Applications of Information and Communications technology

Jamal Ahmed Khan

Lecture 03

Reference book

Charles S. Parker, Understanding Computers: Today and Tomorrow, Course Technology, 25 Thomson Place, Boston, Massachusetts 02210, USA

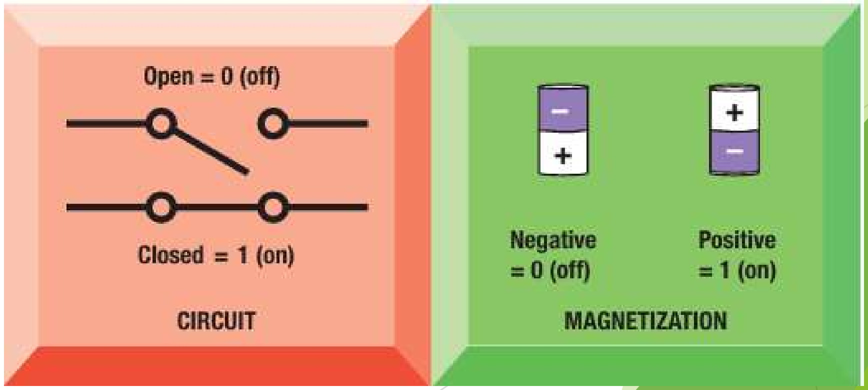
HARDWARE

The System Unit, Processing, and Memory

The system unit of a computing device is sometimes thought of as a mysterious "black box" and often the user does not have much understanding of what hap pens inside it.

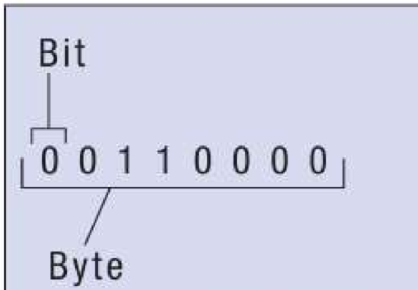
Digital Data representation

Virtually all computers today—such as the embedded computers, mobile devices, per sonal computers, servers, mainframes, and supercomputers discussed in Chapter 1—are digital computers. Digital computers can understand only two (binary) states, usually thought of as off and on and represented by the digits 0 and 1. Consequently, all data processed by a computer must be in binary form (0s and 1s). The 0s and 1s used to represent data can be represented in a variety of ways, such as with an open or closed circuit, the absence or presence of electronic current, two different types of magnetic alignment on a storage medium, and so on



