

1. Web Technology

1.1. Computer programming and coding

(Gaddis, 2018) Think about some of the different ways that people use computers. The uses of computers are almost limitless in our everyday lives. Computers can perform such a wide variety of tasks because they can be programmed. This means that computers are not designed to do just one job, but to do any job that their programs tell them to do. A *program* is a set of instructions that a computer follows to perform a task.

Programs are commonly referred to as *software*. Software is essential to a computer because it controls everything the computer does. All of the software that we use to make our computers useful is created by individuals working as programmers or software developers. A *programmer*, or *software developer*, is a person with the training and skills necessary to design, create, and test computer programs. Computer programming is an exciting and rewarding career. Today, you will find programmers' work used in business, medicine, government, law enforcement, agriculture, academics, entertainment, and many other fields.

1.1.1. Hardware and software

Hardware

The term *hardware* refers to all of the physical devices, or *components*, of which a computer is made. A computer is not one single device, but a system of devices that all work together. Like the different instruments in a symphony orchestra, each device in a computer plays its own part.

If you have ever shopped for a computer, you've probably seen sales literature listing components such as microprocessors, memory, disk drives, video displays, graphics cards, and so on. Unless you already know a lot about computers, or at least have a friend that does, understanding what these different components do might be challenging.

As shown in Figure 1-1, a typical computer system consists of the following major components:

- The central processing unit (CPU)
- Main memory
- Secondary storage devices
- Input devices
- Output devices

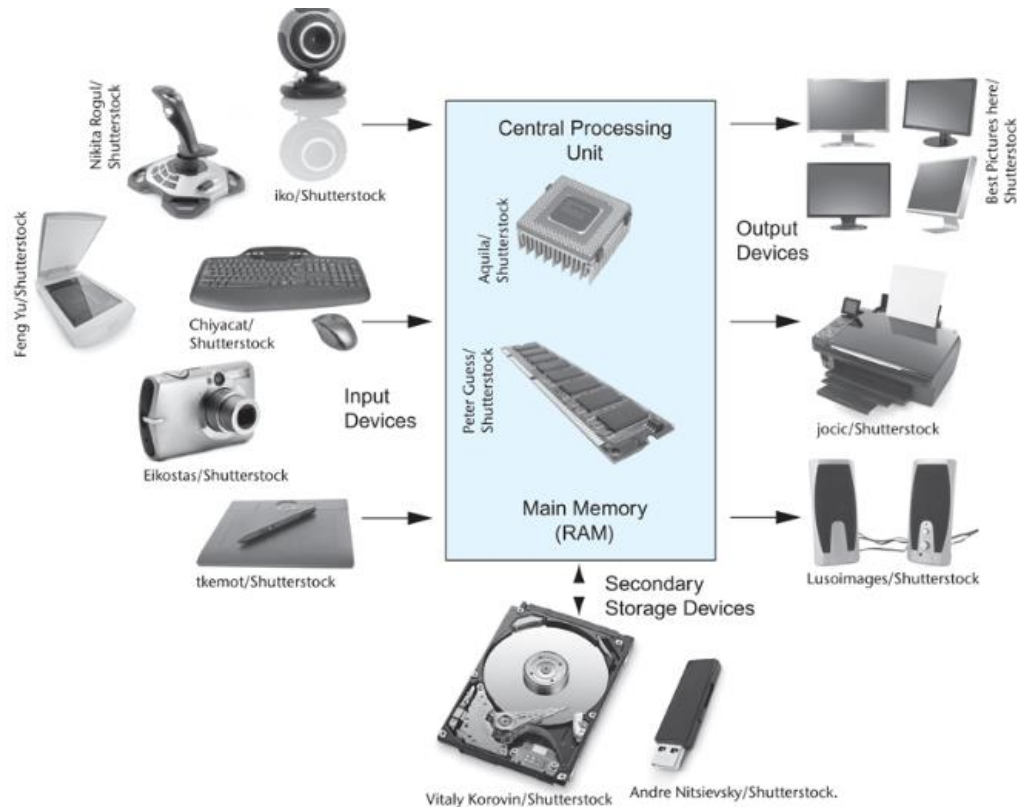


Figure 1-1 Typical components of a computer system

The CPU

When a computer is performing the tasks that a program tells it to do, we say that the computer is *running* or *executing* the program. The *central processing unit*, or *CPU*, is the part of a computer that actually runs programs. The CPU is the most important component in a computer because without it, the computer could not run software.

