



Introduction to Computer Hardware

This chapter introduces you to

- ◆ Definition of Computer
- ◆ Functioning of Computer
- ◆ Strengths and Weaknesses of computer
- ◆ Types of Computer
- ◆ Communication Bus
- ◆ Ports
- ◆ Memory Cards

Introduction

Over the last three decades, man has really understood and greatly benefitted from the immense possibilities offered by the computer. No other technological invention has carved out a niche in the human history in such a short span of time as the computer. It has changed the whole gamut of human life at an overwhelming pace. You will hardly find an area of human activity that has not been benefitted by computer applications.

The computer's capabilities to process, store, and retrieve data and information have made it an integral part of all kinds of environment—home, office or business. The widespread use of computers has made it essential for an educated person to have knowledge about the computer, its advantages and disadvantages, and its internal structure.

A computer mainly consists of two types of components—hardware and software. Hardware is a term used to denote all the tangible parts—whether external or internal—of a computer. In other words, any part of a computer system that you can see and feel is known as hardware, such as keyboard, monitor, hard disk, and speaker. Software, on the other hand, refers to programs and applications that run on the hardware. It consists a series of instructions that tell a computer how to carry out operations for a specific job. Some examples of software are operating systems, Microsoft Word, and Tally.

This chapter introduces you to the computer and its hardware components.

Table 1: Working of a Human to Perform a Given Task

Example	Input Stage	Process Stage	Output stage
Example 1	The teacher gives homework to the student.	The student goes back home and starts doing homework.	The student completes the homework.
Example 2	The father asks the son to buy medicine.	The son goes to the market and buys the medicine.	The son gives the medicine to the father.

The preceding examples illustrate the way a human works. Basically, accomplishment of a task by a human involves three stages. These three stages constitute the Input-Process-Output (I-P-O) cycle. The three stages are:

- Receiving the input
- Processing the input
- Generating the output

If we analyze any task that has been performed by us, we come to know that we also pass through the three stages of the I-P-O cycle while performing that task. Similarly, a computer also follows the I-P-O cycle, as it gets certain input, processes the input, and finally generates the output.

Now, let's understand how a computer performs a given task.

Suppose you give a command to the computer to add two numbers a and b , where $a=5$ and $b=5$. The computer processes your command by performing the addition operation on the numbers a and b . Finally, the computer generates the output as 10. Figure 1 illustrates the three stages in which a computer accomplishes a given task.

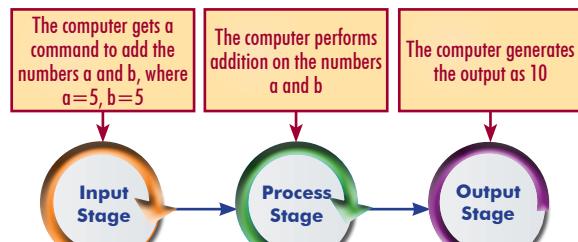
So, we can say that to perform a given task, the computer also follows the three stages of the Input-Process-Output (I-P-O) cycle just like human beings.

Components of a Computer

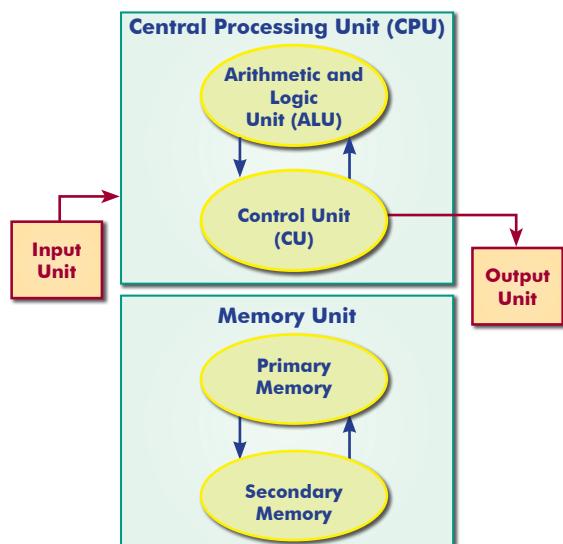
As already discussed, a computer follows the I-P-O cycle to perform a given task. Now, let's know about the components of a computer which take part in the I-P-O cycle. Figure 2 shows the basic structure of a computer.

