



Chapter 1

1

Introduction to Information Technology

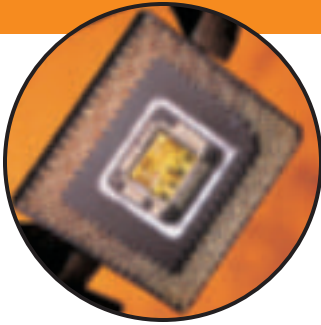
Mind Tools for Your Future

Key Questions

You should be able to answer the following questions.

- 1.1 Infotech Becomes Commonplace: Cellphones, E-Mail, the Internet, & the E-World** How does information technology facilitate e-mail, networks, and the use of the Internet and the Web; what is the meaning of the term *cyberspace*?
- 1.2 The “All-Purpose Machine”: The Varieties of Computers** What are the five sizes of computers, and what are clients and servers?
- 1.3 Understanding Your Computer: What If You Custom-Ordered Your Own PC?** What four basic operations do all computers follow, and what are some of the devices associated with each operation? How does communications affect these operations?
- 1.4 Where Is Information Technology Headed?** What are three directions of computer development and three directions of communications development?

Say goodbye to the personal computing era,” writes technology journalist Kevin Maney. “Just on the horizon is the era that comes next—the personal information era.”¹



You could also call it the era of *pervasive computing*. The world is moving on beyond boxy computers that sit on desks or even on laps. We are entering a time in which handheld computers, two-way wireless pagers, and beefed-up cellphones (not to mention terminals everywhere—libraries, airports, cafes) will let you access information anytime anywhere. And not just general information but *your personal information*—the electronic correspondence, documents, appointments, photos, songs, money matters, and other data important to you.

Central to this concept, as you might expect, is the Internet—the “Net,” that sprawling collection of data residing on computers around the world and accessible by high-speed connections. Everything that presently exists on a personal computer or a laptop, experts suggest, will move onto the Net, giving us greater mobility and wrapping the Internet around our lives.² This is why the Internet is featured so prominently in this book, starting on this page and presented fully in Chapter 2.

With so much information available everywhere all the time, what will this do to us as human beings? We can already see the outlines of the future. One result is *information overload*: The typical American office worker, for instance, sends or receives 201 messages daily—e-mail, voice mail, faxes, Post-its, and so on—with e-mail alone consuming an average of 49 minutes a day.³ Another is *less use of our brains for memorizing*: Familiar phone numbers and other facts are being stored on speed-dial cellphones, pocket computers, and electronic databases, increasing our dependence on technology.⁴ A third result is *a surge in “multitasking” activity*: Young people in particular have become highly skilled in performing several tasks at once, such as talking on the phone, watching TV, answering e-mail, surfing the Web, and doing homework.⁵

These three trends pose unique challenges to how you learn and manage information. An important purpose of this book is to give you the tools for doing so, as we explain at the end of this chapter.

First, however, we need to give you an immediate though brief overview of what computing is and how it works. We begin by discussing the Internet and some of its features, particularly e-mail. We next describe the varieties of computers that exist. We then explain the three key concepts behind how a computer works and what goes into a personal computer, both hardware and software. Finally, we address how to survive in the new ocean of 24/7/365 information.

1.1 Infotech Becomes Commonplace: Cellphones, E-Mail, the Internet, & the E-World

KEY QUESTIONS

How does information technology facilitate e-mail, networks, and the use of the Internet and the Web; what is the meaning of the term cyberspace?

This book is about computers, of course. But not *just* about computers. It is also about the way computers communicate with one another. When computer and communications technologies are combined, the result is ***information technology***—“infotech”—**technology that merges computing with high-speed communications links carrying data, sound, and video**. Examples of information technology include personal computers, of course, but also new forms of telephones, televisions, and various handheld devices.

Note there are two parts to this definition—*computers* and *communications*:

- **Computer technology:** You have certainly seen, and probably used, a computer. Nevertheless, let's define what it is. A **computer** is a **programmable, multiuse machine that accepts data—raw facts and figures—and processes, or manipulates, it into information we can use**, such as summaries, totals, or reports. Its purpose is to speed up problem solving and increase productivity.
- **Communications technology:** Unquestionably you've been using communications technology for years. **Communications technology, also called telecommunications technology, consists of electromagnetic devices and systems for communicating over long distances.** The principal examples are telephone, radio, broadcast television, and cable TV. More recently there has been the addition of communications among computers—which is what happens when people “go online” on the Internet. **Online means using a computer or other information device, connected through a network, to access information and services from another computer or information device.**

As an example of a communication device, let's consider something that seems to be everywhere these days—the cellphone.

The Telephone Grows Up

Seventy-something Louis DeMartino hadn't even had a chance to unwrap the package when a ringing sound came from inside it—a call from his granddaughter as a way of making the family's gift presentation of a cellphone all the more dramatic.⁶ DeMartino may have just been getting started on using this apparatus, but Amit Sinai, 18, like many other teenagers, cannot imagine life without it. Flopping down on her towel after a quick dip in the ocean at a New York beach, for instance, the first thing she does, even before her face starts to dry, is reach for her cellphone and start dialing. “Hi, it's me,” she says. “I'm on the beach. Where are you?”⁷



Cellphone mania has swept the world. All across the globe, people have acquired the portable gift of gab; Finnish wireless giant Nokia estimates that 1 billion people are currently using cellphones.⁸ Some make 45 calls or more a day. It has taken more than 100 years for the telephone to get to this point—getting smaller, acquiring push buttons, losing its cord connection. In 1964, the ★ and # were added to the keypad. In 1973, the first cellphone call was processed. In its standard form, the phone is still so simply designed that even a young child can use it. However, it is now becoming more versatile and complex—a way of connecting to the Internet and the World Wide Web.

Why introduce a book that is about computers with a discussion of telephones? Because Internet phones—such as the Kyocera QCP, the Motorola V60_c, and the Ericsson R380 World—represent another giant step for information technology. (See ● Panel 1.1.) Now you no longer need a personal computer to get on the Internet. These infotech phones, with their small display screens, provide a direct, wireless connection that

enables you not only to make voice calls and check your daily “to-do” list but also to browse the World Wide Web and receive all kinds of information: news, sports scores, stock prices, term-paper research. And you can also send and receive e-mail.

“You've Got Mail!” E-Mail's Mass Impact

It took the telephone 40 years to reach 10 million customers, and fax machines 20 years. Personal computers made it into that many American

● PANEL 1.1

The Internet phone

With an Internet-accessible phone, you have e-mail and specific Web services such as news and stock quotes in addition to regular cellphone services—and, in the case of NTT DoCoMo's FOMA, video.



E-mailer

A college student sends e-mail.

homes 5 years after they were introduced. E-mail, which appeared in 1981, became popular far more quickly, reaching 10 million users in little more than a year.⁹ No technology has ever become so universal so fast. Not surprisingly, then, one of the first things new computer users learn is how to send and receive ***e-mail***—“**electronic mail**,” messages transmitted over a computer network, most often the Internet. A ***network*** is a communications system connecting two or more computers; the Internet is the largest such network.

In 1998, the volume of e-mail in the United States surpassed the volume of hand-delivered mail. In 2002, an esti-

imated average of 8 billion messages a day are zipping back and forth across the United States (which has some 60% of the world’s e-mail accounts), up from 3.5 billion three years earlier.¹⁰ Because of this explosion in usage, suggests a *Business Week* report, “E-mail ranks with such pivotal advances as the printing press, the telephone, and television in mass impact.”¹¹

How is electronic mail different from calling on a telephone or writing a conventional letter? E-mail “occupies a psychological space all its own,” says one journalist. “It’s almost as immediate as a phone call, but if you need to, you can think about what you’re going to say for days and reply when it’s convenient.”¹² E-mail has blossomed, points out another writer, not because it gives us more immediacy but because it gives us *less*. “The new appeal of e-mail is the old appeal of print,” he says. “It isn’t instant; it isn’t immediate; it isn’t in your face.” E-mail has succeeded for the same reason that the videophone—which allows callers to see each other while talking—has been so slow to catch on: because “what we actually want from our exchanges is the minimum human contact commensurate with the need to connect with other people.”¹³

From this it is easy to conclude, as *New York Times* computer writer Peter Lewis did, that e-mail “is so clearly superior to paper mail for so many purposes that most people who try it cannot imagine going back to working without it.”¹⁴ What is interesting, though, is that in these times when images often seem to overwhelm words, e-mail is actually *reactionary*. “The Internet is the first new medium to move decisively backward,” points out one writer, because it essentially involves *writing*. “Ten years ago, even the most literate of us wrote maybe a half a dozen letters a year; the rest of our lives took place on the telephone.”¹⁵ E-mail has changed all that.

The Internet, the World Wide Web, & the “Plumbing of Cyberspace”

Communications is extending into every nook and cranny of civilization. It has been called the “plumbing of cyberspace.” The term *cyberspace* was coined by William Gibson in his novel *Neuromancer*, to describe a futuristic computer network into which users plug their brains. In everyday use, it has a rather different meaning.

Today many people equate cyberspace with the Internet. But it is much more than that, says David Whittle in his book *Cyberspace: The Human Dimension*.¹⁶ Cyberspace includes not only the World Wide Web, chat rooms, online bulletin boards, and member-based services such as America Online—all features we explain in this book—“but also such things as conference calls and automatic teller machines,” he says.¹⁷ We may say that ***cyberspace*** encompasses not only the online world and the Internet in particular but also the whole wired and wireless world of communications in general.

The two most important aspects of cyberspace are the Internet and that part of the Internet known as the World Wide Web.

- **The Internet—“the mother of all networks”:** The Internet is at the heart of the “Information Age.” Called “the mother of all networks,” the *Internet (Net)* is a worldwide network that connects hundreds of thousands of smaller networks. These networks link educational, commercial, nonprofit, and military entities.
- **The World Wide Web—the multimedia part of the Net:** The Internet has been around for more than 30 years. But what made it popular, apart from e-mail, was the development of the *World Wide Web*—an interconnected system of computers all over the world that store information in multimedia form. The word *multimedia*, from “multiple media,” refers to technology that presents information in more than one medium, such as text, still images, moving images, and sound. In other words, the Web provides information in more than one way.

BOOKMARK IT!

PRACTICAL ACTION BOX

Managing Your E-Mail



For many people, e-mail is *the* online environment, more so than the World Wide Web. In one study, respondents reported they received an average of 31 e-mail messages a day.^a But then there are those such as Jeremy Gross, managing director of technology for Countrywide Home Loans, who gets 300 e-mails a day—and about 200 are junk e-mail (spam), bad jokes, or irrelevant memos (the “cc,” or carbon copy).^b Astronomer Seth Shostak gets 50 electronic messages daily, at least half requiring a reply. “If I spend five minutes considering and composing a response to each correspondence,” he complains, “then two hours of my day are busied with e-mail, even when I don’t initiate a single one.”^c

It’s clear, then, that e-mail will increase productivity only if it is used properly. Overuse or misuse just causes more problems and wastes time. The following are some ideas to keep in mind when using e-mail:^d

- **Do your part to curb the e-mail deluge:** Put short messages in the subject line so recipients don’t have to open the e-mail to read the note. Don’t reply to every e-mail message you get. Avoid “cc:ing” (copying to) people unless absolutely necessary. Don’t send chain letters or lists of jokes, which just clog mail systems.
- **Be helpful in sending attachments:** Attachments—computer files of long documents or images—attached to an e-mail are supposed to be a convenience, but often they can be an annoyance. Sending a 1-megabyte file to a 500-person mailing list creates 500 copies of that file—and that many megabytes can clog or even cripple the mail system. (A 1-megabyte file is about the size of a 300-page double-spaced term paper.) Ask your recipients beforehand if they want the attachment and tell them how to open it; they may need to know what word-processing program to use, for example.
- **Be careful about opening attachments you don’t recognize:** Some dangerous computer viruses—renegade programs that can damage your computer—have been spread by e-mail attachments, which are activated only upon opening.
- **Use discretion about the e-mails you send:** E-mail should not be treated as informally as a phone call. Don’t send a message electronically that you don’t want some third party to read. E-mail messages are not written with disappearing ink; they remain in a computer system long after they have been sent. Worse, recipients can easily copy and even alter your messages and forward them to others without your knowledge.
- **Don’t use e-mail in place of personal contact:** Because e-mail carries no tone or inflection, it’s hard to convey personal concern. Avoid criticism and sarcasm in electronic messaging. Nevertheless, you *can* use e-mail to provide quick praise, even though doing it in person will take on greater significance.
- **Be aware that e-mail you receive at work is the property of your employer:** Be careful of what you save, send, and back up.
- **Realize that deleting e-mail messages doesn’t totally get rid of them:** “Delete” moves the e-mail from the visible list, but the messages remain on your hard disk and can be retrieved by experts. Special software, such as Spytech Eradicator and Window Washer, will completely erase e-mail from the hard disk.

