CHAPTER 1

Introduction to Information Technology—Hardware, Software, and Telecommunications

CHAPTER OUTLINE

LEARNING OBJECTIVES

Upon completion of this chapter, you will be able to

- Define information technology, computer, and computer literacy and understand their significance in today's society.
- Describe the classification of computers into supercomputers, mainframes, microcomputers, minicomputers, personal digital assistants (PDAs), and embedded computers.
- Differentiate between hardware and software and discuss the different hardware components of a computer.
- Describe the difference between system and application software, know what an operating system is, and know what various application programs are used for what tasks.
- Discuss the significance of connectivity and networking.
- Discuss the recent expansion of the uses of wireless technologies including cell phones, Global Positioning System (GPS) technology, and PDAs with Internet access.
- List the components necessary for telecommunications to take place.
- State the uses of telecommunications and networking.

INFORMATION TECHNOLOGY AND COMPUTER LITERACY

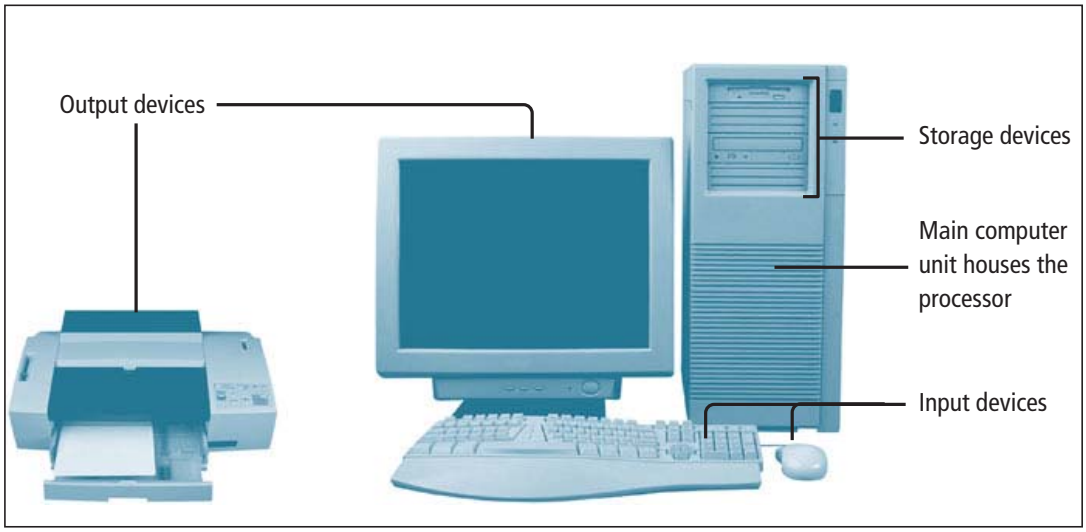
The term **information technology (IT)** includes not only the use of computers but also communications networks and computer literacy—knowledge of how to use computer technology. As in other fields, the basic tasks of gathering, allocating, controlling, and retrieving information are the same. The push to use IT in all aspects of health care, from the electronic health record (EHR) to integrated hospital information technology (HIT) systems, makes it crucial for health care professionals to be familiar with basic computer concepts. In this chapter, we will focus on computer literacy, computers, and networks. Currently, computer literacy involves several aspects. A computer-literate person knows how to make use of a computer in his or her field to make tasks easier and to complete them more efficiently, has a knowledge of terminology, and understands in a broad, general fashion what a computer is and what its capabilities are. **Computer literacy** involves knowledge of the Internet and the World Wide Web and the ability to take advantage of their resources and to critically judge the information.

A **computer** is an electronic device that accepts data (raw facts) as input, processes, or alters them in some way and produces useful information as output. A computer manipulates data by following step-by-step instructions called a **program**. The program, the data, and the information are temporarily stored in memory while processing is going on, and then permanently stored on secondary storage media for future use. Computers are accurate, fast, and reliable.

HARDWARE AND SOFTWARE

To understand the myriad uses of IT in health care, you need to familiarize yourself with computer terminology, hardware, and software applications. Every computer performs similar functions. Specific hardware is associated with each function.

Input devices take data that humans understand and digitize those data, that is, translate them into binary forms of ones and zeroes, ons and offs that the computer processes; a **processing unit** manipulates data; output devices produce information that people understand; memory and **secondary storage devices** hold information, data, and programs (Figure 1.1 ■).



■ **FIGURE 1.1** Computer hardware system.

