chapter 3

Computer Science and the Foundation of Knowledge Model

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OBJECTIVES

1. Describe the essential components of computer systems, including both hardware and software.
2. Recognize the rapid evolution of computer systems and the benefit of keeping up to date with current trends and developments.
3. Analyze how computer systems function as tools for managing information and generating knowledge.
4. Define the concept of human–technology interfaces.
5. Articulate how computers can support collaboration, networking, and information exchange.

Introduction

In this chapter, the discipline of computer science is introduced through a focus on computers and the hardware and software that make up these evolving systems. **Computer science** offers extremely valuable tools that, if used skillfully, can facilitate the **acquisition** and manipulation of data and **information** by health care professionals, who can then synthesize these into an evolving knowledge and **wisdom** base. This process can facilitate **professional development** and the ability to apply evidence-based practice decisions within your practice and, if the results are disseminated and shared, can also advance the professional knowledge base.

This chapter begins with a look at common computer hardware, followed by a brief overview of operating, productivity, creativity, and communication

Key Terms

Acquisition
Application programming interface
Applications
Arithmetic logic unit
Basic input/output system
Binary system
Bit
Bus
Byte
Cache memory
Central processing unit
Communication software
Compact disk–read-only memory
Compact disk–recordable
Compact disk–rewritable
Compatibility
Computer
Computer science

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Key Terms (continued)

Conferencing software
Creativity software
Databases
Degradation
Desktop
Digital video disk
Digital video disk–recordable
Digital video disk–rewritable
Dissemination
Dynamic random access memory
Electronically erasable programmable read-only memory
E-mail
E-mail client
Exabyte
Execute
Extensibility
FireWire
Firmware
Flash memory
Gigabyte
Gigahertz
Graphical user interface
Graphics card
Hard disk
Hard drive
Hardware
Information
Information Age
Instant message
Integrated drive electronics
Internet browser
Keyboard
Knowledge
Laptop
Main memory
Mainframes
Megabyte
Megahertz
Memory

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software. It concludes with a glimpse at how computer systems help to shape knowledge and collaboration and an introduction to human–technology interface dynamics.

The Computer as a Tool for Managing Information and Generating Knowledge

Throughout history, various milestones have signaled discoveries, inventions, or philosophic shifts that spurred a surge in **knowledge** and understanding within the human race. The advent of the computer is one such milestone, which has sparked an intellectual metamorphosis whose boundaries have yet to be fully understood. Computer **technology** has ushered in what has been called the **Information Age**, an age when data, information, and knowledge are both accessible and able to be manipulated by more people than ever before in history. How can a mere machine lead to such a revolutionary state of knowledge potential? To begin to answer this question, it is best to examine the basic structure and components of computer systems.

Essentially, a **computer** is an electronic information-processing machine that serves as a tool with which to manipulate data and information. The easiest way to begin to understand computers is to realize they are input–output systems. These unique machines accept data input via a variety of devices, process data through logical and arithmetic rendering, store the data in memory components, and output data and information to the user.

Since the advent of the first electronic computer in the mid-1940s, computers have evolved to become essential tools in every walk of life, including the health professions. The complexity of computers has increased dramatically over the years and will continue to do so. "Computing has changed the world more than any other invention of the past hundred years, and has come to pervade nearly all human endeavors. Yet, we are just at the beginning of the computing revolution; today's computing offers just a glimpse of the potential impact of computers" (Evans, 2010, p. 3). Major computer manufacturers and researchers, such as Intel, have identified the need to design computers to mask this growing complexity. The sophistication of computers is evolving at amazing speed, yet ease of use or **user-friendly** aspects are also increasing accordingly. This is achieved by honing hardware and software capabilities until they work seamlessly together to ensure user-friendly, intuitive tools for users of all levels of expertise. **Box 3-1** provides information about computing surfaces, an evolving technology.

According to Intel Corporation's technology research team, the goal is "technology that just works." To conceal complexity, Intel Research is looking at a number of solutions by doing the following:

- "Relating user mental models with complex systems and technology to improve the use and adaptation of systems across devices and contexts.

BOX 3-1 MICROSOFT SURFACE TENSION? iTABLE

Dee McGonigle

Do not get too attached to your mouse and keyboard because they will be outdated soon if Microsoft and PQ Labs have their way. Microsoft has introduced the **Microsoft Surface**, and PQ Labs is building custom iTables, according to Kumparak (2009). Have you ever thought of digital information you can touch and grab? Microsoft and PQ Labs are leading us into the next generation of computing, known as surface or table computing.

Surface or table computing consists of a multitouch, multiuser interface that allows one to "grab" digital information and then collaborate, share, and store that information, without using a mouse or keyboard—just the hands and fingers, and such devices as a digital camera and **personal digital assistant** (PDA). This interface generally rests on top of a table and is so advanced that it can actually sense objects, touch, and gestures from many users (Microsoft, 2008).

Imagine entering a restaurant and interacting with the menu through the surface of the table where you sit. Once you have completed your order, you can begin computing by using the capabilities built into the surface or using your own device, such as a PDA. You can set the PDA on the surface and download images, graphics, and text to the surface. You can even communicate with others using full audio and video while waiting for your order. When you have finished eating, you simply set your credit card on the surface, and it is automatically charged; you pick up your credit card and leave. This is certainly a different kind of eating experience—but one that will become common for the next generation of users.

You might be wondering when this new age of computing will be touched by typical users. In fact, it is already used in Las Vegas as well as selected casinos, banks, restaurants, and hotels throughout the United States and Canada.

You should seek to explore this new interface, which will forever change how we interact and compute. Think of the ramifications for health care.

REFERENCES

Kumparak, G. (2009). Look out, Microsoft Surface: The iTable might just trump you in every way. http://www.crunchgear.com/2009/01/10/look-out-microsoft-surface-the-itable-mightjust-trump-you-in-every-way

Microsoft. (2008). Microsoft Surface: General questions. http://www.microsoft.com/SURFACE/about_faqs/faqs.aspx

- Enabling devices to explore their environment to discover other devices and capabilities, and then form integrated 'teams' that self-organize for higher functionality and performance.
- Better control of failure modes, graceful **degradation**, and self-healing across ensembles of devices.
- Zero-knowledge applications and interoperation." (Intel Corporation, 2008, para. 2).

Key Terms (continued)

Microprocessor
Microsoft Surface
Modem
Monitor
Motherboard
Mouse
MPEG-1 Audio Layer-3
Networks
Nonsynchronous
Office suite
Open-source software
Operating system
Palm computers
Parallel port
Peripheral component interconnection
Personal computer
Personal digital assistant
Plug and play
Port
Portability
Portable operating system interface for Unix
Power supply
Presentation
Processing
Productivity software
Professional development
Programmable read-only memory
Publishing
QWERTY
Random-access memory
Read-only memory
Security
Serial port
Small Computer System Interface
Software
Sound card
Spreadsheet
Supercomputers

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Key Terms (continued)

Synchronous dynamic random-access memory
Technology
Terabyte
Throughput
Touchscreen
Universal serial bus
User-friendly
User interface
Video adapter card
Virtual memory
Wearable technology
Wisdom
Word processing
World Wide Web
Yottabyte
Zettabyte

One example of this type of complexity masked in simplicity is the evolution of "**plug and play**" computer add-ons, where a peripheral, such as an iPod or game console, can be simply plugged into a serial or other **port** and instantly used.