According to Nua Internet Surveys (NUA.com), a resource for Internet trends and statistics, more than 407.1 million people were using the Internet worldwide in the summer of 2001. Among them:

- 26 million citizens of China
- One-fifth of Irish homes
- All but 1% of students in the United Kingdom
- 10 million British households
- 40% of German citizens
- 16% of Hungarian citizens
- 2 million Argentines
- 6.7 million Mexicans
- 99% of Canadians ages 9–17
- 3.5 million people in the Arab world
- 3.5 million Australian households
- 7 million, or one-fifth, of Spanish citizens
- 22 million Korean citizens
- 1 million Belgians

There is no doubt the influence of the Net and the Web is tremendous. At present, one-third to one-half of the U.S. population is online; if the Internet industry were a nation, it would be the 18th-largest economy in the world.¹⁸ But just how revolutionary is it? Is it equivalent to the invention of television, as some technologists say? Or is it even more important—equivalent to the invention of the printing press? “Television turned out to be a powerful force that changed a lot about society,” says *USA Today* technology reporter Kevin Maney. “But the printing press changed everything—religion, government, science, global distribution of wealth, and much more. If the Internet equals the printing press, no amount of hype could possibly overdo it.”¹⁹

Perhaps in a few years we’ll begin to know the answer. No massive study was ever done of the influence of the last great electronic revolution to touch us, namely, television. But the Center for Communication Policy at the University of California, Los Angeles, in conjunction with other international universities, has begun to take a look at the effects of information technology—and at how people’s behavior and attitudes toward it will change over a span of years.²⁰

The E-World & Welcome to It

One thing we know already is that cyberspace is saturating our lives. More than 52% of American adults are Internet users, according to a recent survey.²¹ While the average age of users is rising, there’s no doubt that young people love the Net. For instance, an amazingly high percentage of American teenagers—81%—use the Internet, according to Teenage Research Unlimited (TRU), a Chicago market research firm.²² Why is that? E-mail is certainly one important reason—it’s all about staying connected.

But it’s more than just about e-mail. Teenagers are also big participants in online commerce. “When teens want information on a brand,” says TRU’s director of research, “they turn to the Internet first.” Indeed, teens are voracious consumers of all things electronic.

And not just for teens but for most Americans, the use of the Internet’s favorite letter, “e”—as in e-business, e-commerce, e-shopping—is rapidly becoming outmoded. “E” is now part of nearly everything we do. As an executive for a marketing research firm says, “E-business is just business.”²³ The electronic world is everywhere. The Net and the Web are everywhere. Cyberspace permeates everything. What editor Frederick Allen says is true: Infotech has become . . . ordinary.

CONCEPT CHECK

What are the two parts of information technology?

How does e-mail differ from other means of communication?

What is cyberspace, and what are its two most important aspects?

1.2 The “All-Purpose Machine”: The Varieties of Computers

KEY QUESTIONS

What are the five sizes of computers, and what are clients and servers?

When the alarm clock★ blasts you awake, you leap out of bed and head for the kitchen, where you plug in the coffee maker★. After using your electric toothbrush★ and showering and dressing, you stick a bagel in the microwave★, then pick up the TV remote★ and click on the TV★ to catch the weather forecast. Later, after putting dishes in the dishwasher★, you go out and start up the car★ and head toward campus or work. Pausing en route at a traffic light★, you turn on your portable CD player★ to listen to some music.

You haven't yet touched a PC, a personal computer, but you've already dealt with at least 10 computers—as you probably guessed from the ★s. All these familiar appliances rely on tiny “computers on chips” called microprocessors. “These marvels of engineering have been infiltrating our everyday lives for more than a quarter of a century,” says technology writer Dan Gillmor, but “in some ways the revolution has only begun.”²⁴

Maybe, then, the name *computer* is inadequate. As computer pioneer John Von Neumann has said, the device should not be called a computer but rather the “all-purpose machine.” It is not, after all, just a machine for doing calculations. The most striking thing about it is that it can be put to *any number of uses*.

What are the various types of computers? Let's take a look.

All Computers, Great & Small: The Categories of Machines

At one time, the idea of having your own computer was almost like having your own personal nuclear reactor. In those days, in the 1950s and '60s, computers were enormous machines affordable only by large institutions. Now they come in a variety of shapes and sizes, which can be classified according to their processing power.

- **Supercomputers:** Typically priced from \$500,000 to more than \$85 million, *supercomputers* are high-capacity machines with hundreds of thousands of processors that can perform over 1 trillion calculations per second. These are the most expensive but fastest computers available. “Supers,” as they are called, have been used for tasks requiring the processing of enormous volumes of data, such as doing the U.S. census count, forecasting weather, designing aircraft, modeling molecules, breaking codes, and simulating explosion of nuclear bombs. More recently they have been employed for business purposes—for instance, sifting demographic marketing information—and for creating film animation. The fastest computer in the world, which cost \$85 million and looks like rows of refrigerator-size boxes, is the IBM ASCI White (Accelerated Strategies Computing Initiative White) at the Lawrence Livermore Laboratory in Livermore, California. This supercomputer has 8192 processors, and it can process 12.3 trillion operations per second. It takes up 12,000 square feet—the space required by two NBA basketball courts. It weighs 106 tons. It has 97,000 times the memory of a 64-megabyte microcomputer and 16,000 times the secondary storage capacity of a 10-gigabyte microcomputer hard disk. It uses 83 miles of wiring.

Supercomputer
IBM ASCI White





Mainframe computer

- **Mainframe computers:** The only type of computer available until the late 1960s, mainframes are water- or air-cooled computers that cost \$5000–\$5 million and vary in size from small, to medium, to large, depending on their use. Small mainframes (\$5000–\$200,000) are often called *midsize computers*; they used to be called *minicomputers*, although today the term is seldom used. Mainframes are used by large organizations—such as banks, airlines, insurance companies, and colleges—for processing millions of transactions. Often users access a mainframe by means of a terminal, which has a display screen and a keyboard and can input and output data but cannot by itself process data. Mainframes process billions of instructions per second.
- **Workstations:** Introduced in the early 1980s, workstations are expensive, powerful computers usually used for complex scientific, mathematical, and engineering calculations and for computer-aided design and computer-aided manufacturing. Providing many capabilities comparable to midsize mainframes, workstations are used for such tasks as designing airplane fuselages, prescription drugs, and movie special effects. Workstations have caught the eye of the public mainly for their graphics capabilities,



Workstation

which are used to breathe three-dimensional life into movies such as *Jurassic Park III* and *Pearl Harbor*. The capabilities of low-end workstations overlap those of high-end desktop microcomputers.

- **Microcomputers:** Microcomputers, also called personal computers, which cost \$500–\$5000, can fit next to a desk or on a desktop, or can be carried around. They are either stand-alone machines or are connected to a computer network, such as a local area network. A local area network (LAN) connects, usually by special cable, a group of desktop PCs and other devices, such as printers, in an office or a building.

Microcomputers are of several types: *desktop PCs*, *tower PCs*, *laptops* (or *notebooks*), and *personal digital assistants*—handheld computers or palmtops.

Desktop PCs are those in which the case or main housing sits on a desk, with keyboard in front and monitor (screen) often on top. Tower PCs are those in which the case sits as a “tower,” often on the floor beside a desk, thus freeing up desk surface space.

Three types of micro-computers

Desktop, tower, and notebook



Notebook computers, also called laptop computers, are lightweight portable computers with built-in monitor, keyboard, hard-disk drive, battery, and AC adapter that can be plugged into an electrical outlet; they weigh anywhere from 1.8 to 9 pounds.

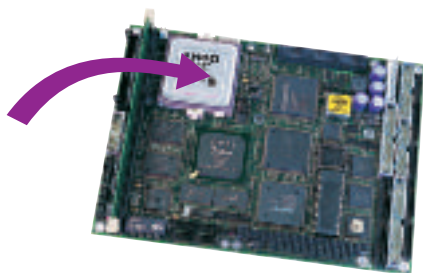
Personal digital assistants (PDAs), also called handheld computers or palmtops, combine personal organization tools—schedule planners, address books, to-do lists—with the ability in some cases to send e-mail and faxes. Some PDAs have

Two types of personal digital assistants



touch-sensitive screens. Some also connect to desktop computers for sending or receiving information. (For now, we are using the word *digital* to mean “computer based.”)

- **Microcontrollers:** Microcontrollers, also called embedded computers, are the tiny, specialized microprocessors installed in “smart” appliances and automobiles. These microcontrollers enable microwave ovens, for example, to store data about how long to cook your potatoes and at what temperature. Recently microcontrollers have been used to develop a new universe of experimental electronic appliances—e-pliances—for example, as tiny Web servers embedded in clothing, jewelry, and household appliances such as refrigerators.²⁵ Microcontrollers are also used in blood pressure monitors, air bag sensors, gas and chemical sensors for water and air, and vibration sensors.



Microcontroller

Servers

The word *server* does not describe a size of computer but rather a particular way in which a computer is used. Nevertheless, because servers have become so important to telecommunications, especially with the rise of the Internet and World Wide Web, they deserve mention here. (Servers are discussed in detail in Chapter 5.)

A server, or network server, is a central computer that holds collections of data (databases) and programs for connecting PCs, workstations, and other devices, which are called clients. These clients are linked by a wired or wireless network. The entire network is called a *client/server network*. In small organizations, servers can store files and transmit e-mail. In large organizations, servers can house enormous libraries of financial, sales, and product information.

You may never see a supercomputer or mainframe or server or even a tiny microcontroller. But you will most certainly get to know the personal computer, if you haven't already. We consider this machine next.

CONCEPT CHECK

Describe the five sizes of computers.

What are the different types of microcomputers?

Define servers and clients.

1.3 Understanding Your Computer: What If You Custom-Ordered Your Own PC?

KEY QUESTIONS

What four basic operations do all computers follow, and what are some of the devices associated with each operation? How does communications affect these operations?

Could you build your own personal computer? Some people do, putting together bare-bones systems for just a few hundred dollars. "If you have a logical mind, are fairly good with your hands, and possess the patience of Job, there's no reason you can't . . . build a PC," says science writer David Einstein. And, if you do it right, "it will probably take only a couple of hours," because industry-standard connections allow components to go together fairly easily.²⁶

Actually, probably only techies would consider building their own PC. But many ordinary users order their own *custom-built* PCs. Let's consider how you might do this.

How Computers Work: Three Key Concepts

We're not actually going to ask you to build or order a PC—just to *pretend* to do so. The purpose of this exercise is to help you understand how a computer works. That information will help you when you go shopping for a new system or, especially, if you order up a custom-built system.

Before you begin, you will need to understand three key concepts.

FIRST: *The purpose of a computer is to process data into information.* **Data** consists of the raw facts and figures that are processed into information—for example, the votes for different candidates being elected to student-government office. **Information** is data that has been summarized or otherwise manipulated for use in decision making—for example, the total votes for each candidate, which are used to decide who won.

SECOND: You should know *the difference between hardware and software.* **Hardware** consists of all the machinery and equipment in a computer system. The hardware includes, among other devices, the keyboard, the screen, the printer, and the "box"—the computer or processing device itself. **Software, or programs,** consists of all the instructions that tell the computer how to perform a task. These instructions come from a software developer in a form (such as a CD, or compact disk) that will be accepted by the computer. Examples you may have heard of are Microsoft Windows or Office XP.

THIRD: Regardless of type and size, *all computers follow the same four basic operations:* (1) *input*, (2) *processing*, (3) *storage*, and (4) *output*. To this we will add (5) *communications*.

- 1. Input operation:** **Input** is whatever is put in ("input") to a computer system. Input can be nearly any kind of data—letters, numbers, symbols, shapes, colors, temperatures, sounds, or whatever raw material needs processing. When you type some words or numbers on a keyboard, those words are considered *input data*.

Survival Tip

Input is covered in detail in Chapter 6.

Survival Tip

Processing is covered in detail in Chapter 5.

Survival Tip

Output is covered in detail in Chapter 6.

Survival Tip

Communications is covered in detail in Chapters 2 and 7.