Although all computers perform similar functions, they are not the same. There are several categories based on size, speed, and processing power: supercomputers are the largest and most powerful. Supercomputers are used for scientific purposes, such as weather forecasting and drug design. Supercomputers take complex mathematical data and create simulations of epidemics, pandemics, and other disasters. Mainframes are less powerful and are used in business for input/output intensive purposes, such as generating paychecks or processing medical insurance claims. Minicomputers are scaled-down mainframes; they are multiuser computers that are used by small businesses. Microcomputers (personal computers) are powerful enough for an individual's needs in word processing, spreadsheets, and database management. Small handheld computers called **personal digital assistants (PDAs)** originally could hold only a notepad, a calendar, and an address book. Today, sophisticated PDAs are used throughout the health care system. Physicians can write prescriptions on PDAs, consult online databases, and capture patient information and download it to a hospital computer. PDAs also hold reference manuals and are used in public health to gather information and help track diseases and epidemics. The **embedded computer** is a single-purpose computer on a chip of silicon, which is

embedded in anything from appliances to humans. An embedded computer may help run your car, microwave, pacemaker, or watch. A chip embedded in a human being can dispense medication, among other things.

Hardware

The physical components of a computer are called **hardware**. Pieces of hardware may be categorized according to the functions each performs: input, process, output, and storage. As you recall, inside the computer, all data are represented by the **binary digits (bits)** 1 (one) and 0 (zero). To translate data into 1s and 0s is to **digitize**.

Input Devices

Input devices function to take data that people understand and translate those data into a form that the computer can process. Input devices may be divided into two categories: **keyboards** and direct-entry devices.

Direct-entry devices include pointing devices, scanning devices, smart and optical cards, speech and vision input, touch screens, sensors, and human-biology input devices.

The pointing device with which you are most familiar is the **mouse**, which you can use to position the insertion point on the screen, or make a choice from a menu. Other pointing devices are variations of the mouse. Light pens, digitizing tablets, and pen-based systems allow you to use a pen or stylus to enter data. The marks you make or letters you write are digitized.

Most **scanning devices** digitize data by shining a light on an image and measuring the reflection. Bar-code scanners read the universal product codes; optical mark recognition devices can recognize a mark on paper; optical character recognition devices can recognize letters. Special scanning equipment called magnetic ink character recognition (MICR) is used by banks to read the numbers at the bottoms of checks. You are familiar with fax machines, which scan images, digitize them, and send them over telecommunication lines. Some scanning devices, called image scanners, scan and digitize whole pages of text and graphics. One scanning device of particular interest to those with impaired eyesight is the Kurzweil scanner—hardware and software—which scans printed text and reads it aloud to the user.

Radio frequency identification (RFID) tags (input devices) are now used to identify anything from the family dog to the sponge the surgeon left in your body, by sending out radio waves. One medical insurance company is conducting a two-year trial with chronically ill patients who will have an RFID the size of a grain of rice implanted. The RFID will contain their medical histories. It transmits 30 feet without the person's knowledge.[1] In 2006, one U.S. company implanted chips in two of its employees "as a way of controlling access to a room where it holds security video footage for government agencies and police."[2]

Several different kinds of cards are used as input devices: your automated teller machine (ATM) card or charge card contains a small amount of data in the magnetic

stripe. A smart card can hold more data and contains a microprocessor. Smart cards have been used as debit cards. Several states now use smart cards as driver's licenses. The card includes a biometric identifier and may include other personal information as well. Privacy advocates fear that there is so much information on the cards that they can become a target for identity thieves. An optical card holds about two thousand pages. The optical card may be used to hold your entire medical history, including test results and X-rays. If you are hospitalized in an emergency, the card—small enough to carry in your wallet—would make this information immediately available.

Vision input systems are currently being developed and refined. A computer uses a camera to digitize images and stores them. The computer "sees" by having the camera take a picture of an object. The digitized image of this object is then compared to images in storage. This technology can be used in adaptive devices, such as in glasses that help Alzheimer's patients. The glasses include a database of names and faces; a camera sees a face, and if it "recognizes" the face, it gives the wearer the name of the subject.

