

Introduction to Information Technology

Your Digital World

Chapter Topics & Key Questions

- 1.1 Infotech Is Commonplace: Cellphones, Email, the Internet, & the E-World** How does information technology facilitate email, 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: How Can You Customize 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?

C omputers and communications. These are the two powerful wellsprings of the Information Age. From them arises a torrent of technological change.



Consider the following recent innovations:

- Desktop computers—“teleputers”—on which you can watch television as well as check email, write documents, and do calculations.
- Cellphones with digital cameras that allow you to check the news, download videoclips, and participate in multiplayer online games.
- Smart, computerized houses that enable the owners to change window tints, turn on music, control thermostats, monitor security, and from their cars miles away open the front door over the internet and watch via webcam to see who enters.
- Internet refrigerators that make ice, keep track of provisions, and allow you to maintain an address book and calendar, watch television, play music, do email, and surf the web.

Some of these devices might seem merely silly. Who really needs a high-tech icebox, for example? However, in some electricity-starved countries, such as Italy, networked appliances can monitor and adjust to power demands.

More importantly, these devices serve to show that we live in the era of *pervasive computing*. The world has moved on beyond boxy computers that sit on desks or even on laps. Today handheld computers and beefed-up cellphones (not to mention terminals everywhere—libraries, airports, cafés) let us access information anytime anywhere. And not just general information but personal information—electronic correspondence, documents, appointments, photos, songs, money matters, and other data important to us.

Central to this concept 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, experts suggest, will move onto the internet, giving us greater mobility and wrapping the internet around our lives.¹ So central is the internet to our lives, in fact, that many writers are now spelling it without the capital “I”—*Internet* becomes *internet*, just as *Telephone* became *telephone*—because both systems belong not to just one owner but to the world. We will follow this new convention in this book.

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*: International Data Corporation (IDC) has forecast that by 2005 more than 36 billion person-to-person emails will be sent daily. Already, the average business user reportedly spends more than 2 hours a day just dealing with email.² 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.³ A third result is a *surge in “multitasking” activity*: People have become highly skilled in performing several tasks at once, such as doing homework while talking on the phone, watching TV, answering email, and surfing the World Wide Web. A fourth, according to technology observer Howard Rheingold, is that *smart mobile devices could produce “smart mobs”*—groups of people who can do things together (in business, politics, and journalism, for example) even if they don’t know each other.⁴ These four trends pose unique challenges to how you learn and manage information. An important

“Just keeping busy.” Multiple electronic devices allow people to simultaneously do multiple tasks—multitasking.



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 email. 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 Is Commonplace: Cellphones, Email, the Internet, & the E-World

KEY QUESTIONS

How does information technology facilitate email, 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*, or “infotech.” **Information technology (IT) is a general term that describes any technology that helps to produce, manipulate, store, communicate, and/or disseminate information.** IT merges computing with high-speed communications links carrying data, sound, and video. Examples of information technology include personal computers but also new forms of telephones, televisions, appliances, and various handheld devices.

Note that there are two important parts to information technology—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 communication among computers—which is what happens when people “go online” on the internet. In this context, **online means using a computer or some 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

Cellphone mania has swept the world. All across the globe, people have acquired the portable gift of gab; a Japanese industry body estimated that 1.25 billion people worldwide will be using cellphones in 2005.⁵ Some cellphone users 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.

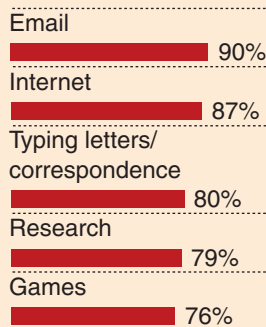


● PANEL 1.1 Smartphone

The Sanyo SCP-8100 cellphone includes a digital camera and can send pictures wirelessly with voice memos attached. It also provides internet access and a browser.

TOP FIVE USES

Percentage of households with PCs that use their computer for each task



Source: *The New York Times*, September 30, 2002, p. C1.

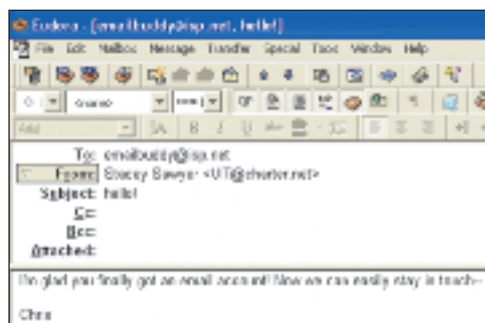
Why introduce a book that is about computers with a discussion of telephones? Because internet phones, especially “smartphones”—such as the Toshiba 2032, Treo 300, Sanyo SCP-8100, and Kyocera 7135—represent another giant step for information technology. (See ● Panel 1.1.) Now you no longer need a personal 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 email. In addition, phones coming on the market now can plug into computer-chip-based sensing devices—from health monitors to automotive diagnostic devices—and translate the data for transmission. For example, if you’re having car trouble, you could plug your smart cellphone into a special port under your car’s dashboard. The phone’s special program would convert engine data and send it to an internet site that could be viewed by mechanics using an auto shop’s computer. The mechanics could diagnose your problem, and then you could decide how to deal with it.

“You’ve Got Mail!” Email’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 homes 5 years after they were introduced. Email, which appeared in 1981, became popular far more quickly, reaching 10 million users in little more than a year.⁶ 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 *email*—“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.

Until 1998, hand-delivered mail was still the main means of correspondence. But in that year, the volume of email in the United States surpassed the volume of hand-delivered mail. In 2002, an estimated average of 8 billion messages a day were zipping back and forth across the United States, up from 3.5 billion 3 years earlier.⁷ By 2006, the total number of email messages sent daily will probably exceed 60 billion worldwide, compared with 31 billion worldwide in 2002.⁸ Already, in fact, email is the leading use of PCs. Because of this explosion in usage, suggests a *Business Week* report, “email ranks with such pivotal advances as the printing press, the telephone, and television in mass impact.”⁹

How is using electronic mail different from calling on a telephone or writing a conventional letter? Email “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.”¹⁰ Email has blossomed, points out another writer, not because it gives us more immediacy but because it gives us *less*. “The new appeal of email is the old appeal of print,” he says. “It isn’t instant; it isn’t immediate; it isn’t in your face.” Email 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.”¹¹



B O O K M A R K I T !

PRACTICAL ACTION BOX

Managing Your Email



For many people, email is the online environment, more so than the World Wide Web. In one study, respondents reported they received an average of 31 email messages a day.^a But then there are those such as Jeremy Gross, managing director of technology for Countrywide Home Loans, who gets 300 emails a day—and about 200 are junk email (spam), bad jokes, or irrelevant memos (the “cc,” previously “carbon copy,” now “courtesy 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 email, even when I don’t initiate a single one.”^c

It’s clear, then, that email 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 email:^d

- *Do your part to curb the email deluge:* Put short messages in the subject line so recipients don’t have to open the email to read the note. Don’t reply to every email 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 email 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 email attachments, which are activated only upon opening.
- *Use discretion about the emails you send:* Email 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. Email 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 email in place of personal contact:* Because email carries no tone or inflection, it’s hard to convey personal concern. Avoid criticism and sarcasm in electronic messaging. Nevertheless, you can use email to provide quick praise, even though doing it in person will take on greater significance.
- *Be aware that email you receive at work is the property of your employer:* Be careful of what you save, send, and back up.
- *Realize that deleting email messages doesn’t totally get rid of them:* “Delete” moves the email 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 email from the hard disk.

From this it is easy to conclude, as *New York Times* computer writer Peter Lewis did, that email “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.”¹² What is interesting, though, is that in these times when images often seem to overwhelm words, email 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.”¹³ Email 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. (*Cyber* comes from “cybernetics,” a term coined in 1948 to apply to the comparative study of

automatic control systems, such as the brain/nervous system and mechanical-electrical communication systems.) In everyday use, this term has a rather different meaning.

Today many people equate cyberspace with the internet. But it is much more than that. 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,” says David Whittler.¹⁴ We may say, then, 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 nonphysical terrain created by computer and communications systems. Cyberspace is where you go when you go online with your computer.

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*** (the “net”) is a worldwide computer network that connects hundreds of thousands of smaller networks. These networks link educational, commercial, nonprofit, and military entities, as well as individuals.
- **The World Wide Web—the multimedia part of the internet:** The internet has been around for more than 30 years. But what made it popular, apart from email, was the development in the early 1990s of the ***World Wide Web***, usually called simply the “web”—an interconnected system of internet computers (called *servers*) that support specially formatted documents 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.

There is no doubt that the influence of the net and the web is tremendous. At present, 61% of all Americans go online at least once a month.¹⁵ But just how revolutionary is the internet? 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.”¹⁶

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.

The E-World & Welcome to It

One thing we know already is that cyberspace is saturating our lives. More than 165.2 million Americans are internet users, according to a recent survey.¹⁷ 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 use the internet, according to Teenage Research Unlimited (TRU), a Chicago market research firm. Why is that? Email is certainly one important reason—it's all about staying connected.

