LESSON 2

Computer Hardware and Software

Now that you know a little bit about the history of computers and how they are useful in various work situations throughout the world, this lesson will tell you what makes up today's personal computer (PC). You learn about basic computer hardware and the importance of keeping your computer and its data safe. Next, you learn all about operating systems—the software that makes it possible for you to use your computer—with a focus on Microsoft Windows XP. Finally, you learn about applications software and how a computer network operates

Computer Parts and Storage Devices

Most computers on the market today have the following components: a processor, RAM, a monitor, a hard disk drive, a keyboard, a mouse, a CD-ROM drive, a sound card, and a modem. In addition, you might want or need components that aren't part of your computer's package, such as a DVD drive, Zip drive, printer, and scanner. The rest of this lesson explains what these components, usually called peripherals, are and how they are used.

A Mouse

Most computers come with a mouse. A *mouse* is just a pointing device for selecting items on the screen. Some designs are different, including the mouse with a small wheel with which you can do some added tricks. An alternative to the mouse is a *track ball*, a stationary cradle containing a ball that you roll with your fingertips. Laptop computers offer another alternative, the *touchpad*—a pressure-sensitive surface built into the keyboard console. It lets you move your cursor by tracing your finger on the touchpad itself.

This mouse is designed to fit the shape of a human hand and contains a wheel for extra functionality.

Keyboards

The computer keyboard is one of the basic ways of entering information into the computer, so most computers have one except certain types of handheld devices. If you've used a typewriter, you can use a computer keyboard. Keyboards come in a variety of styles. The Microsoft keyboard shown below has an ergonomic design that reduces the muscle and tendon strain in the wrists, arms, and elbows.

The optimized keyboard helps reduce the stress on wrists, arms, and elbows.

Monitors

Monitors are a requirement, so they are often included as standard equipment, but not always. Today, monitors are available in all price ranges. Most people think the bigger the monitor, the better, as long as it fits within their allotted budget range. Granted, bigger is more expensive, but today a 17-inch monitor doesn't cost much more than a 15-inch monitor and the difference is more than worth it. The more screen space you have, the easier it is to work with your applications on the computer. Remember, however, that the bigger the display, the larger the tube. A larger tube takes up more room on your desk. (Many manufacturers do offer short-tube monitors that don't eat up a lot of desktop real estate.)

It's not fancy, but this typical computer monitor is all you need.

A good choice when your desk space is at a premium is the flat-panel display, or LCD monitor. An LCD is a tubeless monitor that uses a liquid crystal technology. These monitors require much less desk space, and the absence of a picture tube means lower power consumption and less heat thrown off in your room. The cost is higher than that of a traditional monitor, but the prices are coming down.

Floppy Disk Drive

This comes as standard with most computers. For many years, the floppy disk was *the* way to give someone a document from your machine. You copied the information to the floppy and passed the floppy on. Then came the Internet and networking, which are new and convenient ways to exchange information. Floppy drives are a common way of backing up files.

CD Drive

Almost all computers have CD drives as standard equipment. Most software today is shipped on CDs, as are all the essential learning programs, games, and reference tools such as Microsoft Encarta, an encyclopedia. A CD drive also allows you to use CDs (short for *compact disc*) with your computer. CD drives are rated by the speed at which they can access information on the CD, indicated with a number like 12x, 20x, 32x, or 40x, which is read as "40 speed."

CD drives come in two types: read-only and recordable. With the read only model, you can't save or store any of your own information on a normal CD. Such a CD drive is the computer equivalent of a stereo record that can also hold

text and graphics. Recordable CD drives allow you to copy information to them as you would to floppy disks.

Sound Cards

A sound card is like your stereo amplifier at home, although it does considerably more than that! Unless you open your computer, you won't see your computer's sound card, and if you don't have one, you won't be able to hear any of the sounds a computer is capable of generating. Most computers come equipped with sound cards.

A description of a sound card can be confusing because it has so many incomprehensible-sounding features: MIDI libraries, MIDI interface, sampling capabilities, and audio playback rates. Despite the confusing jargon, you want a sound card that supports the latest standards and features if possible. When a PC is described as a multimedia PC, it will include a sound card. If you're not buying a new computer or are simply upgrading your existing sound card, look for the most common features across the different brands.

Speakers

With a sound card, a CD drive, and speakers, you can play regular audio CDs on your computer and enjoy many of the other audio features of the applications on your computer. But as with your stereo, you can't hear anything unless you have speakers! Most likely, your computer will come with speakers. Speakers come in all price ranges, but even the less expensive ones work well. The speakers plug into the back of your computer, and look similar to the ones shown below.

With these speakers, you can hear music and other special audio, as well as the everyday reminders and warning sounds your computer makes.

Hard Disk Drives—Closet Space for Your Computer Creations

Today, a computer without a hard disk drive is practically unknown. The hard disk drive is a physical part of your computer where you save all your work for access at another time. For new users, the multi-gigabyte drives of today are more than adequate, but some users run out of disk space and need to expand their digital closet space with higher-capacity hard drives. Graphic artists and photographers, for example, can easily use 40 megabytes of disk space just for one image, and some programs require several hundred megabytes of free space to run. If you are going to be working with photos extensively, you might need a larger hard drive, or you might want to check out Zip drives, which are described in a later section.

RAM: Short-Term Memory You Can Buy

All computers come with internal memory, called RAM (pronounced like the animal), which is short for *random access memory*. RAM is sometimes confused with hard disk storage, which is completely different. Your computer needs RAM to run programs. You don't need to know the ins and outs right now, but if you are picking out a new PC, look for one that provides at least 128 megabytes of RAM to work effectively on the Internet. If your computer has less, it won't operate as quickly, but as long as it has enough memory to run current software, your computer will still operate correctly. The minimum for current software is usually 64 megabytes.

Zip Drives

A Zip drive is the newer version of a floppy disk drive. Zip drives, sometimes built into new computers, use a Zip disk that is about twice as thick as a floppy disk and holds 100 megabytes of information (250 megabytes for the newest model)—about 80 times more than a standard floppy disk. A Zip drive is something to consider if you will be working with many photographs that take up a lot of disk space for each image. These drives also provide a convenient way to make backup copies of all the important files you want to keep.

Modems

Modems are now as ubiquitous as computers, and more often than not, they come built into computers. You must have a modem to connect to the Internet, so make sure that your computer has one. If you use telephone lines for Internet access, the typical speed for a home modem is 56 K. If your computer doesn't have one already installed internally, you can obtain an external modem, which sits near your computer rather than inside it. External modems are widely available and require minimum installation.

If you use cable or a dedicated line for Internet access, you will need a specialized modem. These are much faster than the modems designed to work with the telephone lines, but they are more expensive.

Printers

Hundreds of different printers are on the market, in a wide range of prices. Printer technology has advanced dramatically in the last 10 years, so even a less expensive printer can produce impressive results. Some new computer packages include a printer. Printers are easy to buy and easy to install if the computer you obtain doesn't have one.

Printers are distinguished by printing features, output quality, and speed—that is, how many pages they can print in a minute. The most popular printers for home use are ink jet printers. Ink jets print pages by spraying a fine ink mist onto the page and are the type of printers most often used for color printing. Laser printers, although more expensive, are faster and of higher quality, and most models allow only black-and-white printing. Color laser printers can be quite expensive. You can also find multipurpose machines that print, fax, copy, and scan. If you have a need for all these features, check with a local computer store or current magazines to learn more about features and trade-offs.

Laser Printers

Laser printers, long the standard for professional and corporate users, are fast and efficient, and typically are much faster than ink jet printers. Some laser printers can print 32 ppm (pages per minute), which is blazingly fast. They also offer multiple trays for different paper sizes and a host of other features. If you have a small business that requires a good deal of printing or invoicing, or if you expect to use your printer for a community publishing system for a club or group, this type of printer will give you very fast results. However, unless you buy an expensive color laser, you are signing up for black-and-white printing only.

Ink Jet Printers

Ink jet printers are the home standard. They provide color capabilities as well as crisp black and white, but their speed doesn't match that of laser printers. The cheaper models can take more than a minute to print a full page of text. But for most people, the benefits outweigh the inconvenience.

Joysticks for the Future Racecar Driver or Pilot

Computers have become phenomenal game stations, and certain hardware additions can make your playtime wildly enjoyable. You can find several different types of game controllers, including joysticks. As with all computer peripherals, prices vary widely, but a standard joystick is relatively inexpensive. Simple joysticks consist of a single post fixed at the base like a stick shift that can move in all directions. You have probably seen one on a motorized wheelchair to allow the driver to steer with minimal movement. If you are planning to "learn to fly" with Microsoft Flight Simulator, a joystick is required.

This joystick gives you control when you play video games.

Besides joysticks, you can even find steering wheels with dashboard consoles if you want to try your hand at a racecar game. The newest controllers include vibration; when something happens on-screen, the controller vibrates and you feel the jolts and motions of the game you are playing.

Now Playing: A Movie on Your DVD Drive

Never mind the technical details: a DVD drive lets you watch full-length movies on your computer, and you don't even have to rewind! If you are interested and if your computer is set up in a room to allow easy viewing, you can rent videos, not on videotape, but on the newest form of CD drives, the DVD. The DVD is the most recent generation of CD drives; a DVD disk can hold about six times as much information as a regular CD.

CD and DVD Burner

DVD drives still accept standard CD-ROM disks and audio CDs, so you don't need a CD drive if you get a DVD drive.

If you want to write your own CDs but your CD drive doesn't have writing capabilities, you might consider buying a specialized drive for this purpose. This kind of drive is called a *CD burner*. CD burners are quite inexpensive and easy to install. The more expensive *DVD burners* use the newer DVD format, which allows you to store more information on your disks.

Scanners for Transferring Photos onto Your Computer

A scanner is used to copy an image or page for storage and display on the computer. Scanners typically look like little copying machines, with a glass

plate (the plate you put the copy on) and a heavy rubberized mat that lies on top of that.