Speech input systems allow you to talk to your computer, and the computer processes the words as data and commands. A speech-recognition system contains a dictionary of digital patterns of words. You say a word and the speech-recognition system digitizes the word and compares the word to the words in its dictionary. If it recognizes the word, the command is executed. There are speech dictation packages tailored to specific professions. A system geared toward medicine would include an extensive vocabulary of digitized medical terms and would allow the creation of patient records and medical reports. This system can be used as an input device by physicians who, in turn, can dictate notes, even while, for example, operating. Speech recognition is also especially beneficial as an enabling technology, allowing those who do not have the use of their hands to use computers. In English, many phrases and words sound the same, for example, hyphenate and -8 (hyphen eight). Speech-recognition software allows mistakes such as these to be corrected by talking. The newest speech-recognition software does not need training and gets "smarter" as you use it. It looks at context to get homophones (to, too, two) correct.[3]

Of particular interest to health professionals are input devices called **sensors.** A sensor is a device that collects data directly from the environment and sends those data to a computer. Sensors are used to collect patient information for clinical monitoring systems, including physiological, arrhythmia, pulmonary, and obstetrical/neonatal systems. In critical care units, monitoring systems make nurses aware of any change in a patient's condition immediately. They detect the smallest change in temperature, blood pressure, respiration, or any other physiological measurement.

The newest kinds of input devices are called human-biology input devices. They allow you to use your body as an input device. They include biometrics, which are being used in security systems to protect data from unauthorized access. **Biometrics** identify people by their body parts. Biometrics include fingerprints, hand prints, face recognition, and iris scans. Once thought to be almost 100 percent accurate, biometric identification systems are now recognized as far from perfect.

Line-of-sight input allows the user to look at a keyboard displayed on a screen and indicate the character selected by looking at it. Implanted chips have allowed locked-in stroke patients (a syndrome caused by stroke where a person cannot respond, although he or she knows what is going on) to communicate with a computer by focusing brain waves (brain wave input); this is experimental; research is continuing.[4]

Processing Hardware and Memory

Once data are digitized, they are processed. Processing hardware is the brain of the computer. Located on the **main circuit board** (or **motherboard**), the **processor** or **system unit** contains the **central processing unit (CPU)** and **memory**. The CPU has two parts: the **arithmetic-logic unit**, which performs arithmetic operations and logical operations of comparing; and the **control unit**, which directs the operation of the computer in accordance with the program's instructions.

The CPU works closely with memory. The instructions of the program being executed must be in memory for processing to take place. Memory is also located on chips on the main circuit board. The part of memory where current work is temporarily stored during processing is called **random-access memory (RAM)**. It is temporary and volatile. The other part of memory is called **read-only memory (ROM)** or **firmware**; it contains basic start-up instructions, which are burned into a chip at the factory; you cannot change the contents of ROM.

Many computers have **open architecture** that allows you to add devices. The system board contains **expansion slots**, into which you can plug expansion boards for additional hardware. The board has sockets on the outside, called **ports**. You can plug a cable from your new device into the port. The significance of open architecture is the fact that it enables you to add any hardware and software interfaces to your existing computer system. This means you can not only expand the memory of your computer but also add devices that make your computer more amenable to uses in medicine. **Expansion boards** also allow the use of virtual reality simulators, which help in teaching certain procedures.

Output Devices

Once data are processed, **output devices** translate the language of bits into a form humans can understand. Output devices are divided into two basic categories: those that produce **hard copy**, including **printers** and **plotters**; and those that produce **soft (digital) copy**, including **monitors** (the most commonly used output device). Soft copy is also produced by speakers that produce speech, sound, or music.

Secondary Storage Devices

The memory we have discussed so far is temporary or volatile. To save your work permanently, you need secondary storage devices. **Magnetic disk** and magnetic tape and **optical disks** are used as secondary storage media. Magnetic media (disk, diskette, tape, and high-capacity Zip disks) store data and programs as magnetic

spots or electromagnetic charges. High-capacity optical disks (**compact disks [CDs]** or **digital video disks [DVDs]**) store data as pits and lands burned into a plastic disk. **Solid-state memory devices** include flash memory cards used in notebooks, memory sticks, and very compact key chain devices; these devices have no moving parts, are very small, and have a high capacity. USB flash drives have a huge capacity for information.

Software

Software refers to the programs—the step-by-step instructions that tell the hardware what to do. Without software, hardware is useless. Software falls into two general categories: system software and application software.

System Software

System software consists of programs that let the computer manage its resources. The most important piece of system software is the operating system. The **operating system** is a group of programs that manage and organize resources of the computer. It controls the hardware, manages basic input and output operations, keeps track of your files saved on disk and in memory, and directs communication between the CPU and other pieces of hardware. It coordinates how other programs work with the hardware and with each other. Operating systems also provide the **user interface**—that is, the way the user communicates with the computer. For example, Windows provides a **graphical user interface**, pictures or icons that you click on with a mouse. When the computer is turned on, the operating system is **booted** or loaded into the computer's RAM. No other program can work until the operating system is booted.