But it has to do with more than just email. Teenagers are also big participants in online commerce. TRU's studies show that when teens want information on a brand, 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."¹⁸ The electronic world is everywhere. The net and the web are everywhere. Cyberspace permeates everything.

QuickCheck

What are the two parts of information technology?

What is email?

What is cyberspace?

How does the World Wide Web differ from the internet?

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*. Maybe, then, the name "computer" is inadequate. As computer pioneer John Von Neumann has said, the device should not be called the 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 \$350 million, *supercomputers* are high-capacity machines with thousands of processors that can perform more than several trillion calculations per second. These are the most expensive but fastest computers



Supercomputer. The NEC Earth Simulator, the world's fastest computer.

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 encryption 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 \$350 million and looks like rows of refrigerator-size boxes, is the NEC Earth Simulator in Yokohama, Japan. This supercomputer has 5,120 main processors, each of which consists of 8 subprocessors. It occupies a space the size of four tennis courts and uses 2,800 kilometers of cable. NEC's supercomputer will create a "virtual planet earth" by processing mountains of data sent from satellites, ocean buoys, and other worldwide observation points. The system will analyze and predict environmental activities and changes, including global warming, El Niño effects, marine pollution, rainfall patterns, tectonic plate movement, typhoons, and earthquakes.

Supercomputers are still the most powerful computers. But a new generation is coming: "Imagine a trillion laptops in every drop of water," as one writer puts it.¹⁹ The next generation of computers will be made of DNA and will fit into a single human cell. The biological *nanocomputer* will use DNA as its software and enzymes as its hardware;

it will have molecular-sized circuits that will be viewable only through a microscope. (*Nano* means "one-billionth.") This promise of ever smaller, faster, and more powerful computers is an important concept in the realm of pervasive computing, and many companies are working on nanocomputers as you read this, hoping to begin production within 10 years. Some believe that they can create computers the size of a pencil eraser that work 10 times faster than today's fastest supercomputer.²⁰ Undoubtedly nanotech will first be used by the government, the military, universities, and some private corporate laboratories—but nanotech may eventually show up in every device and appliance in your life!

Who Makes the Most Superfast Computers?			
Specifications of Fastest Machine			
Company	Name	Speed (gigaflops)	Location
Hewlett-Packard	ASCI Q	7,727	Los Alamos National Laboratory, NM
IBM	ASCI White	7,226	Lawrence Livermore National Laboratory, CA
Sun Microsystems	HPC 4500	420	Swedish Armed Forces, Stockholm, Sweden
Silicon Graphics	ASCI Blue Mountain	1,608	Los Alamos National Laboratory, NM
Cray	T3E 1200	1,166	Unknown (U.S. government)
NEC	Earth Simulator	35,860	Earth Simulator Center, Yokohama, Japan

Source: Claire Tristram, "Supercomputing Resurrected," February, 2003, p. 54; www.technologyreview.com.



Mainframe. In 2003 IBM launched a new mainframe line code-named T-Rex and formally called the z900 models.

- **Mainframe computers:** The only type of computer available until the late 1960s, *mainframes* are water- or air-cooled computers that cost \$5,000 to \$5 million and vary in size from small, to medium, to large, depending on their use. Small mainframes (\$5,000 to \$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 personal computers usually used for complex scientific, mathematical, and engineering calculations and for computer-aided design and computer-aided manufacturing. Providing many capabilities comparable to midsized 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, which are used to breathe three-dimensional life into movies such as *The Lord of the Rings* and *Harry Potter*. The capabilities of low-end workstations overlap those of high-end desktop microcomputers.



Workstation. Sun Ultra450.

- **Microcomputers:** *Microcomputers*, also called *personal computers (PCs)*, which cost \$500 to \$5,000, 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, notebooks (laptops), and personal digital assistants—handheld computers or palmtops.

Desktop PCs are microcomputers whose case or main housing sits on a desk, with keyboard in front and monitor (screen) often on top.

Tower PCs are microcomputers whose case sits as a “tower,” often on the floor beside a desk, thus freeing up desk surface space.

Two microcomputers. Compaq Evo desktop microcomputer.



HP Compaq Business d220 tower microcomputer.



Notebook



PDA



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 email and faxes. Some PDAs have 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 power setting. 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. Microcontrollers are also used in blood pressure monitors, air bag sensors, gas and chemical sensors for water and air, and vibration sensors.



Microcontroller. The MPXY8020A pressure sensor from Motorola reduces tire blowouts, extends tire life, and improves gas mileage. This embedded computer notifies drivers, via a dashboard display, when tire pressure is not optimal.

Server farms. A group of networked servers that are housed in one location is called a *server farm* or a *server cluster*.



Servers

The word *server* describes not 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 the web, they deserve mention here. (Servers are discussed in Chapter 6.)

A ***server***, or ***network server***, is a central computer that holds collections of data (databases) and programs for connecting or supplying services to 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, provide printing stations, and transmit email. In large organizations, servers may also 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.

QuickCheck

Describe the five sizes of computers.

What are the different types of microcomputers?

Define *servers* and *clients*.

1.3 Understanding Your Computer: How Can You Customize 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?

Perhaps you know how to drive a car. But do you know what to do when it runs badly? Similarly, perhaps you've already been using a personal computer. But do you know what to do when it doesn't act right—when, for example, it suddenly shuts down ("crashes")?

Cars are now so complicated that professional mechanics are often required for even the smallest problems. With personal computers, however, there are still things you can often do yourself—and should learn to do, so that you can be effective, efficient, and employable. To do so, you first need to know how computers work.

How Computers Work: Three Key Concepts

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.²¹

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

We’re not 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 a custom-built system. It will also help you understand how your existing system works, if you have one.

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. Hardware is useless without software. ***Software, or programs, consists of all the electronic 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 and 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 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, pressure, light beams, or whatever raw material needs processing. When you type some words or numbers on a keyboard, those words are considered input data.
 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 internal computer circuitry that temporarily holds data waiting to be processed. Secondary storage, simply called storage, refers to the devices and media that store data or information permanently.*** A floppy disk (diskette) or hard disk is an example of this kind of storage. (Storage also holds the software—the computer programs.)

Survival Tip

Input is covered in detail in Chapter 5.

Survival Tip

Processing is covered in detail in Chapter 4.

Survival Tip

Storage is covered in detail in Chapter 4.

Survival Tip

Output is covered in detail in Chapter 5.