Computers are universal machines because they are general-purpose, symbol-manipulating devices that can perform any task represented in specific programs. For example, they can be used to draw an image, calculate statistics, write an essay, or record your patient data. In a nutshell, computers can be used for data and information storage, retrieval, analysis, generation, and transformation.

Most computers are based on scientist John Von Neumann's model of a processor–memory–input–output architecture. In this model, the logic unit and control unit are parts of the processor, the **memory** is the storage region, and the input and output segments are provided by the various computer devices, such as the keyboard, mouse, monitor, and printer. Recent developments have provided alternative configurations to the Von Neumann model—for example, the parallel computing model, where multiple processors are set up to work together. Nevertheless, today's computer systems share the same basic configurations and components inherent in the earliest computers.

Computer Components

Hardware

Computer **hardware** refers to the actual physical body of the computer and its components. Several key components in the average computer work together to shape a complex yet highly usable machine that serves as a tool for knowledge management, communication, and creativity.

Protection: The Casing

The most noticeable component of any computer is the outer case. **Desktop** personal computers have either a desktop case, which lies flat, horizontally on a desk, and often with the computer monitor positioned on top of it, or a tower case, which stands vertically and usually sits beside the monitor or on a lower shelf or the floor. Most cases come equipped with a case fan, which is extremely critical for keeping the computer components cool when in use. **Laptop** computers combine the casing in a flat rectangular casing that is attached to the hinged or foldable monitor. **Palm computers** and personal digital assistants also have a protective outer plastic and metal case with an embedded liquid crystal display screen.

Central Processing Unit

Sometimes conceptualized as the "brain" of the computer, the **central processing unit** (CPU) is the computer component that actually **executes**, calculates, and processes the binary computer code (which consists of various configurations of 0s and 1s), instigated by the **operating system** (OS) and other **applications** on the computer. The CPU serves as the command center that directs the actions of all other computer components, and it manages both incoming and outgoing data that are processed across components. Common CPUs include the Pentium, K6, PowerPC, and Sparc models.

The CPU contains specific mechanical units, including registers, **arithmetic logic units** (ALUs), a floating point unit, control circuitry, and cache memory. Together, these inner components form the computer's central processor. Registers consist of data-storing circuits whose contents are processed by the adjacent arithmetic and logic units or the floating point unit. **Cache memory** is extremely quick memory that holds whatever data and code are being used at any one time. The CPU uses the cache to store in-process data so that it can be quickly retrieved as needed. The CPU is protected by a heat sink, a copper or aluminum metal block that cools the processor (often with the help of a fan) to prevent overheating.

In the past, the speed and power of a CPU were measured in units of **megahertz** (MHz) and was written as a value in MHz (e.g., 400 MHz, meaning that the **microprocessor** ran at 400 MHz, executing 400 million cycles per second). Today, it is more common to see the speed measured in **gigahertz** (GHz) (1 GHz is equal to 1,000 MHz); thus, a CPU that operates at 4 GHz is 1,000 times faster than an older one that operates at 4 MHz. The more cycles a processor can complete per second, the faster computer programs can run.

In recent years, processor manufacturers, such as Intel, have moved to multicore microprocessors, which are chips that combine two or more processors. In fact, multiple microprocessors have become a standard in both personal and professional-level computers. "Minicomputers, which were traditionally made from off-the-shelf logic or from gate arrays, have been replaced by servers made using microprocessors. **Mainframes** have been almost replaced with multiprocessors consisting of small numbers of off-the-shelf microprocessors. Even high-end **supercomputers** are being built with collections of microprocessors" (Hennessy & Patterson, 2006, p. 3).

Motherboard

The **motherboard** has been called the "central nervous system" of the computer. It is a key foundational component because all other components are connected to it in some way (either directly via local sockets, attached directly to it, or connected via cables). This includes **universal serial bus** (USB) controllers, Ethernet network controllers, integrated graphics controllers, and so forth. The essential structures of the motherboard include the major chip set, super input/output chip, basic input/output system read-only memory (ROM), **bus** communications pathways, and a variety of sockets that allow components to plug into the board. The chip set (often a pair of chips) determines the computer's CPU type and memory. It also houses the north bridge and south bridge controllers that allow the buses to transfer data from one to another.

Power Supply

The **power supply** is a critical component of any computer because it provides the essential electrical energy needed to allow a computer to operate. The power supply unit converts the 120-volt AC main power (provided via the power cable from the wall socket into which the computer is plugged) into low-voltage DC power. Computers depend on a reliable, steady supply of DC power to function properly. The more devices and programs used on a computer, the larger the power supply should be to avoid damage and malfunctioning. Power supplies normally range from 160 to 700 watts, with an average of 300 to 400 watts. Most contemporary power supply units come equipped with at least one fan to cool the unit under heavy use. The power supply is controlled by pressing the on and off switch as well as the reset switch (which restarts the system) of a computer.

Laptop and other portable computing machines, such as electronic readers and tablet computers, are equipped with a rechargeable battery power supply and the standard plug-in variety.

Hard Disk

This component is so named because of the rigid hard disks that reside in it, which are mounted to a spindle that is spun by a motor when in use. Drive heads (most computers have two or more heads) produce a magnetic field through their transducers that magnetizes the disk surface as a voltage is applied to the disk. The **hard disk** acts as a permanent data storage area that holds **gigabytes** (GB) or even **terabytes** (TB) worth of data, information, documents, and programs saved on the computer, even when the computer is shut off. Disk drives are not infallible, however, so backing up important data is imperative.

The computer writes binary data to the hard drive by magnetizing small areas of its surface. Each drive head is connected to an actuator that moves along the disk to hover over any point on the disk surface as it spins. The parts of the hard disk are encased in a sealed unit. The hard drive is managed by a disk controller, which is a circuit board that controls the motor and actuator arm assembly. The **hard drive** produces the voltage waveform that contacts the heads to write and read data and handles communications with the motherboard. It is usually located within the computer's hard outer casing. Some people also attach a second hard drive externally to increase available memory or to back up data.

Main Memory or Random-Access Memory

Random-access memory (RAM) is considered to be volatile memory because it is a temporary storage system that allows the processor to access program codes and data while working on a task. The contents of RAM are lost once the system is rebooted or shut off or loses power.