In the earliest computers, CPUs were huge devices made of electrical and mechanical components such as vacuum tubes and switches. **Figure 1-2** shows such a device. The two women in the photo are working with the historic ENIAC computer. The ENIAC, which is considered by many to be the world's first programmable electronic computer, was built in 1945 to calculate artillery ballistic tables for the U.S. Army. This machine, which was primarily one big CPU, was 8 feet tall, 100 feet long, and weighed 30 tons.

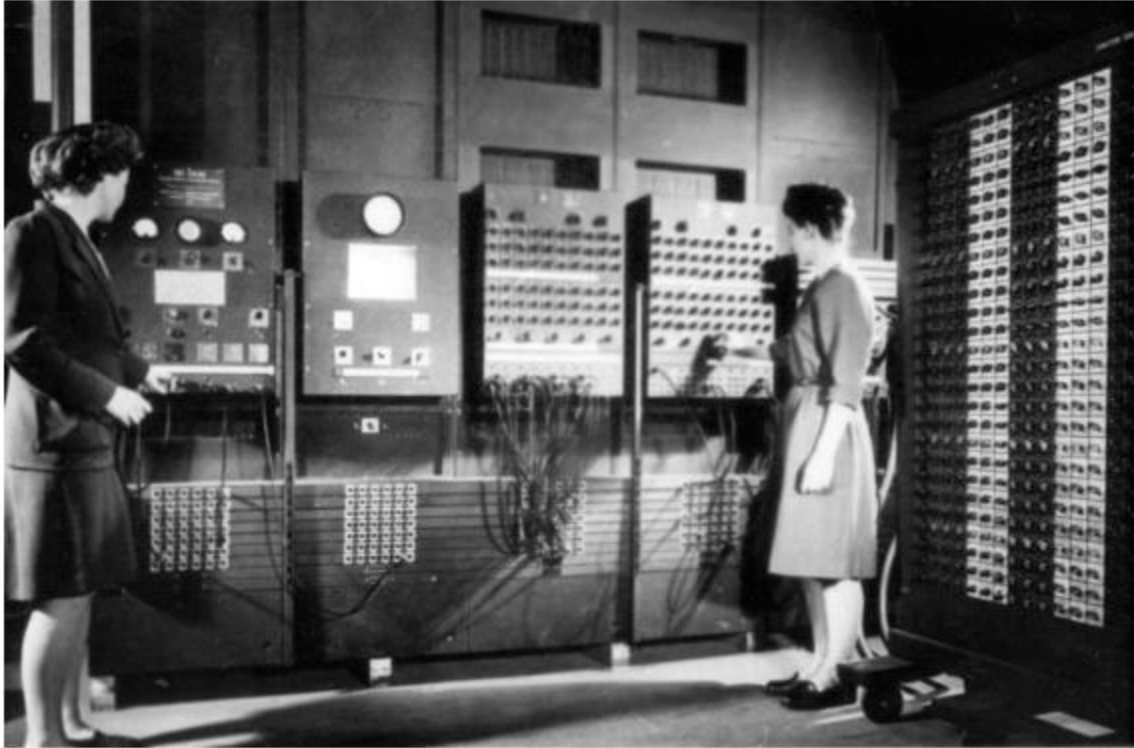


Figure 1-2 The ENIAC computer (courtesy of U.S. Army Historic Computer Images)

Today, CPUs are small chips known as *microprocessors*. **Figure 1-3** shows a photo of a lab technician holding a modern microprocessor. In addition to being much smaller than the old electromechanical CPUs in early computers, microprocessors are also much more powerful.

