

perform a similar set of calculations. The process would be much simpler if your calculator remembered the sequence of calculations and just asked you for this month's checkbook entries.

The idea of a **stored program** means that a series of instructions for a computing task can be loaded into a computer's memory. These instructions can easily be replaced by a different set of instructions when it is time for the computer to perform another task. This ability to switch programs makes computers multipurpose machines.

The stored program concept allows you to use your computer for one task, such as word processing, and then easily switch to a different type of computing task, such as editing a photo or sending an e-mail message. It is the single most important characteristic that distinguishes a computer from other simpler and less versatile digital devices, such as watches, calculators, and pocket-sized electronic dictionaries.

► **What kinds of software do computers run?** Computers run two main types of software: application software and system software. A computer can be applied to many tasks, such as writing, number crunching, video editing, and online shopping. **Application software** is a set of computer programs that helps a person carry out a task. Word processing software, for example, helps people create, edit, and print documents. Personal finance software helps people keep track of their money and investments. Video editing software helps people create home movies and professional films. Software applications are sometimes referred to as **apps**, especially in the context of handheld devices.

Whereas application software is designed to help a person carry out a task, the primary purpose of **system software** is to help the computer system monitor itself in order to function efficiently. An example of system software is a computer **operating system** (OS), which is essentially the master controller for all the activities that take place within a computer. Although an operating system does not directly help people perform application-specific tasks, such as word processing, people do interact with the operating system for certain operational and storage tasks, such as starting programs and locating data files.

## COMPUTER TYPES AND USES

► **Are computers categorized in any way?** At one time it was possible to define three distinct categories of computers. Mainframes were housed in large, closet-sized metal frames. Minicomputers were smaller, less expensive, and less powerful computers that were able, nevertheless, to support multiple users and run business software. Microcomputers were clearly differentiated from computers in other categories because they were dedicated to a single user and their CPUs consisted of a single microprocessor chip.

Today, microprocessors are no longer a distinction between computer categories because just about every computer uses one or more microprocessors as its CPU. The term *minicomputer* has fallen into disuse, and the terms *microcomputer* and *mainframe* are used with less and less frequency.

Computers are versatile machines, but some computers are better suited than others for certain tasks. Categorizing computers is a way of grouping them according to criteria such as usage, cost, size, and capability. Experts don't necessarily agree on the categories or the devices placed in each category, but commonly used computer categories include personal computers, servers, mainframes, and supercomputers.

### TRY IT!

Do you know the difference between the apps you use and your computer's operating system? Which of the following are operating systems?

- ☐ Microsoft Windows
- ☐ Microsoft Word
- ☐ Apple iOS
- ☐ Mac OS X
- ☐ iWork
- ☐ iTunes

### TERMINOLOGY NOTE

The term *personal computer* is sometimes abbreviated as *PC*. However, *PC* can also refer to a specific type of personal computer that descended from the original IBM PC and runs Windows software.

In this book, *PC* refers to IBM PC descendants. It is not used as an abbreviation for *personal computer*.

► **What is a personal computer?** A **personal computer** is a micro-processor-based computing device designed to meet the computing needs of an individual. It commonly includes a keyboard and screen, and provides access to a wide variety of local and cloud-based applications.

Personal computers are available as desktop or portable models, and in a variety of shapes, sizes, and colors. You'll learn more about the wide variety of personal computers in the Hardware chapter. For now, simply remember that computers like those pictured in Figure 1-15 are classified as personal computers.



**FIGURE 1-15**

Personal computer designs run the gamut from drab gray boxes to colorful curvy cases.



► **Are handheld devices computers?** Handheld digital devices include familiar gadgets such as iPhones, iPads, iPods, Garmin GPSs, Droids, and Kindles. These devices incorporate many computer characteristics. They accept input, produce output, process data, and include storage capabilities. Handheld devices vary in their programmability and their versatility.

Handheld devices can be divided into two broad categories: those that allow users to install software applications (apps) and those that do not. Handheld devices that allow you to install applications can be classified as personal computers; devices that are not programmable cannot.

iPads and Droid phones, for example, offer access to a wide range of apps that include games, ebook readers, maps, comics, recipes, and news, which are tasks also performed by personal computers that sit on a desk or table (Figure 1-16).