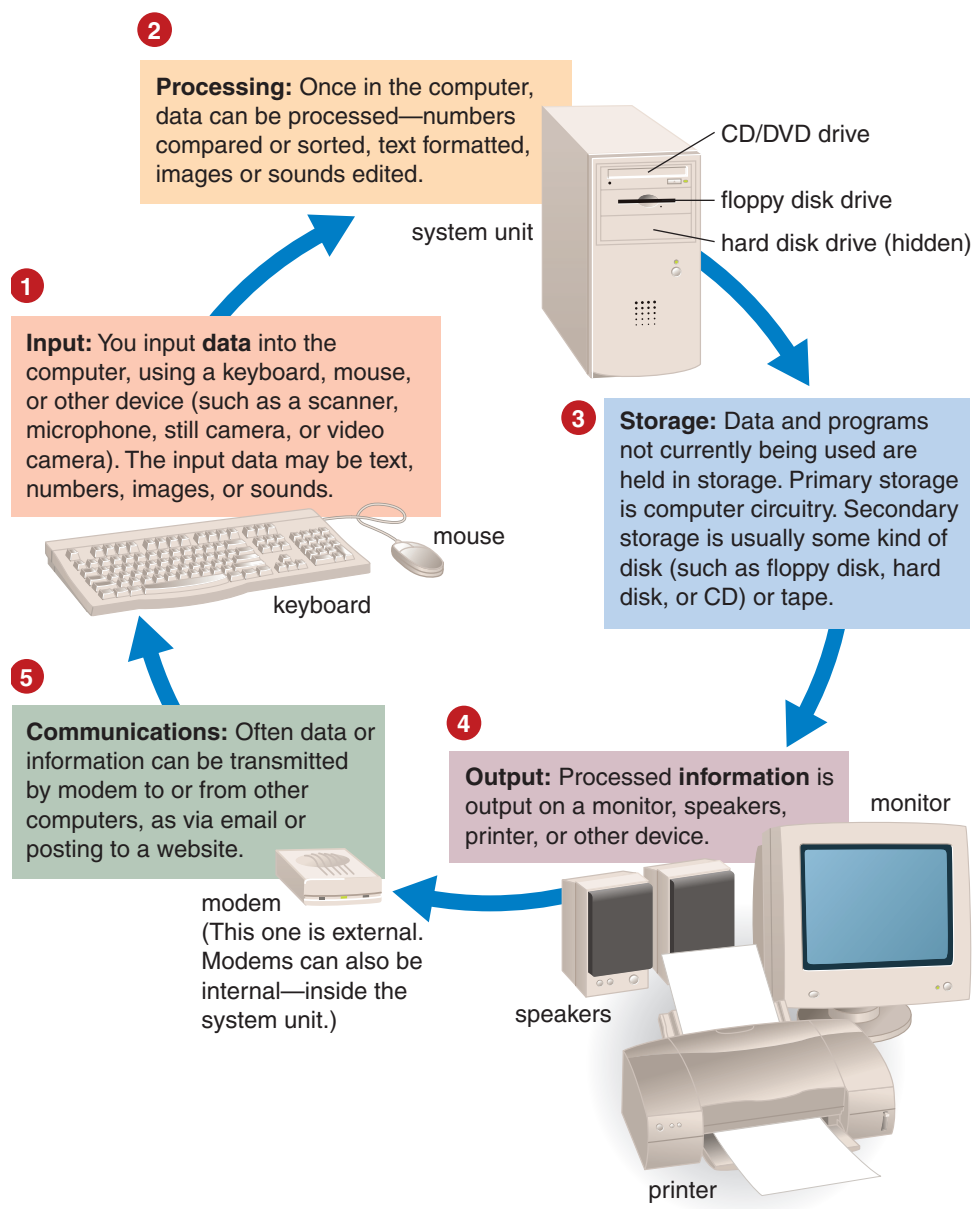
Survival Tip

Communications is covered in detail in Chapters 2 and 6.

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.

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

● PANEL 1.2
Basic operations of a computer



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 knowledgeable about using one and buying 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 kitchen table about to begin assembling them. All you would need is a combination Phillips/flathead screwdriver, perhaps a small wrench, and a static-electricity-arresting strap for your wrist. [Static electricity can adversely affect some computer components.] 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 late 2003 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.)

Note: All the system components you or anyone else chooses *must be compatible*—in other words, each brand must work with other brands. If you work with one company—such as Dell, Apple, or Hewlett-Packard—to customize your system, you won't have to worry about compatibility. If you choose all the components yourself—for example, by going to a computer-parts seller such as Aberdeen (www.aberdeeninc.com)—you will have to check on compatibility as you choose each component. And you'll have to make sure each component comes with any necessary cables, instructions, and component-specific software (called a *driver*) that makes the component run.

This section of the chapter gives you a brief overview of the components; they are all covered in detail in Chapters 2–7.

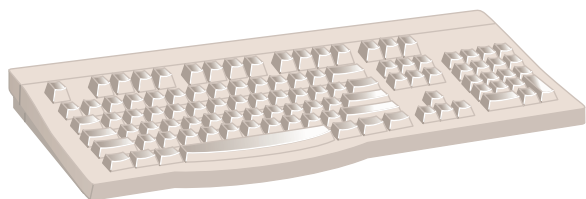
Survival Tip

Hardware Info

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

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*.



Keyboard



Mouse

- **Keyboard:** Cost: \$22–\$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 having 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. (Cordless keyboards work differently.)

- **Mouse:** \$25–\$100. A ***mouse*** is a nonkeyboard input device (“pointing device”) that is used to manipulate objects viewed on the computer display screen. The mouse cord is plugged into the back of the computer or into the back of the keyboard after the other components are assembled. (Cordless mice are also available.)

Processing & Memory Hardware: Inside the System Cabinet

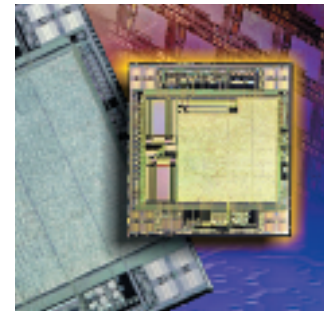
The brains of the computer are the processing and memory devices, which are installed in the case or system cabinet.

Case or system cabinet

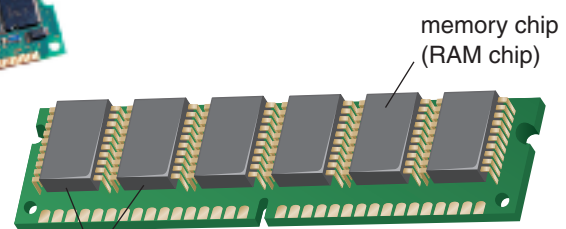


Processor chip. In a cell-phone, the chip (shown on fingertip), which does the most important work, is not much bigger than a display screen icon.

- **Case and power supply:** About \$80–\$160. 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 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:** \$65–\$900 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 (CPU)* 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. The faster the processor, the more expensive it is. For \$65, you might get a 1.33-GHz chip, which is adequate for most student purposes. For \$350, you might get a 2.13-GHz chip, which you would want if you're running software with spectacular graphics and sound, such as those with some new video games. Only older processors' speed is measured in megahertz now, but if you want a cheap processor—for instance, because you plan to work only with text documents—you could get a 233-MHz processor for \$40.
- **Memory chips:** \$20–\$150. These chips 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 at least 128 megabytes, or roughly 128 million characters, of data, which is adequate for most student purposes. If you work with large graphics files, you'll need more memory capacity, 192–256 megabytes or perhaps even 512 megabytes. (We explain the numbers used to measure storage capacities in a moment.)



Memory chips

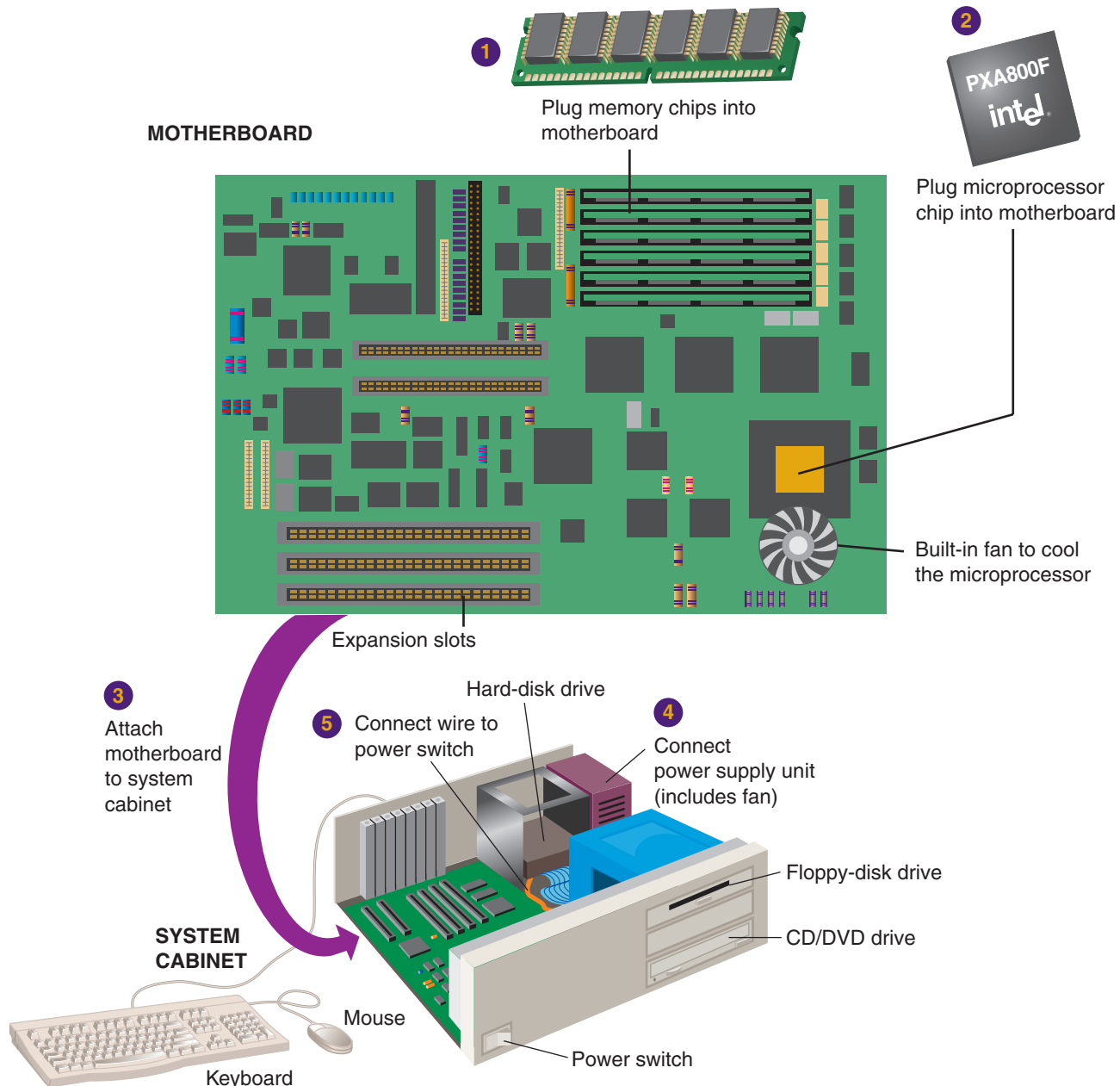


memory chips mounted on module

- **Motherboard:** About \$100–\$180. 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.