Use a scanner such as this one to move print pictures onto your computer.

Scanners are great if you have many pictures that you want to preserve or share with others. Scanners are also great if you have a lot of typed text that you want to store on the computer. Scanners now come with OCR (optical character recognition) software that actually reads the text on the page and turns it into a text file. This doesn't work very well with handwritten text, however, so if your intention is to use a scanner to translate your brother's badly written letters into something legible, don't count on it.

Special Needs

What happens when someone can't use a standard keyboard or mouse? Or what if someone can't read the screen well or hear the computer's audio cues? Smaller companies have created a whole class of hardware for special needs. If you're visually or hearing impaired, or suffer from arthritis or partial paralysis, some useful and well-conceived alternatives are available for you. Some special needs options are built into Windows, and there is a universe of hardware and software options available as well.

The range of options is almost as diverse as the range of special needs. To find the best software and hardware solution, ask your specialist or local gerontologist for more information. When you get on the Web, you'll find a huge number of resources to choose from as well.

Note

Windows XP comes with Accessibility Options, which address many special computing needs. Visit *http://www.microsoft.com/enable/products/* for details on how to access these features and for more information on other accessibility products.

Other Attachments

Besides all the things commonly attached to a computer, an impressive array of other attachments exists. Here are some of the things that might catch your eye. If it's an electrical appliance, there's a good chance that one model or another can connect to your computer. Here is a partial list:

- Some types of musical keyboards referred to as MIDI keyboards or MIDI compatible keyboards can be connected to your computer so that you can record a performance, edit it, and play it back.

- Robotics toys allow you to build a robot, program it on your PC, and then let it roam around your home executing your instructions.

- Digital video cameras can be attached to your computer, and you can transfer images to or from your computer.

- Digital cameras, which are cameras that take instant, filmless pictures, allow you to snap away and then transfer the pictures directly to your PC.

- Sewing machines connect to a personal computer and do extraordinary multicolored stitch work based on the orders you give it.

Protecting Your Computer

Bad things occasionally happen, and they could happen to your computer. Someone might want to gain access to the data you don't want them to see, or you might encounter a computer virus. Your computer's hard disk might wear out or get damaged. Or a fire might destroy your computer. These are all unpleasant problems to deal with, and they can be serious. Fortunately, you don't have to wait until something bad happens before you act. In fact, if you act beforehand, you can greatly reduce the security risks facing your computer and your network.

To protect your data and to prevent disasters, you will need to take some simple steps. In this section, we will look at the security issues you might encounter and the steps you can take to protect yourself.

What You Need to Protect and Why

No device is problem free. Your computer consists of many parts, and parts wear out. Or there might be a disaster, such as a fire or an earthquake. If this happens, your computer could get damaged beyond repair, resulting in the loss of a considerable amount of your data. This data might be personal, such as pictures from your last family reunion, or it might be work data, such as a presentation you were planning to make at a conference next month. In both cases, the loss would be significant.

In addition to risks from natural disasters, computers are at risk from malicious users, also known as hackers, and intruders. Hackers are the computer users interested in taking control of your computer without your consent. They create

small programs, called viruses and worms that can do a lot of damage to an unprotected computer. Your hardware won't be affected, but these programs can erase a lot of your data, clog your network, or cause other problems. In addition, you can inadvertently infect other computers on your network or the computers of your friends and coworkers. Intruders are interested in accessing your system and stealing data. Problems with hackers and intruders are possible if you are online or if someone gains physical access to your computer.

Computer Security Dos and Don'ts

As you can see, some risks are involved when you work on the computer. Fortunately taking some simple precautions can minimize both these types of risks.

Restricting Access to Your Computer

If you store sensitive data on your computer, you don't want just anyone to be able to access or modify the data. The easiest way to gain access to a computer is to be physically present in the same location. Obviously, if your computer is at home, only you and your family might have access to it. If, however, your computer is at work, coworkers and others have an opportunity to access your computer. Some of these people might be simply curious. Others might have more sinister motives. If you want to restrict access to the computer, you will need to create physical barriers. A simple and very effective way is to simply lock your office door!

Locking your office door prevents local access, but if your computer is online, others can still access it remotely by using the network. The simplest way to prevent unauthorized remote access is to use a password for your account. Microsoft Windows XP supports multiple users, each having a separate account with a password known only to the account owner. In this way, the users can't access one another's data unless they specifically share the data.

The best passwords are difficult to guess. So don't use your name, the name of a family member, or your birthday as a password. Ideally, a password will contain a mix of letters, numbers, and punctuation marks and will be at least eight characters long.

Don't write your password on a piece of paper and put it conveniently under the keyboard or the mouse pad. That's where thieves will look first!

Locking the Computer

If you want to get away from your computer for a while and you don't want others to have access to it, but you don't want to shut down either, you can lock your computer. To do this using Windows XP, press the Windows key (that's the key between the Ctrl key and the Alt key) and the L key simultaneously. (If you're using Microsoft Windows 2000 or your keyboard doesn't have a Windows key, you can simultaneously press Ctrl+Alt+Delete and then press the K key.) This action will lock the computer, and nobody will be able to unlock it without your password.

When you come back, you will need to unlock the computer before you can begin working again. To do so, press Ctrl+Alt+Delete. A dialog box will ask you to supply the password. Type the password, press Enter, and the computer unlocks, picking up where you left off.

Running Antivirus Software

Computer viruses sound dangerous, and they can be for an unprotected computer. They can be an annoyance, or they can do major damage, rendering your computer unusable. In the extreme cases, the best course of action might be to reinstall all of the software on your computer. But if you do that, you will lose all of your files and data. You will also lose all of the software updates you might have installed.

To avoid this unpleasant situation, you should always run antivirus software. Several good antivirus programs are available, including products from McAfee and Symantec. Simply install an antivirus program on your computer and set it up so that it scans all the incoming files. The details of the installation differ depending on which software product you choose, but all of the products are easy to install and run.

Once installed, the software will scan the files for all known viruses. Because new viruses emerge from time to time, be sure to update your antivirus software regularly.

Opening E-Mail Attachments

One common way computer viruses propagate is by e-mail attachments. A malicious attachment can masquerade as a legitimate one. So how do you know when it is OK to open an attachment and when it is not? Here are some rules of thumb:

- If the e-mail is from someone you don't know, be especially careful. The safest way to deal with an attachment from someone you don't know is to delete it. But if you are fairly sure the attachment is legitimate, save it to a disk and verify its extension. If the attachment's extension is .exe, .vbs, .js, or any other executable, opening the attachment will cause the program contained in the file to execute. If you don't know what the program does, don't open it. Scan the attachment with antivirus software to confirm that it is safe.

- If the e-mail is from someone you know, that information unfortunately doesn't necessarily mean the e-mail is safe to open. It is possible that the sender opened an unsafe attachment, and the virus contained in the attachment, not the person, sent the message. If you didn't expect a message with an attachment, simply ask the sender whether they e-mailed the attachment to you and whether it is safe to open.

You can search for and download antivirus software from the Internet.

■   If a message urges you to forward it to everyone you know, you can be certain it's not legitimate. Do not forward such messages. They are junk messages at best, or malicious at worst.

Downloading Files from the Internet

The Internet is full of interesting files: pictures, games, puzzles, clever jokes, and the like. It is very tempting to surf the Web in search of all the cool applications you might want to install on your computer. But unfortunately, not all of the available downloads are what they seem. Some might contain a virus, a worm, or other malicious code.

Be careful of downloading files from unknown sources, particularly if you are not the one who initiated the download. Sometimes a malicious application can masquerade as a helpful one, politely asking you to download it. You need to be particularly careful with pop-up windows that appear as you surf the Web; some of these windows start downloading an application to your computer the moment you click OK. If you didn't start the interaction, don't ever download such an application.

If you have found an interesting application and choose to download it, save it to a file on your hard disk drive first. Then, before you install it, scan it with the antivirus software. It will take only a minute or two and could save you a lot of headaches. If the scan comes out fine, go ahead and install the application.

Using Macros

As you work with applications such as Microsoft Word and Microsoft Excel, you will no doubt discover that macros are a very powerful way to complete tasks. Unfortunately, this power can work against you. If you receive a document that contains macros, and you don't know the source of the document, the macros contained in it might perform undesirable actions on your computer. For this reason, it is best to disable macros by default and enable them only if you are sure they are not malicious.

Creating Backups

When you create sensitive or very important data, you want to make sure that the data will still exist even if your computer hard disk gets corrupted, a power outage causes a part of the file to be destroyed, a virus makes the file unusable, or some other calamity strikes.

To guard important data against such occurrences, you need to back it up. Simply create a copy of a file and keep it somewhere safe. For example, if you use an Excel worksheet to store your data on a computer at work, you can make a copy of this worksheet, put it on a floppy disk, and take it home with you. Large files or files that don't change very often can be backed up on a CD.

Don't forget to back up your files periodically, or your backup will become hopelessly out-of-date. The frequency of your backups depends on how often the files change. For example, you probably need only one backup of pictures from your vacation, so once you have backup of your pictures, you don't need

to back them up again. But if you store the results of weekly reports on an Excel spreadsheet, you will need to back up the spreadsheet every couple of weeks, or possibly even weekly.

Operating Systems Defined

An operating system (OS) really makes all of those things we do with the personal computer (PC) possible and practical. In a very real way, you could say that the OS is the PC. Although an OS isn't hardware, it's a piece of software that works with hardware on such an intimate level that it is the two together—PC hardware and the OS—that really give us what we call the PC. In fact, this is exactly what we do when we say, "Microsoft Word runs on Microsoft Windows XP." It's understood by everyone sharing the conversation that the hardware is present. But because different OS's are available for PC hardware, it's more accurate to think of the OS as one of the PC's vital parts.

This section describes the operating system in detail and explains the complex relationship between a computer and an operating system.