- 2. Processing operation:** *Processing* is the manipulation a computer does to transform data into information. When the computer adds $2 + 2$ to get 4, that is the act of processing. The processing is done by the **central processing unit**—frequently called just the **CPU**—a device consisting of electronic circuitry that executes instructions to process data.
- 3. Storage operation:** Storage is of two types—temporary storage and permanent storage, or **primary storage** and **secondary storage**. **Primary storage**, or **memory**, is the computer circuitry that **temporarily** holds data waiting to be processed. This circuitry is inside the computer. **Secondary storage**, simply called **storage**, is the area in the computer where data or information is held **permanently**. A floppy disk or hard disk is an example of this kind of storage. (Storage also holds the *software*—the computer programs.)
- 4. Output operation:** **Output** is whatever is output from (“put out of”) the computer system, the results of processing, usually information. Examples of output are numbers or pictures displayed on a screen, words printed out on paper in a printer, or music piped over some loudspeakers.
- 5. Communications operation:** These days, most (though not all) computers have *communications* ability, which offers an *extension* capability—in other words, it extends the power of the computer. With wired or wireless communications connections, data may be input from afar, processed in a remote area, stored in several different locations, and output in yet other places. However, you don’t need communications ability to write term papers, do calculations, or perform many other computer tasks.

Survival Tip

Storage is covered in detail in Chapter 5.

These five operations are summarized in the illustration on the next page. (See ● Panel 1.2.)

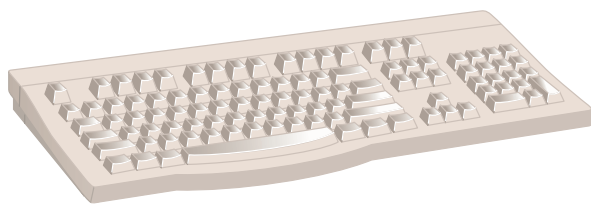
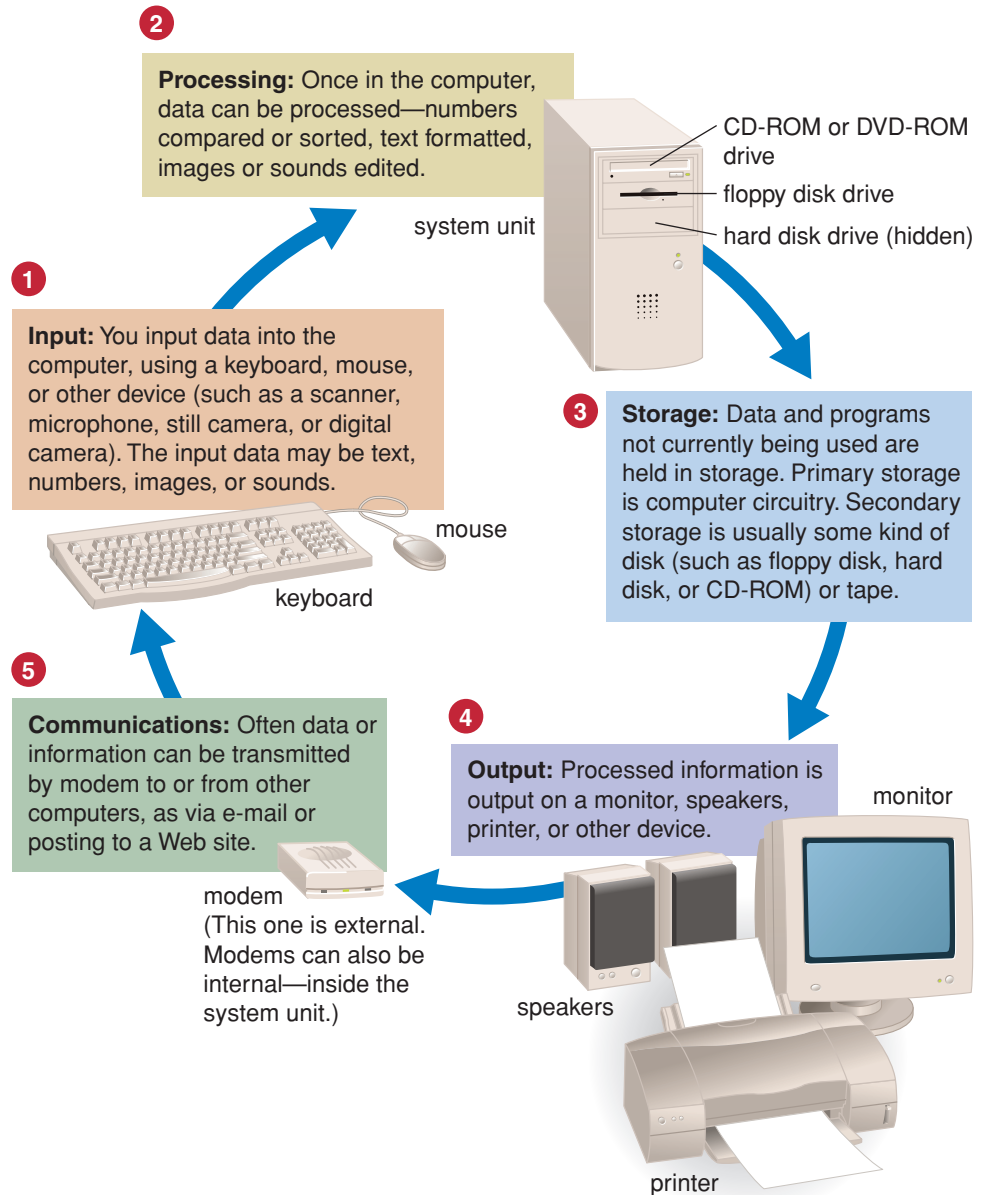
Pretending to Order a Custom-Built Desktop Computer

Now let’s see how you would order a custom-built desktop PC. Remember, the purpose of this is to help you understand the internal workings of a computer so that you’ll be better equipped when you go to buy one. (If you were going to build it yourself, you would pretend that someone had acquired the PC components for you from a catalog company and that you’re now sitting at a workbench or kitchen table about to begin assembling them. All you would need is a screwdriver, perhaps a small wrench, and a static-electricity-free work area. You would also need the manuals that come with some of the components.) Although prices of components are always subject to change, we have indicated *general ranges* of prices for basic equipment current as of early 2002 so that you can get a sense of the relative importance of the various parts. (“Loaded” components—the most powerful and sophisticated equipment—cost more than the prices given here.)

Input Hardware: Keyboard & Mouse

Input hardware consists of devices that allow people to put data into the computer in a form that the computer can use. At minimum, you will need two things: a *keyboard* and a *mouse*.

PANEL 1.2
The basic operations of a computer



Keyboard



Mouse

- **Keyboard:** Cost: \$35–\$70. On a microcomputer, a keyboard is the primary input device. **A keyboard is an input device that converts letters, numbers, and other characters into electrical signals readable by the processor.** A microcomputer keyboard looks like a typewriter keyboard, but besides keys for letters and numbers it has several keys (such as *F* keys and *Ctrl*, *Alt*, and *Del* keys) intended for computer-specific tasks. After other components are assembled, the keyboard will be plugged into the back of the computer in a socket intended for that purpose (unless you have a cordless keyboard).
- **Mouse:** \$30–\$120. **A mouse is an input device that is used to manipulate objects viewed on the computer display screen.** The mouse will be plugged into the back of the computer (or on the back of the keyboard) in a socket after the other components are assembled. (Cordless mice are also available.)

Processing & Memory Hardware: Inside the System Cabinet

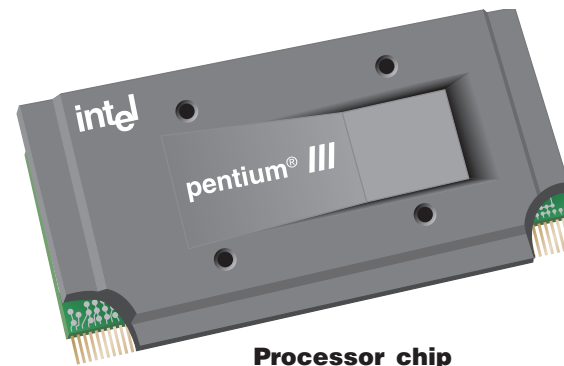
This is the part where most of the assembly work will have to be done. The brains of the computer are the *processing* and *memory* devices, which are housed in the case or system cabinet.

Case or system cabinet



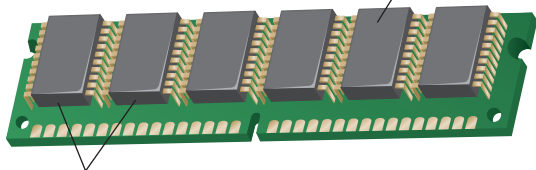
- **Case and power supply:** About \$60. Also known as the *system unit*, the *case* or *system cabinet* is the box that houses the processor chip (CPU), the memory chips, and the motherboard with power supply, as well as some secondary storage devices—floppy-disk drive, hard-disk drive, and CD-ROM or DVD drive, as we will explain. The case comes in desktop or tower models. It includes a power supply unit and a fan to keep the circuitry from overheating.

- **Processor chip:** \$75–\$750 or more. It may be small and not look like much. But it could be the most expensive hardware component of a build-it-yourself PC—and doubtless the most important. A **processor chip** is a tiny piece of silicon that contains millions of miniature electronic circuits. The speed at which a chip processes information is expressed in *megahertz (MHz)*, millions of processing cycles per second, or *gigahertz (GHz)*, billions of processing cycles per second. For \$250, you might get a 600-MHz chip, which is adequate for most student purposes. For top dollar, you might get a 1.7-gigahertz chip, which you would want if you're running software with spectacular graphics and sound, such as those with some video games (Quake).



Processor chip

memory chip (RAM chip)



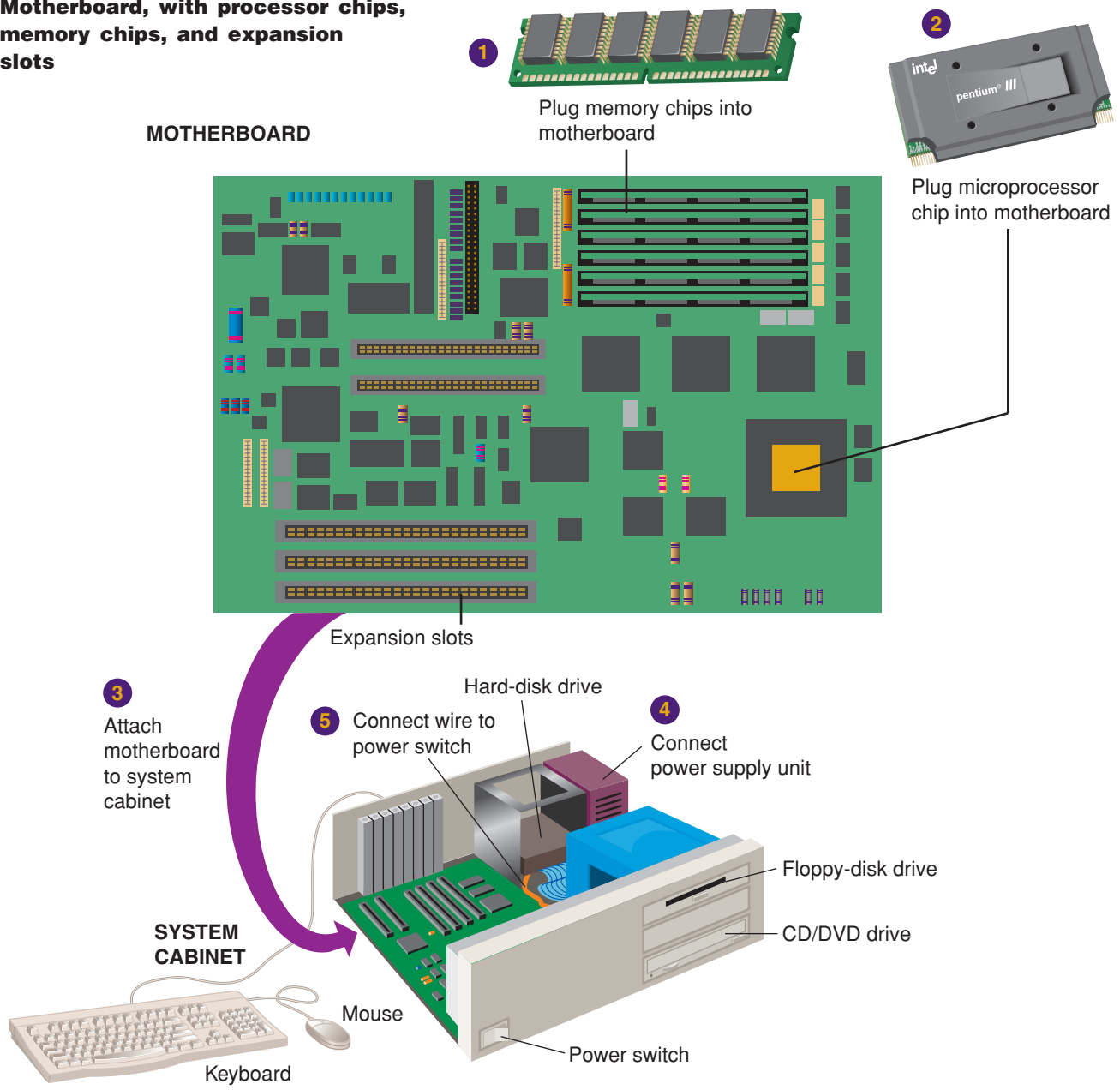
memory chips mounted on module

- **Memory chips:** \$100–\$150. These are also small. *Memory chips*, also known as **RAM (random access memory) chips**, represent primary storage or temporary storage; they hold data before processing and information after processing, before it is sent along to an output or storage device. You'll want enough memory chips to hold 128 megabytes, or roughly 128 million characters, of data, which is adequate for most student purposes. If you work with large graphic files, you'll need more memory capacity, 192–256 megabytes. (We explain the numbers used to measure storage capacities in a moment.)