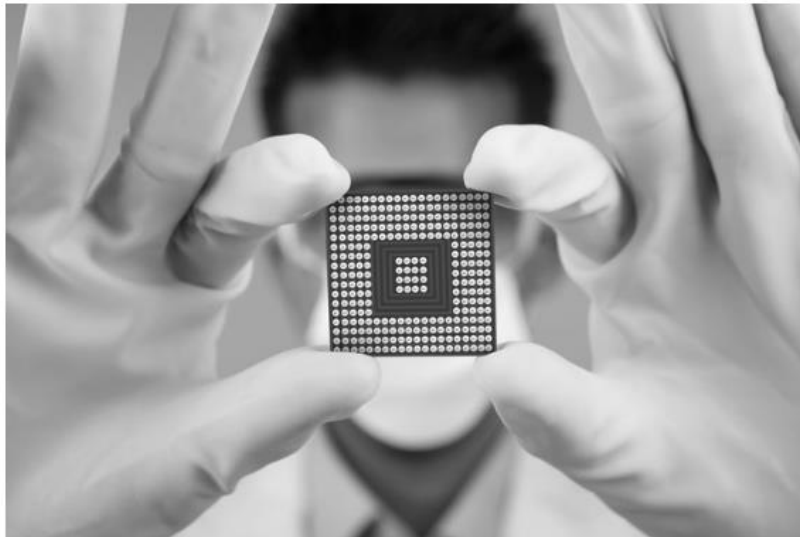


Figure 1-3 A lab technician holds a modern microprocessor (Creativa/Shutterstock)

Main Memory

You can think of *main memory* as the computer's work area. This is where the computer stores a program while the program is running, as well as the data that the program is working with. For example, suppose you are using a word processing program to write an essay for one of your classes. While you do this, both the word processing program and the essay are stored in main memory.

Main memory is commonly known as *random-access memory*, or *RAM*. It is called this because the CPU is able to quickly access data stored at any random location in RAM. RAM is usually a *volatile* type of memory that is used only for temporary storage while a program is running. When the computer is turned off, the contents of RAM are erased. Inside your computer, RAM is stored in chips, similar to the ones shown in [Figure 1-4](#).

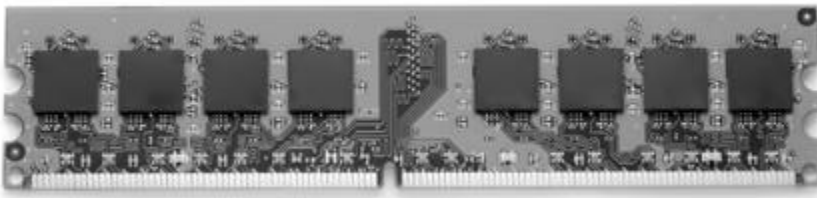


Figure 1-4 Memory chips (Garsya/Shutterstock)

Secondary Storage Devices

Secondary storage is a type of memory that can hold data for long periods of time, even when there is no power to the computer. Programs are normally stored in secondary memory and loaded into main memory as needed. Important data, such as word processing documents, payroll data, and inventory records, is saved to secondary storage as well.

The most common type of secondary storage device is the *disk drive*. A traditional disk drive stores data by magnetically encoding it onto a spinning circular disk. *Solid-state drives*, which store data in solid-state memory, are increasingly becoming popular. A solid-state drive has no moving parts and operates faster than a traditional disk drive. Most computers have some sort of secondary storage device, either a traditional disk drive or a solid-state drive, mounted inside their case. External storage devices, which connect to one of the computer's communication ports, are also available. External storage devices can be used to create backup copies of important data or to move data to another computer.

In addition to external storage devices, many types of devices have been created for copying data and for moving it to other computers. For example, *USB drives* are small devices that plug into the computer's USB (universal serial bus) port and appear to the system as a disk drive. These drives do not actually contain a disk, however. They store data in a special type of memory known as *flash memory*. USB drives, which are also known as *memory sticks* and *flash drives*, are inexpensive, reliable, and small enough to be carried in your pocket.

Optical devices such as the *CD* (compact disc) and the *DVD* (digital versatile disc) are also popular for data storage. Data is not recorded magnetically on an optical disc, but is encoded as a series of pits on the disc surface. CD and DVD drives use a laser to detect the pits and thus read the encoded data. Optical discs hold large amounts of data, and for that reason, recordable CD and DVD drives are commonly used for creating backup copies of data.