The computer system consists of the following main components:

- Input Unit
- Central Processing Unit (CPU)
- Output Unit
- Memory Unit



▲ FIGURE 1: Stages that a Computer Executes to Perform a Given Task



▲ FIGURE 2: Basic Structure of a Computer

Before we discuss these components in detail, here is a broad outline of their role in the I-P-O cycle. The first stage of the I-P-O cycle is performed by the input unit of the computer, the second stage is performed by its processing unit, and the last stage is performed by its output unit. You should note that the main memory of the computer holds the input and the intermediate output during processing.

Input Unit

The input unit operation is performed by the input devices, such as keyboard, mouse, Optical Character Reader (OCR), and graphic tablets. The basic function of the input unit is to take the input and convert it into the machine language (that is, the binary digits (bits) with the combination of 0 and 1) which is understood by the computer. A computer is an electronic device that consists of various components, such as Arithmetic Logic Unit (ALU), control unit, and memory unit. Each of these units contains trillions of small electrical circuits that can be turned on (high voltage) or off (low voltage) by means of an electronic switch. In the binary form, 1 is referred to as the ON (high voltage) state and 0 is referred to as the OFF (low voltage) state. Technically, the input can be described as a statement, which is a combination of data and instructions.

Table 2 lists data and instructions of the input statements from the examples of the tasks given in the preceding section:

Table 2: Instructions and Data of the Input Statements of Task Examples

Input	Data	Instruction
Finish the homework	Homework	Finish
Bring medicine	Medicine	Purchase
Command to add a and b where a=5 and b=5	a=5 and b=5	Add



The primary task of an input unit is to take the input and convert it into the binary form (0 or 1) so that it can be understood by the computer.

Central Processing Unit (CPU)

CPU is often referred to as the brain of a computer. It is also known as the control center of a computer, which controls various operations and interactions that take place among several components of a computer. CPU comprises two components that are responsible for carrying out different functions within a computer system. These two components are:

- ❑ **Control Unit (CU):** Refers to the central controller of a computer that manages various operations. It reads and interprets the instructions of a program and transforms them into control signals, which activate the other parts of the computer that have a role in generating the output. In simple words, CU is responsible for the execution of a program, that is, for carrying out the instructions stored in the program. It is also responsible for implementing the microprocessor instruction set. CU fetches instructions from the computer memory, decodes that information, and finally executes them. After execution, CU sends the necessary signals to the Arithmetic and Logic Unit (ALU) to perform the needed operation. When the operation in hand is completed, CU signals to the memory asking for the next instruction in sequence. Moreover, CU controls the following data flow:
 - ◆ Data flowing from the input devices to the memory
 - ◆ Data flowing from the memory to the output devices
- ❑ **Arithmetic and Logic Unit (ALU):** Helps in performing various arithmetical operations (addition, subtraction, multiplication, and division) and logical operations ($<$, $>$, $<=$, $>=$, $=$, AND, OR, NOT, XOR).

did you know?

Control Unit can be either hardwired or micro-programmed.

Software can be broadly classified into the following three categories:

- ❑ Operating system
- ❑ Language processors
- ❑ Application software

Let's discuss these categories in detail.

Operating System

The Operating System (OS) is defined as the middle layer or interface between the computer hardware and the user. We can say that the work of the operating system is similar to that of a manager of a restaurant. The customer simply places the order, and then the manager manages all the tasks that are essential to fulfill that order. For example, the manager decides who would take the order, who would process it, and who would serve it.

Similarly, the user passes his request to the operating system, and the operating system fulfills that request. The primary goal of an operating system is to provide a convenient environment for using a computer system. Its secondary goal is to use the hardware in an efficient and effective manner.

An operating system is a component of the computer system that effectively controls all other components of the system. The basic constituents of the computer system are given as follows:

- ❑ **Hardware:** Provides basic resources for computing.
- ❑ **Application Program Routines:** Consist of compilers, linkers, database management system, and utility programs. These routines define the ways in which various computing hardware resources can be utilized to solve computing problems of different application programs.
- ❑ **Operating System:** Controls and governs the use of hardware among different application programs.
- ❑ **Humanware:** Refers to various users.

By defining how to perform common functions, the operating system frees the application software to focus more on producing information.