- **Motherboard:** About \$100–\$150. Also called the *system board*, the **motherboard** is the main circuit board in the computer. This is the big green circuit board to which everything else—such as the keyboard, mouse, and printer—attaches through connections (called *ports*) in the back of the computer. The processor chip and memory chips are also installed on the motherboard.

Note that the motherboard has *expansion slots*—for expanding the PC's capabilities—which give you places to plug in additional circuit boards, such as those for video, sound, and communications (modem).

Motherboard, with processor chips, memory chips, and expansion slots



Now the components can be put together. As the illustration above shows, ① the memory chips are plugged into the motherboard. Then ② the processor chip is plugged into the motherboard. Now ③ the motherboard is attached to the system cabinet. Then ④ the power supply unit is connected to the system cabinet. Finally, ⑤ the wire for the power switch, which turns the computer on and off, is connected to the motherboard.

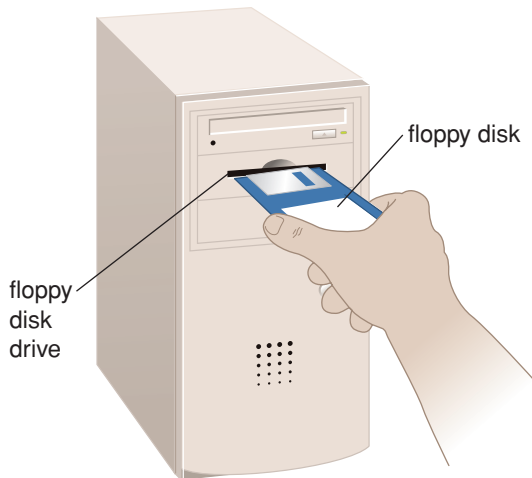
Storage Hardware: Floppy Drive, Hard Drive, & CD-ROM Drive

With the motherboard in the system cabinet, the next step is installation of the storage hardware. Whereas memory chips deal with temporary storage, now we're concerned with *secondary storage* or *permanent storage*, in which you'll be able to store your data for the long haul.

For today's student purposes, you'll need at minimum a floppy-disk drive, a hard-disk drive, and a CD/DVD drive. If you work with large files, you'll

also want a Zip-disk drive. These storage devices slide into the system cabinet from the front and are secured with screws. Each drive is attached to the motherboard by a flat cable (called a *ribbon cable*). Also, each drive must be hooked up to a plug extending from the power supply.

A computer system's data/information storage capacity is represented by bytes, kilobytes, megabytes, gigabytes, and terabytes. Roughly speaking, a *byte* = 1 character of data, a *kilobyte* = 1000 characters, a *megabyte* = 1 million characters, a *gigabyte* = 1 billion characters, and a *terabyte* = 1 trillion characters. A character could be alphabetic (A, B, or C) or numeric (1, 2, or 3) or a special character (!, ?, *, \$, %).



Floppy disk



Zip disk

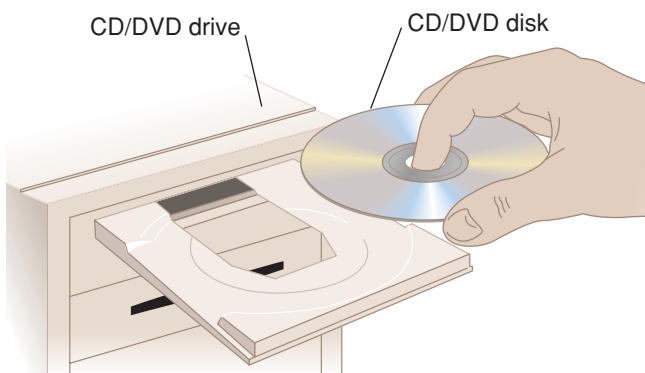
- **Floppy-disk and Zip drives:** \$100–\$180. A ***floppy-disk drive*** is a storage device that stores data on removable 3.5-inch-diameter diskettes. These diskettes don't seem to be "floppy," because they are encased in hard plastic, but the mylar disk inside is indeed flexible or floppy. Each can store 1.44 million bytes (characters) or more of data. With the floppy-disk drive installed, you'll later be able to insert a diskette through a slot in the front and remove it by pushing the eject button. A ***Zip-disk drive*** is a storage device that stores data on floppy-disk cartridges with 70–170 times the capacity of the standard floppy.

- **Hard-disk drive:** \$120 for 20 gigabytes of storage (higher-capacity drives are available). A ***hard-disk drive*** is a storage device that stores billions of characters of data on a nonremovable disk platter. With 20 gigabytes of storage, you should be able to handle most student needs.



Hard-disk drive

- **CD/DVD drive:** \$100–\$400. A ***CD (compact disk) drive***, or its more recent variant, a ***DVD (digital video disk) drive***, is a storage device that uses laser technology to read data from optical disks. These days new software is generally supplied on CDs rather than floppy disks. And even if you can get a program on floppies, you'll find it easier to install a new program from one CD rather than repeatedly inserting and removing, say, 10 or 12 floppy disks.



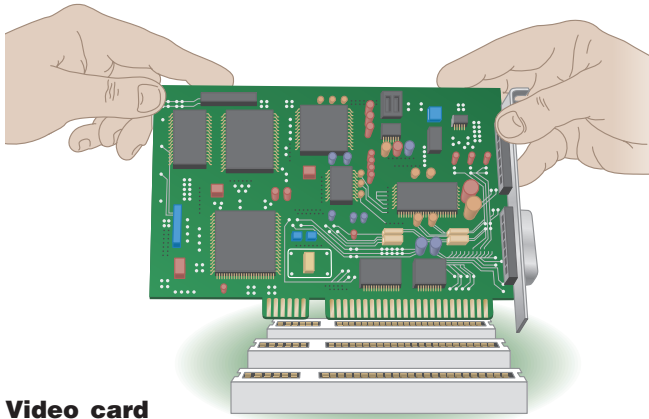
The system cabinet has lights on the front that indicate when these drives are in use. (You must not remove the diskette from the floppy-disk drive until the relevant light goes off, or else you risk damage to both disk and drive.) The wires for these lights need to be attached to the motherboard.

Output Hardware: Video & Sound Cards, Monitor, Speakers, & Printer

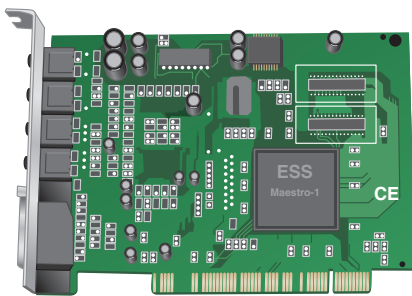
Output hardware consists of devices that translate information processed by the computer into a form that humans can understand—print, sound, graphics, or video, for example. Now a video card and a sound card need to be

installed in the system cabinet. Next the monitor, speakers, and a printer are plugged in.

Incidentally, this is a good place to introduce the term *peripheral device*. A **peripheral device** is any component or piece of equipment that expands a computer's input, storage, and output capabilities. Examples include printers and disk drives.



Video card



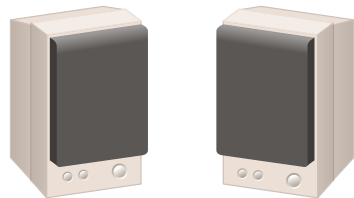
Sound card

- **Video card:** \$50–\$650. You doubtless want your monitor to display color (rather than just black-and-white) images. Your system cabinet will therefore need to have a device to make this possible. A **video card** converts the processor's output information into a video signal that can be sent through a cable to the monitor. Remember the expansion slots we mentioned? Your video card is plugged into one of these on the motherboard. (You can also buy a motherboard with built-in video.)
- **Sound card:** \$30–\$160. You may wish to listen to music on your PC. If so, you'll need a **sound card**, which enhances the computer's sound-generating capabilities by allowing sound to be output through speakers. This, too, would be plugged into an expansion slot on the motherboard. (Once again, you can buy a motherboard with built-in sound.) With the CD-ROM drive connected to the card, you can listen to music CDs.
- **Monitor:** \$200–\$400 for a 17-inch model, \$400 or more for a 19-inch model. As with television sets, the "inch" dimension on monitors is measured diagonally corner to corner. The **monitor** is the display device that takes the electrical

signals from the video card and forms an image using points of colored light on the screen. Later, after the system cabinet has been closed up, the monitor will be connected by means of a cable to the back of the computer, using the clearly marked connector. The power cord for the monitor will be plugged into a wall plug.

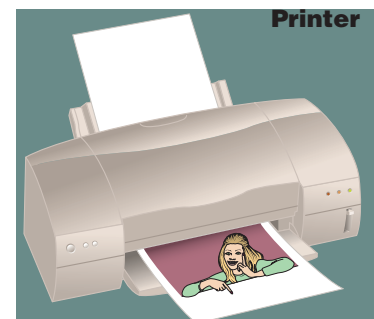


Monitor



Sound speakers

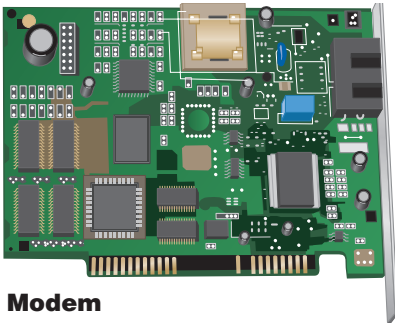
- **Pair of speakers:** \$30–\$250. **Speakers**—the devices that play sounds transmitted as electrical signals from the sound card—may not be very sophisticated, but unless you're into high-fidelity recordings they're probably good enough. The two speakers are connected to a single wire that is plugged into the back of the computer once installation is completed.
- **Printer:** \$80–\$600. Especially for student work, you certainly need a **printer**, an output device that produces text and graphics on paper. There are various types of printers, as we discuss later (Chapter 5). The printer has two connections. One, which relays signals from the computer, goes to the back of the PC, where it connects with the motherboard. The other is a power cord that goes to a wall plug.



Printer

Communications Hardware: Modem

Computers can be stand-alone machines, unconnected to anything else. If all you're doing is word processing to write term papers, that may be fine. As we have seen, however, the *communications* component of the computer system *vastly* extends the range of a PC. Thus, while the system cabinet is still open there is one more piece of hardware to install.



Modem

- **Modem:** \$40–\$100. A **modem** is a device that sends and receives data over telephone lines to and from computers. The modem is mounted on an expansion card, which is fitted into an expansion slot on the motherboard. Later you can run a telephone line from the telephone wall plug to the back of the PC, where it will connect to the modem.

Now the system cabinet is closed up. The person building the system will plug in all the input and output devices and turn on the power “on” button. Your microcomputer system will look similar to the one below. (See ● Panel 1.3.) Are you now ready to roll? Not quite.

Software

With all the pieces put together, the person assembling the computer needs to check the motherboard manual for instructions on starting the system. One of the most important tasks is to install software, of which there are two types—system software and application software.

- **System software:** You're really interested in the type of software that allows you to write documents, do spreadsheets, and so on, which is called application software. Before you can get to that, however, system software must be installed. Examples are Windows 98 or Windows XP, which come on CD disks. The assembler will insert these into your CD drive and follow the onscreen directions for installation. (*Installation* refers to the process of copying software programs from secondary storage media—CDs, for example—onto your system's hard disk, so that you can have direct access to the hardware.)