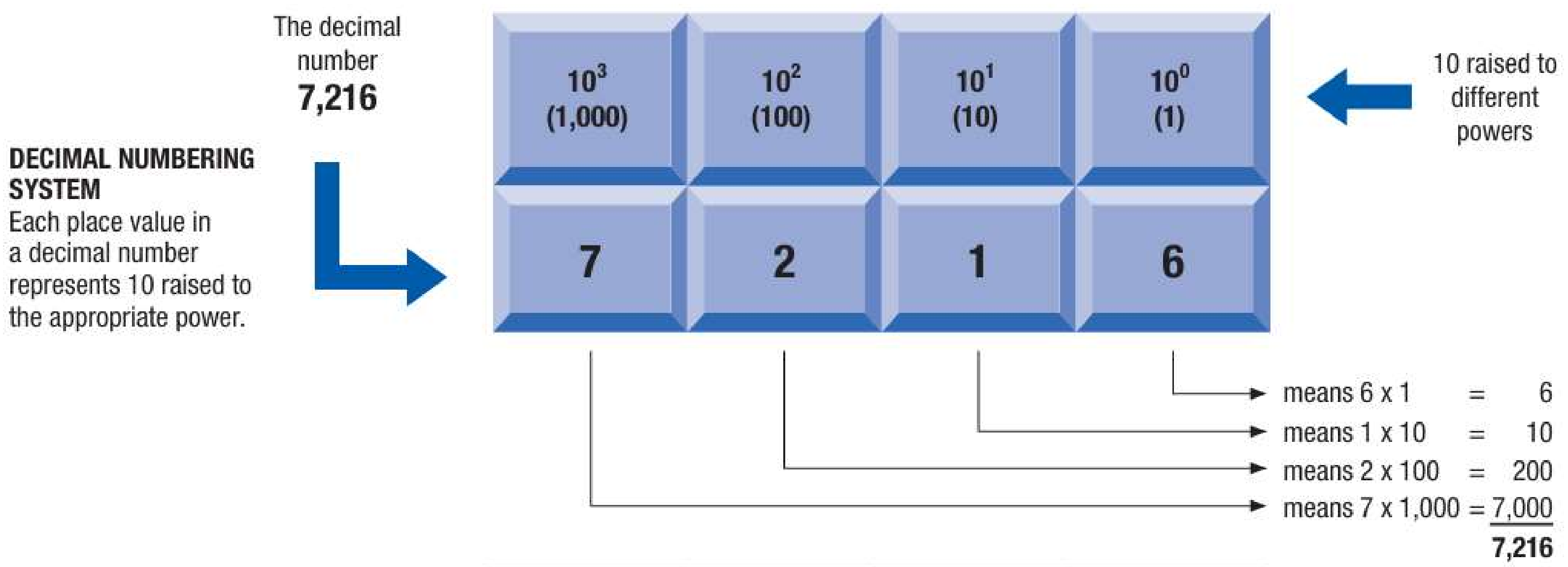
A bit is the smallest unit of data that a computer can recognize. Therefore, the input you enter via a keyboard, the software program you use to play your music collection, the term paper stored on your USB flash drive, and the digital photos located on your smartphone are all just groups of bits. Representing data in a form that can be understood by a digital computer is called digital data representation.

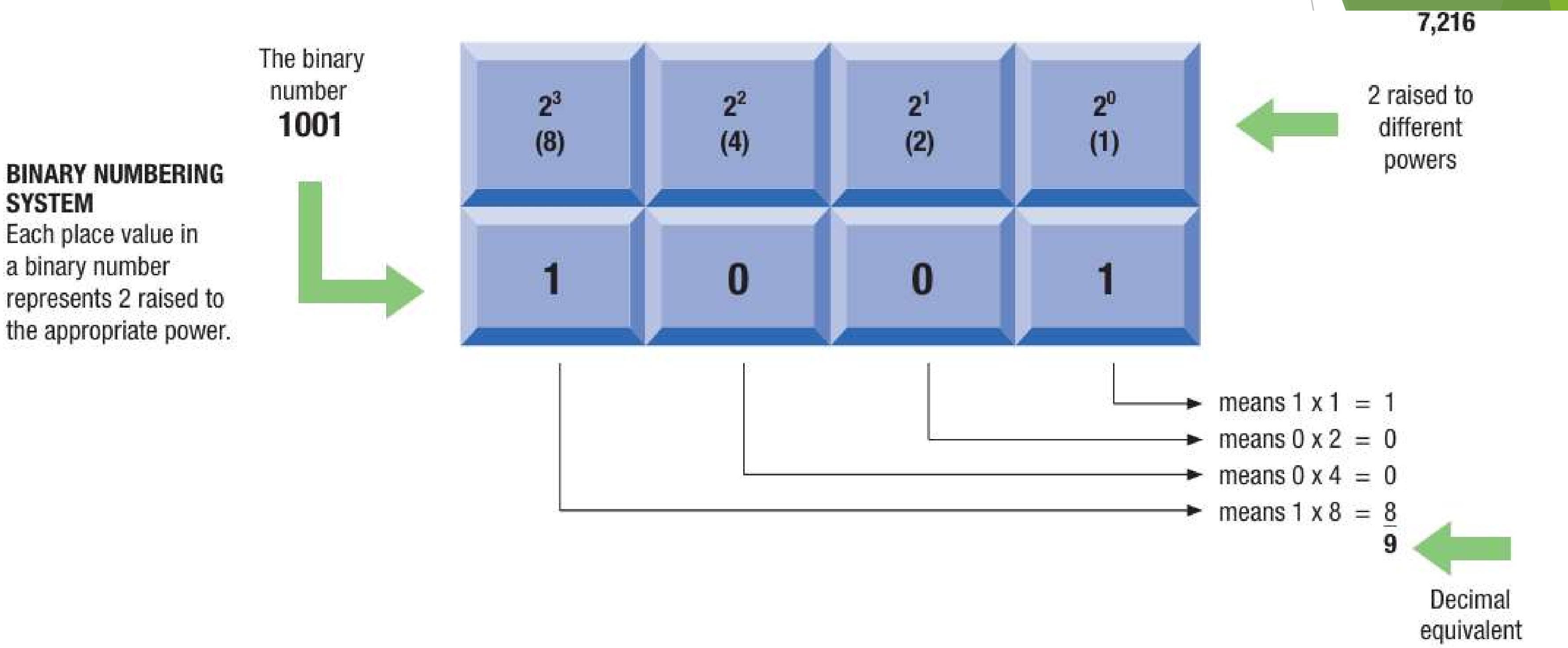
A bit by itself typically represents only a fraction of a piece of data. Consequently, large numbers of bits are needed to represent a written document, computer program, digi tal photo, music file, or virtually any other type of data. Eight bits grouped together are col lectively referred to as ***a byte.***