The memory is actually situated on small chip boards, which sport rows of pins along the bottom edge and are plugged into the motherboard of the computer. These memory chips contain complex arrays of tiny memory circuits that can be either set by the CPU during write operations (puts them into storage) or read by the CPU during data retrieval. The circuits store the data in binary form as either a low (on) voltage stage, expressed as a 0, or a high (off) voltage stage, expressed as a 1. All of the work being done on a computer resides in RAM until it is saved onto the hard drive or other storage drive. Computers generally come with 2 GB of RAM or more, and some offer more RAM via **graphics cards** and other expansion cards.

A certain portion of the RAM, called the **main memory**, serves the hard disk and facilitates interactions between the hard disk and central processor. Main memory is provided by **dynamic random-access memory** (DRAM) and is attached to the processor using specific addresses and data buses.

Synchronous dynamic random-access memory (SDRAM) (also known as static dynamic RAM) is "much faster than conventional (**nonsynchronous**) memory because it can synchronize itself with a microprocessor's bus" (Null & Lobor, 2006, p. 8).

Read-Only Memory

Read-only memory (ROM) is essential permanent or semipermanent nonvolatile memory that stores saved data and is critical in the working of the computer's OS and other activities. ROM is stored primarily in the motherboard, but it may also be available through the graphics card, other expansion cards, and peripherals. In recent years, rewritable ROM chips that may include other forms of ROM, such as **programmable read-only memory** (PROM), erasable ROM, **electronically erasable programmable read-only memory** (EEPROM), and a **flash memory** (a variation of electronically erasable programmable ROM), have become available.

Basic Input/Output System

The **basic input/output system** (BIOS) is a specific type of ROM used by the computer when it first boots up to establish basic communication between the processor, motherboard, and other components. Often called boot firmware, it controls the computer from the time the machine is switched on until the primary OS (e.g., Windows, Mac OS X, or Linux) takes over. The **firmware** initializes the hardware and boots (loads and executes) the primary OS.

Virtual Memory

Virtual memory is a special type of memory is stored on the hard disk to provide temporary data storage so data can be swapped in and out of the RAM as needed. This capability is particularly handy when working with large data-intensive programs, such as games and multimedia.

Integrated Drive Electronics Controller

The **integrated drive electronics** (IDE) controller component is the primary interface for the hard drive, **compact disk–read-only memory** (CD-ROM), or **digital video disk** (DVD) drive, and the floppy disk drive (found largely on pre-2010 computers).

Peripheral Component Interconnection Bus

This component is important for connecting additional plug-in components to the computer. It uses a series of slots on the motherboard to allow **peripheral component interconnection** card plug-in.

Small Computer System Interface

The **Small Computer System Interface** (SCSI) component provides the means to attach additional devices, such as scanners and extra hard drives, to the computer.

DVD/CD Drive

The CD-ROM drive reads and records data to portable CDs using a laser diode to emit an infrared light beam that reflects onto a track on the CD using a mirror positioned by a motor. The light reflected on the disk is directed by a system of lenses to a photodetector that converts the light pulses into an electrical signal; this signal is then decoded by the drive electronics to the motherboard. Both **compact disk–recordable** (CD-R) and **compact disk–rewritable** (CD-RW) drives are common. The same principle applies to **digital video disk–recordable** (DVD-R) and **digital video disk–rewritable** (DVD-RW) drives. A DVD drive can do everything a CD drive can do, plus it can play the content of disks and, if it is a recordable unit, can record data on blank DVDs.

Flash or USB Drive

This portable memory device uses electronically erasable programmable ROM to provide fast permanent memory.

Modem

A **modem** is a component that can be situated either externally (external modem) or internally (internal modem) relative to the computer and enables Internet connectivity via a cable connection through network adapters situated within the computer apparatus.

Connection Ports

All computers have connection ports made to fit different types of plug-in devices. These ports include a monitor cable port, keyboard and mouse ports, a network cable port, microphone/speaker/auxiliary input ports, USB ports, and printer ports (SCSI or parallel). These ports allow data to move to and from the computer via peripheral or storage devices. Specific ports include the following:

- **Parallel**: connects to a printer
- **Serial**: connects to an external modem
- USB: connects to myriad plug-in devices, such as portable flash drives, digital cameras, **MPEG-1 Audio Layer-3** (MP3) players, graphics tablets, and light pens, using a plug-and-play connection (the ability to add devices automatically)

- **FireWire** (IEEE 1394): often used to connect digital-video devices to the computer
- Ethernet: connects networking apparatus, such as Internet and modem cables

Graphics Card

Most computers come equipped with a graphics accelerator card slotted in the microprocessor of a computer to process image data and output those data to the monitor. These in situ graphic cards provide satisfactory graphics quality for two-dimensional art and general text and numerical data. However, if a user intends to create or view three-dimensional images or is an active game user, one or more graphics enhancement cards are often installed.

Video Adapter Cards

Video adapter cards provide video memory, a video processor, and a digital-to-analog converter that works with the CPU to output higher-quality video images to the monitor.

Sound Card

The **sound card** converts digital data into an analog signal that is then output to the computer's speakers or headphones. The reverse is also accomplished by inputting a signal from a microphone or other audio recording equipment, which then converts the analog signal to a digital signal.

Bit

A **bit** is the smallest possible chunk of data memory used in computer processing and is depicted as either a 1 or a 0. Bits make up the **binary system** of the computer.

Byte

A **byte** is a chunk of memory that consists of 8 bits; it is considered to be the best way to indicate computer memory or storage capacity. In modern computers, bytes are described in units of **megabytes** (MB); GB, where 1 GB equals 1,000 MB; or TB, where 1 TB equals 1 trillion bytes or 1,000 GB. **Box 3-2** discusses storage capacities.

Software

Software comprises the application programs developed to facilitate various user functions, such as writing, artwork, organizing meetings, surfing the Internet, communicating with others, and so forth. For the purposes of this overview, the various types of software have been divided into four categories: (1) OS software, (2) productivity software, (3) **creativity software**, and (4) communication software.

User-friendliness is a critical condition for effective software adoption. "End user performance is likely to be facilitated by [the degree of] user friendliness of software packages" (Mahmood, 2003, p. 71). The easier and more intuitive a software package seems to be to a user influences that user's perception of how clear the package is to

BOX 3-2 STORAGE CAPACITIES

Dee McGonigle and Kathleen Mastrian

Storage and memory capacities are evolving. In the past few decades, there have been great leaps in data storage. It all begins with the bit, the basic unit of data storage, composed of 0s and 1s, also known as binary digits (bit). A byte is generally considered to be equal to 8 bits. The files on a computer are stored as binary files. The software that is used translates these binary files into words, numbers, pictures, images, or video. Using this binary code in the binary numbering system, measurement is counted by factors of 2, such as 1, 2, 4, 8, 16, 32, 64, and 128. These multiples of the binary system in computer usage are also prefixed based on the metric system. Therefore, a kilobyte (KB) is actually 2 to the 10th power (210), or 1,024 bytes, but is typically considered to be 1,000 bytes. This is why one sees 1,024 or multiples of that number instead of an even 1,000 mentioned at times in relation to kilobytes.