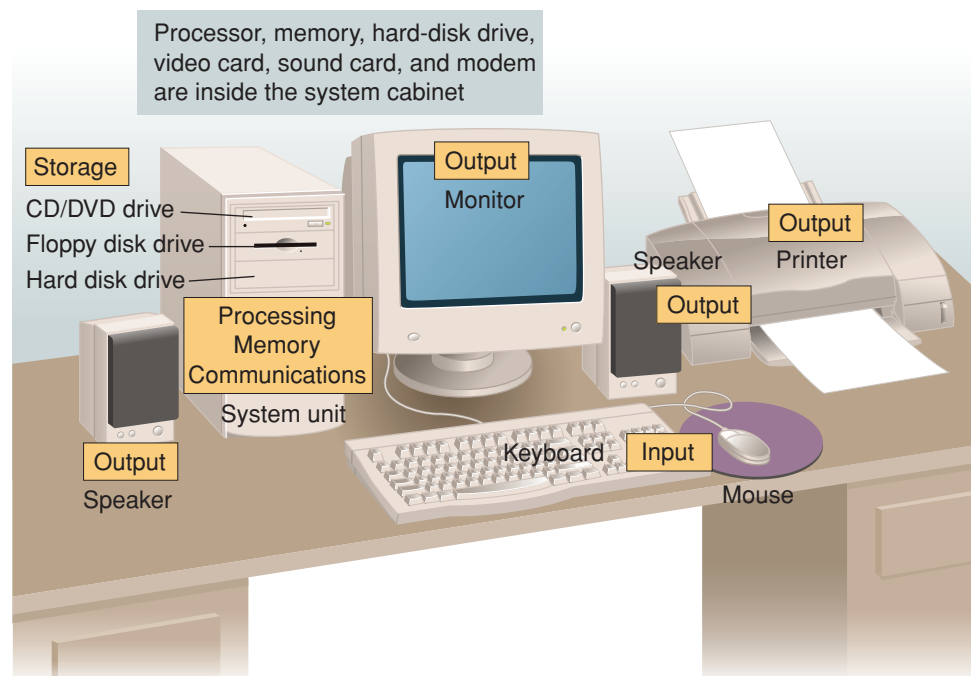
● PANEL 1.3

A completely assembled PC hardware system

Survival Tip

Hardware Info

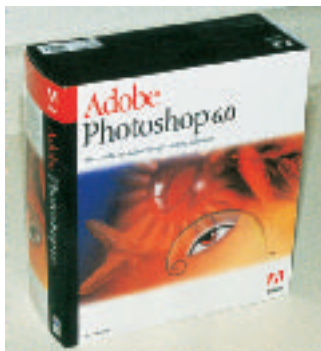
Go to www.bizrate.com/marketplace for a listing of virtually all types of hardware, their descriptions, ratings, prices, and names of sellers.





**System software:
Windows XP**

Microsoft's Bill Gates holds a box of his new XP software.



**Application software:
Adobe Photoshop**

The program comes on a CD.

System software helps the computer perform essential operating tasks and enables the application software to run. System software consists of several programs. The most important is the *operating system*, the master control program that runs the computer. Examples of operating system software for the PC are various Microsoft programs (such as Windows 95, 98, Me, XP, and NT/2000), Unix, and Linux. The Apple Macintosh computer is another matter altogether. As we explain in Chapters 4 and 5, it has its own hardware components and software, which aren't directly transferable to the PC, by and large.

After the system software is installed, setup software for the hard drive, the video and sound cards, and the modem must be installed. These setup programs (called *device drivers*, discussed in Chapter 4) will probably come on CDs (or maybe floppy disks). Once again, the installer inserts these into the drive and then follows the instructions that appear on the screen.

- **Application software:** Now we're finally getting somewhere! After the application software has been installed, you can start using the PC. **Application software enables you to perform specific tasks—solve problems, perform work, or entertain yourself.** For example, when you prepare a term paper on your computer, you will use a word processing program. (Microsoft Word and Corel WordPerfect are two brands.) Application software is specific to the system software you use. If you want to run Microsoft Word, for instance, you'll need to first have Microsoft Windows on your system, not Unix or Linux.

Application software comes on CDs or floppy disks. You insert them into your computer, and then follow the instructions on the screen for installation. Later on you may obtain entire application programs by getting them off the Internet, using your modem.

Although we have said a lot less about software than about hardware, they are equally important. We discuss software in much more detail in Chapters 3 and 4.

Is Getting a Custom-Built PC Worth the Effort?

Does the foregoing description make you want to try putting together a PC yourself? If you add up the costs of all the components (not to mention the value of your time), and then start checking ads for PCs, you might wonder why anyone would bother going to the trouble of building one. And nowadays you would probably be right. "[I]f you think you'd save money by putting together a computer from scratch," says David Einstein, "think again. You'd be lucky to match the price PC-makers are charging these days in their zeal to undercut the competition."²⁷

But had you done this for real, it would not have been a futile exercise: By knowing how to build a system yourself, you'd not only be able to impress your friends, but you'd also know how to upgrade any store-bought system to include components that are better than standard. For instance, as Einstein points out, if you're into video games, knowing how to construct your own PC would enable you to make a system that's right for you. You could include the latest three-dimensional graphics video card and a state-of-the-art sound card, for example. More importantly, you'd also know how to *order* a custom-built system (as from Dell, Gateway, or Micron, the mail-order/online computer makers) that's right for you. In Chapters 5 and 6, we'll expand on this discussion so that you can *really know what you're doing* when you go shopping for a microcomputer system.

Before we end this introductory overview of information technology, let's wrap up the chapter with a look at the future.

Survival Tip

Recycling Old PCs

Have a new computer? Where to donate your old one? Check with schools, after-school programs, churches. Pep Computer Recycling provides a list of recycling firms: www.microweb.com/pepsite/Recycle/National.html
Share the Technology repairs and upgrades old microcomputers to be donated to others: www.sharetechnology.org

CONCEPT CHECK

Describe the three key concepts of how computers work.

Name the principal types of input, processing/memory, storage, output, and communications hardware.

Describe the two types of software.

1.4 Where Is Information Technology Headed?

KEY QUESTIONS

What are three directions of computer development and three directions of communications development?

Considering going into hotel work? Then you'll want to know that the hottest new job there is "computer concierge," or *compcierge* (pay: \$40,000-plus a year), someone with a knowledge of computer systems who helps the 55% of guests who travel with laptop computers when they have PC or online problems.

Or what about accounting? There the newest specialty is *e-commerce accountant* (pay: up to \$54,250), who offers advice on when it makes financial sense to sell goods online, how to find Web developers, and how to manage credit card and sales records.

Today, a knowledge of computers coupled with training in another field offers interesting career paths. Other examples include *bioinformaticist* (biology and computer background, \$100,000-plus salary), who studies gene maps, and *virtual set designer* (training in architecture and 3-D computer modeling; pay: up to \$150,000), who designs sets for TV shows by combining décors built on computers with physical spaces.²⁸

Clearly, information technology is changing old jobs and inventing new ones. To prosper in this environment, you will need to combine a traditional education with training in computers and communications. And you will need to understand what the principal trends of the Information Age are. Let's consider these trends in the development of computers and communications and, most excitingly, the area where they intersect.

Three Directions of Computer Development: Miniaturization, Speed, & Affordability

One of the first computers, the outcome of military-related research, was delivered to the U.S. Army in 1946. ENIAC (short for Electronic Numerical Integrator And Calculator) weighed 30 tons and was 80 feet long and two stories high, but it could multiply a pair of numbers in the then-remarkable time of three-thousandths of a second. This was the first general-purpose, programmable electronic computer, the grandparent of today's lightweight handheld machines.

Grandpa and offspring

ENIAC (left) is the grandfather of today's handheld machines (right).





Microprocessor with integrated circuits (center of chip)

Since the days of ENIAC, computers have developed in three directions—and are continuing to do so.

- **Miniaturization:** Everything has become smaller. ENIAC's old-fashioned radio-style vacuum tubes gave way to the smaller, faster, more reliable transistor. A *transistor* is a small device used as a gateway to transfer electrical signals along predetermined paths (circuits).

The next step was the development of tiny integrated circuits. *Integrated circuits* are entire collections of electrical circuits or pathways that are now etched on tiny squares (chips) of silicon half the size of your thumbnail. *Silicon* is a natural element found in sand. In pure form, it is the base material for computer processing devices.

The miniaturized processor, or microprocessor, in a personal desktop computer today can perform calculations that once required a computer filling an entire room.

- **Speed:** Thanks to miniaturization, computer makers can cram more hardware components into their machines, providing faster processing speeds and more data storage capacity.
- **Affordability:** Processor costs today are only a fraction of what they were 15 years ago. A state-of-the-art processor costing less than \$1000 provides the same processing power as a huge 1980s computer costing more than \$1 million.

These are the three major trends in computers. What about communications?

Three Directions of Communications Development: Connectivity, Interactivity, & Multimedia

Once upon a time, we had the voice telephone system—a one-to-one medium. You could talk to your Uncle Joe and he could talk to you, and with special arrangements (conference calls) more than two people could talk with one another. We also had radio and television systems—one-to-many media (or mass media). News announcers such as Dan Rather, Tom Brokaw, or Peter Jennings could talk to you on a single medium such as television, but you couldn't talk to them.

There have been three recent developments in communications:

- **Connectivity:** *Connectivity* is the ability to connect computers to one another by communications line, so as to provide online information access. The connectivity resulting from the expansion of computer networks has made possible e-mail and online shopping, for example.
- **Interactivity:** *Interactivity* is about two-way communication; a user can respond to information he or she receives and modify the process. That is, there is an exchange or dialogue between the user and the computer or communications device. The ability to interact means users can be active rather than passive participants in the technological process. On the television networks MSNBC or CNN, for example, you can immediately go on the Internet and respond to news from broadcast anchors. In the future, cars may respond to voice commands or feature computers built into the dashboard.



Auto PC

The Clarion Auto PC is the first personal computer designed for a car.

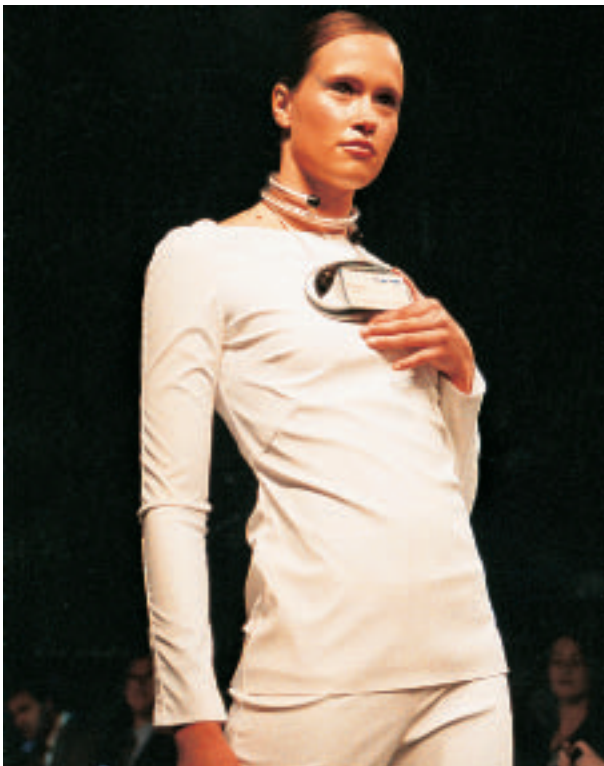
- **Multimedia:** Radio is a single-dimensional medium (sound), as is most e-mail (mainly text). As we mentioned earlier in this chapter, multimedia refers to technology that presents information in more than one medium—such as text, pictures, video, sound, and animation—in a single integrated communication. The development of the World Wide Web expanded the Internet to include pictures, sound, music, and so on, as well as text.

Exciting as these developments are, truly mind-boggling possibilities emerge as computers and communications cross-pollinate.

When Computers & Communications Combine: Convergence, Portability, & Personalization

Sometime in the 1990s, computers and communications started to fuse together, beginning a new era within the Digital Age. The result was three further developments, which haven't ended yet.

