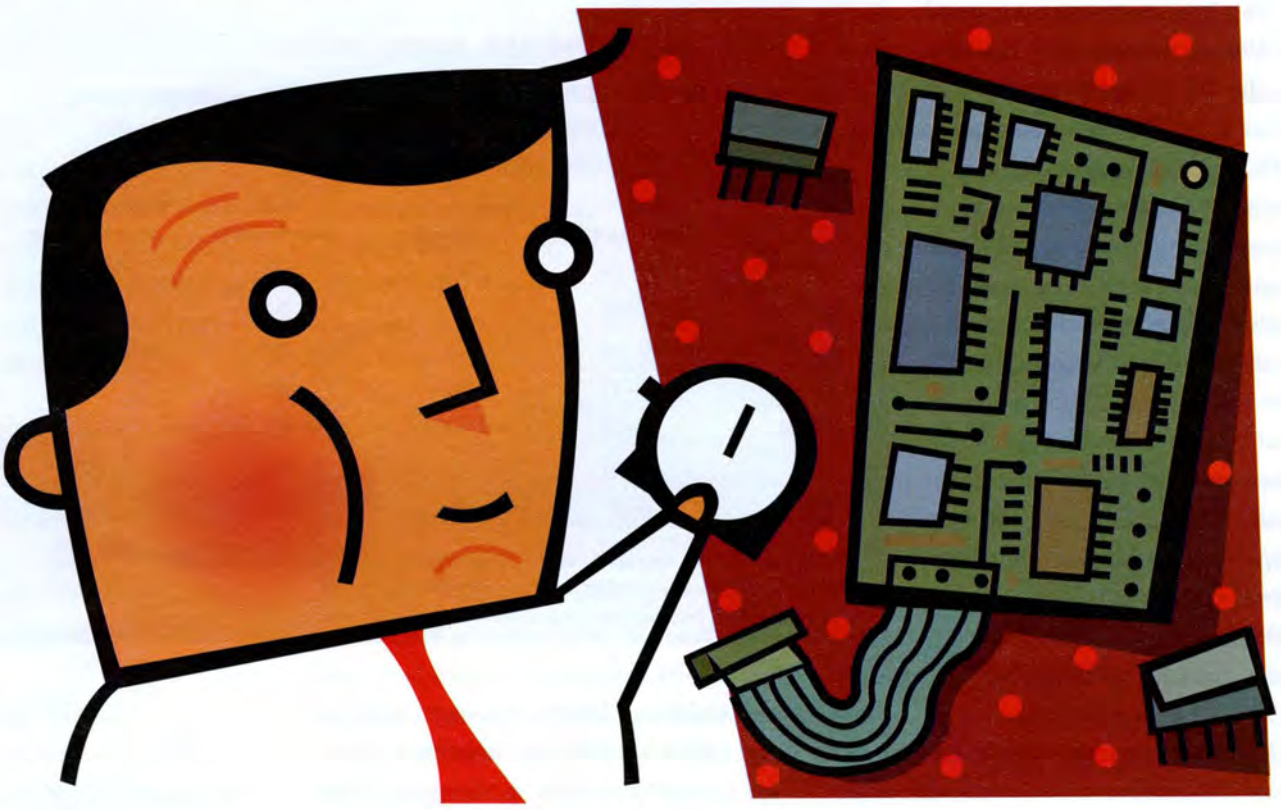
Glossary

clock speed

Clock speed measures how fast the CPU can complete one cycle of instructions. It is measured in megahertz (MHz).

FYI

For a quick introduction to personal computers, read PCs For Dummies by Dan Gookin and Andy Rathbone (IDG Books).



The next question you need to answer is whether to buy an SX- or DX-based system. Once again, you can save a few hundred dollars on an SX system, and if you plan to use only basic applications such as word processing and spreadsheets, an SX system is probably all you'll need. But if you will be creating lots of graphics, or doing intensive calculations or detailed drafting designs, or if you plan to use your PC as the center of a network, we recommend that you invest in a high-speed DX system.

Before we leave the topic of CPUs, we should mention the latest processor from Intel, the Pentium, which offers twice the performance of the 486. The Pentium is considerably more expensive than the 486, but if you can handle the extra expense and want the fastest, most powerful desktop PC available, go for it. (*PC World*'s July 1993 issue looks at the pluses and minuses of this hot new chip.) Along with the Pentium, several other high-performance processors are now emerging in the PC marketplace, including Digital Equipment's Alpha AXP 64-bit CPU, Silicon Graphics' MIPS R4400 CPU, and the PowerPC processor, which is being produced by a consortium made up of Apple, IBM, and Motorola. The Alpha AXP and the MIPS R4400 will be the first non-Intel processors to run a new advanced version of Microsoft Windows called Windows NT, which is mainly designed for larger and more complex computer systems than those typically found in a home office or small business.