Abbreviation	Approximate Size
KB	1 thousand bytes
MB	1 million bytes
GB	1 billion bytes
TB	1 trillion bytes
PB	1,000 terabytes
EB	1,000 petabtyes
ZB	1,000 exabytes
YB	1,000 zettabytes

Representing numerical Data: The Binary numbering system




7,216
BINARY NUMBERING SYSTEM
Each place value in a binary number represents 2 raised to the appropriate power.
The binary number
1001
2^3 (8)
2^2 (4)
2^1 (2)
2^0 (1)
1
0
0
1
2 raised to different powers
means 1 x 1 = 1
means 0 x 2 = 0
means 0 x 4 = 0
means 1 x 8 = 8
9
Decimal equivalent

Coding systems for Text-Based Data

While numeric data is represented by the binary numbering system, text-based data is represented by binary coding systems specifically developed for text-based data—namely, ASCII, EBCDIC, and Unicode. These codes are used to represent all characters that can appear in text data—such as numbers, letters, and special characters and symbols like the dollar sign, comma, percent symbol, and mathematical symbols.

(American Standard Code for Information Interchange)

It is the coding system traditionally used with personal computers. EBCDIC (Extended Binary-Coded Decimal Interchange Code) was developed by IBM, primarily for use with mainframes. ASCII is a 7-digit (7-bit) code, although there are several different 8-bit extended versions of ASCII that contain additional symbols not included in the 7-bit ASCII code. The extended ASCII character sets (see some examples of 8-bit ASCII codes in Figure 2-4) and EBCDIC repre sent each character as a unique combination of 8 bits (1 byte), which allows 256 (28) unique combinations. Therefore, an 8-bit code can represent up to 256 characters (twice as many as a 7-bit code)—enough to include the characters used in the English alphabet, as well as some non-English characters, the 10 digits used in the decimal numbering system, the other characters usually found on a keyboard, and many special characters not included on a key board such as mathematical symbols, graphic symbols, and additional punctuation marks.