Application Software

Application software allows you to apply computer technology to a task you need done. There are application packages for many needs.

Word-processing software allows you to enter text for a paper, report, letter, or memo. Once the text is entered, you can format it, that is, make it look the way you want it to look. You can change the size, style, and face of the type. In addition, margins and justification can be set to any specifications. Style checkers can help you with spelling and grammar. Word-processing software also includes thesauri, headers and footers, index generators, and outlining features.

Electronic spreadsheets allow you to process numerical data. Organized into rows and columns intersecting to form cells, spreadsheets make doing arithmetic almost fun. You enter the values you want processed and the formula that tells the software how to process them and the answer appears. If you made a mistake entering a value, just change it and the answer is **automatically recalculated**. Spreadsheet software also allows you to create graphs easily—just by indicating what cells you want graphed. Electronic health records (EHRs) can use spreadsheets to graph a series of a patient's blood values over time.

Database management software permits you to manage large quantities of data in an organized fashion. Information in a database is organized in tables. The database management software makes it easy to enter data, edit data, sort or organize data, search for data that meets a particular criterion, and retrieve data. Once the structure of the table is defined and the data entered, that data can be used for a variety of purposes without being retyped. Eye-pleasing, businesslike reports can easily be generated by simply defining their structure.

There are also specialized software packages used in specific fields such as medicine. For example, there are specialized accounting programs used in medical offices. Microsoft is considering developing a new software package for the health care industry.[5]

Communications software includes Web browsers, such as Internet Explorer. These programs allow you to connect your computer to other computers in a network.

AN OVERVIEW OF NETWORKING, CONNECTIVITY, AND TELECOMMUNICATIONS

Telecommunications form the third component of IT. The implications of telecommunications for the medical world will be more fully explored in Chapter 4. Although you can enjoy the wonders of the Internet and surf the World Wide Web with very little technical knowledge, this section introduces you to some of the complexities behind networking, connectivity, telecommunications, and the Internet and gives you a foundation for appreciating the impact of these developments on health care.

Standing alone, your computer has access only to the data and information stored on its hard drive and on the disks you insert in its disk drives. If you can connect your personal computer to a network, however, you have access to the data and information on that network as well. The fact that computers can be connected is referred to as **connectivity**. Connectivity greatly enhances the power of your computer, bringing immense stores of information to your fingertips and making it possible for you to interact with people around the world. Connectivity is the prerequisite for developing the field of telemedicine. Computers and other hardware devices that are connected form what is called a **network**. Networks come in all sizes, from small **local area networks (LANs)**, which span one room, to **wide area networks (WANs)**, which may span a state, nation, or even the globe, like the Internet and World Wide Web. Networks can be private or connected through telephone lines, making them **telecommunications networks**. Given the right mix of hardware and software, computers are connected globally.

When computers are connected, the data and information that travel between them must follow some path. There are several communications channels—either wired or wireless. Communications can be high bandwidth (broadband or high speed) or low bandwidth (slow). Most hospitals use broadband connections such as dedicated T1–T3 lines. A slow dial-up connection, however, may be used for sending e-mail and small attachments.

Bluetooth technology is used to create small personal area networks. **Bluetooth** is a wireless technology that can connect digital devices from computers to medical devices to cell phones. For example, if someone is wearing a pacemaker and has a heart attack, his or her cell phone could automatically dial 911.

Transmission is governed by sets of technical standards or rules called **protocols**. The protocols take care of how the connection is set up between devices. Protocols also establish security procedures. You do not have to think about these factors because they are embedded in the communications software. For information on standards-setting organizations, visit ConsortiumInfo.org.

USES OF TELECOMMUNICATIONS AND NETWORKING

The linking of computers and communications devices via telecommunications lines into networks of all sizes has made many things possible. A complete list is beyond the scope of this text. Networking allows such things as the electronic linking of health departments in a National Health Information Network for Public Health Officials. This linking permits the sharing of information, which can be important in containing potential epidemics. The successful sharing of information will only take place if the computers are interoperable.