In the early 1980s, kilobytes were the norm as far as computer capacity went, and 128 KB machines were launched for personal use. Subsequent decades, however, have seen advanced computing power and storage capacity. As capabilities soared, so did the ability to save and store what was used and created. Megabytes (MB) emerged as a common unit of measure; a megabyte is 1,048,576 bytes but is considered to be roughly equivalent to 1 million bytes. The next leap in computer capacity was one that some people could not even imagine: gigabytes (GB). A gigabyte is 1,073,741,824 bytes but is generally rounded to 1 billion bytes. Some computing experts are very concerned that valuable bytes are lost when these measurements are rounded, whereas hard drive manufacturers use the decimal system so their capacity is expressed as an even 1 billion bytes per gigabyte.

The next advancements in computer capacity are moving into the range of terabytes (TB), petabytes (PB), **exabytes** (EB), **zettabytes** (ZB), and **yottabytes** (YB). These terms storage capacity are defined as follows:

TB: 1,000 GB
PB: 1,000,000 GB
EB: 1,000 PB
ZB: 1,000 EB
YB: 1,000 ZB

To put all of this in perspective, Williams (n.d., para. 5) writes about the data powers of 10:

2 KB: a typewritten page
2 MB: a high-resolution photograph
10 MB: a minute of high-fidelity sound or a digital chest X-ray
50 MB: a digital mammogram
1 GB: a symphony in high-fidelity sound or a movie at TV quality
1 TB: all the X-ray films in a large technologically advanced hospital
2 PB: the contents of all U.S. academic research libraries
5 EB: all words ever spoken by human beings

We have not even addressed ZB and YB. Stay tuned.

REFERENCE

Williams, R. (n.d.). Data powers of ten. http://ict.stmargaretsacademy.org.uk/computing/hardware/dataquan/d_p_ten2.html

understand and to use. The rapid evolution of hardware mentioned previously has been equally matched by the phenomenal development in software over the past three or four decades.

Commercial Software

Several large commercial software companies, such as Apple, Microsoft, IBM, and Adobe, dominate the market for software and have done so since the advent of the **personal computer**. Licensed software has evolved over time; hence, most products have a long version history. Many software packages, such as office suites, are expensive to purchase; in turn, there is a "digital divide" as far as access and affordability go across societal spheres, especially when viewed from a global perspective.

Open-Source Software

The **open-source software** movement began several years ago but recently has become a powerful movement that is changing the software production and consumer market. In addition to commercially available software, a growing number of open-source software packages are being developed in all four of the categories addressed in this chapter. The open-source movement was begun by developers who wished to offer their creations to others for the good of the community and encouraged them to do the same. Users who modify or contribute to the evolution of open-source software are obligated to share their new code, but essentially the software is free to all. Both Open Office and KOffice are examples of open-source productivity software.

OS Software

The OS is the most important software on any computer. It is the very first program to load on computer start-up and is fundamental for the operation of all other software and the computer hardware. Examples of commonly used OSs include the Microsoft Windows family, Linux, Mac OS X, and Unix. The OS manages both the hardware and the software and provides a reliable, consistent interface for the software applications to work with the computer's hardware. An OS must be both powerful and flexible to adapt to the myriad types of software available, which are made by a variety of development companies. New versions of the major OSs are equipped to deal with multiple users and handle multitasking with ease. For example, a user can work on a word processing document while listening for an "e-mail received" signal, have an **Internet browser** window open to look for references on the Internet as needed, listen to music in the CD drive, and download a file—all at the same time.

OS tasks can be described in terms of six basic processes:

- Memory management
- Device management

- Processor management
- Storage management
- Application interface
- **User interface** (usually a **graphical user interface** [GUI])

OSs should be convenient to use, easy to learn, reliable, safe, and fast. They should also be easy to design, implement, and maintain and should be flexible, reliable, error free, and efficient. For example, Silbershatz, Baer Galvin, and Gagne (2013) described how "Microsoft's design goals for Windows included security, reliability, Windows and POSIX application compatibility, high performance, extensibility, portability, and international support" (p. 831). The following goals were established by Microsoft:

- **Portability**: The OS can be moved from one hardware architecture to another with few changes needed.
- **Security**: The OS incorporates hardware protection for virtual memory and software protection mechanisms for OS resources, including encryption and digital signature capabilities.
- **Portable operating system interface for Unix** (POSIX) compliance: Applications designed to follow the POSIX (IEEE 1003.1) standard can be compiled to run on Windows without changing the source code. Windows XP had higher compatibility with the applications that ran on earlier versions of Windows, such as Windows 95.
- Multiprocessor support: The OS is designed for symmetrical multiprocessing.
- **Extensibility**: This capability is provided by using a layered architecture with a protected executive layer for basic system services, several server subsystems that operate in user mode, and a modular structure that allows additional environmental subsystems to be added without affecting the executive layer.
- International support: The Windows OS supports different locales via the national language support application programming interface (API).
- **Compatibility** with MS-DOS and MS-Windows applications.

Productivity Software

Productivity software, such as **office suites**, is the type of software most commonly used both in the workplace and on personal computers. Several software companies produce these multiple-program software, which usually bundles together **word processing**, **spreadsheets**, **databases**, **presentation**, Web development, and **e-mail** programs.

The intent of office suites is generally to provide all of the basic programs that office or knowledge workers need to do their work. The bundled programs within the suite are organized to be compatible with one another, are designed to look similar to one another for ease of use, and provide a powerful array of tools for data manipulation, information gathering, and knowledge generation. Some office suites add other programs, such as database creation software, mathematical editors, drawing, and desktop

TABLE 3-1 OFFICE SUITE SOFTWARE FEATURES AND EXAMPLES

	OFFICE SUITE SOFTWARE	
Program	**Application**	**Examples**
Word processing	Composition, editing, formatting, and producing text documents	Microsoft Word, Open Office Writer, KOffice KWord, Corel WordPerfect or Corel Write, Apple Pages
Spreadsheets	Grid-based documents in ledger format; organizes numbers and text; calculates statistical formulae	Microsoft Excel, Open Office Calc, KOffice Kspread, Corel Quattro Pro, Apple Numbers
Presentations	Slideshow software, usually used for business or classroom presentations using text, images, graphs, media	Microsoft Power Point, Open Office Impress, KOffice KPresenter, Corel Show, Apple Keynote
Databases	Database creation for text and numbers	Microsoft Access (in elite packages), Open Office Base, KOffice Kexi, Corel Calculate, Corel Paradox
E-mail	Integrated e-mail program to send and receive electronic mail	Microsoft Outlook, Corel WordPerfect Mail, Mozilla Thunderbird
Drawing	Graphics and diagram drawing	Open Office Draw, Corel Presentation Graphics, KOffice Kivio, Karbon, Krita
Math formulas	Inserts math equations in word processing and presentation work	Open Office Math, KOffice KFormula
Desktop publishing	Page layouts and publication-ready documents	Microsoft Publisher (in elite packages), Apple Pages

publishing programs. **Table 3-1** summarizes the programs included in five of the most popular office suites: Microsoft Office, Open Office, KOffice, Corel WordPerfect Suite, and Apple iWork (for Macintosh computers). Of these five, Open Office (for Windows, Linux, Solaris, Mac OS X, FreeBSD, and HP-UX OSs) and KOffice (for Linux environments but also being developed for Windows and Mac OS X platforms) are open-source, free software.