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).

Now the components can be put together. As the illustration below shows, ❶ the memory chips are plugged into the motherboard. Then ❷ the processor chip is plugged into the motherboard. Now ❸ the motherboard is attached to the system cabinet. Then ❹ the power supply unit is connected to the system cabinet. Finally, ❺ 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/DVD Drive

With the motherboard in the system cabinet, the next step is installation of the storage hardware. Whereas memory chips deal only with temporary storage, *secondary storage*, or *permanent storage*, stores your data for as long as you want.

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:

1 byte = 1 character of data (A character can be alphabetic—A, B, or C—or numeric—1, 2, or 3—or a special character—!, ?, *, \$, %.)

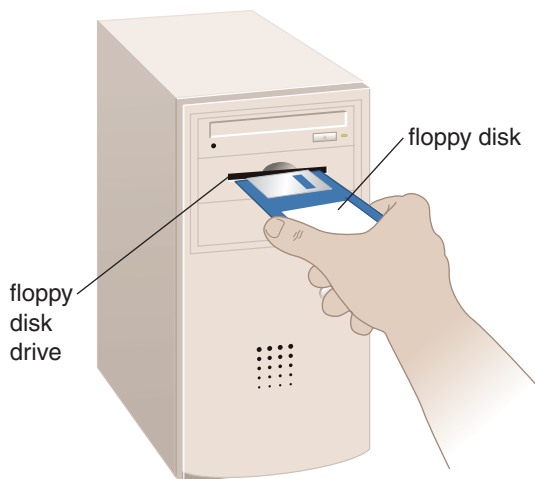
1 kilobyte = 1,024 characters

1 megabyte = 1,048,576 characters

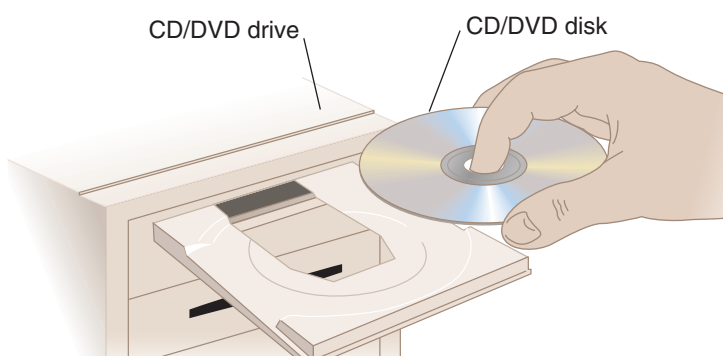
1 gigabyte = more than 1 billion characters

1 terabyte = more than 1 trillion characters.

Floppy disk and drive



Zip disk and drive



- **Floppy-disk and Zip drives:** \$25 (floppy)–\$150 (Zip). 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 removable floppy-disk cartridges with 70–170 times the capacity of the standard floppy.

- **Hard-disk drive:** \$110 for 80 gigabytes of storage (higher-capacity and lower-capacity drives are available). A ***hard-disk drive*** is a storage device inside the computer case that stores billions of characters of data on a nonremovable disk platter. With 80 gigabytes of storage, you should be able to handle most student needs.

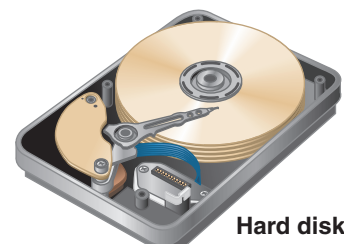
- **CD/DVD drive:** \$50. A ***CD (compact-disk) drive***, or its more recent variant, a ***DVD (digital video-disk) drive***, is a storage device that uses laser technology to read data from optical disks. (Some companies call a DVD a "digital versatile disk.") These days new software is generally supplied 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.



Floppy disk



Zip disk



Hard disk

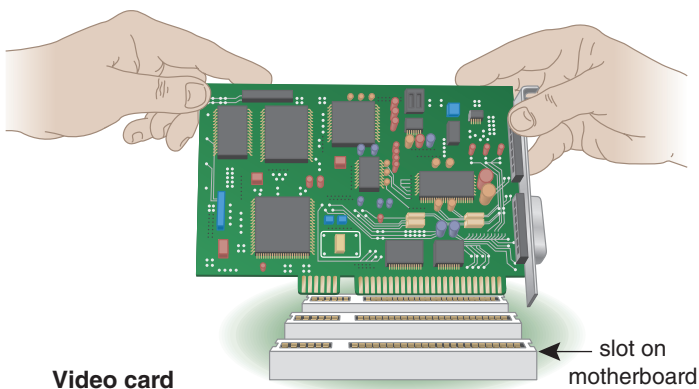
The system cabinet has lights on the front that indicate when these drives are in use. (You must not remove the diskette from the floppy-disk drive until its light goes off, or else you risk damage to both disk and drive.) The wires for these lights need to be attached to the motherboard.

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.

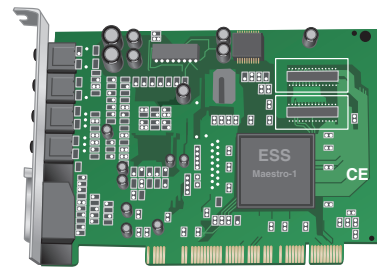
This is a good place to introduce the term *peripheral device*. A **peripheral device** is any component or piece of equipment that expands a computer's input, storage, and output capabilities. In other words, a peripheral device is not part of the essential computer. Peripheral devices can be inside the computer or connected to it from the outside. Examples include printers and disk drives.

- **Video card:** \$50–\$500. 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 mother board with built-in video.)
- **Sound card:** \$30–\$200 and higher. You may wish to listen to music on your PC. If so, you'll need a **sound card**, which enhances



Video card

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 drive connected to the card, you can listen to music CDs.

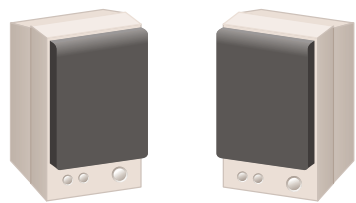


Sound card

- **Monitor:** \$100–\$200 or higher for a 17-inch model, \$200–\$1,000 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.



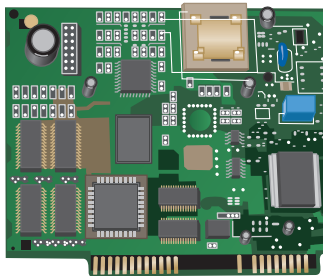
Monitor



Sound speakers



Printer



Internal modem

- **Pair of speakers:** \$25–\$250. *Speakers* are the devices that play sounds transmitted as electrical signals from the sound card. They 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:** \$50–\$700. 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. 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. Color printers are more expensive than black-and-white printers, and fast printers cost more than slow ones.

Communications Hardware: Modem

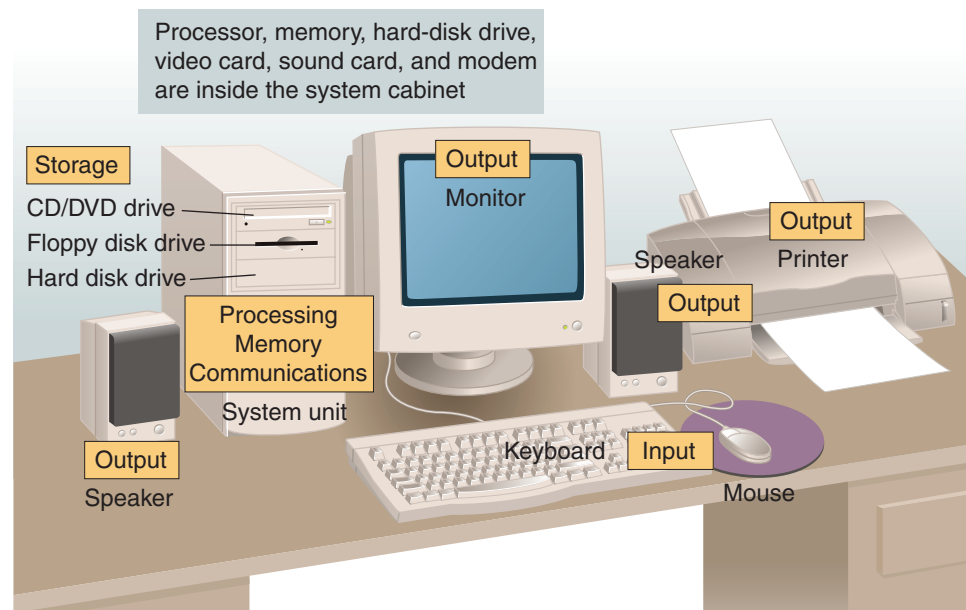
Computers can be stand-alone machines, unconnected to anything else. If all you're doing is word processing to write term papers, a stand-alone system may be fine for you. As we have seen, however, the communications component of the computer system vastly extends the range of a PC. Thus, while the system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

- **Modem:** \$40–\$100. A standard *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.