The PC and the OS: A Team Effort

For software to be written so that the first personal computers (PCs) and their successors could flourish, these computers had to perform in certain predictable ways, responding to certain predefined commands. Therefore, many key characteristics of the first PCs were adopted as *standards*. Standard ways of sending information to the video monitor meant that whatever task you were performing and whatever software you were using, you'd actually be able to see the results. Likewise, standard ways of sending characters to a printer meant that you could print anything your PC could produce.

It's one of those historical ironies that this type of standardization—everybody doing things exactly the same way—was what made the first PC family of computers (made by IBM) successful as personal computers. By agreeing to restrict the "do your own thing" nature of the PC in some very low-level, fundamental ways, early software and hardware manufacturers could successfully market and sell add-ons to make the PC do just about anything.

If you'd like an analogy, think of television. As long as everyone agrees on how the television works as a whole, you and I can watch whichever channel we like. It makes no difference whether two people in two different houses are watching two different shows on different channels. The television works because signals are sent out in certain ways, received by every television in certain ways, and treated in certain standard ways inside the box. So television is more personal because its underpinnings are standardized.

Of course, the spirit of competition means that everybody doesn't just agree on how things should work. People try alternatives, and sometimes better ways of doing things get devised. The new ways become standards in their turn and are replaced by still newer standards, and so on. Competing or different standards often coexist too. The choices you make may be greatly shaped by which basic set of assumptions—which standard—most closely fits your needs. This is how

we end up with so many different ways to display realistic 3D images on a monitor and why two very different families of computer—the PC family and the Apple Macintosh family—can both be successful.

It's important to understand this: for technology, agreements among huge numbers of people about how certain things will happen can allow each of those individual people to ultimately have more choices and get down to business in his or her own way.

Operating System Basics

In brief, an *operating system* is an intermediary between computer hardware and the software applications that let you actually get your work done. Although you may not be used to thinking of it this way, the operating system is actually software, but it's software that bridges the gap between hardware and all the other software—your programs and your data—on the PC. Just as there are standards for how PC hardware works, an operating system establishes some standard ways of interacting with that hardware. Software doesn't have to understand all the hardware in the world. It just needs to understand the operating system it requires.

Let me give you an example. Microsoft Word 2002 runs under Windows XP. On the simplest level, that means that Word can run on any PC that is using Windows XP as its operating system. That PC can be made by any manufacturer. Word will still work just fine. How?

Because the different manufacturers of PCs follow the variety of hardware standards you read about a moment ago, and Windows XP can reliably communicate with all that different hardware.

Microsoft Word doesn't have to know the difference between a hard disk, a floppy disk, or a recordable DVD. It just has to know that the operating system expects certain commands that mean, "Here is some data; store it on the device I've selected."

The people who wrote Microsoft Word didn't need to know about the brands and models of hardware that might run their software. In fact, we don't usually even talk about specific hardware "running" software. Instead, we say that Microsoft Word runs under Windows XP.

Creating a Collaborative Relationship

The collaboration between the PC's hardware and its operating system really got the computing revolution rolling. The operating system eliminated the impossible burden of understanding and accounting for every possible PC component and program that someone might produce. Manufacturers could be sure of success by making hardware that was flexible and compatible with the operating system. Programmers could be sure of success by writing software that would work properly because it talked only to the operating system (which took care of all of the software's hardware needs, such as saving files and printing). Success wants more success, so products available for the PC diversified and created entirely new markets.

As success spread rapidly and the PC evolved, the number of standards surrounding it went into the hundreds (although you can still count the hugely important ones on two hands). The collaboration between the hardware and the operating system became increasingly important. New hardware, undreamed of even by the early visionaries, came into being to let us do things that nobody thought anybody could ever do with a PC. Here's just a brief list of some of the common tasks we use PCs for today that were considered science fiction just a decade or two ago:

- Take and work with digital photographs that rival film for quality.

- Process thousands of transactions from all over via a single telephone line.

- Allow coworkers worldwide to simultaneously work on the same project while discussing it in real time.

- Edit digital video at broadcast quality.

- Store a high-quality movie on a 5-inch plastic disc.

- Teach fully interactive, live university classes with the professor in his or her office and the students all over the country.

- Compose, perform, produce, record, and distribute your own symphony without leaving your desk.

As new products and capabilities emerged, it fell on the operating system to keep everything working together happily. If you suspect that that burden has changed operating systems a lot, you're absolutely right. The PC's operating systems have evolved so much, it can be hard to recognize that they're the offspring of MS-DOS, Microsoft's first operating system, which looks nothing like Windows XP today. Some people might even say that the operating system has changed more than the base PC hardware. One type of new hardware may have nothing to do with another, but it all has to work in concert with the basic components inside the PC. Imagine trying to control your digital camera's options if your PC had to pretend it was a floppy disk drive or a printer! And imagine if the only way to get information from one document into another was to type it by hand. The operating system had to grow to solve these problems.

What the Operating System Does

Put all of the necessary hardware pieces of a PC together in a case. Assemble them perfectly and arrange them with the greatest of care. Check and double-check every connection. Buy each piece from the most reliable, reputable manufacturer you can find. Spend as much money as you like. Then turn it on, and what happens?

<BEEP!>

And that's all you get. Just a beep and a few bits of text on the screen that say—rather sardonically, you might think—"OK, you put me together right. Bully for you." Then nothing. What did you forget? Why isn't the computer doing anything?

What's missing is *everything*. The reason the computer isn't doing anything is that a computer can't do anything but check that its key parts are connected properly and apparently are in working order. That's all any PC does without the help of an operating system (OS). Your PC's processor is technically the hardware's brains, but it doesn't do much thinking without an OS. So what is an OS, what does it do, and why is it so important?

Imagine for a moment that you're hired to work in a big theater. There's a huge production going on, with great costumes, incredible music, a stellar cast. Sounds great, huh? It is, except that you are the only crew member in the entire building. And not just tonight; every performance.

You control the curtain, run the sound board, lights, move sets on and off stage, and assist with all costume changes. You operate the riggings, tune every instrument in the orchestra—and conduct as well; you sit in the prompter's box in case someone forgets a line, and you're the carpenter and welder who build all the sets. You're the lighting designer, the scenic artist, the usher; you even take tickets and do security. You're the director, you had to write most of the script, and you even have to entertain patrons during the intermission.

Congratulations! You're an operating system.

Every job mentioned—which, you'll notice, includes just about everyone except the actors—is a delightfully close analogy for one of the tasks that your PC's operating system performs. To explain, let's divide some of those theater jobs into two categories: "For the Production" and "For the Audience."

For the Production	For the Audience
Carpenter	Ticket taker
Sound engineer	Concierge
Electrician	Lounge singer
Set designer	Usher
Script writer and director	Sound board operator
Security	Security

Of course, everything that happens in a theater is ultimately for the audience, but in a more direct way, people such as the electrician and the set designers do their jobs to make the performance possible, whereas people such as the sound board operator and the concierge make the performance enjoyable. Of course, good security is important to everyone. The production depends on it to provide safety for famous actors and to make sure nobody gets in without paying. The audience depends on it to provide safety for themselves and to make sure nobody misbehaves and ruins the show. What you are for my theater of the mind, an operating system is for your PC.

Like your theater jobs, the operating system's jobs fit into one of two groups. We'll call all the "For the Production" duties *system tasks*, and we'll put all the "For the Audience" duties in a special category called the *user interface*. Every operating system performs these two types of tasks, either seeing to the needs of the PC itself or seeing to the needs of the person operating the PC. As in theater, everything in the PC's world happens for the user's benefit, but a huge

part of an operating system's time is spent minding those system tasks that make the "production" possible.

System Tasks

If you're putting on a show and you're responsible for everything except the acting, you're going to be busy long before opening night. The PC's operating system is also busy right from the start. Seconds after you apply power to your PC, the OS is working. During those seconds, your PC hardware is running a small set of self-tests to make sure it can find everything a PC needs, such as memory, its video system, storage devices, and a keyboard.

Note

Remember that PCs were originally a text-oriented system in which you typed commands to make everything happen rather than pointing and clicking. Historically, because a mouse was optional, searching for a mouse isn't part of most PCs' *power-on self tests*, known collectively as the *POST*.

This process of starting itself up and making sure it's ready to work is traditionally called *booting*, now often just called *starting up*.

As soon as your PC detects its storage devices, it knows how to do only one thing. It can move the device's read/write heads to a predefined location and read what's stored there. This predefined location is called the *boot sector*, and what's stored there is a tiny bit of code called the *bootstrap loader*.

The bootstrap loader is the first part of your PC's operating system. It's not built into the hard disk itself but is written there like any other data when the operating system is installed and the hard disk is set up for that particular operating system to use (a process called *formatting*). The bootstrap loader code is read from disk and loaded into memory, and its instructions are performed by your PC's central processing unit (CPU). Those instructions simply tell your hard drive's read/write heads where to find the next piece of the operating system. That piece knows how to load the next pieces until finally, all of the underlying parts of the operating system are read from disk into memory and are running.

Those underlying system tasks never stop running until you turn your PC off again. What is the OS doing? Among many other things, it's detecting and configuring every bit of hardware that's part of your PC, from your memory to your sound card to your USB ports. The entire time your PC is on, the OS manages all of that hardware, making sure that each piece operates in concert with every other piece, with no conflicts.