Creative Software

Creative software includes programs that allow users to draw, paint, render, record music and sound, and incorporate digital video and other multimedia in professional aesthetic ways to share and convey information and knowledge (**Table 3-2**).

Communication Software

Networking and **communication software** enable users to dialogue, share, and network with other users via the exchange of e-mail or **instant messages**, by accessing

TABLE 3-2 CREATIVE SOFTWARE FEATURES AND EXAMPLES

CREATIVE SOFTWARE	
Program and Application	**Software Examples**
Raster graphics programs Draw, paint, render, manipulate and edit images, fonts, and photographs to create pixel-based (dot points) digital art and graphics	Adobe Photoshop and Fireworks, Ulead PhotoImpact, Corel Draw, Painter, and Paint Shop Pro, GIMP (open source), KOffice's Krita (open source)
Vector graphics programs Mathematically rendered, geometric modeling is applied through shapes, curves, lines, points and manipulated for shape, color, size. Ideal for printing and three-dimensional (3D) modeling	Adobe Flash, Freehand, and Illustrator, CorelDraw and Designer, Open Office Draw (open source), Mirosoft Visio, Xara Xtreme, KOffice Karbon14 (open source)
Desktop publishing programs Page layout and publishing preparation for printed and web documents, such as magazines, journals, books, newsletters, brochures	Adobe InDesign, Corel PageMaker, Microsoft Publisher, Scribus (open source), QuarkXPress, Apple Pages (note that many of the graphics programs can also be used for DTP)
Web design programs Create, edit, update webpages using specific codes, such as XML, CSS, HTML, and JAVA	Adobe Dreamweaver, Coffee Cup, Microsoft FrontPage, Nvu (open source), W3C's Amaya (open source)
Multimedia programs Combines text, audio, images, animation, and video into interactive content for electronic presentation	Adobe Flash, Microsoft Movie Maker, Apple QuickTime and FinalCut Studio, Corel VideoStudio, Ulead VideoStudio, Real Studio, CamStudio (open source), Audacity (open source)

the World Wide Web, or by engaging in virtual meetings using **conferencing software** (**Table 3-3**).

Acquisition of Data and Information: Input Components

Input devices include the keyboard, mouse, joysticks (typically used for playing computer games), game controllers or pads; Web cameras (webcams), stylus (often used with tablets or personal digital assistants), image scanners for copying a digital image of a document or picture, or other plug-and-play input devices, such as digital cameras, digital video recorders (camcorders), MP3 players, electronic musical instruments, and physiologic monitors (**Figure 3-1**). These devices are the origin or medium used to input text, visual, audio, or multimedia data into the computer system for viewing, listening, manipulating, creating, or editing. The two primary input devices on a computer are the keyboard and mouse.

Keyboard

Computer **keyboards** are very similar to the typewriter keyboards of earlier days and usually serve as the prime input device that enables the user to type words, numbers,

TABLE 3-3 COMMUNICATION SOFTWARE FEATURES AND EXAMPLES

COMMUNICATION SOFTWARE	
E-mail client Allows user to read, edit, forward, and send email messages to other users via an Internet connection. The software can be resident on the computer or accessed via the World Wide Web	**Resident programs** Microsoft Outlook and Outlook Express, Eudora, Pegasus, Mozilla Thunderbird, Lotus Notes **Web-based programs** Gmail, Yahoo Mail, Hotmail
Internet browsers Enables user to access, browse, download, upload, and interact with text, audio, video, and other Web-based documents	Mozilla Firefox, Microsoft Internet Explorer, Google Chrome, Apple Safari, Opera, Microbrowser (for mobile access)
Instant messaging (IM) Real-time text messaging between users, can attach images, videos, and other documents via personal computer, cell phone, hand-held devices	MSN Instant Messenger, Microsoft Live Messenger, Yahoo Messenger, Apple iChat
Conferencing Enables user to communicate in a virtual meeting room setting to share work, discussions, planning, using an intranet or Internet environment; can exhibit files, video, screen shots of content	Adobe Acrobat Connect, Microsoft Live Meeting or Meeting Space, GotoMeeting, Meeting Bridge, Free Conference, RainDance, WebEx

and commands into the computer's programs. Standard computer keyboards have 101 keys and are organized to facilitate Latin-based languages using a **QWERTY** layout (so named because these letters appear on the first six keys in the first row of letters).

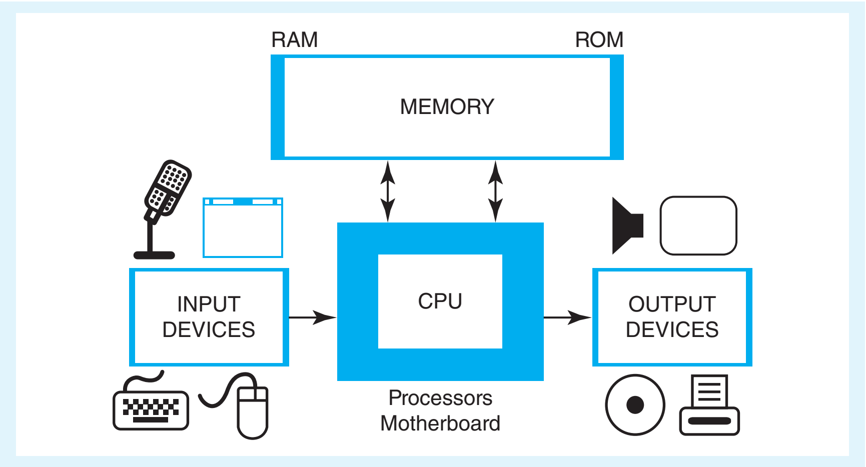

Figure 3-1
Computer System

Certain keys are used as command keys, particularly the control (Ctrl), alternate (Alt), delete (Del), and shift keys, all of which can be used to activate useful commands. The escape (Esc) key allows the user instantly to exit a process or program. The F keys, numbered F1 through F12, are function keys. They are used in different ways by particular programs. If a program instructs users to press the F8 key, they would do so by pressing F8. The print screen (PrtScn) key sends a graphical picture or screenshot of a computer screen to the clipboard. This copied screenshot can then be pasted in any graphic program that can work with bitmap files.

Mouse

The **mouse** is the second most commonly used input device. It is manipulated by the user's hand to point, click, and move objects around on the computer screen. A mouse can come in a number of different configurations, including a standard mechanical trackball serial mouse, bus mouse, PS/2 mouse, USB-connected mouse, optical lens mouse, cordless mouse, and optomechanical mouse.