THE EXPANSION OF WIRELESS TECHNOLOGY: CELL PHONES, GLOBAL POSITIONING SYSTEMS, WI-FI, AND PERSONAL DIGITAL ASSISTANTS (PDAs)

During the last few years, the use of wireless technologies has expanded. Cell phones, Global Positioning System (GPS) technology, and PDAs with Internet access have become commonplace. In places without electricity and without landlines, wireless networks using cell phones and PDAs are both bringing health information to people and gathering information to track the spread of disease. **Wi-Fi** is a wireless technology that allows you to connect, for example, a PDA (and other devices) to a network (including the Internet) if you are close enough to a Wi-Fi access point. There are currently investigations into the possibility that wireless communication poses a radiation threat.[6]

The most common wireless device is the **cell phone**. The use of GPS technology, which can pinpoint your location to within several feet, is widely available. Radio frequency identification (RFID) tags are becoming more and more common. RFID tags can be incorporated into products; they receive and send a wireless signal. By identifying doorways and other objects, these tags could be used to help people with impaired vision. They can be incorporated into sponges used in surgeries, so that

sponges are not left in the patient. They could be incorporated into medication bottles, so that people could more easily locate their medications.[7]

THE INTERNET AND THE WORLD WIDE WEB

The **Internet** (short for *inter*connected *net*work) is a global network of networks, connecting innumerable smaller networks, computers, and users. It is run by a committee of volunteers; no one owns it or controls it. The Internet originated in 1969 as **ARPAnet**, a project of the Advanced Research Projects Agency of the U.S. Department of Defense. The Department of Defense was attempting to create both a national network of scientists and a communications system that could withstand nuclear attack. The network was, therefore, to be decentralized, forming a communications web with no central authority. The protocol that eventually governed ARPAnet and continues to govern the Internet today is public domain software called **transmission-control protocol/Internet protocol (TCP/IP)**. Any computer or network that subscribes to this protocol can join the Internet.

Intranets/Extranets

Private corporate or hospital networks that use the same structure as the Internet and TCP/IP protocols are called **intranets**. Software called a **firewall** is used to protect the intranet from unauthorized users. What the user sees looks like a Web page. Companies can use the intranet to distribute information to employees in an easy, attractive format, for training videos, or to post job openings. If the intranet in one organization is linked to other intranets in other organizations, it becomes an **extranet**.

Internet Services

Once you are connected, what services are available? You can access reliable, peer-reviewed medical information databases, such as MEDLINE using a search engine called **PubMed** (http://www.ncbi.nlm.nih.gov/PubMed/). MedlinePlus is a fairly reliable site for consumers of health care information. However reliable the site, the information should be reasonable and should be checked. For example, the Food and Drug Administration (FDA) can provide a great deal of health information; however, much of its drug approval project budget comes from the drug companies it regulates. Drug companies provide "more than 50 percent of the Center for Drug Evaluation's budget."[8,9] Be very careful of any information you find, whatever the source. Try to check it with another source.

You can find support groups and information on almost any disease, medication, hospital, and treatment. The information, which may or may not be accurate, can be so up to date that your physician may not even be aware of it. Internet support groups may help people cope with illness and isolation.

The **World Wide Web (WWW)** or **Web** is the part of the Internet that is most accessible and easiest to navigate. The Web is made up of information organized as documents (pages). The information on the Web is stored in files called **Web sites**. To browse the Web, you need a connection to the Internet and software called a **Web browser**. Finding what you are looking for on the Web can be challenging. If you know the address **(uniform resource locator [URL])**, you can just type it in. If you, however, are just looking for information on a particular topic, you can use a program called a **search engine**.

The Internet and Web provide an enormous amount of information—some of it reliable, some not. The lack of regulation, the freewheeling quality, is also an attraction but may bring some negative consequences. *Any* information may find its way onto the Internet, and there are no safeguards for accuracy. How do you judge the reliability of medical information on the Net? There are health Web sites that rate services. These rating services, however, are not subject to regulation or quality control either. Recognizing the difficulty of sifting through the health information and advice on the Internet, in 1997, the Federal Department of Health and Human Services created Healthfinder (http://www.healthfinder.gov), a listing of "sites 'hand-picked' . . . by health professionals." Most of the sites it recommends are "government agencies, non-profit and professional organizations, universities, libraries," although it does list a few commercial sites. Along with a listing, **Healthfinder** provides the source of the information and a summary.

The lack of regulation applies not only to speech and information but also to commerce. Web sites promote and sell worthless remedies. These sites play on fear—for example, promoting protection from severe acute respiratory syndrome (SARS), which first appeared in February 2003.