Input Devices

Input is any data the computer collects from people and from other devices. The component that collects the data and sends it to the computer is called an *input device*. Common input devices are the keyboard, mouse, touchscreen, scanner, microphone, and digital camera. Disk drives and optical drives can also be considered input devices, because programs and data are retrieved from them and loaded into the computer's memory.

Output Devices

Output is any data the computer produces for people or for other devices. It might be a sales report, a list of names, or a graphic image. The data is sent to an *output device*, which formats and presents it. Common output devices are video displays and printers. Disk drives can also be considered output devices because the system sends data to them in order to be saved.

Software

If a computer is to function, software is not optional. Everything computer does, from the time you turn the power switch on until you shut the system down, is under the control of software. There are two general categories of software: system software and application software. Most computer programs clearly fit into one of these two categories. Let's take a closer look at each.

System Software

The programs that control and manage the basic operations of a computer are generally referred to as *system software*. System software typically includes the following types of programs:

Operating Systems

An *operating system* is the most fundamental set of programs on a computer. The operating system controls the internal operations of the computer's hardware, manages all of the devices connected to the computer, allows data to be saved to and retrieved from storage devices, and allows other programs to run on the computer. Popular operating systems for laptop and desktop computers include Windows, macOS, and Linux. Popular operating systems for mobile devices include Android and iOS.

Utility Programs

A *utility program* performs a specialized task that enhances the computer's operation or safeguards data. Examples of utility programs are virus scanners, file compression programs, and data backup programs.

Software Development Tools

Software development tools are the programs that programmers use to create, modify, and test software. Assemblers, compilers, and interpreters are examples of programs that fall into this category.

Application Software

Programs that make a computer useful for everyday tasks are known as *application software*. These are the programs that people normally spend most of their time running on their computers. Two commonly used applications: Microsoft Word, a word processing program, and PowerPoint, a presentation program. Some other examples of application software are spreadsheet programs, email programs, web browsers, and game programs.

1.1.2 How Computers Store Data

A computer's memory is divided into tiny storage locations known as *bytes*. One byte is only enough memory to store a letter of the alphabet or a small number. In order to do anything meaningful, a computer has to have lots of bytes. Most computers today have millions, or even billions, of bytes of memory.

Each byte is divided into eight smaller storage locations known as bits. The term *bit* stands for *binary digit*. Computer scientists usually think of bits as tiny switches that can be either on or off. Bits aren't actual "switches," however, at least not in the conventional sense. In most computer systems, bits are tiny electrical components that can hold either a positive or a negative charge. Computer scientists think of a positive charge as a switch in the *on* position, and a negative charge as a switch in the *off* position. **Figure 1-5** shows the way that a computer scientist might think of a byte of memory: as a collection of switches that are each flipped to either the on or off position.

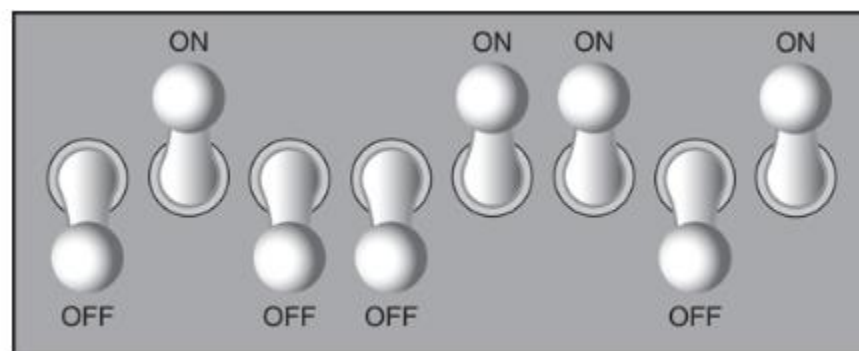


Figure 1-5 Think of a byte as eight switches

When a piece of data is stored in a byte, the computer sets the eight bits to an on/off pattern that represents the data. For example, the pattern on the left in **Figure 1-6** shows how the number 77 would be stored in a byte, and the pattern on the right shows how the letter A would be stored in a byte. We explain below how these patterns are determined.