Finally, you should be aware that there are many ways to upgrade your computer once you buy it. Most 486 systems provide a convenient way to improve performance: You can insert an OverDrive processor from Intel into your computer. The OverDrive processor does the same job as the 486DX2 proces-

sor: It doubles the clock speed of the CPU for many operations. When you install it you'll see a 50 to 70 percent performance improvement. An OverDrive processor costs several hundred dollars, and you may never need it. But it's nice to know you can buy a less-powerful 486 system and upgrade it if you need to. It's a good idea to ask your salesperson about the upgradability of any system you're considering.

RAM and cache memory

As we mentioned earlier, the operating memory in your computer system is called RAM. Your software uses this memory to process tasks when you're working on the computer. The amount of RAM greatly affects a PC's performance. RAM is measured in megabytes (MB): 8 bits (the amount of data in one letter) equals one byte, and 1 million bytes equals 1MB. In the DOS and Windows environments, up to a threshold of about 8MB you'll find that more RAM means better performance.

If you plan to use Windows, you'll want at least 4MB of RAM, and 8MB is even better. Most systems come standard with 4MB of RAM, but an additional 4MB cost less than $200. If you can afford it, go with more memory. In some applications you'll appreciate the speed difference.

Another type of memory that is usually either standard or optional on PCs is cache memory. Cache memory stashes your most frequently used data in a special section of high-speed memory (the cache) instead of on the hard disk. (Your operating system automatically figures out what data you use most often.) Since the CPU can retrieve data from the cache memory much more quickly than from the hard disk, you can do some tasks much faster with cache memory, particularly large database and graphics operations. When you shut off your PC, the contents of the cache are automatically saved.

Most 486 systems come with 8 kilobytes (K) of cache memory and include the option to add an additional 64K. If you expect to work with large databases or complex graphics, check with your sales representative to see whether the system you want to purchase has built-in cache memory and the option to expand it.

Your PC's hard disk

Virtually all modern PCs come with an internal hard disk (also called a hard drive). You usually do your work and store it on the hard disk, which, as we've said, is your computer's permanent (or long-term) memory. Your hard disk is also where you store your applications, and you will need one in your system in order to run Windows.

As with memory and speed, the more hard disk capacity you can afford, the better. The minimum size we recommend for a desktop system is 120MB. If you plan to use the system as the center of a network (or if you work extensively with graphics or desktop publishing), you'll need a larger hard disk, such as 240MB. However, even if you don't have those kinds of requirements yet, it never hurts to have the additional capacity. The cost difference between 120MB and 240MB is only a couple of hundred dollars.

Bits, bytes, and megabytes

8 bits = 1 byte

1 million bytes = 1 megabyte (MB)

one letter (character) = 8 bits = 1 byte

one double-spaced page of text (250 words)
≅ 1500 characters ≅ 1500 bytes

1MB ≅ 650 double-spaced typed pages

Outside the computer unit

Outside the main computer unit, hooked to it by cables, are a video display monitor that lets you see what you're doing, a typing keyboard, and a mouse, which controls the pointer on your computer screen. The configuration of these basic components can vary from one machine to another, but they exist in most computers. (For example, a notebook PC contains the monitor, the keyboard, and the computer all in one unit.) In this guide, we're going to limit our discussion to the components and technology that go into current desktop PCs.

Video monitors

The great majority of Windows users opt for color monitors. Color gives you more options than a monochrome monitor, and for most people color is easier to work with. Some users who mostly write text on their PCs prefer monochrome (gray-scale) monitors, because they tend to produce less glare. But today's color monitors are so sophisticated that they produce very readable text, as well as brilliant graphics. In addition, you always have the option of telling your color monitor to show text in shades of gray only.

The crispness of your monitor's images depends on how much resolution you have. Video resolution is measured in pixels, which are groups of light-emitting dots on the screen that can be turned on and off. The patterns formed by these dots create the image you see on the screen (somewhat like the graininess of black-and-white photographs). The more pixels the screen can display (the finer the grain), the higher the resolution. More pixels means better control of light and contrast.

The video graphics standard on PCs is called Video Graphics Array (VGA). Standard VGA graphics systems have a resolution of 640 by 480 pixels. This resolution is adequate for working intermittently on the computer or for doing short tasks such as updating a spreadsheet or creating a graph. But if you plan to work on-screen in long stints, VGA resolution will be hard on your eyes.