IN THE NEWS

Excerpt from, "Like Having a Secretary in Your PC"

by David Pogue

NOT AVAILABLE FOR ELECTRONIC VIEWING

Excerpt from, "Like Having a Secretary in Your PC" *(continued)*

NOT AVAILABLE FOR
ELECTRONIC VIEWING

CHAPTER SUMMARY

Chapter 1 introduces the reader to the concepts of IT and computer literacy and their significance. It also deals with computer hardware and software and how they interact to accept data as input, process the data, and produce information as output. This chapter familiarizes you with networking and connectivity, telecommunications, the Internet, and World Wide Web and gives you the basic information you need for appreciating the significance of these developments in medicine.

- IT includes not only computers but also communications networks and computer literacy.
- Computer literacy is knowledge of computers and their functions.
- A computer is an electronic device that can accept data as input, process the data, and produce information as output following step-by-step instructions called a program.
- Inside a digital computer, all data and information are represented by combinations of binary digits (bits).
- Physical components of a computer are called hardware.
- Input devices digitize data, so that the computer can process the data.
  - Input devices include keyboards and direct-entry devices.
  - Direct-entry devices include pointing devices, scanning devices, smart cards, optical cards, sensors, and human-biology input devices.
- The system unit includes the CPU, which is comprised of the arithmetic-logic unit and the control unit, and memory, which temporarily stores the work you are currently doing. The CPU and memory work together following the instructions of a program to process data into information.
- Output devices (printers and monitors) present the processed information to the user.
- Secondary storage devices (drives) and media (diskettes, hard disks, optical disks, Zip disks, magnetic tape, and solid-state memory devices) allow you to store information permanently.
- Software (programs) is comprised of the step-by-step instructions that tell the hardware how to process data.
- Software is classified as system software, which controls the basic operation of the hardware, and application software, which completes tasks for the user.
- When computers are connected in networks, the data that are transmitted travel over a path or medium.
- Data transmission is governed by technical standards or rules called protocols.
- Wireless transmission is becoming more and more common with the widespread use of cell phones and other wireless devices.
- The connection of computers and communications devices into networks makes many things possible, including telemedicine.
- The Internet is a global network of networks, which makes vast amounts of information available.

- The World Wide Web is part of the Internet, organized as documents with links to other documents.
- Speech-recognition software is getting better and better.

KEY TERMS

application software
arithmetic-logic unit
ARPAnet
automatically recalculated
binary digits (bits)
biometrics
Bluetooth
booted
cell phone
central processing unit (CPU)
communications software
compact disks (CDs)
computer
computer literacy
connectivity
control unit
database management software
digital video disks (DVDs)
digitize
direct-entry devices
electronic spreadsheets
embedded computer
expansion boards
expansion slots
extranet
firewall
firmware
graphical user interface
hard copy
hardware
Healthfinder
information technology (IT)
input devices
Internet
intranets
keyboards
local area networks (LANs)
magnetic disk
main circuit board (or motherboard)
memory
monitors
mouse
network
open architecture
operating system
optical disks
output devices
personal digital assistants (PDAs)
plotters
ports
printers
processing unit
processor
program
protocols
PubMed
radio frequency identification (RFID) tags
random-access memory (RAM)
read-only memory (ROM)
scanning devices
search engine
secondary storage devices
sensor
soft (digital) copy
software
solid-state memory devices
system software
system unit
telecommunications networks
transmission-control protocol/Internet protocol (TCP/IP)
uniform resource locator (URL)
user interface
Web browser
Web sites
wide area networks (WANs)
Wi-Fi
word processing software
World Wide Web (WWW) or Web

REVIEW EXERCISES

Multiple Choice

1. A computer literate person _____.
   A. can use a computer to perform tasks in his or her field
   B. is generally familiar with what a computer can do
   C. can program a computer
   D. A and B
2. Binary digits (ones and zeroes) are used to represent _____ inside the computer.
   A. words
   B. music
   C. graphics
   D. All of the above
3. A/An _____ is a computer that can solve complex scientific equations and may be used for worldwide weather forecasting.
   A. supercomputer
   B. mainframe
   C. embedded computer
   D. microcomputer
4. A/An _____ can generate a payroll for a large business. Several hundred users can access terminals at the same time.
   A. supercomputer
   B. mainframe
   C. embedded computer
   D. microcomputer
5. The type of input device that collects data directly from the environment and sends the data to the computer is called a _____. It is used in clinical monitoring devices.
   A. scanner
   B. sensor
   C. mouse
   D. keyboard
6. Pointing devices include the _____.
   A. mouse
   B. trackball
   C. light pen
   D. All of the above
7. An input device that reads printed text aloud is the _____.
   A. keyboard
   B. mouse
   C. digitizing tablet
   D. Kurzweil scanner