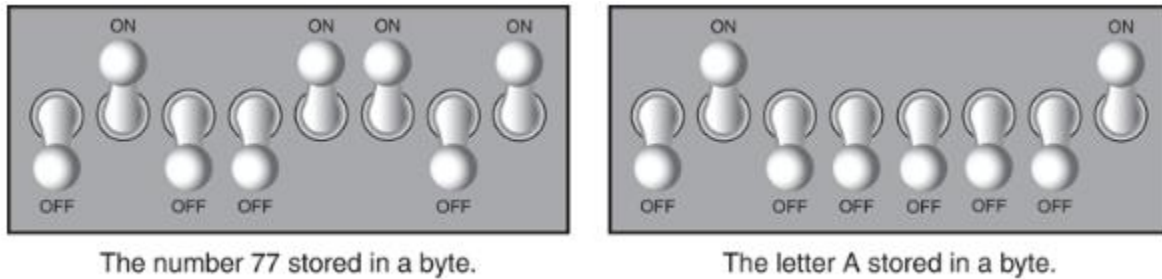


Figure 1-6 Bit patterns for the number 77 and the letter A

Storing Numbers

A bit can be used in a very limited way to represent numbers. Depending on whether the bit is turned on or off, it can represent one of two different values. In computer systems, a bit that is turned off represents the number 0, and a bit that is turned on represents the number 1. This corresponds perfectly to the *binary numbering system*. In the binary numbering system (or *binary*, as it is usually called), all numeric values are written as sequences of 0s and 1s. Here is an example of a number that is written in binary:

10011101

The position of each digit in a binary number has a value assigned to it. Starting with the rightmost digit and moving left, the position values are 2^0 , 2^1 , 2^2 , 2^3 , and so forth, as shown in **Figure 1-7**. **Figure 1-8** shows the same diagram with the position values calculated. Starting with the rightmost digit and moving left, the position values are 1, 2, 4, 8, and so forth.

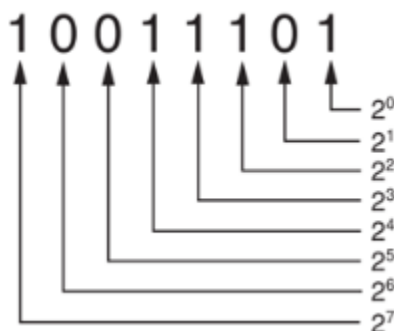


Figure 1-7 The values of binary digits as powers of 2

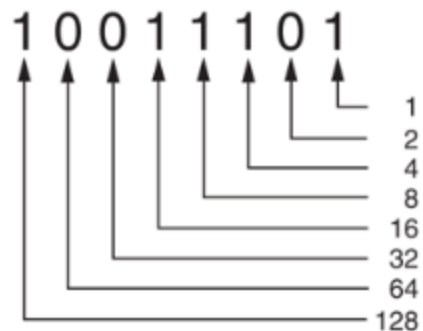


Figure 1-8 The values of binary digits

To determine the value of a binary number, you simply add up the position values of all the 1s. For example, in the binary number 10011101, the position values of the 1s are 1, 4, 8, 16, and 128. This is shown in **Figure 1-9**. The sum of all of these position values is 157. So, the value of the binary number 10011101 is 157.

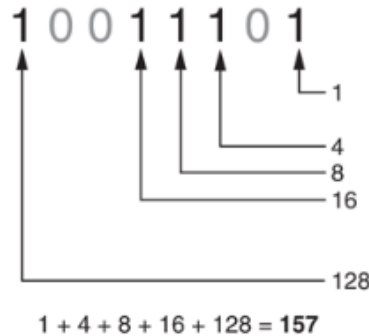


Figure 1-9 Determining the value of 10011101

Figure 1-10 shows how you can picture the number 157 stored in a byte of memory. Each 1 is represented by a bit in the on position, and each 0 is represented by a bit in the off position.