The OS is also always monitoring your storage devices, making sure that whenever data needs to be read or written, the job is done properly. The OS is also always managing any networking capabilities your PC has, checking for connections, and establishing which networking protocols will be used to

actually do the job of networking. After all of these underlying jobs are up and running successfully, the OS begins to load and run the user interface.
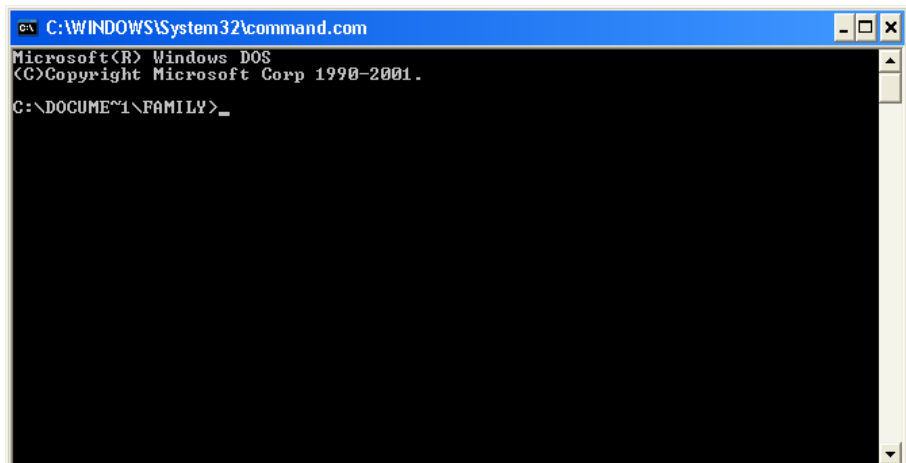
User Interface

Probably the most significant change in the world of operating systems (at least from the user's perspective) came in 1984, when Apple Computer released the Apple Macintosh computer. The Macintosh was the first commercially released computer that allowed people to interact with it graphically, using the mouse and the icons we're so familiar with now. The part of the operating system that allows us to do that goes by the rather grand name *graphical user interface*, but everybody just calls it the GUI (pronounced "gooey").

It's now dramatically easier to work with a PC, thanks to GUIs such as Microsoft Windows XP. Once you learn how the GUI operates, you'll discover that every well-behaved program or tool that works with the GUI works in much the same way. So the GUI really reduces the PC learning curve. And some tasks, such as photograph editing, aren't even practical without a GUI. Because everything is easier to do, we do more than ever before on PCs. Doing more, we are doing more *different* things. So the GUI operating system is a significant part of what makes a PC a personal computer.

You see the results of the OS performing all of its system tasks, but you don't see those tasks directly. Everything you do see on your PC—except for the specific operation of each application and program—is the second half of the OS, the user interface.

A user interface can be simple, like the command-driven text-only world of MS-DOS. This world is all but gone, but its likeness remains in the Windows XP Command window. This command-based environment was intimidating for new users, and it made writing applications hard too.


```
C:\WINDOWS\System32\command.com
Microsoft(R) Windows DOS
(C)Copyright Microsoft Corp 1990-2001.

C:\DOCUME~1\FAMILY>_
```

The Windows XP Command window provides a text-only environment like that of the original MS-DOS.

Fortunately, the PC world changed when its primary user interface went from being command-driven to being graphical. The GUI allows users to select

objects using some type of pointing device and then manipulate those objects by clicking the pointer on them, or something similar. Windows XP is the latest OS generation that provides this interface for PCs. The Windows user interface might be the only one you've ever seen or used.
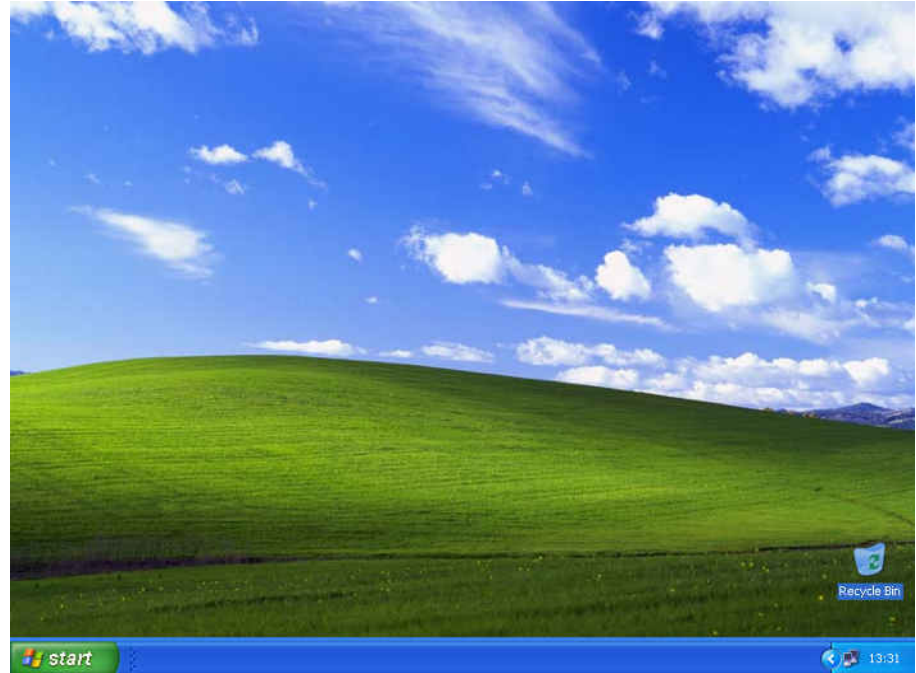
This is the desktop, the fundamental working environment provided by the graphical user interface of Windows XP.

Windows has changed a lot over the years, but its GUI still performs the same sorts of "For the Audience" tasks that it did originally. The GUI provides the windowing and menu-based environment to which we're all accustomed. It displays the mouse pointer (in conjunction with several system tasks that actually make the mouse operate), and it's responsible for the visual appearance of everything we see when we use Windows.

One of the most obvious and dramatic benefits of any GUI—and of Windows XP in particular—is that it makes sure all our applications look right. Whereas the Windows XP system tasks make sure that all our peripherals and hardware function properly, the GUI makes sure the applications look right and that they look *similar*. You don't need to know much about a GUI to work with it, and after you learn how one program operates, you'll find that you can work (at least fundamentally) with any well-behaved application.

All of the menus, windows, and icons that the Windows XP GUI provides are the sets for your PC's theater. The standardized look and feel is the product of the Windows operating system's careful set design, art direction, and costuming. Their regular appearance and operation are the products of the operating system's script writing and direction. In case you're wondering how the lounge singer fits into the picture, consider that everything the Windows Media Player does, along with your screen savers and other little digital

distractions, are the entertainment that keeps you happy during intermission while the real actors (your productive applications) aren't busy.

Windows XP Manages Devices

Many of the system tasks that the Windows XP operating system performs are far more technical and minute than we need to consider. Suffice it to say that if you think it would be a lot of work to be the only person working in a theater, that's nothing compared with what Windows does behind the scenes. Windows system tasks that are closest and dearest to us users are the many jobs it does to keep all of our hardware working properly. Let's talk about a couple of the major points regarding how hardware works.

To work with Windows, each device needs to know something about Windows, and Windows needs to know something about each device. The devices need to know which hardware resources they're allowed to use, and Windows manages all of these very strictly. The devices need to get Windows' attention whenever they've got something to accomplish, and they need to know how to do that, how Windows will respond, and how to proceed. Windows, in turn, needs to know all the same things in reverse, as well as being able to detect each device's operating characteristics.

This last capability is provided not by Windows per se, but *to* Windows by a system called Plug and Play. Plug and Play is partly built into each modern peripheral's own circuitry, is partly built into each PC's motherboard, and is partly built into Windows. Whereas Plug and Play tells Windows which hardware resources a device wants to use—and what it can use if those aren't available—the actual bridge between each device and the user interface is managed by the Windows system task side. Windows uses *drivers* to understand each peripheral's needs.

The Plug and Play system doesn't provide these drivers in the hardware because that would be too hard to change if changes needed to be made or if performance could be improved by making the device work differently than was originally conceived. Instead, Plug and Play simply identifies each device to Windows, and Windows loads the necessary device drivers into memory.

Manufacturers also provide drivers on CD in the box with their products and make latest versions available for download over the Internet.

Device drivers come in two flavors: those built into Windows and those provided by each peripheral manufacturer. If a peripheral has been designed to work exactly in accordance with certain standards that Microsoft has developed for that type of peripheral, Windows uses one of its own *standard* drivers. If the manufacturer has provided a driver to Microsoft, that driver can be distributed on the Windows XP CD, and Windows will use it.

Windows manages the loading and operation of all the hardware drivers your system requires, and the drivers act as a bridge, or *translator*. Drivers know how their own hardware works, and they know how Windows works. If a manufacturer writes its driver code in accordance with the Windows Driver Model (WDM), perfect functioning is all but guaranteed. The Windows Driver Model sets forth standard ways of getting Windows to perform key peripheral tasks. The driver sends an instruction of this type to Windows, Windows

responds, and the driver then knows how to convert the Windows response to whatever the peripheral needs.

Windows XP adheres to the WDM, which means that products that use a WDM driver were, in a sense, created for Windows XP. When you see the Microsoft logo on a product indicating that it is certified for Windows XP, that's part of what that means. It also means that the manufacturer has sent its drivers to Microsoft for rigorous testing and has passed Microsoft's standard tests of reliability. When a driver meets this standard, Microsoft signs it with a bit of code that identifies it uniquely. These *signed drivers* help Windows XP know that it is running the best possible version of a peripheral's driver and that once the right driver is selected, it isn't accidentally replaced by a less-acceptable version.

What Are Hardware Resources?

Every piece of hardware requires *resources* to work with Windows, but what are they? In a broad sense, *hardware resources* are your PC's memory, your PC's processor, and the paths your hardware uses to work with that memory and processor. Every device, even your mouse, needs at least some memory to function. (That's what keeps the mouse pointer in one place; its position is stored in a tiny amount of memory set aside for that purpose.)

If some big application or some other device used the same bit of memory as the mouse, your mouse pointer would be all over the place. Similarly, if your word processor loaded into the same bits and bytes of memory that your video card was trying to use, your video display would be a mess, full of random spots of light meaning nothing (because the code that makes your word processor work doesn't follow the rules your video card requires to put an image on the screen).