Figure 4 illustrates the relationship that exists between various constituents of the computer system. The following are some major functions of an operating system:

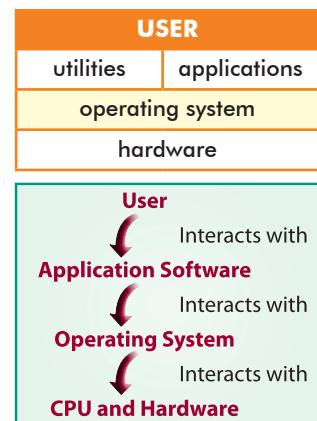
- ❑ It provides the user with an interface either through commands (if using DOS) or graphics (if using Windows).
- ❑ It acts as a resource manager. In other words, it manages the resources of a computer system, such as processor, memory, files, and I/O devices. It keeps track of their status.
- ❑ It receives the input from an input device and sends the output to the output device.
- ❑ It is responsible for the memory management (how the information is stored or retrieved). In other words, it keeps track of files and directories on the computer hard disk.

definition

An **operating system** acts as an intermediary (providing communication) between the user of a computer and computer hardware.

did you know?

The Apple Lisa (1983) was the first successful computer with a Graphical User Interface (GUI) and a mouse.



▲ FIGURE 4: Relationship between Constituents of a Computer System

particular tasks, such as accounting, reservation, and banking operations. Application software can be of the following two types:

- ❑ **Customized application software:** The customized application software is developed and designed as per the user requirements, which may vary from user to user. It is developed to cater to the needs of the system of a particular organization, which has different processes. A customized application software that is developed for one user cannot be directly installed into another user's workplace as the two users may have different requirements.
- ❑ **General application software:** The general application software is developed and designed by considering general requirements of a large number of users. This software can be used by different users simultaneously as it is developed to fulfill their general requirements. Tally is a good example of this kind of software.

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Difference between Firmware and Liveware

The difference between firmware and liveware are as follows:

- ❖ Firmware is a set of prewritten programs that are used at the time of booting (whenever a computer is switched on) of a computer system. It is permanently stored in the Read Only Memory (ROM) and cannot be modified by the user. Basic Input-Output Services (BIOS) is an example of firmware.
- ❖ Liveware is the term used to address people who are associated with a computer system and have benefitted from it, for example, the accountant (liveware) using the Tally software.

 Let's now learn about the strengths and weaknesses of a computer. 

1.3 Strengths and Weaknesses of Computer

You must have observed the increasing use of computers in most of the fields concerning human activities, such as banking, railways, airways, hotels, schools, shops, colleges, and industries. Owing to the following advantages of the computer, more and more people and organizations have shifted to the computerized style of working:

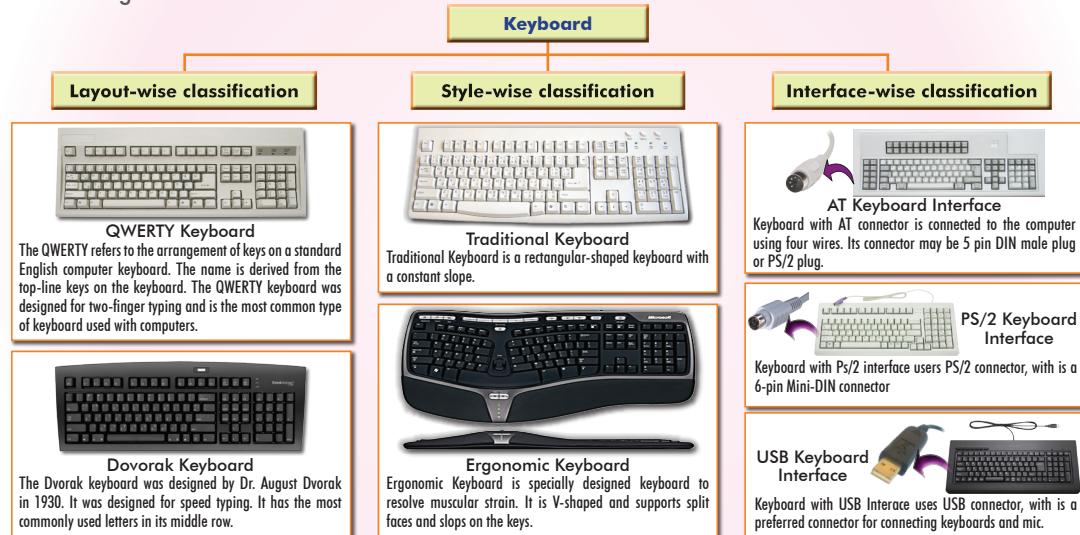
- ❑ **Speed:** A computer system can perform operations much faster than human beings. It actually processes a large amount of information in seconds and presents the output. A modern computer is capable of executing millions of instructions in one second.
- ❑ **Accuracy:** A computer system performs any task with a high degree of accuracy. Actually, a computer system does not commit a mistake until the input data has some error.
- ❑ **Versatility:** A computer system is versatile and can be used in almost any field, such as education, entertainment, and medicine.
- ❑ **Diligence:** A computer system does not get tired of working for long periods or by doing a repetitive work.
- ❑ **High storage capacity:** A computer system is capable of storing high amount of data in very less space by providing secondary storage devices, such as Compact disc—Read Only Memory (CD-ROM) and Digital Versatile Disc (DVD). For example, a CD-ROM of 4.7 inch diameter can store up to 700 MB of data. A DVD is capable of storing data of many CDs. However, new-age memories, such as blue memories, are capable of storing 6250,000 bits per square centimeter of space.