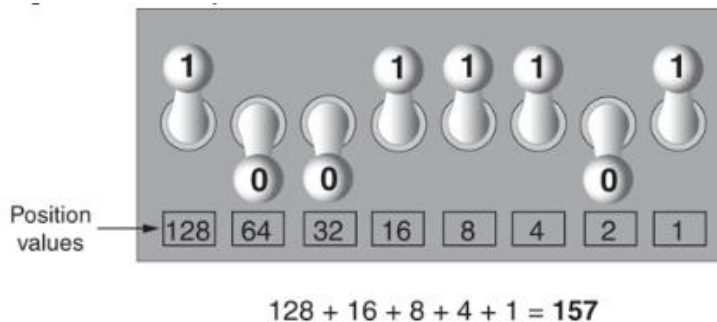


Figure 1-10 The bit pattern for 157

When all of the bits in a byte are set to 0 (turned off), then the value of the byte is 0. When all of the bits in a byte are set to 1 (turned on), then the byte holds the largest value that can be stored in it. The largest value that can be stored in a byte is $1 + 2 + 4 + 8 + 16 + 32 + 64 + 128 = 255$. This limit exists because there are only eight bits in a byte.

What if you need to store a number larger than 255? The answer is simple: use more than one byte. For example, suppose we put two bytes together. That gives us 16 bits. The position values of those 16 bits would be $2^0, 2^1, 2^2, 2^3$, and so forth, up through 2^{15} . As shown in **Figure 1-11**, the maximum value that can be stored in two bytes is 65,535. If you need to store a number larger than this, then more bytes are necessary.

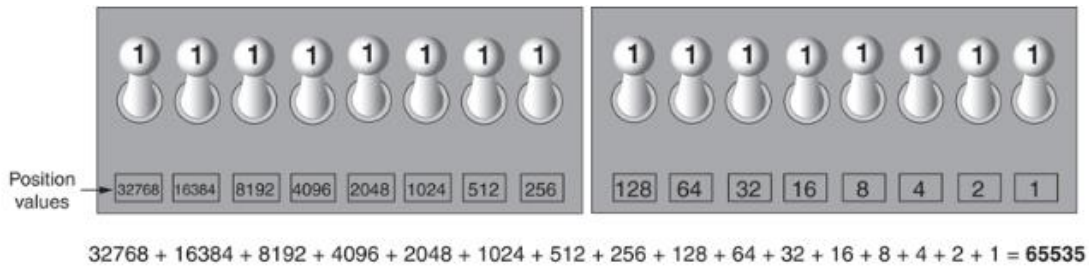


Figure 1-11 Two bytes used for a large number

Storing Characters

Any piece of data that is stored in a computer's memory must be stored as a binary number. That includes characters, such as letters and punctuation marks. When a character is stored in memory, it is first converted to a numeric code. The numeric code is then stored in memory as a binary number.

Over the years, different coding schemes have been developed to represent characters in computer memory. Historically, the most important of these coding schemes is *ASCII*, which stands for the *American Standard Code for Information Interchange*. ASCII is a set of 128 numeric codes that represent the English letters, various punctuation marks, and other characters. For example, the ASCII code for the uppercase letter A is 65. When you type an uppercase A on your computer keyboard, the number 65 is stored in memory (as a binary number, of course). This is shown in [Figure 1-12](#).

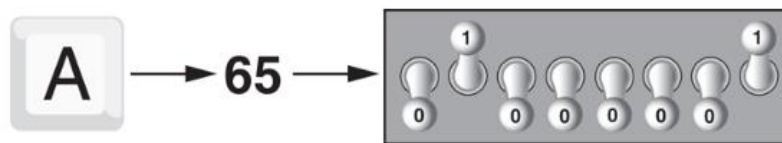


Figure 1-12 The letter A is stored in memory as the number 65

In case you are curious, the ASCII code for uppercase B is 66, for uppercase C is 67, and so forth. The ASCII character set was developed in the early 1960s and was eventually adopted by almost all computer manufacturers. ASCII is limited, however, because it defines codes for only 128 characters. To remedy this, the Unicode character set was developed in the early 1990s. *Unicode* is an extensive encoding scheme that is compatible with ASCII, but can also represent characters for many of the languages in the world. Today, Unicode is quickly becoming the standard character set used in the computer industry.