Other types of communications connections exist, which we cover in Chapter 6. However, standard modems are still commonly used.

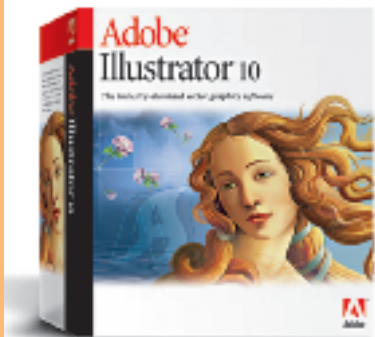
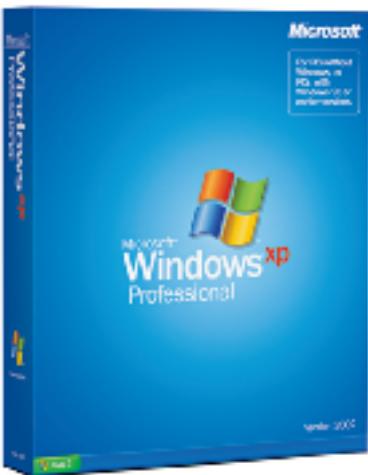
Now the system cabinet is closed up. The person building the system will plug in all the input and output devices and turn on the power "on" button. Your microcomputer system will look similar to the one below. (See • Panel 1.3.) Are you now ready to roll? Not quite.

• **PANEL 1.3**
Completely assembled PC hardware system



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, the electronically encoded instructions that tell the computer hardware what to do. Software is what makes the computer worthwhile. There are two types—*system software* and *application software*.



- **System software:** First, system software must be installed. **System software helps the computer perform essential operating tasks and enables the application software to run.** System software consists of several electronically coded 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), Unix, and Linux. The Apple Macintosh microcomputer is another matter altogether. As we explain in Chapters 4 and 5, it has its own hardware components and software, which, by and large, aren't directly transferable to the Windows PC.

System software comes most often on CDs. The person building your computer system will insert these into your CD drive and follow the on-screen directions for installation. (*Installation* is 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 your hardware.)

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 (*drivers*, discussed in Chapter 3) will probably come on CDs (or maybe floppy disks). Once again, the installer inserts these into the appropriate 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.) Adobe Illustrator and Photoshop are popular application programs for creating and manipulating graphics. 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 system software on your system, not Unix or Linux.

Application software comes on CDs or floppy disks packaged in boxes that include instructions. You insert the CDs 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 (downloading them from) the internet, using your modem or another type of communications connection, as we discuss in Chapters 2 and 6.

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. "If 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."²²

But had you done this for real, it would not have been a futile exercise: By knowing how to build a system yourself, not only would you 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 important, 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 4 and 5, 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.

QuickCheck

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?

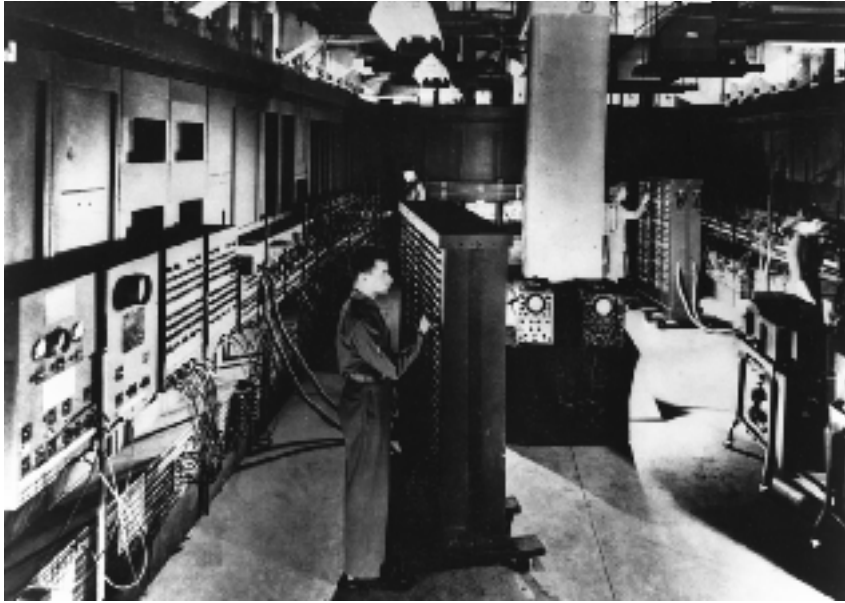
KEY QUESTION

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

Today almost every job and profession require computer skills of some sort. Some are ordinary jobs in which computers are used as ordinary tools. Others are specialized jobs in which advanced computer training combined with professional training gives people dramatically new careers. Consider:

- In the hotel business, even front-desk clerks need to know how to deal with computerized reservation systems. Some hotels, however, also have a so-called computer concierge, someone with a knowledge of computer systems who can help guests who have notebooks with their online and other problems.
- In law enforcement, police officers need to know how to use computers while on patrol or at their desks to check out stolen cars, criminal records, outstanding arrest warrants, and the like. However, investigators with specialized computer backgrounds are also required to help solve fraud, computer break-ins, accounting illegalities, and other high-tech crimes.
- In entertainment, computers are used for such ordinary purposes as budgets, payroll, and ticketing. However, there are also new careers in virtual set design, combining training in architecture and 3-D computer modeling, and in creating cinematic special effects

Clearly, information technology is changing old jobs and inventing new ones. To prosper in this environment, you will need to combine a traditional



● PANEL 1.4
Grandparent and offspring
 ENIAC (*left*) is the grandparent of today's handheld machines (*right*).


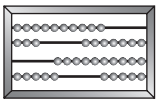
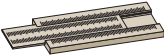


education with training in computers and communications. And you will need to understand what the principal trends of the Information Age are. Let's consider these trends in the development of computers and communications and, most excitingly, the area where they intersect.

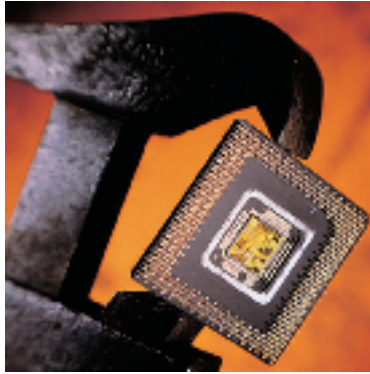
Three Directions of Computer Development: Miniaturization, Speed, & Affordability

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. (*See ● Panel 1.4.*) This was the first general-purpose, programmable electronic computer, the grandparent of today's lightweight handheld machines.

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

Timeline
 Overview of some of the historical developments in information technology.

4000–1200 BCE	3000 BCE	1621 CE	1642	1666	1801
Inhabitants of the first known civilization in Sumer keep records of commercial transactions on clay tablets 	Abacus is invented in Babylonia 	Slide rule invented (Edmund Gunther) 	First mechanical adding machine (Blaise Pascal) 	First mechanical calculator that can add and subtract (Samuel Morland) 	A linked sequence of punched cards controls the weaving patterns in Jacquard's loom



Integrated circuit

- **Miniaturization:** Everything has become smaller. ENIAC's old-fashioned radio-style vacuum tubes gave way after 1947 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 and new material used in making processors, 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 \$1,000 provides the same processing power as a huge 1980s computer costing more than \$1 million.

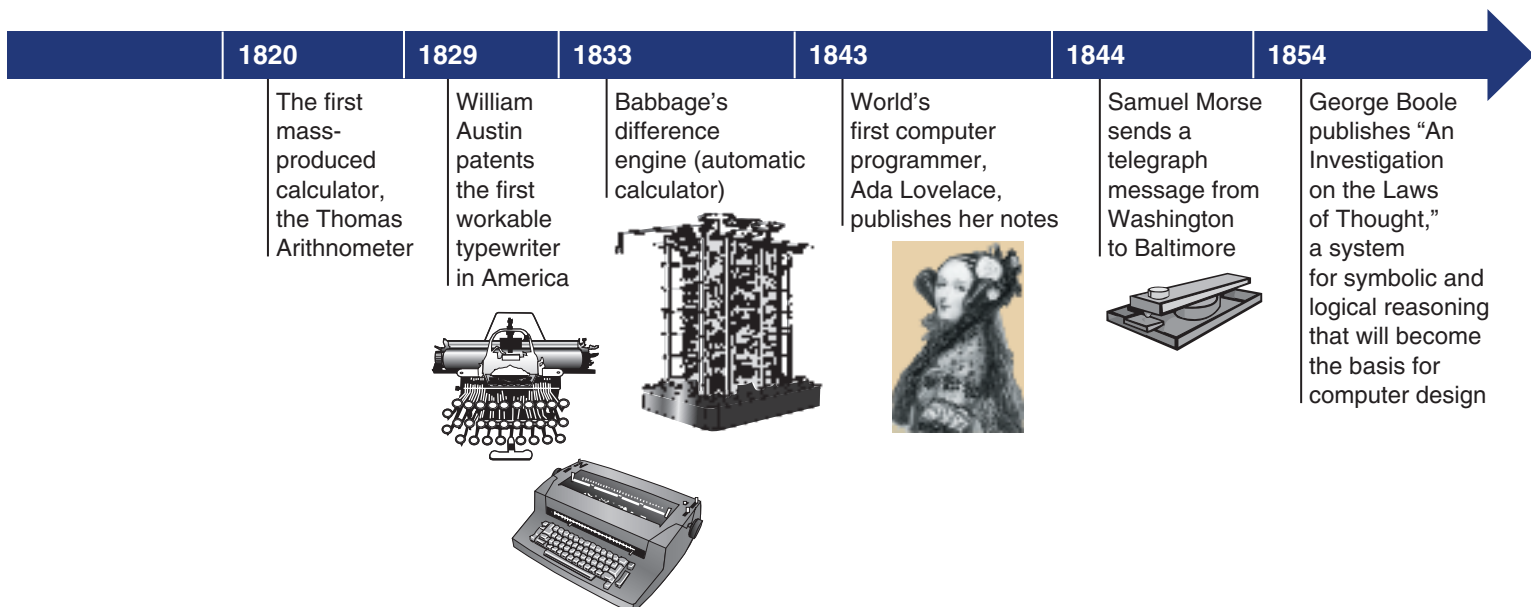
These are the three major trends in computers. What about communications?