8. The actual manipulation of data inside the computer is performed by the _____.
   A. input devices
   B. output devices
   C. processing unit
   D. secondary storage devices
9. Wi-Fi _____.
   A. is a wireless technology
   B. allows you to connect to the Internet
   C. Both A and B
   D. None of the above
10. In areas of the world that lack electricity and landlines, _____ bring health information and help track the spread of disease.
   A. cell phones
   B. desktop computers
   C. PDAs
   D. Only A and C
11. During the past few years, the use of _____ technology (including cell phones and PDAs) has expanded.
   A. wired
   B. wireless
   C. Both A and B
   D. None of the above
12. Standards governing communications are called _____.
   A. standards
   B. protocols
   C. conventions
   D. rules
13. The _____ is a global network that connects many smaller networks.
   A. intranet
   B. extranet
   C. Internet
   D. None of the above
14. The part of the Internet comprised of pages with hyperlinks to other pages is referred to as the _____.
   A. public information utility
   B. bulletin board system
   C. World Wide Web
   D. None of the above
15. The _____ directs the operation of the computer in accordance with the program's instructions.
   A. arithmetic-logic unit
   B. control unit
   C. printer
   D. All of the above

True/False Questions

1. Embedded computers can be embedded in humans as well as appliances. _____
2. IT includes not only computers but also networks and computer literacy. _____
3. Information from reliable sites (such as the FDA) does not need to be checked. _____
4. A computer manipulates data by following the step-by-step instructions of a program. _____
5. Hardware refers to the physical components of the computer. _____
6. Another word for hardware is programs. _____
7. Solid-state memory devices include flash memory cards. _____
8. The main circuit board of a computer is also called the motherboard. _____
9. Application software controls the basic operations of the computer hardware including input and output. _____
10. The operating system must be booted for the computer to work. _____
11. If you are using a computer to create a budget, you would need a word processing program. _____
12. The binary number system uses two digits: 0 and 1. _____
13. RFID tags can be incorporated into products; they send a wireless signal. _____
14. Hospitals may use broadband connections for real-time consultations. _____
15. You are sure to get reliable medical information from the Web. _____

Critical Thinking

1. What input devices do you foresee being used in the health care field? Comment on how such devices as sensors and speech-recognition devices are especially relevant to your discipline.
2. What measures can be taken to help assure the quality of medical information one receives over the World Wide Web?
3. Critically examine the issue of implanting RFIDs into humans.
4. Critically examine the issue of conflict of interest. Discuss the FDA. Does a conflict of interest necessarily corrupt information from the organization?

NOTES

1. Anjana Ahuja, "Doctor, I've Got This Little Lump in My Arm . . . Relax, That Tells Me Everything," timesonline.co.uk, July 24, 2006, http://www.timesonline.co.uk/tol/comment/columnists/anjana_ahuja/article691731.ece (accessed November 12, 2007).
2. Richard Waters, "U.S. Group Implants Electronic Tags in Workers," ft.com, February 12, 2006, http://www.ft.com/cms/s/2/ec414700-9bf4-11da-8baa-0000779e2340.html (accessed November 12, 2007).
3. David Pogue, "Like Having a Secretary in Your PC," nyt.com, July 20, 2006, http://www.nytimes.com/2006/07/20/technology/20pogue.html?partner=rssnyt&emc=rss (accessed November 12, 2007).
4. Jeffrey Winters, "Communicating by Brain Waves," *Psychology Today*, http://psychologytoday.com/articles/PTO-20030724-000002.html (accessed November 12, 2007).

5. Steve Lohr, "Microsoft to Offer Software for Health Care Industry," nyt.com, July 27, 2006, http://www.nytimes.com/2006/07/27/technology/27soft.html?ex=1311652800&en=2e589acf4a87ba92&ei=5090&partner=rssuserland&emc=rss (accessed November 12, 2007).
6. "WiFi could be Health Risk at Schools," PhysOrg.com, http://www.physorg.com/news96519690.html (accessed November 12, 2007).
7. John Peifer, "Mobile Wireless Technologies for Rehabilitation and Independence," *Journal of Rehabilitation Research & Development* 42, no. 2 (March/April 2005): vii–x.
8. Manette Loudon, "The FDA Exposed: An Interview with Dr. David Graham, the Vioxx Whistleblower," Newstarget.com, August 30, 2005, http://www.newstarget.com/011401.html (accessed November 12, 2007).
9. Sidney Wolfe, "How Independent Is the FDA?" *Frontline,* November 13, 2003, http:// www.pbs.org/wgbh/pages/frontline/shows/prescription/hazard/independent.html (accessed November 27, 2007).