Advanced Number Storage

Earlier, you read about numbers and how they are stored in memory. While reading that section, perhaps it occurred to you that the binary numbering system can be used to represent only integer numbers, beginning with 0. Negative numbers and real numbers (such as 3.14159) cannot be represented using the simple binary numbering technique we discussed.

Computers are able to store negative numbers and real numbers in memory, but to do so they use encoding schemes along with the binary numbering system. Negative numbers are encoded using a technique known as *two's complement*, and real numbers are encoded in *floating-point notation*. You don't need to know how these encoding schemes work, only that they are used to convert negative numbers and real numbers to binary format.

Other Types of Data

Computers are often referred to as digital devices. The term *digital* can be used to describe anything that uses binary numbers. *Digital data* is data that is stored in binary format, and a *digital device* is any device that works with binary data. In this section, we have discussed how numbers and characters are stored in binary, but computers also work with many other types of digital data.

For example, consider the pictures that you take with your digital camera. These images are composed of tiny dots of color known as *pixels*. (The term pixel stands for *picture element*.) As shown in [Figure 1-13](#), each pixel in an image is converted to a numeric code that represents the pixel's color. The numeric code is stored in memory as a binary number.

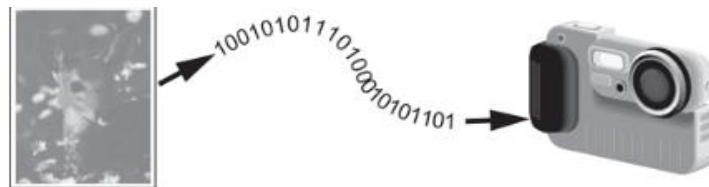


Figure 1.13 A digital image is stored in binary format

The music that you play on your CD player, iPod, or MP3 player is also digital. A digital song is broken into small pieces known as *samples*. Each sample is converted to a binary number, which can be stored in memory. The more samples that a song is divided into, the more it sounds like the original music when it is played back. A CD quality song is divided into more than 44,000 samples per second! (Gaddis, 2018)

1.2. Web Technology

The World Wide Web -www

The World Wide Web (WWW) is a network of online content that is formatted in HTML and accessed via HTTP. The term refers to all the interlinked HTML pages that can be accessed over the Internet. The World Wide Web was originally designed in 1991 by Tim Berners-Lee while he was a contractor at CERN.

The World Wide Web is most often referred to simply as "the Web."

The Internet

The **Internet**, sometimes called simply "the Net," is a worldwide system of computer networks - a network of networks in which users at any one computer can, if they have permission, get information from any other computer (and sometimes talk directly to users at other computers).

Using the Internet, computers connect and communicate with each other, primarily using the TCP/IP (Transmission Control Protocol / Internet Protocol). Think of TCP/IP as a book of rules, a step-by-step guide that each computer uses to know how to talk to another computer.

ISPs (Internet service providers)

ISPs (Internet service providers), the companies that provide Internet service and connectivity, also follow these rules. The ISP provides a bridge between your computer and all the other computers in the world, which are all a part of the Internet. The ISP uses the TCP/IP protocols to make computer-to-computer connections possible and transmit data between them. When connected to an ISP, you are assigned an IP address, which is a unique address given to your computer or network and allows it to be found while on the Internet.

URL (Uniform Resource Locator)

Abbreviated as *URL*, a Uniform Resource Locator is a way of identifying the location of a file on the internet. They're what we use to open not only websites, but also to download images, videos, software programs, and other types of files that are hosted on a server.

Opening a *local* file on your computer is as simple as double-clicking it, but to open files on *remote* computers, like web servers, we must use URLs so that our web browser knows where to look. For example, opening the HTML file that represents the web page explained below, is done by entering it into the navigation bar at the top of the browser you're using.

Uniform Resource Locators are most commonly abbreviated as *URLs* but they're also called *website addresses* when they refer to URLs that use the HTTP or HTTPS protocol.