All About Applications

Up to now, you've been finding out about your computer: how to use it and what to do with it. But computers are not *just* about operating systems, or even files or folders or disks. They're about applications—the programs that actually make computers do the things you want them to do. Applications are what you turn to when you want to use your computer to write, draw, play chess, learn a different language, design a garden, remodel your kitchen, or brush up on anything from calculus to chemistry.

Despite all the work that applications can help you do, a lesson about applications can't do a lot in the hands-on area, for the simple reason that in order to help you learn how to write or draw or design a landscape or solve an equation, the book would have to assume that an appropriate application was either on your computer or ready for you to install. And unfortunately, a book can't make that assumption or provide you with the necessary applications.

What this section *can* do is take you on a tour of some popular types of application software. It can show you what they look like, roughly how you use

them, and, more important, explain why or when you might want to put them to work.

Basic Types of Desktop Applications

To start off, take a look at five applications: word processors, spreadsheets, presentations, databases, and e-mail and calendar management. All five applications are widely used both at home and in business.

Microsoft Office XP is actually a *suite* of applications, meaning that it is a collection of these complementary programs that work together to help you accomplish what you need to do. These are the core programs that make up Office XP:

■ Microsoft Word 2002, a word processing program you can use to write letters, create reports, publish newsletters, and more.

■ Microsoft Excel 2002, a spreadsheet program capable of simple to complex financial operations, sorting and analyzing data, and charting and reporting.

■ Microsoft PowerPoint 2002, a presentation graphics program you can use to create slide shows for presentations, kiosk displays, and even broadcasting on the Web.

■ Microsoft Access 2002, a relational data management program that helps you organize, track, sort, filter, and report on your data.

■ Microsoft Outlook 2002, an information and communication manager you can use to send and receive e-mail, organize your calendar, and keep track of notes, tasks, and your personal and business contacts.

This section defines each type of desktop application and tells you a little about the Microsoft software solution for each.

Word Processing Software

Word processors need little introduction. You use them to write things. This course, for example. Or a newsletter. Or a book report. Or anything else made up mostly of words.

Are there serious advantages to using a word processor? You bet. With a word processor:

■ You can shape and reshape both what you say and the way it looks until you're 100 percent satisfied, and then print it out.

■ You never have to worry about running lines off the bottom of the page or staying in the margins—the program takes care of that for you, breaking lines and pages as you type. All you have to figure out is where to end one paragraph and begin a new one.

■ You can make titles and headings bigger or darker than the rest of the text, and you can even print them in a different typeface if you want.

| In this course we also discuss other Microsoft applications, such as Microsoft FrontPage, a professional-level Web page creation program. |

■   You can print as many copies as you want, and each one looks like—indeed is—an "original."

And best of all, you *never* have to use an eraser.

Microsoft Word is the word processing software that is included in Office.
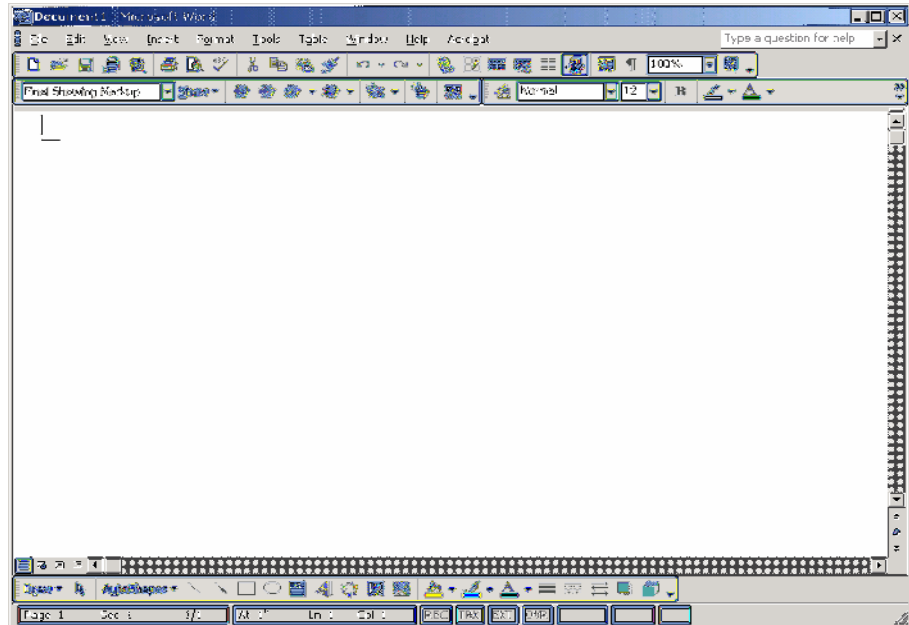
Take a look at Word, Microsoft's word processing software.

Spreadsheet Programs

A spreadsheet program is the electronic equivalent of as many ledger books as you can imagine, each one full of ledger sheets. As you'll see in this book, some of the tasks you can assign to a spreadsheet seem to have very little to do with calculating balances or profits and losses. Yet they are ideal jobs for a spreadsheet because of the way such a program organizes and works with information. Whenever you have numbers to work with, or information—say a student grade sheet, if you are a teacher—that's best presented in a grid you read both across and down, that's the time to think about using a spreadsheet.

Unlike a word processor, which is designed to deal with lines and paragraphs of information, you can see here that a spreadsheet is designed to deal with "nuggets" of information that are entered into the spaces, known as *cells,* that march across the sheet in *rows* and down the sheet in *columns*. This basic organization is the hallmark of every electronic spreadsheet.

Microsoft Excel is the Office answer to spreadsheet software.
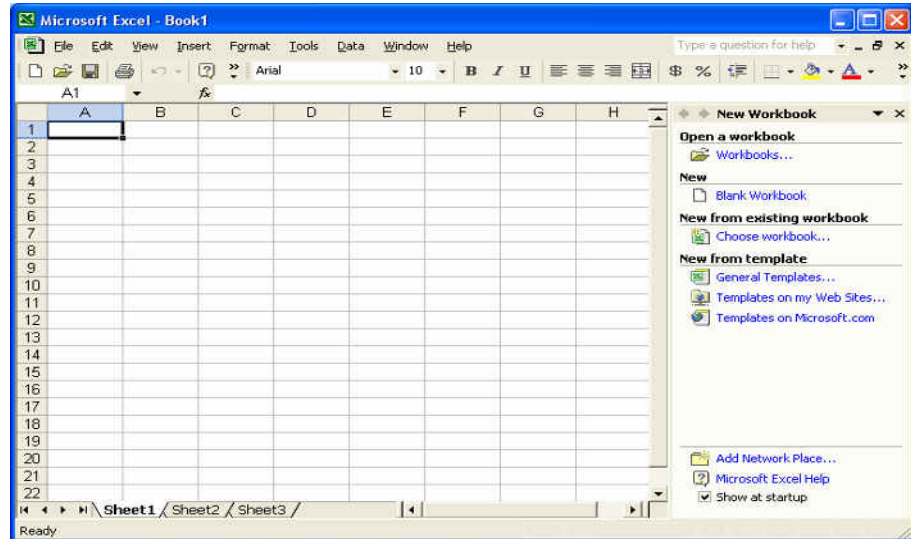
*Meet Excel: Microsoft's spreadsheet software.*

Presentation Software

If you're giving a presentation, you no longer have to use an old overhead projector and messy pens, a dusty chalkboard, or piles of paper handouts. Presentation software lets you create a slide show with all of your notes, visual aids, and even movies or sound and broadcast it to a room full of people.

Presentation software not only makes it easy to present your content, but it makes planning and organizing your talk easier as well. It provides layouts and text and graphic placeholders so that you only have to click and type to add your content. You can also add speaker notes to remind yourself what to say during the presentation—no more note cards necessary! And your audience or students will no longer have to frantically take notes while trying to listen to you. Presentation software allows you to print your slides as handouts so that the people in the audience have the presentation in front of them and can actually listen to what you have to say.

Microsoft PowerPoint is the presentation software that comes as part of Office.
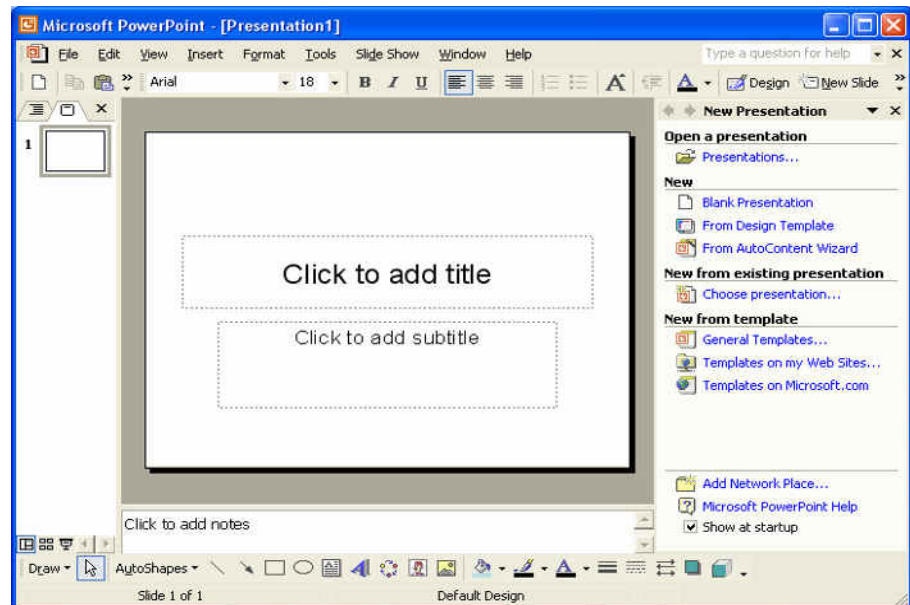
Microsoft PowerPoint is your answer for creating effective presentations.