Unicode

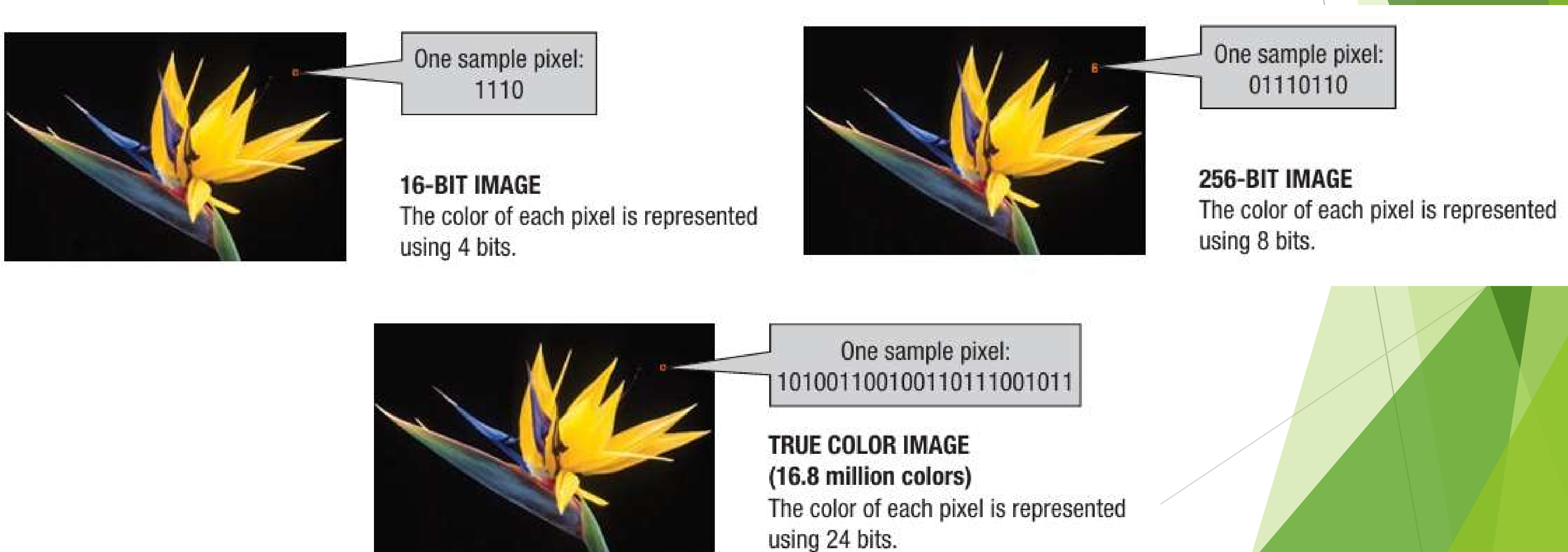
Many characters, such as these, can be represented by Unicode but not by ASCII or eBCDIC. Unlike ASCII and EBCDIC, which are limited to only the Latin alphabet used with the English language, Unicode is a universal international coding standard designed to rep resent text-based data written in any ancient or modern language, including those with different alphabets, such as Chinese, Greek, Hebrew, Amharic, Tibetan, and Russian.

Unicode is quickly replacing ASCII as the primary text-coding system. In fact, Unicode includes the ASCII character set so ASCII data can be converted easily to Unicode when needed. Unicode is used by most Web browsers and is widely used for Web pages and Web applications (Google data, for instance, is stored exclusively in Unicode). Most recent software programs, including the latest versions of Microsoft Windows, OS X, and Microsoft Office, also use Unicode, as do modern programming languages, such as Java and Python.

Coding systems for Other Types of Data

Graphics data consists of still images, such as photographs or drawings. One of the most common methods for storing graphics data is in the form of a bitmap image—an image made up of a grid of small dots, called pixels (short for picture elements), that are colored appropriately to represent an image. The color to be displayed at each pixel is represented by some combi nation of 0s and 1s, and the number of bits required to store the color for each pixel ranges from 1 to 24 bits.

For example, each pixel in a monochrome graphic can be only one of two possible colors (such as black or white). These monochrome images require only one bit of storage space per pixel (for instance, the bit would contain a 1 when representing a pixel that should display as white, and the bit would contain a 0 for a pixel that should display as black). Images with more than two colors can use 4, 8, or 24 bits to store the color data for each pixel—this allows for 16 (24)



The number of bits used per pixel depends on the type of image being stored; for instance, the JPEG images taken by most digital cameras today use 24-bit true color images. While this can result in large file sizes, images can typically be compressed to a smaller file size when needed, such as to send a lower-resolution version of an image via e-mail. Other common image formats include TIF (used with scanned images), BMP (created with some painting programs), GIF (an older format for Web page images), and PNG (a newer format for Web page images).