Processing of Data and Information: Throughput/ Processing Components

All of the hardware discussed earlier in this chapter is involved in the **throughput** or **processing** of input data and in the preparation of output data and information. Specific software is used, depending on the application and data involved. One key hardware component, the computer monitor, is a unique example of a visible throughput component—it is the part of the computer that users focus on the most when they are working on a computer. Input data can be visualized and accessed by manipulating the mouse and keyboard input devices, but it is the monitor that receives the user's attention. The monitor is critical for the efficient rendering during this part of the cycle because it facilitates user access and control of the data and information.

Monitor

The **monitor** is the visual display that serves as the landscape for all interactions between user and machine. It typically resembles a television screen and comes in various sizes (usually ranging from 15 to 21 inches) and configurations. Monitors either are based on cathode ray tubes (the conventional monitor with a large section behind the screen) or are thinner, flat-screen liquid crystal display devices. Some computer monitors also have a **touchscreen** that can serve as an input device when the user touches specific areas of the screen.

Monitors vary in their refresh rate (usually measured in megahertz) and dot pitch. Both of these characteristics are important for user comfort. The faster the refresh rate, the cleaner and clearer the image on the screen because the monitor refreshes the screen contents more frequently. For example, a monitor with a 100 MHz refresh rate refreshes the screen contents 100 times per second. Similarly, the larger the dot pitch factor, the smaller the dots that make up the screen image, which provides a more detailed display on the monitor and also facilitates clarity and ease of viewing.

If equipped with a touchscreen, a monitor can also serve as an input device when activated by a stylus or finger pressure. Some users might also consider the monitor to be an output device because access to input and stored documents is often performed via the screen (e.g., reading a document that is stored on the computer or viewable from the Internet).

Dissemination: Output Components

Output devices carry data in a usable form through exit devices in or attached to a computer. Common forms of output include printed documents, audio or video files, physiologic summaries, scan results, and saved files on portable disk drives, such as a CD, DVD, flash drive, or external hard drive. Output devices literally put data and information at the user's fingertips, which can then be used to develop knowledge and even wisdom. The most commonly used output devices include printers, speakers, and portable disk drives.

Printer

Printers are external components that can be attached to a computer using a printer cord that is secured into the computer's printer port. Printers enable users to print a hard paper copy of documents that are housed on the computer.

The most common printer types are the ink-jet and laser printers. Ink-jet printers are more economical to use and offer quite good quality; they apply ink to paper using a jet-spray mechanism. Laser printers produce publisher-ready quality printing if combined with good-quality paper but cost more in terms of printing supplies. Both types of printers can print in black and white or in color.

Speakers

All computers have some sort of speaker setup, usually small speakers embedded in the monitor, in the case, or, if a laptop, close to the keyboard. Often, external speakers are added to a computer system using speaker connectors; these devices provide enhanced sound and a more enjoyable listening experience.

What is the Relationship of Computer Science to Knowledge?

Scholars and researchers are just beginning to understand the effects that computer systems, architecture, applications, and processes have on the potential for knowledge acquisition and development. Users who have access to contemporary computers equipped with full Internet access have resources at their fingertips that were only dreamed of before the 21st century. Entire library collections are accessible, with many documents available in full printable form. Users are also able to contribute to the development of knowledge through the use of productivity, creativity, and communication software. In addition, using the **World Wide Web** interface, users are able to disseminate knowledge on a grand scale with other users.

This deluge of information available via computers must be mastered and organized by the user if knowledge is to emerge. Discernment and the ability to critique and filter this information must also be present to facilitate the further development of wisdom.

The development of an understanding of computer science principles as they apply to technology used in your practice can facilitate optimal usage of the technology for knowledge development in the profession. The maxim that "knowledge is power" and that the skillful use of computers lies at the heart of this power is a presumption: Once health care professionals become comfortable with the various technologies, they can shape them, refine them, and apply them in new and different ways, just as they have always adapted earlier equipment and technologies. Health care professionals must harness the power of data and information through the use of computer technologies to build knowledge and gain wisdom.

How Does the Computer Support Collaboration and Information Exchange?

Computers can be linked to other computers through networking software and hardware to promote communication, information exchange, work sharing, and collaboration. Such **networks** can be local or organizationally based, with computers joined together into a local area network or organized on a wider area scope (e.g., a city or district) using a metropolitan area network or encompassing computers at an even greater distance (e.g., a whole country or continent or the Internet itself) using a wide area network configuration (Sarkar, 2006). Network interface cards are used to connect a computer and its modem to a network.

Networks within health care can manifest in several different configurations, including client-focused networks, such as in telehealth, e-health, and client support networks; work-related networks, including virtual work and virtual social networks; and learning and research networks, as in communities of practice. These trends are still in their infancy in most work environments (and most health care professionals' personal lives), but they are predicted to grow dramatically in the future:

> *As the Net generation grows in influence, the trend will be toward networks, not hierarchies; toward open collaboration rather than authority; toward consensus rather than arbitrary edict. The communication support provided by networks and information systems will also alter patterns of social interaction within a healthcare organization. This technology provides a medium for greater accessibility to shared information and support for rich interpersonal exchange and collaboration across departmental boundaries. (Richards, 2001, p. 10)*

Virtual social networks are another form of professional network that have expanded phenomenally since the advent of the Internet and other computer software and hardware:

> *Electronic media do more than just expand access to vast bodies of information. They also serve as a convenient vehicle for building virtual social networks for*

creating shared knowledge through collaborative learning and problem solving. Cross pollination of ideas through worldwide connectivity can boost creativity synergistically in the co-construction of knowledge. (Bandura, 2002, p. 4)

Health care–related virtual social networks provide a cyberspace for specific health care professionals to make contacts, share information and ideas, and build a sense of community. Social communication software is used to provide a dynamic virtual environment, and often virtual social networks provide communicative capabilities through posting tools, such as blogs, forums, and wikis; e-mail for sharing ideas on a smaller scale; collaborative areas for interaction, creating, and building digital artifacts or planning projects; navigation tools for moving through the virtual network landscape; and profiles to provide a space for each member to disclose personal information with others. Health care professionals who have to engage in shift work often find that virtual social networks can provide a sense of connection with other professionals that is available around the clock. Because time is often a factor in any social interchange, virtual communication offers an alternative for practicing health care professionals, who can access information and engage in interchanges at any time of day. With active participation, the interchanges and shared information and ideas of the network can culminate in valuable social and cultural capital, available to all members of that network. Often, health care professional virtual social networks are created for the purpose of exchanging ideas on practice issues and best practices; to become more knowledgeable about new trends, research, and innovations in health care; or to participate in advocacy, activist, and educational initiatives.