Database Software

Database programs come in multiple sizes, from simple to quite large. For example, governments rely on databases for keeping track of information—taxes, social security, veterans' benefits, and so on. Databases such as those fall into the "quite large" category, and they require teams of trained professionals to update them and to keep them accurate. On a lesser scale are databases such as inventories, employee information, and sales that are maintained in large corporations around the world. These, too, require trained professionals.

People can and do use databases for much smaller, everyday projects. They are great for organizing and keeping track of any collection of related information that you want to organize, sort through, and be able to update whenever you want.

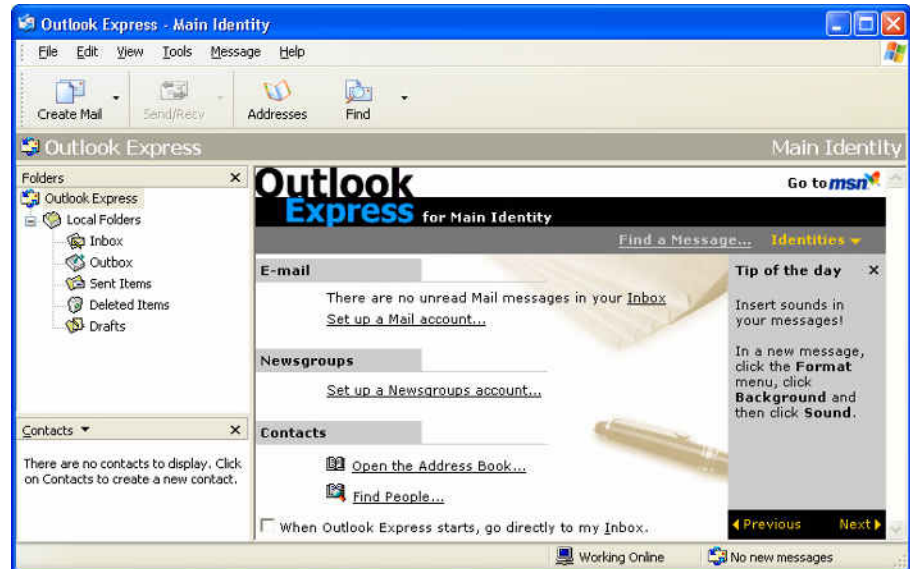The database software that is part of Office is called Microsoft Access.
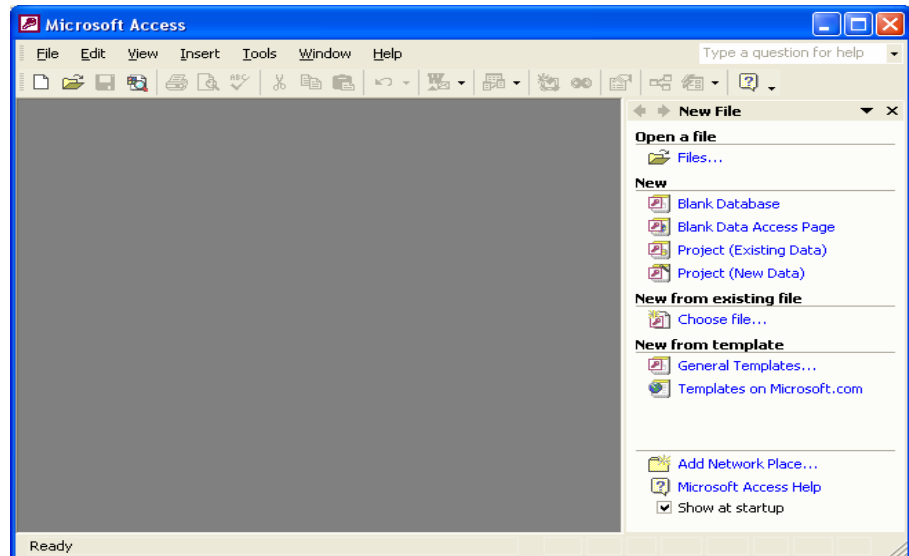
Make your own database using Microsoft Access.

E-Mail and Calendar Management

E-mail is becoming an increasingly popular way to communicate with people all over the world. Instead of having expensive phone conversations with someone halfway around the world, you can use e-mail to cheaply and instantly send them a message containing pictures, files, or even a video. You can use e-mail software to store the addresses and contact information of all of your students, colleagues, friends, and family. You can organize your e-mail inbox so that you can keep related e-mails in folders and have a record of important conversations.

Microsoft offers two e-mail programs: Microsoft Outlook, part of Microsoft Office, and Microsoft Outlook Express a component of Windows XP.

Outlook Express is the e-mail software that comes as part of Windows XP.

The e-mail program that is part of Office is called Microsoft Outlook. It's a much more robust program than Outlook Express, offering a place for notes, a journal, and a task list to remind you of what you need to do each day. Most useful, though, is the calendar feature of Outlook. You can use the calendar to keep track of your meetings each day and view or print your schedule for the day, week, or month. You can use the Outlook calendar to schedule meetings with other people, attaching the meeting agenda and booking resources (such as conference rooms) that you'll need for the meeting. Outlook also allows you to create recurring meetings of any frequency you choose—weekly, biweekly, monthly, or annually. And the reminders that are attached to each meeting announcement let you know when a meeting or appointment is approaching. The reminder plays a chime and displays a dialog box to alert you to the coming meeting.
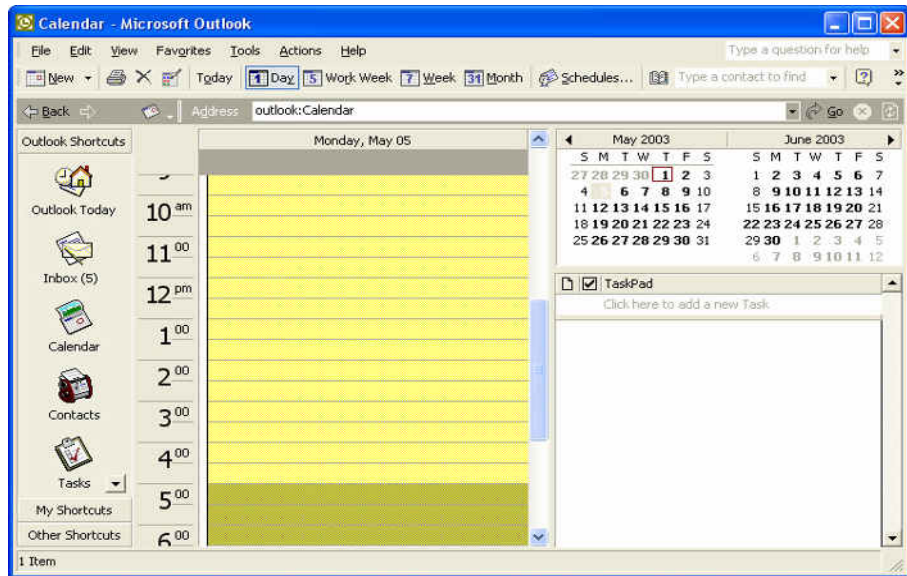
Use Microsoft Outlook to keep track of your day and schedule meetings with others.

Making Your Desktop Applications Work Together

By now you're probably getting a pretty good idea of the various capabilities wrapped up in this one software suite you're preparing to use. Whether you want to work with words, numbers, images, Web content, or data, there's a program in Office XP that was created just to do what you want to do. No matter what kind of result you need to produce—a report, a Web page, a spreadsheet, a database, a presentation, or an e-mail campaign—Office XP most likely has the tool to help you produce it.

Here are just a few of the ways in which you might use Office XP:

- You can create a newsletter in Word, turn it into Web content using FrontPage, and send out an e-mail version using Outlook or Outlook Express.

- You can store all the book information for your personal library in an Access database and track any books you've purchased or borrowed in Excel. You can do a mass mailing to friends using the mail-merge feature of Word.

- If you are a teacher, you can create a professional-level school Web site using FrontPage, compose the annual parent letter in Word, and import charts you created in Excel to portray the school's financial picture.

- You can use Outlook to help you organize your calendar, schedule meetings with your colleagues, track client information, assign tasks (for yourself and others), add notes to reviewed documents, and manage your ever-growing contact list.

> # Tip
>
> The best use of Office XP is, of course, whatever you plan to do with it. How will the Office XP applications help you in your day-to-day work? Thinking through the tasks you do either manually or with another program and asking yourself now how you would like to improve or streamline those tasks can help you get the most out of Office as we go along.

One of the biggest benefits of using Office XP as a suite of applications is the easy way in which you can use the programs together. The individual programs are so seamlessly integrated that you can move data from Word to Excel to PowerPoint to Access without a second thought. You can edit a table in Word and have its information—which originally came from Excel—updated automatically. You can create a Web page in FrontPage, then make some changes in Word, and then move back to FrontPage again, all simply and easily—and with no glitches or format conversions to worry you.

And not only will your facts and figures transfer smoothly from one application to another, but your understanding of the different features the programs share is also transferrable knowledge. From the basic look and feel of the screen to using the Help system to saving, printing, renaming, and deleting files, the similarity among the applications will lessen your learning curve and give you a head start each time you use a new program.

Web Applications: How the Web Works for You

The World Wide Web is an amazing place. More and more information and services are being made available via the Web on a daily basis. Many of these services make your life easier because you can perform daily chores from your computer and not have to drive all over town running errands. This section describes a few examples of Web applications and how the Web can work for you.

Search Tools

You can find anything on the Web, or so it seems. And one of the reasons you can find information is the abundance of search tools. Yahoo, Google, MSN, and others all provide great search tools that allow you to simply type a description of what you want to find, and you will receive a list of possible related sites. Narrowing down that list and finding what you want can be a bit of an art form. If your search is too broad, you may receive literally millions of links to information. Part VI, Lessons 1 through 3, gives you some tips on how to effectively search the Web.