- **Convergence:** *Convergence* describes the combining of several industries through various devices that exchange data in the format used by computers. The industries are computers, communications, consumer electronics, entertainment, and mass media. Convergence has led to electronic products that perform multiple functions, such as TVs with Internet access or phones with screens displaying text and pictures.
- **Portability:** In the 1980s, portability, or mobility, meant trading off computing power and convenience in return for smaller size and weight. Today, however, we are close to the point where we don't have to give up anything. As a result, experts have predicted that small, powerful, wireless personal electronic devices will transform our lives far more than the personal computer has done so far. "[T]he new generation of machines will be truly personal computers, designed for our mobile lives," wrote one journalist back in 1992. "We will read office memos between strokes on the golf course and answer messages from our children in the middle of business meetings."²⁹ Today such activities are commonplace. The risk they bring is that, unless we're careful, work will invade our leisure time.
- **Personalization:** Personalization is the creation of information tailored to your preferences—for instance, programs that will automatically cull recent news and information from the Internet on just those topics you have designated. Companies involved in e-commerce can send you messages about forthcoming products based on your pattern of purchases, usage, and other criteria. Or they will build products (cars, computers, clothing) customized to your heart's desire.



Portability
A wearable computer



“E” Also Stands for Ethics

Every computer user will have to wrestle with ethical issues related to the use of information technology. ***Ethics*** is defined as a set of moral values or principles that govern the conduct of an individual or a group. Because ethical questions arise so often in connection with information technology, we will note them, wherever they appear in this book, with the symbol shown in the margin. Here, for example, are some important ethical concerns pointed out by Tom Forester and Perry Morrison in their book *Computer Ethics*.³⁰ These considerations are only a few of many; we’ll discuss others in subsequent chapters.

- **Speed and scale:** Great amounts of information can be stored, retrieved, and transmitted at a speed and on a scale not possible before. Despite the benefits, this has serious implications “for data security and personal privacy,” as well as employment, they say, because information technology can never be considered totally secure against unauthorized access.
- **Unpredictability:** Computers and communications are pervasive, touching nearly every aspect of our lives. However, at this point, compared to other pervasive technologies—such as electricity, television, and automobiles—information technology seems a lot less predictable and reliable.
- **Complexity:** Computer systems are often incredibly complex—some so complex that they are not always understood even by their creators. “This,” say Forester and Morrison, “often makes them completely unmanageable,” producing massive foul-ups or spectacularly out-of-control costs.

CONCEPT CHECK

- Describe the three directions in which computers have developed.
- Describe the three recent directions in which communications have developed.
- Discuss four effects of the fusion of computers and communications.
- Name three ethical considerations that result from information technology.

Onward: Handling Information in the Era of Pervasive Computing

The mountain of information threatens to overwhelm us. How will we cope? Consider the three challenges we mentioned at the start of this chapter:

- **Learn to deal with information overload:** The volume of available information far exceeds the amount of time needed to absorb it. To avoid being buried in an avalanche of unnecessary data, we must learn to distinguish what we *really* need from what we *think* we need. Throughout this book, we present suggestions for how to deal with too much information. In this first chapter, these are featured in the Practical Action Box (“Managing Your E-Mail”) and the Experience Box (see page 24, “Better Organization & Time Management”).
- **Have a strategy for what you memorize and what you don’t:** Probably you’re already feeling stressed about what you have to memorize. Passing the course for which this book is intended, for example, requires you to absorb and remember a number of facts, and we

provide suggestions for how to do that in the following Experience Box. Other matters, such as phone numbers, Internet addresses, and birth dates, can be stored on a cellphone or handheld computer. But don't entrust such information to just one device. The airlines, for instance, recover thousands of cellphones every month that passengers have misplaced (and that most don't claim because they've already bought a new one).³¹ Thus, it's best to have your important phone numbers stored elsewhere as well.

- **Learn how to make your personal “multitasking” efficient:**

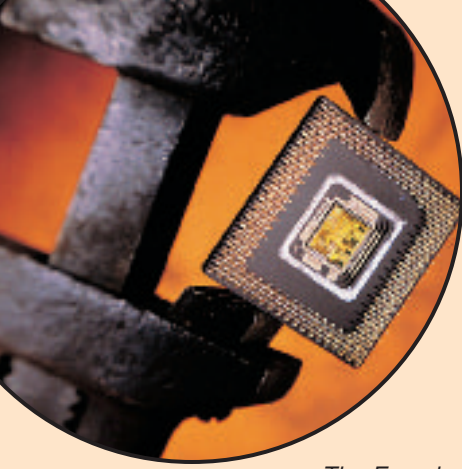
“Multitasking” describes a computer's ability to run several programs at once (as we describe in Chapter 3). However, it has also become a popular term for people performing several tasks at once, such as studying while eating, listening to music, talking on the phone, and handling e-mail. You may think you're one of those people who has no trouble juggling all this, but the brain has limits and can do only so much at one time. For instance, it has been found that people who do two demanding tasks simultaneously—drive in heavy traffic and talk on a cellphone, for instance—do neither task as well as they do each alone.³² Indeed, the result of constantly shifting attention is a sacrifice in quality for *any* of the tasks with which one is engaged. This clearly has some consequences for studying.

This book offers a variation on multitasking that is designed to reinforce learning of the book. Whenever you see the mouse icon, such as the one shown at left, you're invited to go to our website and use your mouse to “click along” while reading the text. The material shown on the website won't take the place of the text, but it will add to it and help to reinforce the information—so that you'll better retain it in preparation for a test.

To see how the first “click-along” works, go to www.mhhe.com/cit/uit5e, and engage the material there. This first instance describes what we mean by multitasking and how it can be used as a positive feature to reinforce learning as you read this book.

CLICK-ALONG 1-1
Understanding your
personal multitasking





Experience Box

Better Organization & Time Management: Dealing with the Information Deluge in College—and in Life

The Experience Box appears at the end of each chapter. Each box offers you the opportunity to acquire useful experience that directly applies to the Digital Age. This first box illustrates skills that will benefit you in college, in this course and others. (Students reading the first four editions of our book have told us they received substantial benefit from these suggestions.)

“How on earth am I going to be able to keep up with what’s required of me?” you may ask yourself. “How am I going to handle the information glut?” The answer is: *by learning how to learn*. By building your skills as a learner, you certainly help yourself do better in college. More than that, however, you also train yourself to be an information manager in the future.

Using Your “Prime Study Time”

Each of us has a different energy cycle. The trick is to use it effectively. That way, your hours of best performance will coincide with your heaviest academic demands. For example, if your energy level is high during the evenings, you should plan to do your studying then.

To capitalize on your prime study time, you take the following steps: (1) Make a study schedule for the entire term and indicate the times each day during which you plan to study. (2) Find some good places to study—places where you can avoid distractions. (3) Avoid time wasters, but give yourself frequent rewards for studying, such as a snack, a TV show, a conversation with a friend.

Improving Your Memory Ability

Memorizing is, of course, one of the principal requirements for succeeding in college. And it’s a great help for success in life afterward. Some suggestions:

Get Rid of Distractions Distractions are a major impediment to remembering (as they are to other forms of learning). *External distractions* are those over which you have no control—hallway noises, instructor’s accent, people whispering in the library. If you can’t banish the distraction by moving, you might try to increase your interest in the subject you are studying. *Internal distractions* are daydreams, personal worries, hunger, illness, and other physical discomforts. Small worries can be shunted aside by listing them on a page for future handling. Large worries may require talking with a friend or counselor.

Space Your Studying, Rather Than Cramming Cramming—making a frantic, last-minute attempt to memorize massive amounts of material—is probably the least effective means of absorbing information. Research shows that it’s best to space out your studying of a subject over successive days. A series of study sessions over several days is preferable to trying to do it all during the same number of hours on one day.³³ It is *repetition* that helps move information into your long-term memory bank.

Review Information Repeatedly—Even “Overlearn” It By repeatedly reviewing information—what is known as “rehearsing”—you can improve both your retention and your understanding of it. Overlearning is continuing to review material even after you appear to have absorbed it.

Use Memorizing Tricks There are several ways to organize information so that you can retain it better. For example, you can make drawings or diagrams (as of the parts of a computer system). Some methods of establishing associations between items you want to remember are given in the box. (See ● Panel 1.4, next page.)



PANEL 1.4

Some memorizing tricks

- **Mental and physical imagery:** Use your visual and other senses to construct a personal image of what you want to remember. Indeed, it helps to make the image humorous, action-filled, sexual, bizarre, or outrageous in order to establish a personal connection. Example: To remember the name of the 21st president of the United States, Chester Arthur, you might visualize an author writing the number “21” on a wooden chest. This mental image helps you associate chest (Chester), author (Arthur), and 21 (21st president).
- **Acronyms and acrostics:** An acronym is a word created from the first letters of items in a list. For instance, *Roy G. Biv* helps you remember the colors of the rainbow in order: red, orange, yellow, green, blue, indigo, violet. An acrostic is a phrase or sentence created from the first letters of items on a list. For example, *Every Good Boy Does Fine* helps you remember that the order of musical notes on the treble staff is *E-G-B-D-F*.
- **Location:** Location memory occurs when you associate a concept with a place or imaginary place. For example, you could learn the parts of a computer system by imagining a walk across campus. Each building you pass could be associated with a part of the computer system.
- **Word games:** Jingles and rhymes are devices frequently used by advertisers to get people to remember their products. You may recall the spelling rule “I before E except after C or when sounded like A as in *neighbor* or *weigh*.” You can also use narrative methods, such as making up a story.

How to Improve Your Reading Ability: The SQ3R Method

SQ3R stands for *survey, question, read, recite, and review*.³⁴ The strategy behind it is to break down a reading assignment into small segments and master each before moving on. The five steps of the SQ3R method are as follows:

1. Survey the Chapter Before You Read It Get an overview of the chapter or other reading assignment before you begin reading it. If you have a sense what the material is about before you begin reading it, you can predict where it is going. In this text, we offer on the first page of every chapter a list of **Key Questions**. We also present “preview”-type material under the heading **Graphical Interface: A Visual Overview of This Chapter**. Finally, at the end of the chapter we offer a **Summary**, which describes what a term or concept means and why it is important.

2. Question the Segment in the Chapter Before You Read It This step is easy to do, and the point, again, is to get yourself involved in the material. After surveying the entire chapter, go to the first segment—section, subsection, or even paragraph, depending on the level of difficulty and density of information. Look at the topic heading of that segment. In your mind, restate the heading as a question. In this book, following each section head we present a **Key Question**. An example in this chapter was “What are three directions of computer development and the three directions of communications development?”

After you have formulated the question, go to steps 3 and 4 (read and recite). Then proceed to the next segment and restate the heading there as a question.

3. Read the Segment About Which You Asked the Question Now read the segment you asked the question about. Read with purpose, to answer the question you formulated. Underline or color-mark sentences you think are important, if they help you answer the question. Read this portion of the text more than once, if necessary, until you can answer the question. In addition, determine whether the segment covers any other significant questions, and formulate answers to these, too. After you have read the

segment, proceed to step 4. (Perhaps you can see where this is all leading. If you read in terms of questions and answers, you will be better prepared when you see exam questions about the material later.)

4. Recite the Main Points of the Segment Recite means “say aloud.” Thus, you should speak out loud (or softly) the answer to the principal question or questions about the segment and any other main points. In this book, we have placed **Concept Checks** here and there throughout that serve this function.

5. Review the Entire Chapter by Repeating Questions After you have read the chapter, go back through it and review the main points. Then, without looking at the book, test your memory by repeating the questions.

Clearly the SQ3R method takes longer than simply reading with a rapidly moving color marker or underlining pencil. However, the technique is far more effective because it requires your involvement and understanding. This is the key to all effective learning.

Learning from Lectures

Does attending lectures really make a difference? Research shows that students with grades of B or above were more apt to have better class attendance than students with grades of C— or below.³⁵

Some tips for getting the most out of lectures:

Take Effective Notes by Listening Actively Research shows that good test performance is related to good note taking.³⁶ And good note taking requires that you listen actively—that is, participate in the lecture process. Here are some ways to take good lecture notes:

- **Read ahead and anticipate the lecturer:** Try to anticipate what the instructor is going to say, based on your previous reading. Having background knowledge makes learning more efficient.
- **Listen for signal words:** Instructors use key phrases such as “The most important point is . . .,” “There are four reasons for . . .,” “The chief reason . . .,”

“Of special importance . . .,” “Consequently . . .” When you hear such signal phrases, mark your notes with a ! or *.

- **Take notes in your own words:** Instead of just being a stenographer, try to restate the lecturer’s thoughts in your own words, which will make you pay attention more.
- **Ask questions:** By asking questions during the lecture, you necessarily participate in it and increase your understanding.

Review Your Notes Regularly Make it a point to review your notes regularly—perhaps on the afternoon after the lecture, or once or twice a week. We cannot emphasize enough how important this kind of reviewing is.