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 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* refers to the connection of computers to one another by a communications line in order to provide online information access and/or the sharing of peripheral devices. The connectivity resulting from the expansion of computer networks has made possible email and online shopping, for example.





Interactivity. A dashboard computer allows drivers to request information about their car's operation, geographic location, and nearby services.

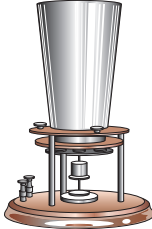
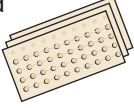

- **Interactivity:** *Interactivity* refers to two-way communication; the user can respond to information he or she receives and modify what a computer is doing. That is, there is an exchange or dialogue between the user and the computer, and the computer responds to user requests. A noninteractive program, once started, continues without requiring human contact, or interaction. 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. Today, most application software is interactive. In the future, cars may respond to voice commands or feature computers built into the dashboard.
- **Multimedia:** Radio is a single-dimensional medium (sound), as is most email (mainly text). As 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 Information Age. The result was three further developments, which have only just begun.

- **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, cellphones that are also digital cameras, and refrigerators that allow you to send email.
- **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. "The

1876	1890	1895	1907	1920–1921	1924
Alexander Graham Bell patents the telephone 	Electricity used for first time in a data-processing project (punched cards)—Hollerith's automatic census-tabulating machine (used punched cards) 	First radio signal transmitted 	First regular radio broadcasts from New York	The word "robot," derived from the Czech word for compulsory labor, is first used to mean a humanlike machine	T.J. Watson renames Hollerith's machine company, founded in 1896, to International Business Machines (IBM)

(Left) Micro Vision's Retinal Scanning Display records what the user is seeing and sends the data to a mode worn on the user's belt.
 (Right) The HandsFreeMobile e-Belt wearable computer.

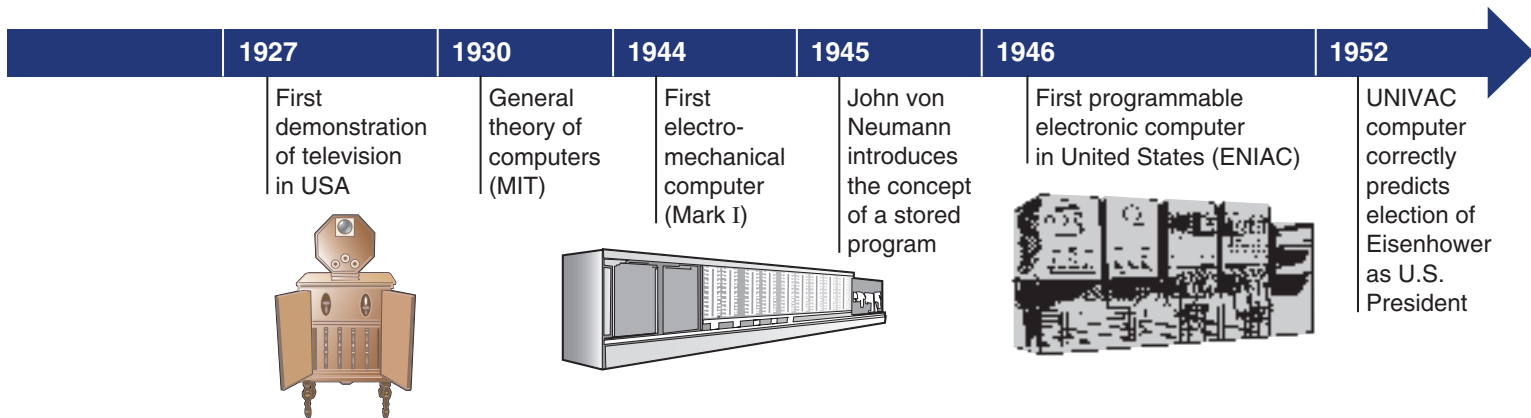


new generation of machines will be truly personal computers, designed for our mobile lives," wrote one journalist back in 1992. "We will read office memos between strokes on the golf course and answer messages from our children in the middle of business meetings."²³ Today such activities are commonplace, and smartphones are taking on other functions. 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.

“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*.²⁴ These considerations are only a few of many; we'll discuss others in subsequent chapters.

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

Survival Tip

Share the Technology repairs and upgrades old microcomputers to be donated to others: www.sharetechnology.org

- **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, Forester and Morrison 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.



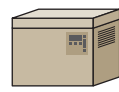

QuickCheck

Describe the three directions in which computers have developed.
 Describe the three recent directions in which communications have developed.
 Discuss three 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 four 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

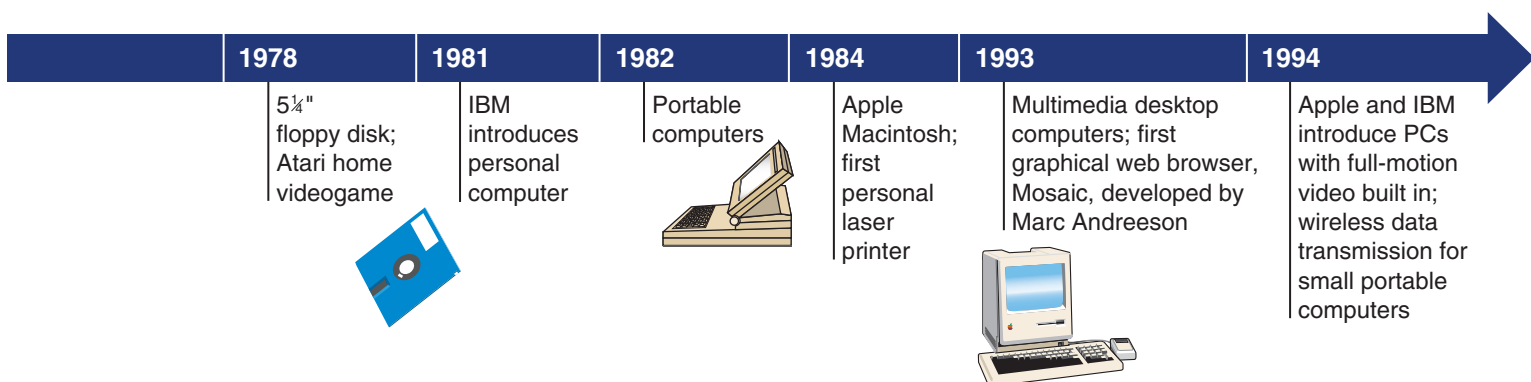
1964	1967	1969	1970	1971	1975	1976
IBM introduces 360 line of computers	Hand-held calculator 	ARPANet established by U.S. Advanced Research Project Agency, led to internet	Micro-processor chips come into use; floppy disk introduced for storing data	First pocket calculator 	First micro-computer (MIT's Altair 8800) 	Apple I computer (first personal computer sold in assembled form) 

**more
info!**

From now on, whenever you see this icon you'll find information about internet sites to visit and how to search for terms related to the topic just discussed.

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 Email.").

- **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 that you absorb and remember a number of facts. 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).²⁵ Thus, it's best to have your important phone numbers stored elsewhere as well.
- **Learn how to make your personal "multitasking" efficient:** *Multitasking* refers to a computer's ability to run several programs at once (as we describe in Chapter 4). 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 email. 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. 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.
- **Be aware that "smart mobs" could also be dumb mobs:** We mentioned the notion that smart mobile devices could produce groups of people—"smart mobs"—who cooperate in ways never before possible because they carry portable technology that possesses both computing and communications capabilities. Yet there is also the possibility that others—the government, corporate marketers—could transform these devices into weapons against the users. Thus, you need to become aware of how security and privacy can be abridged in ways that could transform you from a member of a smart mob to that of a "dumb mob."