Shopping Applications

The Web can be considered the world's largest shopping mall. If you want to purchase something, be it clothing, books, or a new car, someone on the Web probably has it for sale. Many stores maintain a Web site in addition to their catalog or traditional storefronts. In fact, buying off the Web is similar to

buying something from a catalog. The Web usually allows you access to the store's catalog of merchandise, and then you can purchase your selection directly from the Web site or you can call a toll-free number and place your order with a customer service representative, just as if you were ordering from a print catalog.

Security

Ordering items from the Web using a credit card is fast and reasonably secure. Contrary to popular fiction, it is quite difficult for someone to grab your credit card number as you enter it in a secure Web site. Your credit card number is encrypted as your computer sends it out, and even if intercepted, the number would be very difficult to decrypt. Once your transaction is complete, the card number might become part of the store's records, and then it might be vulnerable to someone stealing it along with other credit card numbers. But the same thing can occur when you use a credit card at a storefront or when ordering from a mail order catalog. In other words, as long as you are working with a firm you know and trust, ordering from the Internet is no more dangerous than using your credit card in a store.

Travel

If you are planning a vacation or any sort of trip, the Web has many different applications that can assist you with all the details. If you are driving, you can research your destination, get maps that are adapted to the type of driving you prefer (major highways, scenic roads, shortest routes, and so forth), or locate things to do and see along the way. Often you can also make required reservations at hotels and other places along your route.

For air travel and other trips, several Web sites are virtual travel agencies. These sites can help you find the best price on air travel, make airline reservations, locate and make reservations at convenient hotels, reserve cars, and make all of your travel arrangements for you.

Online Banking

A growing Web application is online banking and finance. The Web is a perfect way to access and control your personal finances. More and more banks and financial institutions are implementing online banking. Online banking allows you to manage all your personal finances from your computer. You can write checks, transfer funds, and manage your accounts 24 hours a day, 7 days a week, without even leaving the comfort of your home or office.

Online banking is fairly straightforward. For example, to pay bills, you access your account and the bill paying application. You type the payee information (usually just once—the system will remember this information for you), the amount you want to pay, and the date the bill is due. When the due date approaches, the money is either electronically transferred to pay your bill or the bank prints an actual check and mails it for you to your vendor.

This allows you to pay all your bills when it is convenient for you, but the funds will not leave your account until your bills are due. Over time this can save you money, especially if you earn interest on your account. You can also check the status of your accounts anytime you want so that you know exactly which bills need to be paid in the near future and what funds you have available at any time.

Entertainment

The Web is an amazing source of entertainment. There are sites that cover virtually any hobby or interest that you may have (and if there are not, you can create one!). You can get information on how to complete your latest project or ideas for your next one.

One area that is constantly growing is online gaming. You can access Web sites where you can participate in your favorite computer game and compete against players from all over the world.

News

Many newspapers have a free online edition. You can access and read the latest news. Stories can be posted on the Web sooner than they can make it on TV, radio, or print. Internet stories may be text only, or they may contain pictures, audio, and even complete video segments.

An Overview of Networking

By itself, a computer is a powerful tool. You can use it to write reports, play games, or even create programs that do exactly what you want them to. When computers are hooked together in a network, the benefits of each individual computer increase dramatically

If you and your coworkers use computers as part of your jobs, those computers are probably connected in a *network*. When computers are part of a network, you can choose to make some of your files available to your coworkers, print a hard copy of a report on the nice color printer on the other side of the building, or send e-mail to a colleague who is out of town at a conference.

If you're worried that setting up a network is a tremendous undertaking that only the bravest, hardiest, and most technically savvy souls should attempt, you can set those concerns aside. If you can turn a screwdriver and rearrange furniture, you have all the skills needed to connect your computers to a network. You might need to add some software to your computers to make the network work, but it's not too much more difficult than putting in a game.

In this section, you'll be introduced to the hardware and software pieces you put together to build a network. Once you can recognize the elements of a network, you'll learn how to piece them together to create a network that works for you.

How to Recognize a Network When You See One

Because you've spent some time around computers, you know that there are usually a fair number of wires and cables running from the body of the computer to the bits that help it work, such as the monitor, keyboard, mouse, and *modem*.

The monitor, keyboard, mouse, and modem cables all plug in to jacks with hardware and software (usually included in the operating system, such as Microsoft Windows XP) that can understand the signals being sent over the wire. When you press Enter on your keyboard, the keypress sends a specific signal over the wire, which your computer receives, interprets, and passes along to whatever application you're running.

Components of a Network

The principle that the hardware for a computer relies on physical connections (using the jacks) and software to interact with an application also applies to computer networks. To connect the computers to the network, you need to have the necessary hardware and software on each computer to send and receive signals, plus cables or a wireless channel. Here's a quick rundown of the hardware you need to build a wired network that includes Internet access, with full descriptions to follow:

■   Computers, to give you something to network

■   A modem for each computer, to connect you to the Internet

■   A network interface card for each computer, to let your computers plug in to your network

■   Hubs and routers, to help direct signals on your network

■   Cat-5 cable, to connect your computers to your modem, hubs, and routers

Computers

You've probably already figured out that a computer network requires computers. The good news is that your computers don't have to be the newest models available. In fact, you can create the networks described in this book with any computer that runs Microsoft Windows 98 Second Edition (SE) or later. And your computers don't all need to be running the same operating system. Just as long as your computers are running Windows 98 SE or later, you can put them all together in a network. Of course, every new version of Windows has better networking capabilities than previous versions, so you should try to make the computer with the most recent operating system the main computer of your network. If you have an Internet connection, the computer with the most recent version of Windows should also be the computer with which you connect to the Internet.

Modems

If you want to share an Internet connection, the first thing you need is a modem. Almost every computer sold today comes with an analog modem, which lets you connect to the Internet at relatively slow speeds, but you might want to either lease or purchase a broadband modem so that you can connect to the Internet at speeds up to 100 times faster than is possible with an analog modem.

Network Interface Cards

Network interface cards (NICs), also known as network adapters or Ethernet adapters, connect your computer to a network, whether that network is the Internet, a home network, or your organization's network. Many computers sold today come with an analog modem and a NIC, which is the most useful adapter for use in small networks. Some vendors offer computers with NICs for wireless network connections or other types of networks.

Note

Ethernet is a standard for communicating data across a network. Older systems could transfer data at a rate of 10 Mbps (megabits per second), but practically all adapters sold today are capable of transferring data at a rate of 100 Mbps.

If your computer doesn't come with a NIC, you can install any one of a number of different types of adapters, depending on your needs and your computer. The most common type of adapter to buy is a card you plug into an *expansion slot* in your computer. The process for putting a card in an expansion slot is pretty straightforward, but you do need to make sure that the card you buy will fit into your expansion slot.

While there are many types of expansion slots in your computer, there are two types of expansion slots you can use to plug in NICs, Peripheral Component Interconnect (PCI) local bus and Industry Standard Architecture (ISA). You'll need to check your computer's documentation to figure out which kind of expansion slots you have.

 If you don't have any available expansion slots (many discount computers come with only one or two free slots), or if you just don't feel like opening up your computer, you might want to buy an external NIC that connects to your computer through a universal serial bus (USB) port.

Hubs and Routers

Once you have chosen the computer you want to serve as the main computer of your network, you need to buy a piece of equipment that lets you share the connection among other computers on the network. As always, you need to make some choices. The first is whether you want to have a simple Internet

connection without a hardware barrier between your computer and other Internet users' computers, or whether you want to add security to your network and make those who would do you harm work a lot harder to get at you.

To set up a simple network, one without a hardware barrier between you and the Internet, you can buy a hub. These inexpensive boxes usually have from three to eight ports that share your Internet connection among the same number of computers. If you'd rather spend a bit more money to help keep your network safe, you can buy a router.

Hardware That Does Too Much

When you go into a computer store to buy your networking hardware, you may see hardware that looks similar to a basic router or hub but that is more expensive. These items are called switches and switching hubs, and you might not need them for your network. A regular hub broadcasts data it receives to every computer on your network. For a small network, that's fine—the computers can pick out the data they need, and you'll never notice the extra traffic. A switching hub, however, remembers the program or software process (such as a Web browser) that requested the data and sends it directly to that program, reducing the amount of network traffic. Switches and switching hubs are necessary for large corporate networks, but although they'll work perfectly well, you might not need to spend the extra money they cost to get what you need.

Once you've figured out whether you want a hub or a router, or possibly both if you have a lot of computers, you need to decide on the type of connections you want for your network. If you don't mind running cables around your room, or if you're in a new building with Ethernet cable installed, you can go with a wired network. If you'd rather have more freedom of movement and don't mind spending more money on hubs, routers, and NICs, you can go with a wireless network.

Cat-5 Cable

If you choose to put in a wired network, you'll become quite familiar with Cat-5 cable. Cat-5 is short for "Category 5," a standard put forth by the Telecommunications Industry Association and the International Standards Organization, and it means that the cable is able to transmit data over your network at the highest speed your NICs can transmit it. (Your computer can process data much faster than you can ship it over a cable, so you don't need to worry about that.) You can buy cables in precut lengths, or you can make your own and, after a small initial investment for tools, save money whenever you want to add a computer to your network or move a computer out of reach of an existing cable.

Network Topologies

Topology is a pretty fancy word, but in this context it simply means "layout" or "design." It's important to have an idea of what your network will look like before you start buying equipment to connect your computers. Although some retailers allow you to return your purchases, the time you save running to and from the store (and any restocking fee the store may charge) is worth a little advance reading.