Audio Data

Audio data—such as a song or the sound of someone speaking—must be in digital form in order to be stored on a storage medium or processed by a computer. To convert analog sound to digital sound, several thousand samples—digital representations of the sound at particular moments—are taken every second. When the samples are played back in the proper order, they re-create the sound of the voice or music. For example, audio CDs record sound using 2-byte samples, which are sampled at a rate of 44,100 times per second. When these samples are played back at a rate of 44,100 samples per second, they sound like continuous voice or music. With so many samples, however, sound files take up a great deal of storage space—about 32 MB for a 3-minute stereo song.

Because of its large size, audio data is usually compressed to reduce its file size when it is transmitted over the Internet or stored on a smartphone or another device. For example, files that are MP3-encoded—that is, compressed with the MP3 compression algorithm developed by the Motion Pictures Expert Group (MPEG)—are about 10 times smaller than their uncompressed digital versions, so they download 10 times faster and take up one-tenth of the storage space. The actual storage size required depends on the bit rate—the number of bits to be transferred per second when the file is played—used when the file is initially created; audio files using the com mon bit rate of 128 Kbps (thousands of bits per second) are about one-tenth the size of the origi nal CD-quality recording.

Video data

Video Data—such as home movies, feature films, video clips, and television shows—is displayed using a collection of frames; each frame contains a still image. When the frames are projected one after the other (typically at a rate of 24 frames per second (fps) for film based video and 30 or 60 fps for video taken with digital video cameras), the illusion of movement is created. With so many frames, the amount of data involved in showing a two-hour feature film can be substantial. Fortunately, like audio data, video data can be compressed to reduce it to a manageable size. For example, a two-hour movie can be com pressed to fit on a single DVD disc or to be delivered over the Web.