URL is usually pronounced with each letter spoken individually (i.e. *u - r - l*, not *earl*). It used to be an abbreviation for *Universal Resource Locator* before being changed to Uniform Resource Locator.

Examples of URLs

You're probably used to entering in URL, like this one for accessing Google's website:

```
https://www.google.com
```

The entire address is called the URL. Another example is this website (first) and Microsoft's (second):

```
https://lifewire.com  
https://www.microsoft.com
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Web Server and Hosting

Server hosting refers to the outsourcing of an organization's server placement and platform to a third-party Managed Hosting Provider (MSP). A client uses the Internet to connect to data and applications on a managed server and pays a recurring fee to the hosting provider. A MSP usually operates and manages large data centers with dozens, hundreds or thousands of hosted servers for two or more clients. This model is known as colocation or colocated hosting.

The server hosting model provides a best-of-all-worlds scenario by giving organizations access to server platforms to host their applications and data without shouldering attendant costs.

HTML and CSS



ML (the Hypertext Markup Language) and CSS (Cascading Style Sheets) are two of the core technologies for building Web pages. HTML provides the *structure* of the page, CSS the (visual and aural) *layout*, for a variety of devices. Along with graphics and scripting, HTML and CSS are the basis of building Web pages and Web Applications.

What is HTML?

HTML is the language for describing the structure of Web pages. HTML gives authors the means to:

- Publish online documents with headings, text, tables, lists, photos, etc.
- Retrieve online information via hypertext links, at the click of a button.
- Design forms for conducting transactions with remote services, for use in searching for information, making reservations, ordering products, etc.
- Include spread-sheets, video clips, sound clips, and other applications directly in their documents.

With HTML, authors describe the structure of pages using *markup*. The *elements* of the language label pieces of content such as “paragraph,” “list,” “table,” and so on.

What is XHTML?

XHTML is a variant of HTML that uses the syntax of XML, the Extensible Markup Language. XHTML has all the same elements (for paragraphs, etc.) as the HTML variant, but the syntax is slightly different. Because XHTML is an XML application, you can use other XML tools with it (such as XSLT, a language for transforming XML content).

What is CSS?

CSS is the language for describing the presentation of Web pages, including colors, layout, and fonts. It allows one to adapt the presentation to different types of devices, such as large screens, small screens, or printers. CSS is independent of HTML and can be used with any XML-based markup language. The separation of HTML from CSS makes it easier to maintain sites, share style sheets across pages, and tailor pages to different environments. This is referred to as the *separation of structure (or: content) from presentation*.

Text Editor

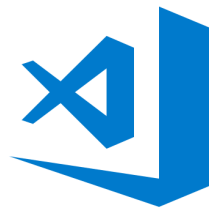
A **text editor** is program that allows you to open, view, and edit plain **text** files. Unlike word processors, **text editors** do not add formatting to **text**, instead focusing on **editing** functions for plain **text**. **Text editors** are **used by** a wide variety of people, for a wide variety of purposes.

Editing HTML and CSS code can be done without any specific tools. In fact, if you have a simple text editor, you are good to go. However, just because you can do something doesn't mean it is the best way to do it – and that applies to web development as well.

Web development IDE does all the things simple text editors do plus a number of more advanced stuff that you can't do with text editors. For instance, while an editor such as Sublime or Atom can be used as an HTML CSS JavaScript editor, they only allow you to write code.

Of course, they come with a bunch of convenient features such as syntax highlighting, customizable interfaces, and extensive navigation tools, you will need additional features to make a functional app. For example, you will need a debugger and a compiler.

Visual Studio Code, VS code, text editor



Visual Studio Code

Visual Studio Code is a lightweight but powerful source code editor which runs on your desktop and is available for Windows, macOS and Linux. It comes with built-in support for JavaScript, TypeScript and Node.js and has a rich ecosystem of extensions for other languages and runtimes (such as C++, C#, Java, Python, PHP, Go, .NET). Begin your journey with VS Code with these introductory videos (<https://code.visualstudio.com/docs/getstarted/introvideos>). Visual Studio Code is **FREE**