Super VGA (SVGA) has a resolution of 800 by 600 pixels—much sharper than VGA. Extra-sharp resolution is available in high-resolution 1024-by-768-pixel video monitors, which can be used by many of today's PCs.

Your choice between VGA, SVGA, and "high-res" comes down to cost. A high-res monitor costs a couple of hundred dollars more than an SVGA monitor. Remember that a high-end monitor will not only be easier on your eyes but also more fun to use. That means you'll look forward to working—

and playing—on your great video monitor.

The number of colors you can display simultaneously on your monitor depends on the amount of video memory that is available in your system. More video memory is required to display a larger number of colors. For example, you can see 16 colors simultaneously if your system has 512K of video memory, or 256 colors with 1MB of video memory. For basic business applications, 16 colors is adequate. But if you plan to do a lot of work with graphics, you'll probably want 256 colors. (You can even go up to 32,000 colors with a high-res monitor equipped with 2MB of video memory.) Note too that you can add additional video memory to most desktop PCs if you want to increase color capacity later. You can also upgrade your monitor's resolution by adding a video adapter board, as long as your PC has an available expansion slot.

Other features to look for in desktop monitors are small dot pitch, a noninterlaced monitor, and a high refresh rate. Dot pitch is the distance between neighboring dots of the same color. The smaller the dot pitch, the sharper the image. A dot pitch of .28mm or less will produce clear images. A noninterlaced monitor uses a scanning technique that minimizes flickering, which is hard on the eyes. Your eyes will also appreciate a monitor with a fast refresh rate, which enhances the crispness of video display. We recommend monitors with a refresh rate of at least 70 Hertz (70 screens per second). To sum up, you'll get the best image from a noninterlaced monitor with a dot pitch of at least .28mm and a refresh rate of 70Hz or higher.

As for monitor size, bigger is better. Desktop monitors are generally 14 to 17 inches across, measured diagonally, while laptop screens range from 6 to 11 inches.

Note that laptop and notebook computers have liquid crystal display (LCD) screens, which are generally only available in VGA resolution. If you're planning to use your machine 8 hours a day, this is a drawback. But you can plug your laptop or notebook into a larger and higher-resolution stationary monitor when you're back in the office.

Local-bus video

Many PC vendors advertise their units as **local-bus video** systems. This means the PC uses a separate high-speed bus (or pathway) to transmit data from the CPU to the video system, rather than the standard bus used for sending data to hard disks and other components. (Some systems use a high-speed local bus for sending data to networks and to hard disks, but the primary application is for speeding up graphics display.) Most 486 systems now include some sort of local-bus video system, either a proprietary local-bus design or one of the emerging local-bus standards (these include Video Equipment Standards Association (VESA) and Peripheral Component Interconnect (PCI)). It's wise to purchase a PC with local-bus video, because it will greatly enhance the performance of your graphics displays.

Permanent data storage

There are various ways to store data that you create or manipulate on your PC. While computer systems have become increasingly reliable, human error and power failures can still threaten valuable data. Making a second or even a third copy of important files is a

Glossary

local-bus video

Local-bus video PCs use a separate high-speed "bus," or pathway, to transmit data to the monitor, which means graphics functions operate more quickly.

VGA, SVGA, and high-resolution monitors

VGA	SVGA	High-resolution
640 by 480 pixels	800 by 600 pixels	1024 by 768 pixels

Parallel, serial, and SCSI ports

Computers communicate with the outside world by means of ports. A port is an electrical connection that can send signals or data through a cable to another device. Ports are also sometimes called interfaces, because the port creates an interface between the computer and some other device.

PCs have three main types of ports: parallel, serial, and SCSI (pronounced "scuzzy") ports. Special ports also exist for connecting external monitors and keyboards, but these ports aren't used to communicate with devices outside your computer system.

Parallel ports send several streams of data at once. They are used primarily to connect with printers. Recently, high-speed parallel ports have become common: They are used for connecting to printers and for connecting one computer to another for high-speed data transfers.

Serial ports transmit one bit of data at a time. They are found on most kinds of computers and are used mainly to connect a telephone modem to the computer or to connect two PCs together by means of a serial cable. Internal modems also connect to a serial port, but the serial connection is inside the computer.

Many computers have more than one serial port. The first serial port in the system is called "COM1," the second is called "COM2," and so on. (Serial ports are also referred to as "RS-232 ports," because they are based on the RS-232 data transmission protocol.)

SCSI (Small Computer System Interface) ports originally were more common on Macintosh and some UNIX-based computer systems, but they are now becoming increasingly common as an option on PCs. SCSI is the standard interface for CD ROM drives, many laser printers, tape drives, and other peripheral devices. An advantage to SCSI devices is that they can be connected to any computer that has a SCSI port.