► **Is an Xbox a computer?** A **videogame console**, such as Nintendo's Wii, Sony's PlayStation, or Microsoft's Xbox, is a computer, but would not generally be referred to as a personal computer because of its history as a dedicated game device. Videogame consoles originated as simple digital devices that connected to a television and provided only a pair of joysticks for input.

Today's videogame consoles contain microprocessors that are equivalent to any found in a fast personal computer, and they are equipped to produce graphics that rival those on dedicated technical and scientific computers. Add-ons such as keyboards, DVD players, and Internet access make it possible to use a videogame console for activities similar to those for which you'd use a personal computer. Despite these features, videogame consoles like the one in Figure 1-17 fill a specialized niche and are not considered a replacement for a personal computer.

**FIGURE 1-16**

Tablet computers, high-end mobile phones, and similar handheld devices allow you to install your choice of application software.



**FIGURE 1-17**

A videogame console includes circuitry similar to a personal computer's, but its input and output devices are optimized for gaming.



► **What is a workstation?** The term **workstation** has two meanings. It can simply refer to an ordinary personal computer that is connected to a network. A second meaning refers to powerful desktop computers used for high-performance tasks, such as medical imaging and computer-aided design, that require a lot of processing speed. Workstations, such as the one pictured in Figure 1-18, typically cost a bit more than an average personal computer.

► **What makes a computer a server?** In the computer industry, the term *server* has several meanings. It can refer to computer hardware, to a specific type of software, or to a combination of hardware and software. In any case, the purpose of a **server** is to serve computers on a network (such as the Internet or a home network) by supplying them with data.

Any software or digital device, such as a computer, that requests data from a server is referred to as a **client**. For example, on the Internet, a server might respond to a client's request for a Web page. Servers also handle the steady stream of e-mail that travels among clients from all over the Internet. A server might also allow clients within a home, school, or business network to share files or access a centralized printer.

Client computers can download and upload files from servers. The term **download** refers to the process of copying a file from a server to your own client computer. For example, you can say "I had to download the file before I could install it." The term can also refer to the file that you download, as in "I had to delete the download because it was infected with a virus."

**Upload** refers to the process of copying files from your client computer to a server. As with the term *download*, *upload* can also refer to the file you have uploaded.

Remarkably, just about any personal computer, workstation, mainframe, or supercomputer can be configured to perform the work of a server. That fact should emphasize the concept that a server does not require a specific type of hardware. Nonetheless, computer manufacturers such as IBM, SGI, HP, and Dell offer devices called servers (Figure 1-19) that are especially suited for storing and distributing data on a network.

**FIGURE 1-18**

A workstation resembles a desktop computer, but typically features more processing power and storage capacity.

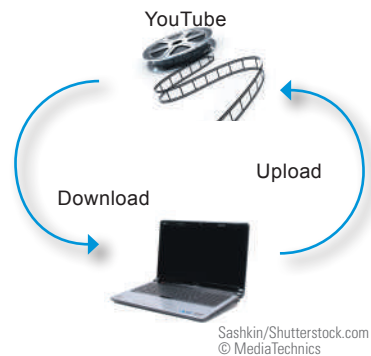


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**TRY IT!**

How would you classify the computer in this diagram?

- ☐ A server
- ☐ A client
- ☐ Both



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**FIGURE 1-19**

Some servers look like personal computer tower units, whereas others are housed in industrial-looking cases.

Server prices vary, depending on configuration, but tend to be more similar to workstation prices than personal computer prices. Despite impressive performance on server-related tasks, these machines do not offer features such as sound cards, DVD players, and other fun accessories, so they are not a suitable alternative to a personal computer.

### ► What's so special about a mainframe computer? A

**mainframe computer** (or simply a mainframe) is a large and expensive computer capable of simultaneously processing data for hundreds or thousands of users. Mainframes are generally used by businesses or governments to provide centralized storage, processing, and management for large amounts of data. Mainframes remain the computer of choice in situations where reliability, data security, and centralized control are necessary.