Becoming an Effective Test Taker

Besides having knowledge of the subject matter, you can acquire certain skills that will help during the test-taking process. Some suggestions:³⁷

Reviewing: Study Information That Is Emphasized & Enumerated Because you won’t always know whether an exam will be an objective or essay test, you need to prepare for both. Here are some general tips.

- **Review material that is emphasized:** In the lectures, this consists of any topics your instructor pointed out as being significant or important. It also includes anything he or she spent a good deal of time discussing or specifically advised you to study. In the textbook, pay attention to key terms, which are often emphasized in boldface type, and their definitions. (In this text, we put key terms *and* their definitions in boldface.)
- **Review material that is enumerated:** Pay attention to any numbered lists, both in your lectures and in your notes. Enumerations often provide the basis for essay and multiple-choice questions.

Spend the night before the test reviewing your notes. Then go to bed without interfering with the material you have absorbed. (For example, don’t watch TV.) Get up early the next morning, and review your notes again.

Test Taking: Read Directions & Budget Your Time Get to the classroom early and find a quiet spot. If you don’t have a watch, sit where you can see a clock. Avoid talking with others (so as not to increase your anxiety), and do a last review of your notes. Some other test survival skills:

- **Read the test directions:** Many students don’t do this and end up losing points because they didn’t understand precisely what was required of them. Also, listen to any verbal directions or hints your instructor gives before the test.

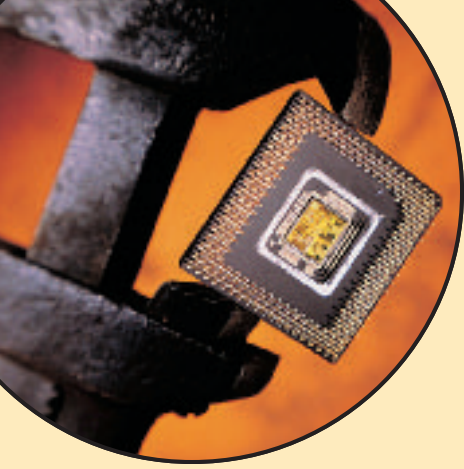
- **Budget your time:** Here is an important point of test strategy: Before you start, read through the entire test and figure out how much time you can spend on each section. There is a reason for budgeting your time, of course. You would hate to find you have only a few minutes left and a long essay still to be written. Write the number of minutes allowed for each section on the test booklet or scratch sheet and stick to the schedule. The way you budget your time should correspond to how confident you feel about answering the questions.

Objective Tests: Answer Easy Questions & Eliminate Options Some suggestions for taking objective tests, such as multiple-choice, true/false, or fill-in, are as follows:

- **Answer all questions—easy ones first:** Unless the instructor says you will be penalized for wrong answers, try to answer all questions. Don’t waste time stewing over difficult questions. Do the easy ones first, and come back to the hard ones later.
- **Eliminate the options:** Cross out answers you know are incorrect. Be sure to read all the possible answers, especially when the first answer is correct. (After all, other answers could also be correct, so that “All of the above” may be the right choice.) Pay attention to options that are long and detailed, since answers that are more detailed and specific are likely to be correct.

Essay Tests: First Anticipate Answers & Prepare an Outline Because time is limited, your instructor is likely to ask only a few essay questions during the exam. The key to success is to try to anticipate beforehand what the questions might be and memorize an outline for an answer. Here are the specific suggestions:

- **Anticipate ten probable essay questions:** Use the principles we discussed above of reviewing lecture and textbook material that is emphasized and enumerated. You will then be in a position to identify ten essay questions your instructor may ask. Write out these questions.
- **Prepare and memorize informal essay answers:** For each question, list the main points that need to be discussed. Put supporting information in parentheses. Circle the key words in each main point and below the question put the first letter of the key word. Make up catch phrases, using acronyms, acrostics, or word games, so that you can memorize these key words. Test yourself until you can recall the key words the letters stand for and the main points the key words represent.



Summary

Note to the reader: “KQ” refers to Key Questions on the first page of each chapter. The number ties the summary term to the corresponding section in the book.

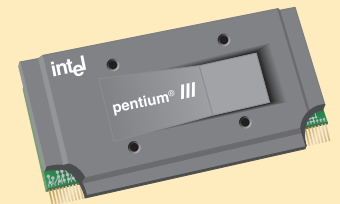
application software (p. 18, KQ 1.3) Software that has been developed to solve a particular problem, perform useful work on general-purpose tasks, or provide entertainment. **Why it's important:** *Application software such as word processing, spreadsheet, database manager, graphics, and communications packages are commonly used tools for increasing people's productivity.*



case (p. 13, KQ 1.3) Also known as the *system unit* or *system cabinet*; the box that houses the processor chip (CPU), the memory chips, and the motherboard with power supply, as well as storage devices—floppy-disk drive, hard-disk drive, and CD or DVD drive. **Why it's important:** *The case protects many important processing and storage components.*

CD drive (p. 15, KQ 1.3) Storage device that uses laser technology to read data from optical disks. **Why it's important:** *New software is generally supplied on CD-ROM disks rather than diskettes. And even if you can get a program on floppies, you'll find it easier to install a new program from one CD-ROM disk rather than repeatedly inserting and removing many diskettes. The newest version is called DVD (digital video disk). The DVD format stores even more data than the CD format.*

central processing unit (CPU) (p. 11, KQ 1.3) Device consisting of electronic circuitry that executes instructions to process data. **Why it's important:** *The CPU is the “brain” of the computer.*



chip (p. 13, KQ 1.3) Tiny piece of silicon that contains millions of miniature electronic circuits used to process data. **Why it's important:** *Chips have made possible the development of small computers.*

clients (p. 9, KQ 1.2) Computers and other devices connected to a server, a central computer. **Why it's important:** *Client/server networks are used in many organizations for sharing databases, devices, and programs.*

communications technology (p. 3, KQ 1.1) Also called *telecommunications technology*; consists of electromagnetic devices and systems for communicating over long distances. **Why it's important:** *Communications systems using electronic connections have helped to expand human communication beyond face-to-face meetings.*

computer (p. 3, KQ 1.1) Programmable, multiuse machine that accepts data—raw facts and figures—and processes (manipulates) it into useful information, such as summaries and totals. **Why it's important:** *Computers greatly speed up problem solving and other tasks, increasing users' productivity.*

connectivity (p. 20, KQ 1.4) Ability to connect computers to one another by communications lines, so as to provide online information access. **Why it's important:** *Connectivity is the foundation of the advances in the digital age. It provides online access to countless types of information and services. The connectivity resulting from the expansion of computer networks has made possible e-mail and online shopping, for example.*

convergence (p. 21, KQ 1.4) The combining of several industries through various devices that exchange data in the format used by computers. The industries are computers, communications, consumer electronics, entertainment, and mass media. **Why it's important:** *Convergence has led to electronic products that perform multiple functions, such as TVs with Internet access or phones with screens displaying text and pictures.*



cyberspace (p. 4, KQ 1.1) Term used to refer to the online world and the Internet in particular but also the whole wired world of communications in general. **Why it's important:** *More and more human activities take place in cyberspace.*

data (p. 10, KQ 1.3) Raw facts and figures that are processed into information. **Why it's important:** *Users need data to create useful information.*

desktop PC (p. 8, KQ 1.2) Microcomputer unit that sits on a desk, with the keyboard in front and the monitor often on top. **Why it's important:** *Desktop PCs and tower PCs are the most commonly used types of microcomputer.*

DVD drive (p. 15, KQ 1.3) See CD drive.

e-mail (electronic mail) (p. 4, KQ 1.1) Messages transmitted over a computer network, most often the Internet. **Why it's important:** *E-mail has become universal; one of the first things new computer users learn is how to send and receive e-mail.*

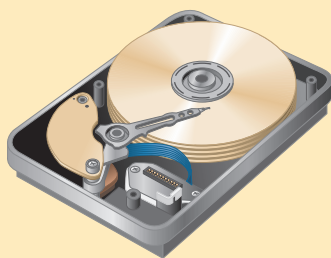


Ethics

ethics (p. 22, KQ 1.4) Set of moral values or principles that govern the conduct of an individual or a group. **Why it's important:** *Ethical questions arise often in connection with information technology.*

expansion slots (p. 13, KQ 1.3) Internal "plugs" used to expand the PC's capabilities. **Why it's important:** *Expansion slots give you places to plug in additional circuit boards, such as those for video, sound, and communications (modem).*

floppy-disk drive (p. 15, KQ 1.3) Storage device that stores data on removable 3.5-inch-diameter flexible diskettes encased in hard plastic. **Why it's important:** *Floppy-disk drives are included on almost all microcomputers and make many types of files portable.*



hard-disk drive (p. 15, KQ 1.3) Storage device that stores billions of characters of data on a nonremovable disk platter inside the computer case. **Why it's important:** *Hard disks hold much more data than diskettes do. Nearly all microcomputers use hard disks as their principal secondary-storage medium.*

hardware (p. 10, KQ 1.3) All machinery and equipment in a computer system. **Why it's important:** *Hardware runs under the control of software and is useless without it. However, hardware contains the circuitry that allows processing.*

information (p. 10, KQ 1.3) Data that has been summarized or otherwise manipulated for use in decision making. **Why it's important:** *The whole purpose of a computer (and communications) system is to produce (and transmit) usable information.*

information technology (p. 2, KQ 1.1) Technology that merges computing with high-speed communications links carrying data, sound, and video. **Why it's important:** *Information technology is bringing about the fusion of several important industries dealing with computers, telephones, televisions, and various handheld devices.*

input (p. 10, KQ 1.3) Whatever is put in ("input") to a computer system. Input devices include the keyboard and the mouse. **Why it's important:** *Useful information cannot be produced without input data.*

interactivity (p. 20, KQ 1.4) Two-way communication; a user can respond to information he or she receives and modify the process. **Why it's important:** *Interactive devices allow the user to actively participate in a technological process instead of just reacting to it.*

Internet (p. 5, KQ 1.1) Worldwide network that connects hundreds of thousands of smaller networks linking computers at academic, scientific, and commercial institutions. **Why it's important:** *Thanks to the Internet, millions of people around the world can share all types of information and services.*



keyboard (p. 12, KQ 1.3) Input device that converts letters, numbers, and other characters into electrical signals readable by the processor. **Why it's important:** *Keyboards are the most common kind of input device.*

local area network (LAN) (p. 8, KQ 1.2) Network that connects, usually by special cable, a group of desktop PCs and other devices, such as printers, in an office or building. **Why it's important:** *LANs have replaced mainframes for many functions and are considerably less expensive.*



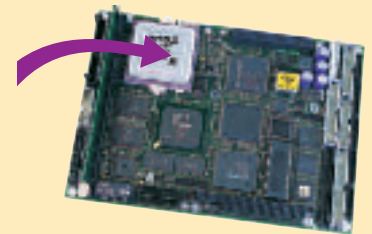
mainframe (p. 8, KQ 1.2) Second-largest computer available, after the supercomputer; capable of great processing speeds and data storage. Costs \$5000–\$5 million. Small mainframes are often called *midsize computers*. **Why it's important:** *Mainframes are used by large organizations (banks, airlines, insurance companies, universities) that need to process millions of transactions.*

memory chip (p. 13, KQ 1.3) Also known as *RAM* (for *random access memory*) chip; represents *primary storage* or *temporary storage*. **Why it's important:** *Holds data before processing and information after processing, before it is sent along to an output or storage device.*

microcomputer (p. 8, KQ 1.2) Also called *personal computer*; small computer that fits on or next to a desktop, or can be carried around. Costs \$500–\$5000. **Why it's important:** *The microcomputer has lessened the reliance on mainframes and has provided more ordinary users with access to computers. It can be used as a stand-alone machine or connected to a network.*



microcontroller (p. 9, KQ 1.2) Also called an *embedded computer*; the smallest category of computer. **Why it's important:** *Microcontrollers are built into "smart" electronic devices, such as appliances and automobiles.*



modem (p. 17, KQ 1.3) Device that sends and receives data over telephone lines to and from computers. **Why it's important:** *A modem enables users to transmit data from one computer to another by using standard telephone lines instead of special communications equipment.*



monitor (p. 16, KQ 1.3) Display device that takes the electrical signals from the video card and forms an image using points of colored light on the screen. **Why it's important:** *Monitors enable users to view output without printing it out.*

motherboard (p. 13, KQ 1.3) Main circuit board in the computer. **Why it's important:** *This is the big green circuit board to which everything else—such as the keyboard, mouse, and printer—is attached. The processor chip and memory chips are also installed on the motherboard.*

mouse (p. 12, KQ 1.3) Input device used to manipulate objects viewed on the computer display screen. **Why it's important:** *For many purposes, a mouse is easier to use than a keyboard for inputting commands. Also, the mouse is used extensively in many graphics programs.*



multimedia (p. 5, KQ 1.1) From "multiple media"; technology that presents information in more than one medium, including text graphics, animation, video, and sound. **Why it's important:** *Multimedia is used increasingly in business, the professions, and education to improve the way information is communicated.*

network (p. 4, KQ 1.1) Communications system connecting two or more computers. **Why it's important:** *Networks allow users to share applications and data and to use e-mail. The Internet is the largest network.*



notebook computer (p. 9, KQ 1.2) Also called *laptop computer*; lightweight portable computer with a built-in monitor, keyboard, hard-disk drive, battery, and adapter; weighs 1.8–9 pounds. **Why it's important:** *Notebook and other small computers have provided users with computing capabilities in the field and on the road.*

online (p. 3, KQ 1.1) Using a computer or other information device, connected through a network, to access information and services from another computer or information device. **Why it's important:** *Online communication is widely used by businesses, services, individuals, and educational institutions.*

output (p. 11, KQ 1.3) Whatever is output from (“put out of”) the computer system; the results of processing. **Why it's important:** *People use output to help them make decisions. Without output devices, computer users would not be able to view or use the results of processing.*

peripheral device (p. 16, KQ 1.3) Any component or piece of equipment that expands a computer's input, storage, and output capabilities. Examples include printers and disk drives. **Why it's important:** *Most computer input and output functions are performed by peripheral devices.*