We have just read about the advantages of a computer. However, it also has certain limitations, which are as follows:

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Classification of Keyboards

Depending on their layouts, styles, and interfaces, keyboards can be classified into various categories, as shown in Figure A:



▲ FIGURE A: Classification of Keyboards

Mouse

A mouse is a pointing (input) device that was developed by Douglas Engelbart in 1963. When you move a mouse on a smooth surface, then a cursor also moves on the screen in the same direction. A mouse generally has two or three buttons. It may also have a wheel in the middle. It can perform various operations, such as point, drag, click, double-click, right-click, press wheel, rotate wheel, and right drag. The benefits of a mouse are as follows:

- ❑ It is perfect for pointing objects on the screen of desktop computers
- ❑ It is inexpensive (except wireless mouse) and easily usable

The limitations of a mouse are as follows:

- ❑ It requires a flat surface which is close/near to the computer
- ❑ It is difficult to use with laptop and other portable computer devices

The different types of mouse are:

- ❑ Mechanical mouse
- ❑ Opto-mechanical mouse
- ❑ Optical mouse
- ❑ Wireless mouse

Let's learn about each type of mouse in detail.

did you know?

Generally, the mouse speed is expressed in Dots Per Inch (DPI), which refers to the number of pixels the mouse cursor will move when the mouse is moved one inch.

Flatbed Scanner

A flatbed scanner is larger in size than a handheld scanner. It is expensive but produces high-quality images. Flatbed scanners have flat surfaces on which the sheet to be scanned is placed. They are capable of scanning a page in a single pass only.

Figure 20 shows a flatbed scanner.



▲ FIGURE 20:
A Flatbed Scanner

Drum Scanner

A drum scanner is a medium-sized scanner. It consists of a rolling drum. The sheet to be scanned is placed on the scanner so that the drum can roll over the entire sheet while scanning it.

Figure 21 shows a drum scanner.



▲ FIGURE 21:
A Drum Scanner

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Comparative Study of Handheld, Flatbed, and Drum Scanners

Table A presents a comparison between the handheld, flatbed, and drum scanners:

Table A: Comparison Between Handheld, Flatbed, and Drum Scanners

Handheld Scanner	Flatbed Scanner	Drum Scanner
Less expensive	More expensive but produces high-quality images	Less expensive
Less wide and handy	Flat surface	Medium-sized
More passes per scan	Single pass per scan	Drum rolls for scanning an image

Bar Code Reader

A bar code is a collection or a sequence of lines of different heights and widths that are printed on various types of products. These lines are coded in an unintelligible format so that the normal user cannot read and understand the meaning of the code. The machine that reads bar codes is called a bar code reader. The bar code reader emits a light beam, which gets reflected from the bar code image. The light sensitive detector in the bar code reader recognizes the bar code image which is then converted into a numeric code which can be further processed. Figure 22 shows the bar code pattern and the bar code reader. The benefits of a bar code reader are given as follows:

- ❑ It is quick and reliable for inputting data.
- ❑ It reads images even if there are curves or irregular surfaces.

The limitation of a bar code reader is that it can take input only in the form of numbers.



▲ FIGURE 22: The Bar Code Pattern and the Bar Code Reader



You can see a bar code on the back cover of this book.