Through the use of portable disk devices, such as flash drives, CDs, and DVDs, people can share information, documents, and communications by exchanging files. Since the advent of the Internet in the mid-1980s, the World Wide Web has evolved to become a viable and user-friendly way for people to collaborate and exchange information, projects, and other knowledge-based files, such as websites, e-mail, social networking applications, and webinar logs. **Box 3-3** provides information on Web 2.0, the latest iteration of the World Wide Web.

What is the Human–Technology Interface?

In the context of using a computer system, the human–technology interface is facilitated by the input and output devices discussed previously in this chapter. Specifically, the keyboard, mouse, monitor, laser pen, joystick, stylus, game pads and controls, and other USB or plug-and-play devices, such as MP3 players, digital cameras, digital camcorders, musical instruments, and handheld smaller computers, such as PDAs, are all viable devices for interfacing with a computer.

The GUI associated with the OS of a computer provides the onscreen environment for direct interaction between the user and the computer. The typical GUI provided by Windows or Mac OS X utilizes a user-friendly desktop metaphor interface that is made up of the input and output devices and icons that represent files, programs, actions, and processes. These interface icons can be activated by clicking the mouse buttons to

BOX 3-3 WEB 2.0 TOOLS

Dee McGonigle, Kathleen Mastrian, and Wendy Mahan

Web 2.0—the name given to the new World Wide Web tools—enables users to collaborate, network socially, and disseminate knowledge with other users on a scale that was once not even comprehensible. These programs promote data and information exchange, feedback, and knowledge development and **dissemination**.

To facilitate a selective review of the Web 2.0 tools available, they have been categorized into three areas here: (1) tools for creating and sharing information, (2) tools for collaborating, and (3) tools for communicating. Examples of tools for creating and sharing information include blogs, podcasts, Flickr, YouTube, Hellodeo, Jing, Screencast-o-matic, Facebook, MySpace, and MakeBeliefsComix. Examples of tools for collaborating with others include Google Docs, Zoho, wikis, Del.icio.us, and Gliffy. Finally, some tools for communicating with others include Adobe Connect, Vyew, Skype, Twitter, and instant messaging.

The application of the creating and sharing information tools has led to an explosion of social networking on the Web. YouTube has promoted the "broadcast yourself" proliferation. Anyone can launch a video onto YouTube that is shared with others over the Web. Similarly, Flickr allows users to upload and tag personal photos to share either privately or publicly. Both Facebook and MySpace promote socializing on the Web. Facebook is a social utility, and MySpace is a place for friends, according to the descriptions found on these websites. Other tools let users create and share recorded messages, diagrams, screen captures, and even custom comic strips.

Collaborating over the Web has become easier. Indeed, it is a way of life for many people. Google Docs and Zoho allow users to create online and share and collaborate in realtime. Wikis are server-based software programs that enable users to generate and edit webpage content using any browser. Del.icio.us is a social bookmarking manager that uses tags to identify or describe the bookmarks that can be shared with others.

Communicating with others includes audio- and videoconferencing in realtime. Adobe Connect is a comprehensive Web communications solution. Although a fee-based service, it does provide a free trial. Users should read all of the documentation on Adobe's site before downloading, installing, and using this software. Vyew is free, always-on collaboration plus live webinars. Skype allows users to make calls in audio only or with video. Users can download Skype for free, but, depending on the type of calls made, fees or charges could be assessed. Individuals should read through all of the information before downloading, installing, and using this software. Twitter allows participants to answer the question "What are you doing?" with messages containing 140 or fewer characters. Although Twitter can be used to keep the friends in a person's network updated on daily activities, it can also be used for other purposes, such as asking questions or expressing thoughts. In addition, Twitter can be accessed by cell phones, so users can stay in touch on the go.

Along with all of the advantages and intellectual harvesting capabilities from the use of these tools come serious security issues. Wagner (2007) warns the user to "bear in mind before you jump in that you're giving information to a third-party company to store" (para. 5). He also states that "you should talk to your company's legal and compliance offices to be sure you're obeying the law and regulations with regard to managing company's information" (para. 5). One suggestion that Wagner offers is that if you do not want to involve a third party, "wikis provide a good alternative for organizations looking to maintain control of their own software. Organizations can install wiki software on their own, internal servers" (para. 6).

This new wave of Web-based tools facilitates the ability to interact, exchange, collaborate, communicate, and share in ways that have only begun to be realized. As the tools and their innovative uses continue to expand, users need to stay vigilant to handle the associated security challenges. These Web 2.0 tools are providing a new cyber-playground that is limited only by users' own imaginations and intelligence. We encourage you to explore these tools. Refer to this text's companion website (http://go.jblearning.com/mcgonigle) for more information.

BOX 3-3 WEB 2.0 TOOLS (continued)

REFERENCE

Wagner, M. (2007). Nine easy Web-based collaborative tools. http://www.forbes.com/2007/02/26/google-microsoft-bluetie-enttech-cx_mw_0226smallbizresource.html

perform various actions, such as to provide information, execute functions, open and manipulate folders (directories), select options, and so forth.

Although these aspects of a computer system may be taken for granted, they are critical in facilitating a sense of comfort and competency in users of the system. This environment is particularly critical in health care when computers are used in the context of care. One question that arises is, Do health care professionals control these information technology tools, or do the tools shape the activities, decisions, and attention of the health care professionals as users of technology? Both possibilities can be answered in the affirmative to some extent, but the former is the safest situation for health care (for an expanded discussion of this issue, see Chapter 19). If the health care professional needs to focus on the software or hardware because of difficult-to-use programs, confusing GUI schema, or sheer complexity in the programming, the health care professional's provision of care will suffer. It is critical that any software and hardware used in the practice milieu be expertly designed to facilitate care in a user-friendly, intuitive way. This is one reason that all health care professional practice areas are developing informatics experts, to be placed in positions of authority where they can facilitate the adoption of computer systems within health care environments. It is essential that the activities of the health care professionals are reflected well within the software that is used in the specific care setting. If health care professionals are knowledgeable about computers and related technologies, they will be able to provide meaningful data and information about how computer systems best work within their particular care areas.

In an ideal world, health care professionals would be able to use and interact with computer technologies effectively to enhance patient care. They would understand computer science and know how to harness its capabilities to benefit the profession and ultimately their patients.

Looking to the Future

The current trends toward **wearable technology**, smaller and faster handheld and portable computer systems, and high-quality video and voice-activated inventions will further facilitate the use of computers in all areas of health care practice and professional development. The field of computer science will continue to contribute to the evolving art and science of health care informatics. New trends promise to bring wide-sweeping and (it is hoped) positive changes to health care. Computers and other technologies have the potential to support a more patient-oriented or patient-centered health care system in which patients truly become active participants in their own health care planning and decisions. Mobile health technology, telehealth, sophisticated electronic health records, and next-generation technology are predicted to contribute to high-quality care and consultation within health care settings, including patients' homes and communities.