The price of a mainframe computer typically starts at \$100,000 and can easily exceed \$1 million. Its main processing circuitry is housed in a closet-sized cabinet (Figure 1-20); but after large components are added for storage and output, a mainframe computer system can fill a good-sized room.



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**FIGURE 1-20**

This IBM z9 mainframe computer weighs 2,807 pounds and is about 6.5 feet tall.

► **How powerful is a supercomputer?** A computer falls into the **supercomputer** category if it is, at the time of construction, one of the fastest computers in the world (Figure 1-21).

Because of their speed, supercomputers can tackle complex tasks and compute-intensive problems that just would not be practical for other computers. A **compute-intensive** problem is one that requires massive amounts of data to be processed using complex mathematical calculations. Molecular calculations, atmospheric models, and climate research are all examples of projects that require massive numbers of data points to be manipulated, processed, and analyzed.

Common uses for supercomputers include breaking codes, modeling worldwide weather systems, and simulating nuclear explosions. One impressive simulation, which was designed to run on a supercomputer, tracked the movement of thousands of dust particles as they were tossed about by a tornado.

At one time, supercomputer designers focused on building specialized, very fast, and very large CPUs. Today, most supercomputer CPUs are constructed from thousands of microprocessors. Of the 500 fastest supercomputers in the world, the majority use microprocessor technology.



Lawrence Livermore National Laboratory

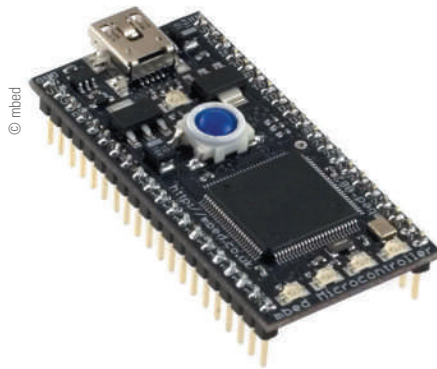
**FIGURE 1-21**

In 2012, IBM's Blue Gene/Q became the fastest supercomputer in the world. With a speed of 16.32 petaflops, the number of calculations this computer can perform in one hour would require 300 years if every person on Earth used a handheld calculator.



## MICROCONTROLLERS

► **What is a microcontroller?** Have you ever wondered how a guided missile reaches its target or how your refrigerator knows when to initiate a defrost cycle? What controls your microwave oven, digital video recorder, washing machine, and watch? Many common appliances and machines are controlled by embedded microcontrollers. A **microcontroller** is a special-purpose microprocessor that is built into the machine it controls. A microcontroller, such as the one in Figure 1-22, is sometimes called a computer-on-a-chip or an embedded computer because it includes many of the elements common to computers.



**FIGURE 1-22**

A microcontroller is a self-contained chip that can be embedded in an appliance, vehicle, or other device.

► **How does a microcontroller work?** Consider the microcontroller in a Sub-Zero refrigerator. It accepts user input for desired temperatures in the refrigerator and freezer compartments. It stores these desired temperatures in memory. Temperature sensors collect additional input of the actual temperatures. The microcontroller processes the input data by comparing the actual temperature to the desired temperature. As output, the microcontroller sends signals to activate the cooling motor as necessary. It also generates a digital readout of the refrigerator and freezer temperatures.

► **Is a microcontroller really a computer?** Recall that a computer is defined as a multipurpose device that accepts input, produces output, stores data, and processes it according to a stored program. A microcontroller seems to fit the input, processing, output, and storage criteria that define computers. Some microcontrollers can even be reprogrammed to perform different tasks.

Technically, a microcontroller could be classified as a computer. Despite this technicality, however, microcontrollers tend to be referred to as processors rather than as computers because in practice they are used for dedicated applications, not as multipurpose devices.

### TRY IT!

Which one of the following would you most likely use to add and use apps such as games and weather tracking?

- ☐ A microcontroller
- ☐ Any handheld digital device
- ☐ A handheld computer