Summary

Note to the reader: “KQ” refers to the Key Questions listed on the first page of each chapter and repeated with each numbered main section head.

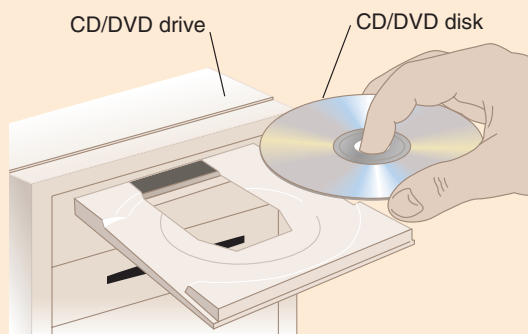
application software (p. 20, KQ 1.3) Software that has been developed to solve a particular problem, perform useful work on general-purpose tasks, or provide entertainment. **Why it's important:** Application software such as word processing, spreadsheet, database management, graphics, and communications packages are commonly used tools for increasing people's productivity.



case

case (p. 15, 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 (compact-disk) drive (p. 17, 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 CDs 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 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. 15, KQ 1.3) The computer's main chip, consisting of electronic circuitry that executes instructions to process data. **Why it's important:** The CPU is the “brain” of the computer.

chip See **processor chip**.

clients (p. 11, 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.



computer

connectivity (p. 23, KQ 1.4) Ability to connect computers to one another by communications lines, so as to provide online information access and/or the sharing of peripheral devices. **Why it's important:** Connectivity is the foundation of the advances in the Information Age. It provides online access to countless types of information and services. The connectivity resulting from the expansion of computer networks has made possible email and online shopping, for example.

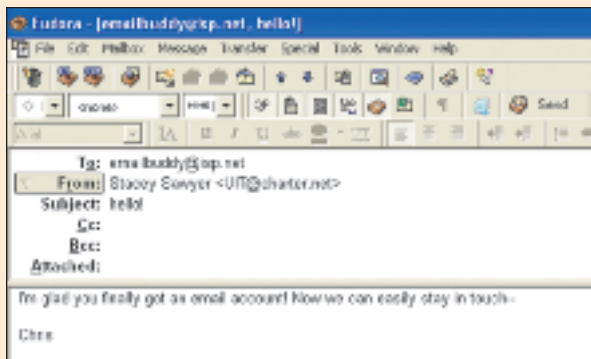
cyberspace (p. 6, KQ 1.1) Term used to refer to the online world and the internet in particular but also the whole wired and wireless world of communications in general. **Why it's important:** More and more human activities take place in cyberspace.

data (p. 12, KQ 1.3) Raw facts and figures processed into information. **Why it's important:** Users need data to create useful information.

desktop PC (p. 9, 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 (digital video-disk) drive See CD drive.

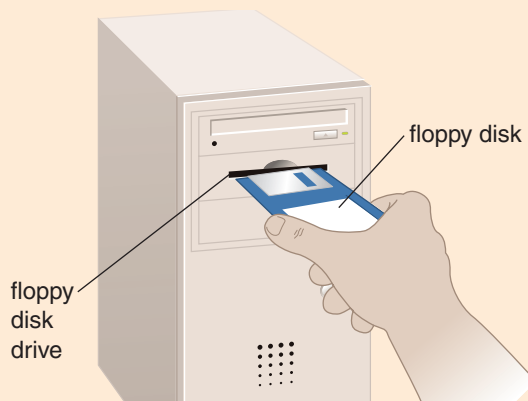
email



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

ethics (p. 25, 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. 16, 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. 17, 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. 17, KQ 1.3) Storage device that stores billions of characters of data on a nonremovable disk platter usually 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.

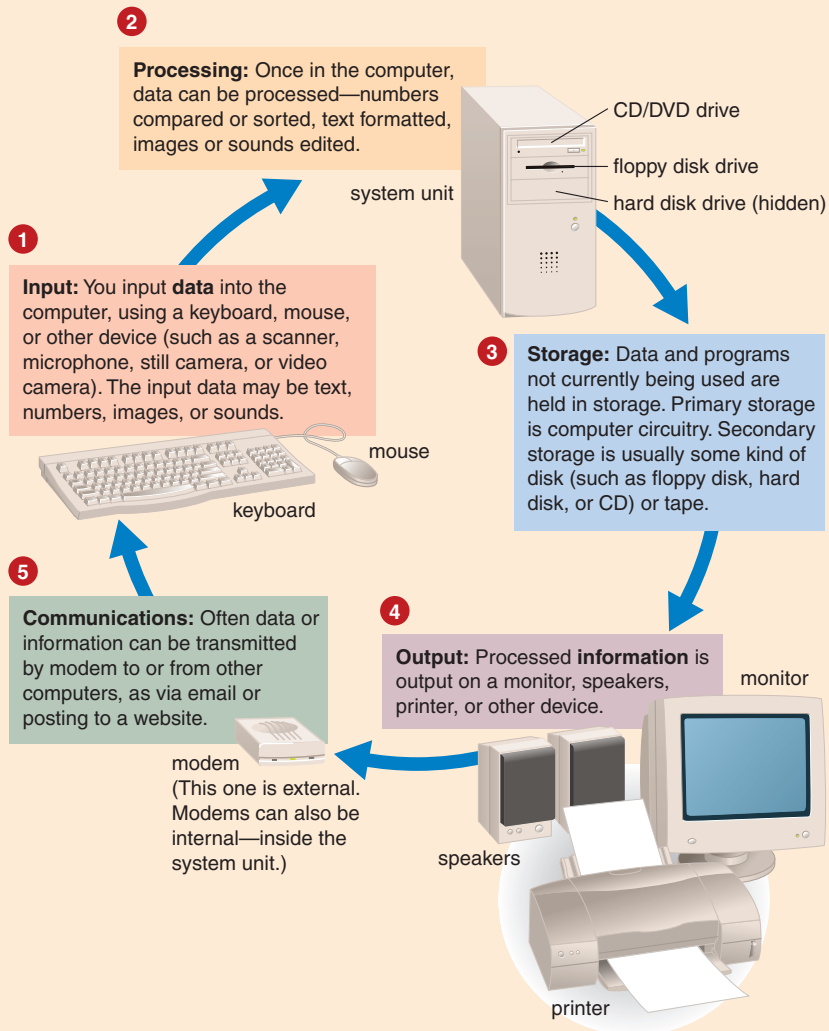


hardware (p. 12, KQ 1.3) All machinery and equipment in a computer system. **Why it's important:** Hardware runs under the control of software and is useless without it. However, hardware contains the circuitry that allows processing.

information (p. 12, 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 (IT) (p. 3, KQ 1.1) Technology that helps to produce, manipulate, store, communicate, and/or disseminate information. **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. 12, 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. 24, 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.

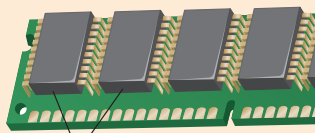
internet (the “net”) (p. 6, KQ 1.1) Worldwide computer network that connects hundreds of thousands of smaller networks linking computers at academic, scientific, and commercial institutions, as well as individuals. **Why it’s important:** Thanks to the internet, millions of people around the world can share all types of information and services.

keyboard (p. 14, 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. 9, 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 a building. **Why it’s important:** LANs have replaced mainframes for many functions and are considerably less expensive.

mainframe (p. 9, KQ 1.2) Second-largest computer available, after the supercomputer; capable of great processing speeds and data storage. Costs \$5,000–\$5 million. Small mainframes are often called *midsized*

computers. **Why it’s important:** Mainframes are used by large organizations (banks, airlines, insurance companies, universities) that need to process millions of transactions.



memory chips mounted on module

memory chip (p. 15, 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. 9, KQ 1.2) Also called *personal computer*; small computer that fits on or next to a desktop or can be carried around. Costs \$500–\$5,000. **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.