Computers are becoming more powerful yet more compact, which will contribute to the development of expanding technological initiatives. Some of these initiatives are described here. These innovations are some of the many computer and technological applications being used and developed. As health care professionals gain proficiency in capitalizing on the creative, time-saving, and interactive capabilities emerging from information technology research, the field of health care informatics will grow in similar proportions.

Voice-Activated Communicators

Voice-activated communicators are being used and new iterations developed by a variety of companies, including Vocera Communications. Vocera (2015) developed the Vocera B3000n Communication Badge that

> *is a lightweight, voice-controlled, wearable device that enables instant two-way or one to many conversations using intuitive and simple commands. The Vocera Badge is widely used by mobile workers who need wearable devices that provide the convenience and expedience of being able to respond to calls without pressing a button (i.e. sterile operating rooms, nuclear power plants, hotel staff, security personnel). (para. 1)*

These new technologies will permit health care professionals to use wireless, hands-free devices to communicate with one another and to record data. This technology is becoming a user-friendly and cost-effective way to increase clinical productivity.

Game and Simulation Technology

Game and simulation technology is offering realistic, innovative ways to teach content in general, including health care informatics concepts and skills. The same technology that powers video games is being used to create dynamic educational interfaces to help students learn about pathophysiology, care guidelines, and a host of other topics. Such applications are also very valuable for client education and health promotion materials. The "serious games" industry is growing since video game producers are now looking beyond mere entertainment to address public and private policy, management, and leadership issues and topics, including those related to health care. For example, the Games for Health Project, initiated by the Robert Wood Johnson Foundation (2015), is working on developing best practices to support innovation in health care training, messaging, and illness management. The Serious Games & VE Arcade & Showcase is presented at the annual meetings of the Society for Simulation in Healthcare (2015) (http://www.ssih.org) and is continuing to flourish with numerous products available to demonstrate.

Virtual Reality

Virtual reality is another technological breakthrough that is and will continue to influence health care education and professional development. Virtual reality is a three-dimensional, computer-generated "world" where a person (with the right equipment) can move about and interact as if he or she were actually in the visualized location. The person's senses are immersed in this virtual reality world using special gadgetry, such as head-mounted displays, data gloves, joysticks, and other hand tools. The equipment and special technology provides a sense of presence that is lacking in multimedia and other complex programs. According to Smith (2015), "It's crazy but true: Virtual reality will be a real thing in people's homes by this time next year" (para. 1). There are numerous products available. Virtual Realities (2015) stated that they provide "head mounted displays, head trackers, motion trackers, data gloves, 3D controllers, haptic devices, stereoscopic 3D displays, VR domes and virtual reality software. Virtual realities products are used by government, educational, industrial, medical and entertainment markets worldwide" (para. 1). Oculus VR (2015) developed Rift, which is the next generation of virtual reality products, and they are currently distributing the developer kits. HTC (2015) manufactures consumer electronics and developed the Vive headset. Smith believes that the Vive headset will be on the market soon, followed by Oculus Rift headsets and Sony's Morpheus headset for their PlayStation 4.

Mobile Devices

Mobile devices will be used more by health care professionals both at the point of care and in planning, documenting, interacting with the interprofessional health care team, and research. They will be using such powerful wearable technologies as nano-based diagnostic sensors in their personal lives, just as their patients do. Health care professionals will also be generating their own data streams and receiving data from the wearable and mobile devices their patients use. Silbershatz et al. (2013) stated that Apple IOS and Google Android are "currently dominating mobile computing" (p. 37). Perry (2015) stated that it is "estimated more than 177 million wearable devices will be in use by 2018" (para. 5). Cisco (2014) reported that "by the year 2020, the majority of Generation X and Y professionals believe that smartphones and wearable devices will be the workforce's most important 'connected' device—while the laptop remains the workplace device of choice" (para. 1). Data are truly at our fingertips.

Summary

The field of computer science is one of the fastest-growing disciplines. Astonishing innovations in computer hardware, software, and architecture have occurred over the past few decades, and there are no indications that this trend will come to a halt anytime soon. Computers have increased in speed, accuracy, and efficiency yet now cost less and have reduced physical size compared to their forebears. These trends are predicted to continue. Current computer hardware and software serve as vital and valuable tools for both health care professionals and patients to engage in onscreen and online activities that provide rich access to data and information. Productivity, creativity, and communication software tools also enable health care professionals to work with computers to further foster knowledge acquisition and development. Wide access to vast stores of information and knowledge shared by others facilitates the emergence of wisdom in users, which can then be applied to health care in meaningful and creative ways. It is imperative that health care professionals become discerning yet skillful users of computer technology to apply the principles of health care informatics to practice and to contribute to their profession's ever-growing body of knowledge.

Working Wisdom

Since the beginning of their professions, health care professionals have applied their ingenuity, resourcefulness, and professional awareness of what works to adapt technology and objects to support patient care, usually with the intention of promoting efficiency but also in support of patient comfort and healing. This resourcefulness could also be applied effectively to the adaptation of information technology within the care environment to ensure that the technology truly does serve patients and the interprofessional health care team.

Consider this question: "How can you develop competency in using the various computer hardware and software not only to promote efficient patient care and to develop yourself professionally but also to further the development of your profession's body of knowledge?"

Thought-Provoking Questions

1. How can knowledge of computer hardware and software help health care professionals participate in information technology adoption decisions in the practice area?
2. How can new computer software help health care professionals engage in professional development, collaboration, and knowledge dissemination activities at their own pace and leisure?

Apply Your Knowledge

You are a member of the health care professional/information technology council. The council has been charged by the administration with researching the configuration of various portable computer devices. Each member of the council is expected to select and examine one portable computer device. Search the Internet and select a portable computer device to evaluate. This may be any type of portable computer device, including (but not limited to) a laptop, a notebook, and a tablet.

1. Identify the specific computer device, the model you are evaluating, and the URL for the device description providing the information for your responses to the questions.
2. What processor does it have?
    a. What is a processor?
    b. Why is it important?
    c. How much speed does this processor have?
3. How much RAM does it have?
    a. What is RAM?
    b. Why is it important to know this feature and the available options when choosing this device for multimedia purposes?
    c. What type of RAM does it have?
4. What is the size of the hard drive?
    a. What is a hard drive?
    b. Why is it important to know this feature?
5. What is the difference between system and application software?
    a. Identify and describe one system software that for this device.
    b. Identify and describe one application software for this device.

Additional Resources

BBC Absolute Beginner's Guide to Using Your Computer: A WebWise Guide. http://www.bbc.co.uk/webwise/abbeg/abbeg.shtml

BBC's Computer Tutor: The BBC's Guide to Using a Computer. http://www.bbc.co.uk/webwise/topics/your-computer

Laptop Buying Guide: 8 Essential Tips http://blog.laptopmag.com/laptop-buying-guide

Nursing Informatics and the Foundation of Knowledge http://go.jblearning.com/mcgonigle

Society for Simulation in Healthcare http://www.ssih.org

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