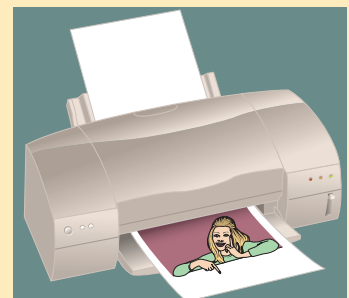
personal digital assistant (PDA) (p. 9, KQ 1.2) Also known as *handheld computer* or *palmtop*; used as a schedule planner and address book and to prepare to-do lists and send e-mail and faxes. **Why it's important:** *PDA's make it easier for people to do business and communicate while traveling.*

primary storage (p. 11, KQ 1.3) Also called *memory*; computer circuitry that temporarily holds data waiting to be processed. **Why it's important:** *By holding data, primary storage enables the processor to process.*

printer (p. 16, KQ 1.3) Output device that produces text and graphics on paper. **Why it's important:** *Printers provide one of the principal forms of computer output.*

processing (p. 11, KQ 1.3) The manipulation the computer does to transform data into information. **Why it's important:** *Processing is the essence of the computer, and the processor is the computer's "brain."*

secondary storage (p. 11, KQ 1.3) Also called *storage*; devices and media that store data and programs *permanently*—such as disks and disk drives, tape and tape drives, CDs and CD drives. **Why it's important:** *Without secondary storage, users would not be able to save their work. Storage also holds the computer's software.*

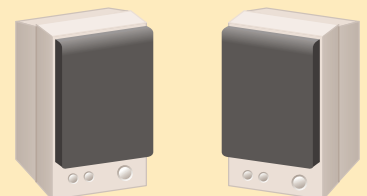


server (p. 9, KQ 1.2) Computer in a network that holds collections of data (databases) and programs for connecting PCs, workstations, and other devices, which are called *clients*. **Why it's important:** *Servers enable many users to share equipment, programs, and data.*

software (p. 10, KQ 1.3) Also called *programs*; step-by-step instructions that tell the computer hardware how to perform a task. **Why it's important:** *Without software, hardware is useless.*

sound card (p. 16, KQ 1.3) Special circuit board that enhances the computer's sound-generating capabilities by allowing sound to be output through speakers. **Why it's important:** *Sound is used in multimedia applications. Also, many users like to listen to music CDs on their computers.*

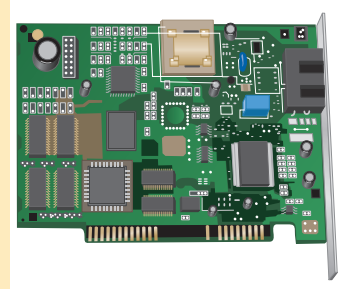
speakers (p. 16, KQ 1.3) Devices that play sounds transmitted as electrical signals from the sound card. Speakers are connected to a single wire plugged into the back of the computer. **Why it's important:** *See sound card.*





supercomputer (p. 7, KQ 1.2) High-capacity computer with hundreds of thousands of processors that is the fastest calculating device ever invented. Costs \$85 million or more. **Why it's important:** *Supercomputers are used primarily for research purposes, airplane design, oil exploration, weather forecasting, and other activities that cannot be handled by mainframes and other less powerful machines.*

system software (p. 18, KQ 1.3) System software helps the computer perform essential operating tasks. **Why it's important:** *Application software cannot run without system software. System software consists of several programs. The most important is the operating system, the*



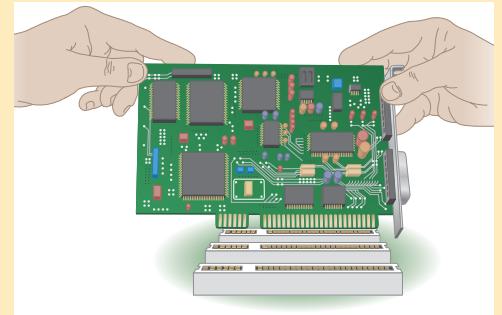
master control program that runs the computer. Examples of operating system software for the PC are various Microsoft programs (such as Windows 95, 98, NT, Me, and XP), Unix, Linux, and the Macintosh operating system.

terminal (p. 8, KQ 1.2) Input and output device that uses a keyboard for input and a monitor for output; it cannot process data. **Why it's important:** *Terminals are generally used to input data to and receive data from a mainframe computer system.*



tower PC (p. 8, KQ 1.2) Microcomputer unit that sits as a "tower" often on the floor, freeing up desk space. **Why it's important:** *Tower PCs and desktop PCs are the most commonly used types of microcomputer.*

video card (p. 16, KQ 1.3) Circuit board that converts the processor's output information into a video signal for transmission through a cable to the monitor. **Why it's important:** *Virtually all computer users need to be able to view video output on the monitor.*



workstation (p. 8, KQ 1.2) Smaller than a mainframe; expensive, powerful computer generally used for complex scientific, mathematical, and engineering calculations and for computer-aided design and computer-aided manufacturing. **Why it's important:** *The power of workstations is needed for specialized applications too large and complex to be handled by PCs.*

World Wide Web (p. 5, KQ 1.1) The part of the Internet that stores information in multimedia form—sounds, photos, and video as well as text. **Why it's important:** *The Web is the most widely known part of the Internet.*



Zip-disk drive (p. 15, KQ 1.3) Storage device that stores data on floppy-disk cartridges with at least 70 times the capacity of the standard floppy. **Why it's important:** *Zip drives are used to store large files.*

Chapter Review

More and more educators are favoring an approach to learning (presented by Benjamin Bloom and his colleagues in *Taxonomy of Educational Objectives*) that follows a hierarchy of six critical-thinking skills: (a) two lower-order skills—*memorization* and *comprehension*; and (b) four higher-order skills—*application*, *analysis*, *synthesis*, and *evaluation*. While you may be able to get through many introductory college courses by simply memorizing facts and comprehending the basic ideas, to advance further you will probably need to employ the four higher-order thinking skills.

In the Chapter Review following the end of each chapter, we have implemented this hierarchy in a three-stage approach, as follows:

- **Stage 1 learning—memorization:** “I can recognize and recall information.” Self-test questions, multiple-choice questions, and true/false questions enable you to test how well you recall basic terms and concepts.
- **Stage 2 learning—comprehension:** “I can recall information in my own terms and explain them to a friend.” Using open-ended short-answer questions, we ask you to re-express terms and concepts in your own words.
- **Stage 3 learning—applying, analyzing, synthesizing, evaluating:** “I can apply what I’ve learned, relate these ideas to other concepts, build on other knowledge, and use all these thinking skills to form a judgment.” In this part of the Chapter Review, we ask you to put the ideas into effect using the activities described, some of which include Internet activities. The purpose is to help you take possession of the ideas, make them your own, and apply them realistically to your life.

stage 1 LEARNING MEMORIZATION

“I can recognize and recall information.”

Self-Test Questions

1. The _____ refers to the part of the Internet that stores information in multimedia form.
2. _____ and _____ refer to the two types of microcomputer. One sits on the desktop and the other usually is placed on the floor.
3. _____ technology merges computing with high-speed communications lines carrying data, sound, and video.
4. A _____ is a programmable, multiuse machine that accepts data and processes it into information.
5. Messages transmitted over a computer network are called _____.
6. The _____ is a worldwide network that connects hundreds of thousands of smaller networks.
7. _____ refers to technology that presents information in more than one medium.
8. _____ are high-capacity machines with hundreds of thousands of processors.
9. Embedded computers, or _____, are installed in “smart” appliances and automobiles.
10. The kind of software that enables users to perform specific tasks is called _____ software.

Multiple-Choice Questions

1. Which of the following converts computer output into displayed images?
 - a. printer
 - b. monitor
 - c. floppy-disk drive
 - d. processor
 - e. hard disk drive

2. Which of the following computer types is the smallest?
 - a. mainframe
 - b. microcomputer
 - c. microcontroller
 - d. supercomputer
 - e. workstation
3. Which of the following is a secondary storage device?
 - a. processor
 - b. memory chip
 - c. floppy-disk drive
 - d. printer
 - e. monitor
4. Since the days when computers were first made available, computers have developed in three directions. What are they?
 - a. increased expense
 - b. miniaturization
 - c. increased size
 - d. affordability
 - e. increased speed
5. Which of the following operations constitute the four basic operations followed by all computers?
 - a. input
 - b. storage
 - c. programming
 - d. output
 - e. processing

True/False Questions

- T F** 1. Mainframe computers process faster than microcomputers.
- T F** 2. Main memory is a software component.
- T F** 3. The operating system is part of the system software.
- T F** 4. Processing is the manipulation by which a computer transforms data into information.
- T F** 5. Primary storage is the area in the computer where data or information is held permanently.

stage 2 LEARNING COMPREHENSION

"I can recall information in my own terms and explain them to a friend."

Short-Answer Questions

1. What does *online* mean?
2. What is the difference between system software and application software?
3. Briefly define *cyberspace*.
4. What is the difference between software and hardware? Between system software and application software?
5. Briefly describe what a local area network is.

stage 3 LEARNING APPLYING, ANALYZING, SYNTHESIZING, EVALUATING

"I can apply what I've learned, relate these ideas to other concepts, build on other knowledge, and use all these thinking skills to form a judgment."

Knowledge in Action

1. Do you wish there was an invention to make your life easier or better? Describe it. What would it do for you? Come up with ideas on how that device may be constructed.
2. Determine what types of computers are being used where you work or go to school. In which departments are the different types of computer used? What are they used for? How are they connected to other computers?
3. Imagine a business you could start or run at home. What type of business is it? What type of computer(s) do you think you'll need? Describe the computer system in as much detail as possible, including hardware components in the areas we have discussed so far. Keep your notes and then refine your answers after you have completed the course.

Web Exercises

1. Are computers, cellphones, and other electronic devices bad for our health? You may have heard the term *electromagnetic radiation* and dismissed it as an obscure scientific term not worth understanding. Visit the links below to become educated on a topic that will be discussed more seriously and frequently when our society becomes completely wireless.

http://gladstone.uoregon.edu/~dgibbens/no_denial/em_radiation.html

www.nzine.co.nz/articles/Electromagnetic_Radiation/

www.eos.ncsu.edu/eos/info/computer_ethics/social/workplace/emr/study.html

2. List the pros and cons of a paperless environment. Do you feel this challenge is something to strive for? Run a Web search on what others are doing to implement this idea in their workplaces.
3. Computer pioneer John Von Neumann was one of a group of individuals who conceived the idea of the “stored program.” He could also divide two 8-digit numbers in his head. Spend a few hours researching this remarkable man. Add the words Tesla, Einstein, Montauk, Bielek, or Teller to the search, and you will receive bizarre search results. Had you heard of John Von Neumann before reading this textbook?
4. Looking for legally free programs? Some great places to start:

www.download.com

www.shareware.com

www.freeware.com

(They're all essentially part of *www.cnet.com*.)

5. Visit the following websites to become aware of some topics of interest in the computing world. Full comprehension of these topics isn't necessary at this time; this is only to familiarize you with subject matter you may come in contact with.

www.siliconvalley.com

www.zdnet.com/eweek

www.artificialintelligence.com

www.technology.com