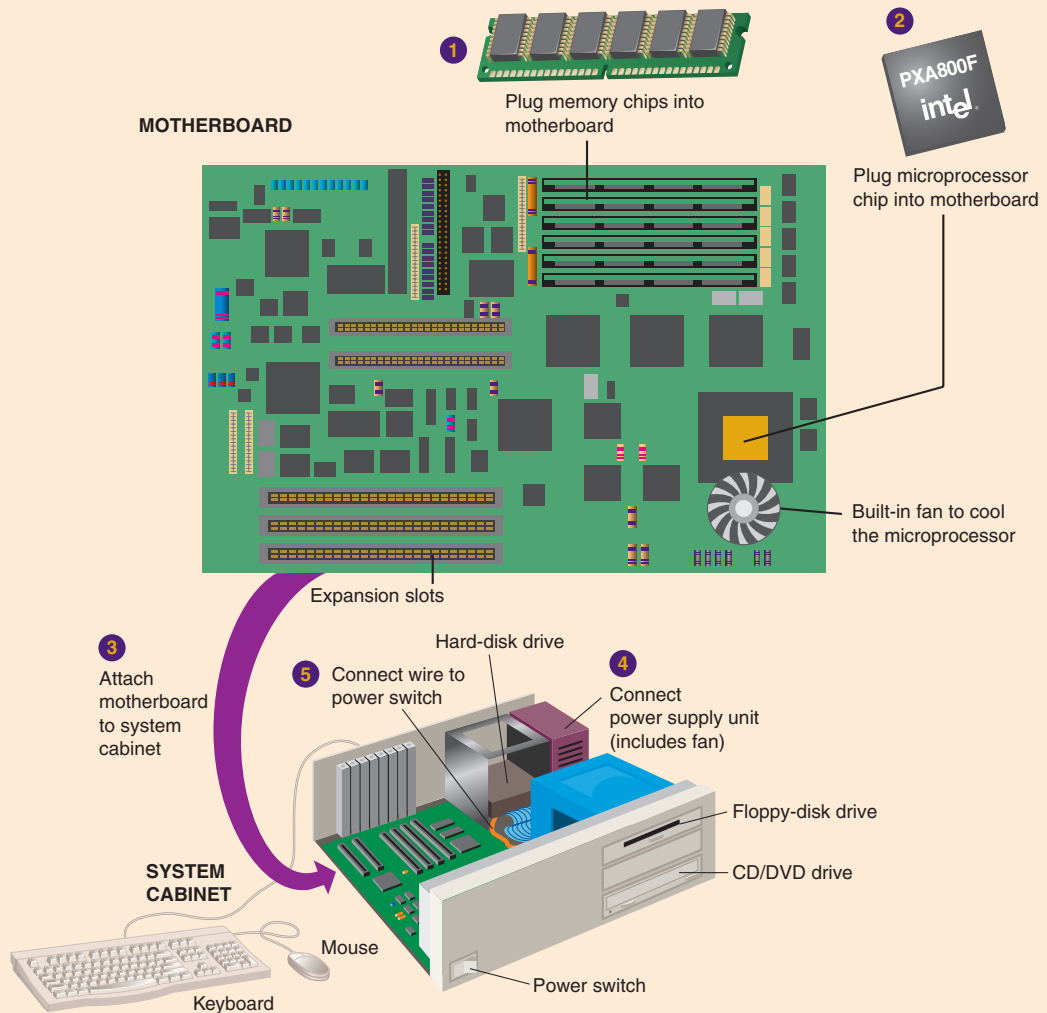
microcontroller (p. 10, KQ 1.2) Also called an *embedded computer*; the smallest category of computer. **Why it’s important:** Microcontrollers are built into “smart” electronic devices, such as appliances and automobiles.

modem (p. 19, 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. 18, 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. 16, 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. 14, KQ 1.3) Nonkeyboard input device, called a “pointing 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. 24, KQ 1.4) From “multiple media”; technology that presents information in more than one medium—including text graphics, animation, video, and sound—in a single integrated communication. **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



notebook computer (p. 10, 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 some 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. 13, 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. 18, 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.

PDA



personal digital assistant (PDA) (p. 10, 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 email and faxes. **Why it’s important:** PDAs make it easier for people to do business and communicate while traveling.

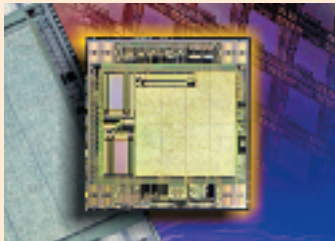
primary storage (p. 12, KQ 1.3) Also called *memory*; internal computer circuitry that temporarily holds data waiting to be processed. **Why it’s important:** By holding data, primary storage enables the processor to process.

printer (p. 19, 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. 12, 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.”

chip



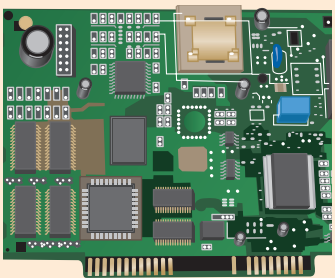
processor chip (p. 15, KQ 1.3) Also called *central processing unit (CPU)*; tiny piece of silicon that contains millions of miniature electronic circuits used to process data. **Why it’s important:** Chips have made possible the development of small computers.

secondary storage (p. 12, 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. 11, 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. 12, KQ 1.3) Also called *programs*; step-by-step electronically encoded instructions that tell the computer hardware how to perform a task. **Why it’s important:** Without software, hardware is useless.

sound card



sound card (p. 18, 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. 19, 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 thousands of processors that is the fastest calculating device ever invented. Costs up to \$350 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

system software (p. 20, KQ 1.3) Software that 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. 9, 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. 9, 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. 18, 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

workstation (p. 9, 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 (the "web") (p. 6, KQ 1.1) The interconnected system of internet servers that support specially formatted documents 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. 17, KQ 1.3) Storage device that stores data on removable 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.



Zip disk and drive

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 at 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 reexpress 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 micro-computer. 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 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.
11. RAM is an example of _____ storage, and a hard drive is an example of _____ storage.
12. A _____ is a communications system connecting two or more computers.

13. The four basic operations of all computers are _____, _____, _____, and _____, and to this we also add communications.

Multiple-Choice Questions

1. Which of the following devices 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
6. Supercomputers are used for:
 - a. breaking codes
 - b. simulations for explosions of nuclear bombs
 - c. forecasting weather
 - d. keeping planets in orbit
 - e. all of the above
 - f. only a, b, and c
7. What is the leading use of computers?
 - a. web surfing
 - b. email
 - c. e-shopping
 - d. word processing
8. Which is the main circuit board in the computer?
 - a. RAM chip (random access memory)
 - b. CPU processor chip (central processing unit)
 - c. motherboard (system board)
 - d. hard drive

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.
- T F** 6. The keyboard and the mouse are examples of input devices.
- T F** 7. The biological nanocomputer will use DNA as its software and enzymes as its hardware.
- T F** 8. Radio is a form of multimedia.
- T F** 9. Computers are becoming larger, slower, and more expensive.

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?
5. What is a local area network?
6. What is multimedia?
7. What is the difference between microcomputers and supercomputers?
8. What is the function of RAM?

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.
4. Has reality become science fiction? Or has science fiction become science fact? Watch a recent science fiction movie, and list all the futuristic technology used.

Categorize according to the operations of input, output, processing, storage, or communications.

- From what you've read and what you have experienced and/or observed in your life, do you have a positive, negative, or impartial outlook of our rapidly converging technological society? Why? Reevaluate your answers at the end of the course.

Web Exercises

If you are not yet familiar with web surfing, wait until you have finished Chapter 2 to do the following web exercises.

- 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.
 - www.nzine.co.nz/articles/Electromagnetic_Radiation/
 - www.eos.ncsu.edu/eos/info/computer_ethics/social/workplace/emr/study.html
 - www.howstuffworks.com/cell-phone-radiation.htm
- 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.
- 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; look up some of the books he wrote at online bookstores and read the reviews. Also search these words: *Tesla, Einstein, Montauk, Bielek, Teller* (you will receive bizarre search results). Had you heard of John Von Neumann before reading this textbook?
- Looking for legally free programs? Some great places to start:
 - www.download.com
 - www.shareware.com
 - www.freeware.com
- 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.computeruser.com/
 - www.computermarket.com/news/
 - <http://slashdot.org/>
- So you want to be a millionaire? Visit the web link below for various kinds of interactive calculators that can tell you how much you will need to earn and save to become a millionaire. The website has links that can also calculate other things such as how much you will need to save for retirement and how many tax exemptions you have.
 - http://retireplan.about.com/library/weekly/aa_calculators_a.htm
- Is there an end to Pi (3.14)? Read the article at the page listed below to see how a Tokyo research team used a supercomputer to calculate Pi to 1.2411 trillion decimal places.
 - <http://pub39.ezboard.com/fhuntforplanetxfrm49.showMessage?topicID=59.topic>
 - www.newscom.au/common/story_page/0,4057,5638320%5E1702,00.html
- Go to www.nec.com/global/features/index9.html www.es.jamstec.go.jp/esc/eng to see the Earth Simulator, the world's fastest supercomputer. You read in this chapter (p. 8) about some of the things this supercomputer is used for. What other uses are mentioned at this website?

Who's Online?

English language:

About 231 million (36.5% of total world online population)

Non-English language:

About 403.5 million (63.5%)

Chinese—68.4 million (10.8%)

Japanese—61.4 million (9.3%)

Spanish—40.8 million (7.2%)

German—42 million (6.6%)

Korean—28.3 million (4.5%)

French—22 million (3.5%)

Italian—24 million (3.8%)

Portuguese—19 million (3%)

Dutch—12.4 million (2%)

Arabic—5.5 million (.9%)

Of course, other language groups are also online, and the numbers increase daily.

Source: Global Reach, Global Internet Statistics, January 19, 2003, <http://greach.com/eng/ed/gre/index.php3>; "Languages on the I-net."