Representing software Programs: machine Language

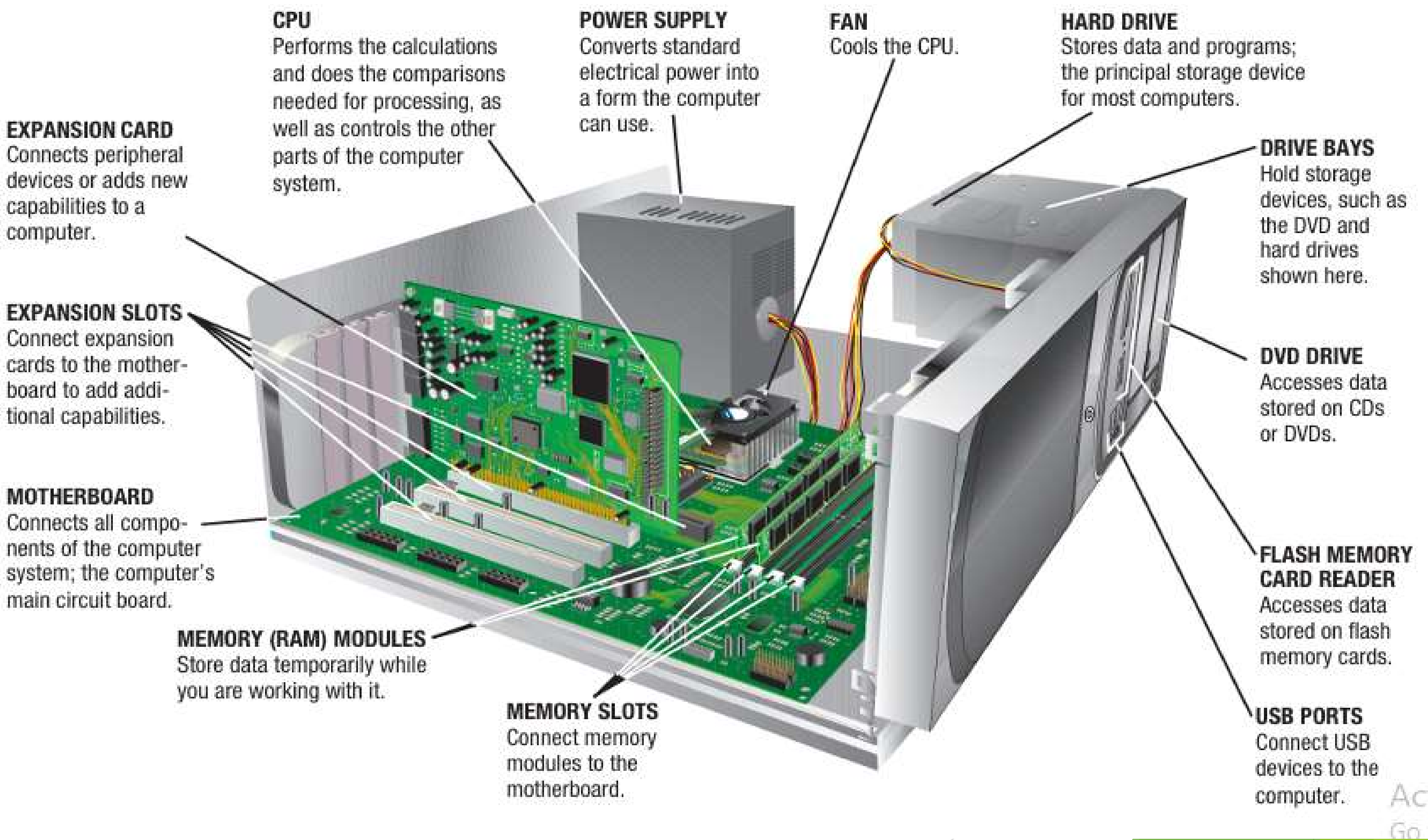
Just as numbers, text, and multimedia data must be represented by 0s and 1s, software pro grams must also be represented by 0s and 1s. Before a computer can execute any program instruction, such as requesting input from the user, moving a file from one storage device to another, or opening a new window on the screen, it must convert the instruction into a binary code known as machine language. An example of a typical machine language instruction is as follows:
01011000011100000000000100000010

The system unit

The system unit is the main case of a computer or mobile device. It houses the processing hardware for that device, as well as other components, such as storage devices, the power supply, and cooling hardware.

The motherboard

A circuit board is a thin board containing computer chips and other electronic components. Computer chips, also called integrated circuits (ICs), contain interconnected components (such as transistors) that enable electrical current to perform particular functions. The main circuit board inside the system unit is called the motherboard.



CPU
Performs the calculations and does the comparisons needed for processing, as well as controls the other parts of the computer system.
POWER SUPPLY
Converts standard electrical power into a form the computer can use.
FAN
Cools the CPU.
HARD DRIVE
Stores data and programs; the principal storage device for most computers.
EXPANSION CARD
Connects peripheral devices or adds new capabilities to a computer.
DRIVE BAYS
Hold storage devices, such as the DVD and hard drives shown here.
EXPANSION SLOTS
Connect expansion cards to the motherboard to add additional capabilities.
DVD DRIVE
Accesses data stored on CDs or DVDs.
MOTHERBOARD
Connects all components of the computer system; the computer's main circuit board.
FLASH MEMORY CARD READER
Accesses data stored on flash memory cards.
MEMORY (RAM) MODULES
Store data temporarily while you are working with it.
MEMORY SLOTS
Connect memory modules to the motherboard.
USB PORTS
Connect USB devices to the computer.

The Power supply and Drive Bays

Most personal computers plug into a standard electrical out let. The power supply inside a computer delivers electricity to the computer via a power cord. Portable computers and mobile devices contain rechargeable battery packs, which are charged via a power outlet; some devices can be charged via a computer as well. One issue with newer portable computers and mobile devices is the growing use of built-in batteries. Although these batteries allow the devices to be lighter and are supposed to last for the typical life of the device, they are more difficult and expensive to replace if they fail.