If you plan to use a SCSI device, you'll need to purchase a SCSI controller for your PC, which is an adapter card that plugs into an expansion slot.

smart idea. This is especially true for small businesses, whose profitability can depend on preserving electronic customer records. It makes sense to store (or "back up") your data every day, week, or month, depending on how important the data is to you or how often you make changes to it. It's also smart to store one backup copy of your data away from your home office.

Long-term data storage options for your PC include **floppy disks**, **tape drives**, and **CD ROM drives**. Normally, computer users back up data by copying it onto floppy disks. But if you think about trying to save 150MB of data on individual 1.44MB floppy disks, it would take more than 100 disks and a lot of manual swapping to do the job. Of course, the new data that you create from day to day will amount to far less than 150MB, and if you're diligent about backing up your files regularly, you can get by with storing your files on floppy disks. Data compression software is helpful for this task; it allows you to consolidate the amount of space that a document takes up by approximately one-half. Even then, though, you'd still need several dozen floppy disks to store 150MB of data.

Another option for backing up your data is a tape drive unit. A tape drive unit, which can be connected to or installed inside your PC, is similar to a tape recorder. It can store data on tape magnetically. Tape backup units come with software that includes data compression, which allows most units to back up at least 200MB of data on a single tape. Good tape backup units cost around $1000. They offer

an economical and painless way to keep your data backed up in case of a hard disk failure.

A variety of tape drive formats exists; we recommend the Irwin Servo or QIC-80 format. You can buy tape drives from such vendors as Colorado, Iomega, Legacy, Maynard, Tallgrass Technologies, and Tecmar.

Still another form of data storage is a CD ROM drive. CD ROM stands for "compact disk read-only memory." A CD ROM drive reads information encoded on disks just like regular CDs directly into your PC. (In fact, you can use a CD ROM drive to play music on some PC audio systems.) In other words, it's a one-way method of communication: Your computer can read data from CD ROM disks, but it can't add to or edit them.

Although you can't use CD ROM to store your own data, you can accumulate a huge library of information on CD ROM, ranging from complete encyclopedias to travel guides to last year's editions of the *Wall Street Journal*. Software vendors are also starting to distribute software on CD ROM, particularly large programs that would require a lot of floppy disks. Priced at around $500, CD ROM drives are a good investment.

If you want to set up your PC so it can record or play back sounds, such as music or voice (you can even use your PC as an answering machine), add-in sound boards such as Artisoft's Sounding Board are available for around $100. You can also use sound boards to record voice messages on PCs within a network. Note, though, that recorded sound takes up a lot of hard disk space.

Expandability

PCs usually have **expansion slots**, which let you add special-purpose devices inside your computer. These printed circuit boards, called "adapters," "add-in boards," or "add-in cards," are available for a variety of uses, including networks, modems, graphics, and tape drives. Although some adapter cards are self-contained devices (such as internal modems and network adapters), many adapter cards control other devices and are therefore called "controllers." A high-performance graphics controller controls your PC's monitor. A tape drive controller controls the tape drive. A SCSI controller controls SCSI devices such as CD ROM players, hard disks, or laser printers. (For more information, see "Parallel, serial, and SCSI ports" on the previous page.) Devices such as tape drives, hard disks, and CD ROM players may be mounted either internally or externally, but in either case they require an adapter card.

Expansion slots and their adapter cards are accessed through an expansion bus. The standard PC expansion bus is based on Industry Standard Architecture (ISA), which allows up to 16 bits of data to be transmitted simultaneously. A higher-performance 32-bit bus, called the Extended Industry Standard Architecture (EISA), is available on some PCs, and some PCs have both ISA and EISA expansion slots. Most adapter cards use the ISA bus, and unless you have special needs, it will be adequate.

When you are thinking about what PC to buy, consider how many expansion slots you might need. Most desktop PCs come with at least three, which means you could add a network adapter, a SCSI controller, and an internal modem. (Note that most notebook PCs have only one expansion slot, for an internal modem.)

Writing it down

Now that you have read this chapter, you can turn to the shopping list on the inside back cover of this workbook and make some notes regarding what computer hardware you'll need to buy. ●

Glossary

floppy disk

A floppy disk is a removable disk that you insert into your floppy drive. You can transfer files or software applications from floppy disks to your hard disk (hard drive) or vice versa.

tape drive

A tape drive is a device you can connect to your PC either internally or externally for backing up data on magnetic tape.

CD ROM drive

A CD ROM drive allows you to import data from CD ROM disks into your computer. It can be installed inside your PC or attached externally.

expansion slots

Expansion slots allow you to plug adapter cards into your PC for performing such special functions as networking or high-speed graphics.