2.1: Introduction

Information systems comprise six components: hardware, software, data, communication, people, and process. In this chapter, we will review hardware. Hardware is the tangible or physical parts of computing devices to function. We will review the hardware components of information systems, learn how it work, and discuss some current trends.

Computer hardware encompasses digital devices you can physically touch. This includes devices such as the following:

- desktop computers
- e-readers
- input devices, such as keyboards, mice, and scanners
- laptop computers
- mobile phones
- output devices such as 3d printers and speakers
- smartphones
- smartwatches
- Smart home devices
- storage devices, such as flash drives
- tablet computers
- virtual Reality headsets

Besides these more traditional computer hardware devices, many items that were once not considered digital devices are now becoming computerized. Digital technologies are now being integrated into many everyday objects, so the days of a device being labeled computer hardware may end. Examples of digital devices include automobiles, refrigerators, doorbells, and even soft-drink dispensers. Let's begin with some key metrics and terminologies used in describing units in devices before we get to look at each device in detail.

2.1.1: Digital Devices

A digital device is any physical equipment containing a computer or microcontroller; examples include smartphones, watches, and tablets. A digital device processes electronic signals that represent either a one ("on") or a zero ("off"). The presence of an electronic signal represents the "on" state; the absence of an electronic signal represents the "off" state.

Each one or zero is referred to as a bit (a contraction of a binary digit); a group of eight bits is a byte. The first personal computers could process 8 bits of data simultaneously; modern PCs can now process thousands of bits simultaneously. The larger the number of bits, the faster information can be processed simultaneously.

For the inquiring mind: Understanding Decimal and Binary number systems

The system of numbering we are most familiar with is the decimal numeral system, also known as base-ten numbering. The decimal digits are 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. In base-ten numbering, each position in the number represents a power of ten, going from right to left, with the far-right position representing 10^0 (ones), the next position from the right representing 10^1 (tens), then 10^2 (hundreds), then 10^3 (thousands), etc. The '10' means the base ten.

Example: How do we express the number 2053 or "two thousand and fifty-three" in base-ten format?

Going from left to right, the number 2053 in decimal represents: (2 x 1000) + (0 x 100) + (5 x 10) + (3 x 1) = 2000 + 0 + 50 + 3 = 2050, as shown in the table below:

Example: Based-ten system for decimal number 2053

Position Exponent (note the '10' is the base ten)	10^4 (read ten to the power of 4)	10^3	10^2	10^1	10^0
Answer	2050 =	2000	+0	+50	+ 3

Decimal Number		2	0	5	3
Decimal Representation		(2 *1000 (position value))	+ (0 *100)	+ (5 * 10)	+ (3 * 1)
Position Value in decimal	10 to the power of 4 =10,000	1000	100	10	1

However, computers use the base-two number system, also known as binary. The binary digits are 0 and 1. Information is expressed by combinations of 'on' or 'off' electrical signals. The digit 0 represents 'off,' and 1 represents 'on.' Each position in a binary number represents a power of 2, going from right to left, with the far-right position representing 2^0 (ones), the next position from the right representing 2^1 (tens), then 2^2 (hundreds), then 2^3 (thousands), etc.

Example: What is the decimal value of the binary number 1010? (i.e., convert binary 1010 to a decimal value)

Going from left to right, the number 1010 in the binary represents: (1 * 8) + (0 * 4) + (1 * 2) + (0 * 1) =8 + 0 + 2 + 0 =10 in decimal, as shown in the table below:

Converting a binary number to a decimal example: Binary number 1010 is the decimal number 10

Position Exponent (note the '2' is the base two)	2(read 2 to the power of 4)	2^3	2^2	2^1	2^0
Position Value in decimal	2 to the power of 4 = 16	8	4	2	1
Binary Number		1	0	1	0
Convert to base ten decision		(1 * 8 (position value in decimal))	+ (0 *4)	+ (1 * 2)	+ (0 * 1)
Answer	10 =	8	+0	+2	+0

As digital devices' capacities grew, new terms were developed to identify the capabilities of processors, memory, and disk storage space.

Let's get familiar with the terminologies to express the different sizes in bytes.

Definition: Terms for different magnitudes expressed in bytes

We discussed that computer systems operate using a binary number of systems with two digits: 0 and 1. Each digit is also called a bit. It takes 8 bits to describe a letter in the alphabet, such as the letter A. Eight bits is also called a byte. Prefixes were applied to the word byte to represent different orders of magnitude. The prefixes were initially meant to represent multiples of 1024 but have more recently been rounded to mean multiples of 1000.

Prefixes to express different magnitude in bytes

To Say	Use Prefix	Complete Expression
1 byte	No prefix needed	1 byte
One thousand bytes	kilo	1 kilobyte

To Say	Use Prefix	Complete Expression
One million bytes	mega	1 megabyte
One billion bytes	giga	1 gigabyte
One trillion bytes	tera	1 terabyte
One quadrillion bytes	peta	1 petabyte
One quintillion bytes	exa	1 exabyte
One sextillion bytes	zetta	1 zettabyte
One septillion bytes	yotta	1 yottabyte

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