There are two basic topologies for computer networking, but there's really only one you need to worry about. The first one, the *token ring* topology, is described as sort of a history lesson, and then there's the *star* topology, described as the basic jumping-off point for every type of small network you should consider when using personal computers. Back in the early days of computer networking, computers could be connected to share information, but the shape of the network was a circle. In other words, every computer was part of a ring.
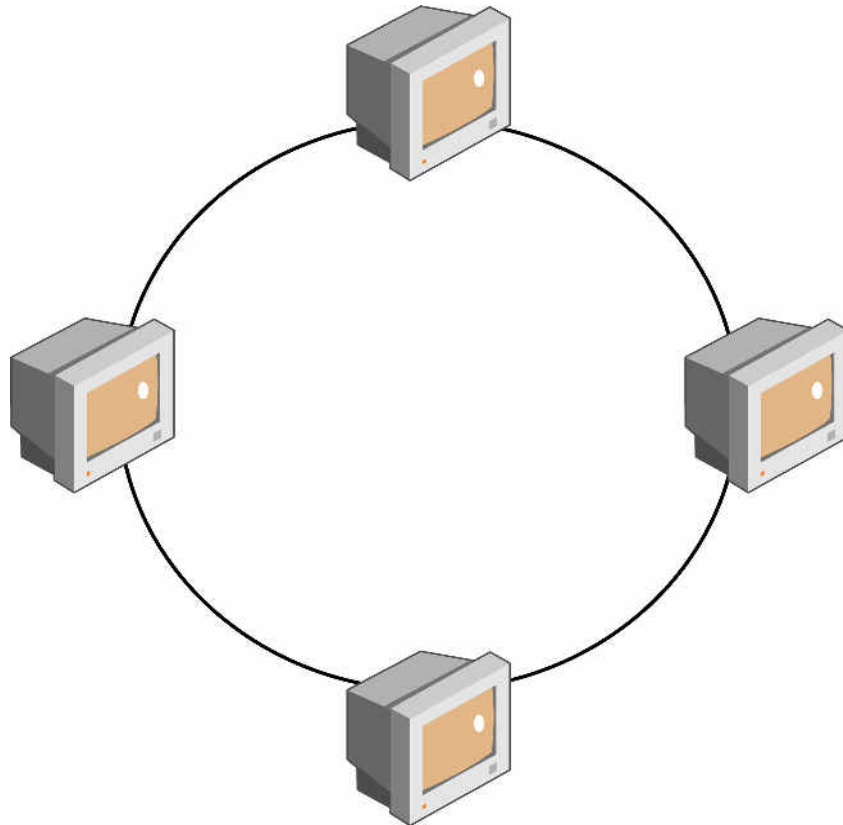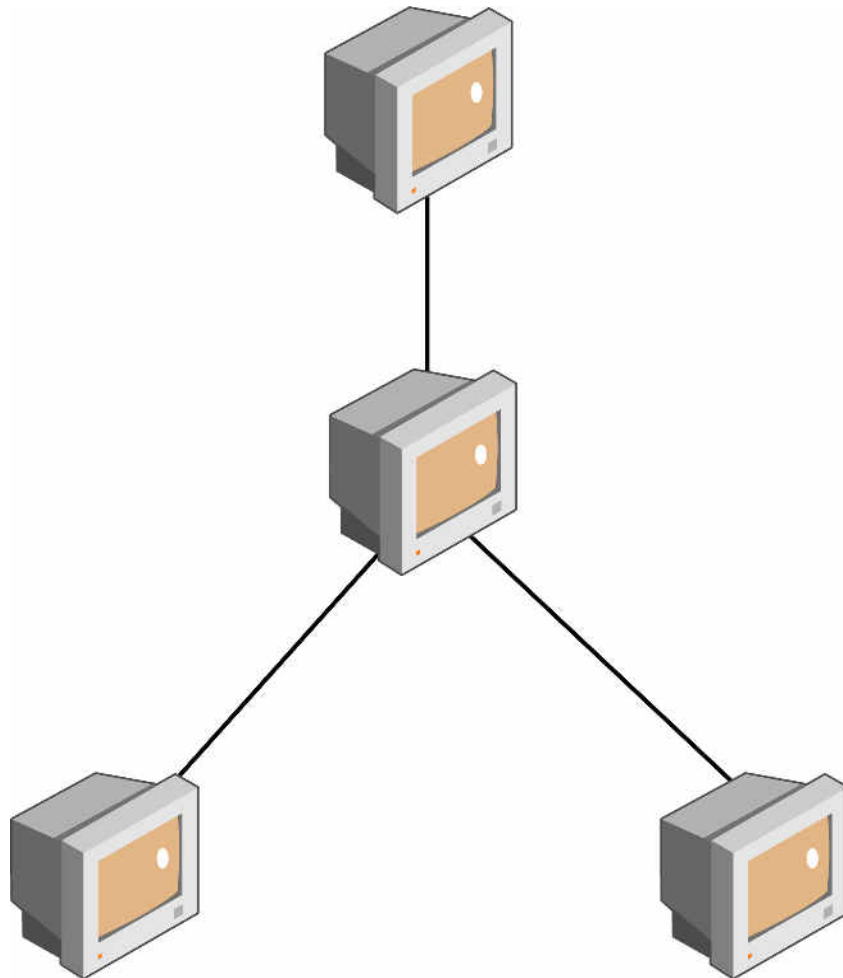
These computers are arranged in a token ring network, in which the computers connect in a chain.

In the four-computer network shown in the previous figure, if you wanted to get a file from the computer on the opposite side of the network, you would need to send the request through one of the computers next to the computer you were using. Your neighboring computer would pass the request along to the computer with the information you wanted, which would then forward the data

along the circle until it reached you. The token ring topology was a great way to link computers together, but it suffered from one major flaw: a failure in any computer on the circle would break the chain, meaning any computer beyond the break was unreachable. For companies with networks of more than three or four computers, the situation quickly became intolerable. Not knowing which machine to blame for the failure is unacceptable. Picking a machine at random won't get the network back up and running.

A better network topology is the star, in which a single computer serves as the main computer for the network.

These computers are arranged in a star topology, in which only a failure in the hub or router will bring down the entire network.

The central computer is linked to the other computers in the network by a series of NICs attached to the network through a hub or router. In this configuration, if you can't get data from another computer on the network, you know that your computer isn't working, the target computer isn't working, or your hub isn't working. You can easily tell whether your computer is working, and you can try to get at files on other network computers to test your hub, so figuring

out where the problem lies is usually pretty simple. After all, knowing what to blame is at least half the battle.

Note

You can add all sorts of extensions to a star network, such as attaching another hub to include more computers in your network. The sample network shown in the previous figure is a simple version of a star topology.

Put Your Network to Work...and Play

Part of what makes it worthwhile to have a small network is the convenience of being able to use the resources attached to any computer on the network from anywhere in your organization . That statement is literally true if you have a wireless network at home and feel like taking your laptop computer out onto the deck so you can look at the sunset, and almost true if you have a wired network. And even then, you can still choose where in the building you want to work.

Share Internet Access

By setting up a network, you can have every computer in your organization share your Internet connection. If you're lucky enough to have a broadband connection, a colleague in your organization can do research on the Web while you send e-mail to another colleague. It'll be a bit slower going if you connect to the Internet using an analog modem, but the utility of the network and the simultaneous Internet connections more than make up for the lower speeds. If you can convince everyone, including yourself, to conserve bandwidth and avoid sites with a lot of large graphics, sound files, or animations, you can still use the Internet effectively.

Share Files

One benefit of sharing a file across your network, as opposed to copying the file to a floppy disk and carrying it to another computer, is that you reduce the risk that you'll save or copy the wrong version of the file and erase hours of work or that the floppy could fail or your file could be too big to fit on it. Another important advantage is the ability to collaborate with others on some projects by sharing folders and files. With all files stored in one place, everybody can easily find the files they need and there is no need to maintain multiple copies of the same file. Also, with one version of the file, you avoid the situation in which two people modify the same file in different ways. If you have ever had to merge changes to a file made by several people, you will really appreciate this feature.

Share Printers

Another advantage of networks is that you can buy just one printer and make it available to anyone on your network. If you're tired of shuttling floppy disks full of files from your computer to a computer with a printer, you can add a printer to any computer on your network and print to it from any computer in your organization.

Chat

Chatting and instant messaging can be a great way for you to meet other people with similar interests in a reasonably safe environment. Chat rooms are areas on the Internet where computer users from all over the world can get together and converse about whatever topic is assigned to the area. You can also use chat tools over your network to communicate with folks in other parts of your organization Now, rather than having to walk to your colleague's office to see if she's on the computer or if she knows the answer to a question, you can open a chat window and ask her over the network.

Chat rooms have gotten a bit of a bad reputation from strangers preying on kids. For example, they may elicit information they need to commit robbery— or even worse crimes. Those things do happen, and you'll need to be on guard to protect yourself.

Play Multiplayer Games

And now we get to the really fun part of having a network, particularly one with a high-speed Internet connection: playing games. There are literally thousands of games you can play over the Internet, from role-playing games such as Asheron's Call to family classics such as Spades and Hearts to strategy games such as Age of Empires. If you're not a gamer, your shared Internet connection will still be useful. If you do play games, a shared Internet connection will seem like a breath of fresh air. And with a network, you can invite your friends and colleagues to play the game as part of a team. While you should be sure to keep the noise down, there's nothing quite like yelling, "Help!" and having the other three people in the room yell, "Where are you?" as they come to your aid, axes and swords swinging.

Lesson Wrap-Up

In this lesson you learned about basic computer hardware and the importance of keeping your computer and its data safe. You learned also about operating systems and Microsoft Windows XP. Finally, you learned about applications software and how a computer network operates

Quick Quiz

1. What is the difference between hard-disk storage and RAM?

2. What hardware do you need to connect to the Internet?

3. What's the best way to keep your computer's data safe?

4. What should you *avoid* using as your personal password?

5. What can you do to protect yourself from a computer virus?

6. What is "Windows" and why do you need it to run an IBM-compatible personal computer?

7. What are the basic types of desktop applications and how are they used?

8. What are the fundamental components of a computer network?

Putting It All Together

Exercise 1: Using the Control Panel in Windows, locate the System Properties window and determine how much RAM your computer possesses.

Exercise 2: To learn more about computer viruses and how you can protect your Microsoft Office applications, open your Web browser and select File, Open. Enter the following Internet address in the text box: http://office.microsoft.com/assistance/9798/virusres.aspx.