ADDITIONAL RESOURCES

Anderson, Sandra. *Computer Literacy for Health Care Professionals.* Albany, NY: Delmar, 1992.

Austen, Ian. "A Scanner Skips the ID Card and Zeroes In on the Eyes." nyt.com, May 15, 2003. http://topics.nytimes.com/2003/05/15/technology/circuits/15howw.html (accessed August 17, 2006).

Baase, Sara. *A Gift of Fire: Social, Legal, and Ethical Issues in Computing.* Upper Saddle River, NJ: Prentice-Hall, 1996.

Beekman, George. *Computer Confluence: Exploring Tomorrow's Technology.* 5th ed. Upper Saddle River, NJ: Prentice Hall, 2002.

Bureau of Labor Statistics. *Occupational Outlook Handbook (OOH), 2006–07 Edition.* http:// www. bls.gov/oco/ (accessed November 12, 2007).

Divis, Dee Ann. "Bill would Push Driver's License with Chip." March 17, 2003, *The Washington Times,* May 1, 2002.

Eisenberg, Anne. "When the Athlete's Heart Falters, a Monitor Dials for Help." nyt.com, January 9, 2003. http://query.nytimes.com/gst/fullpage.html?res=9B03E0DE113EF93AA35752C0A9659C8B63 (accessed November 12, 2007).

Evans, Alan, Kendall Martin, and Mary Anne Poatsy. *Technology in Action.* Upper Saddle River, NJ: Prentice Hall, 2006.

Feder, Barnaby. "Face-Recognition Technology Improves." nyt.com, March 14, 2003. http://query.nytimes.com/gst/fullpage.html?res=9805E0D9103EF937A25750C0A9659C8B63 (accessed November 12, 2007).

Fein, Esther B. "For Many Physicians, E-Mail is the High-Tech House Call." *The New York Times,* November 20, 1997, A1, B8.

Harmon, Amy. "U.S., in Shift, Drops Its Effort to Manage Internet Addresses." *The New York Times,* June 6, 1998, A1, D2.

Markoff, John. "High-Speed Wireless Internet Network Is Planned." nyt.com, December 6, 2002. http://query.nytimes.com/gst/fullpage.html?res=9807EEDB133BF935A35751C1A9649C8B63 (accessed November 12, 2007).

Oakman, Robert L. *The Computer Triangle.* 2nd ed. New York: Wiley, 1997.

Petersen, Melody. "A Respiratory Illness: Cashing in; The Internet Is Awash in Ads for Products Promising Cures or Protection." nyt.com, April 14, 2003, http://query.nytimes.com/gst/fullpage.html?res=950DE5DA133BF937A25757C0A9659C8B63 (accessed November 12, 2007).

Race, Tim. "What Do They Mean by Digital, Anyhow?" *The New York Times,* March 19, 1998, G11.

Senn, James A. *Information Technology in Business: Principles, Practices, and Opportunities.* 2nd ed. Upper Saddle River, NJ: Prentice Hall, 1998.

Stewart, Angela. "Health Departments will Link Up to Share Data." *Star-Ledger*, July 18, 1998.
Stewart, Angela. "A Shot-in-the-Arm Microchip could Save Your Life." nj.com, August 7, 2006. http://www.nj.com/news/ledger/jersey/index.ssf?/news/ledger/stories/microchip_0807.html (accessed November 12, 2007).
"What Is Bluetooth?" Palowireless. http://www.palowireless.com/infotooth/whatis.asp (accessed November 12, 2007).

RELATED WEB SITES

The following Web sites provide research information on medical matters. We cannot, however, vouch for the accuracy of the information.

Healthfinder.gov (http://www.healthfinder.gov), for a government listing of nonprofit and government organizations that provide you with health-related information.
HealthTouch Online (http://www.healthtouch.com), for information on medications.
MedicineOnLine (http://www.meds.com), for information on pharmaceutical and medical device companies.
OncoLink (http://www.oncolink.upenn.edu), for information on cancer.
PubMed (http://www.ncbi.nlm.nih.gov/PubMed), for access to reliable medical information databases.
U.S. National Library of Medicine (http://www.nlm.nih.gov/). Services include Health Information, MEDLINE/PubMed, MEDLINEplus, NLM Gateway, Library Services, Catalog, Databases, Historical Materials, MeSH, Publications. Description: The world's largest medical library.