Computer is an advanced electronic device that takes raw data as an input from the user and processes it under the control of a set of instructions (called program), produces a result (output), and saves it for future use. This tutorial explains the foundational concepts of computer hardware, software, operating systems, peripherals, etc. along with how to get the most value and impact from computer technology.

Functionalities of a Computer

If we look at it in a very broad sense, any digital computer carries out the following five functions –

- **Step 1** – Takes data as input.
- **Step 2** – Stores the data/instructions in its memory and uses them as required.
- **Step 3** – Processes the data and converts it into useful information.
- **Step 4** – Generates the output.
- **Step 5** – Controls all the above four steps.

Advantages of Computers

Following are certain advantages of computers.

High Speed

- Computer is a very fast device.
- It is capable of performing calculation of very large amount of data.
The computer has units of speed in microsecond, nanosecond, and even the picosecond. It can perform millions of calculations in a few seconds as compared to man who will spend many months to perform the same task.

Accuracy
- In addition to being very fast, computers are very accurate.
- The calculations are 100% error free.
- Computers perform all jobs with 100% accuracy provided that the input is correct.

Storage Capability
- Memory is a very important characteristic of computers.
- A computer has much more storage capacity than human beings.
- It can store large amount of data.
- It can store any type of data such as images, videos, text, audio, etc.

Diligence
- Unlike human beings, a computer is free from monotony, tiredness, and lack of concentration.
- It can work continuously without any error and boredom.
- It can perform repeated tasks with the same speed and accuracy.

Versatility
- A computer is a very versatile machine.
- A computer is very flexible in performing the jobs to be done.
- This machine can be used to solve the problems related to various fields.
- At one instance, it may be solving a complex scientific problem and the very next moment it may be playing a card game.

Reliability
- A computer is a reliable machine.
- Modern electronic components have long lives.
- Computers are designed to make maintenance easy.

Automation
- Computer is an automatic machine.
• Automation is the ability to perform a given task automatically. Once the computer receives a program i.e., the program is stored in the computer memory, then the program and instruction can control the program execution without human interaction.

Reduction in Paper Work and Cost

• The use of computers for data processing in an organization leads to reduction in paper work and results in speeding up the process.
• As data in electronic files can be retrieved as and when required, the problem of maintenance of large number of paper files gets reduced.
• Though the initial investment for installing a computer is high, it substantially reduces the cost of each of its transaction.

Disadvantages of Computers

Following are certain disadvantages of computers.

No I.Q.

• A computer is a machine that has no intelligence to perform any task.
• Each instruction has to be given to the computer.
• A computer cannot take any decision on its own.

Dependency

• It functions as per the user’s instruction, thus it is fully dependent on humans.

Environment

• The operating environment of the computer should be dust free and suitable.

No Feeling

• Computers have no feelings or emotions.
• It cannot make judgment based on feeling, taste, experience, and knowledge unlike humans.
• Generation in computer terminology is a change in technology a computer is/was being used. Initially, the generation term was used to distinguish between varying hardware technologies. Nowadays, generation includes both hardware and software, which together make up an entire computer system.
• There are five computer generations known till date. Each generation has been discussed in detail along with their time period and characteristics. In the following table, approximate dates against each generation has been mentioned, which are normally accepted.
• Following are the main five generations of computers.
<table>
<thead>
<tr>
<th>S.No</th>
<th>Generation &amp; Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>First Generation</td>
</tr>
<tr>
<td>2</td>
<td>Second Generation</td>
</tr>
<tr>
<td>3</td>
<td>Third Generation</td>
</tr>
<tr>
<td>4</td>
<td>Fourth Generation</td>
</tr>
<tr>
<td>5</td>
<td>Fifth Generation</td>
</tr>
</tbody>
</table>

Central Processing Unit (CPU) consists of the following features –

- CPU is considered as the brain of the computer.
- CPU performs all types of data processing operations.
- It stores data, intermediate results, and instructions (program).
- It controls the operation of all parts of the computer.

CPU itself has following three components.

- Memory or Storage Unit
- Control Unit
- ALU(Arithmetic Logic Unit)
Memory or Storage Unit

This unit can store instructions, data, and intermediate results. This unit supplies information to other units of the computer when needed. It is also known as internal storage unit or the main memory or the primary storage or Random Access Memory (RAM).

Its size affects speed, power, and capability. Primary memory and secondary memory are two types of memories in the computer. Functions of the memory unit are −

- It stores all the data and the instructions required for processing.
- It stores intermediate results of processing.
- It stores the final results of processing before these results are released to an output device.
- All inputs and outputs are transmitted through the main memory.

Control Unit

This unit controls the operations of all parts of the computer but does not carry out any actual data processing operations.

Functions of this unit are −

- It is responsible for controlling the transfer of data and instructions among other units of a computer.
- It manages and coordinates all the units of the computer.
- It obtains the instructions from the memory, interprets them, and directs the operation of the computer.
- It communicates with Input/Output devices for transfer of data or results from storage.
- It does not process or store data.

**ALU (Arithmetic Logic Unit)**

This unit consists of two subsections namely,

- Arithmetic Section
- Logic Section

**Arithmetic Section**

Function of arithmetic section is to perform arithmetic operations like addition, subtraction, multiplication, and division. All complex operations are done by making repetitive use of the above operations.

**Logic Section**

Function of logic section is to perform logic operations such as comparing, selecting, matching, and merging of data.

Following are some of the important input devices which are used in a computer –

- Keyboard
- Mouse
- Joy Stick
- Light pen
- Track Ball
- Scanner
- Graphic Tablet
- Microphone
- Magnetic Ink Card Reader (MICR)
- Optical Character Reader (OCR)
- Bar Code Reader
- Optical Mark Reader (OMR)

**Keyboard**

Keyboard is the most common and very popular input device which helps to input data to the computer. The layout of the keyboard is like that of traditional typewriter, although there are some additional keys provided for performing additional functions.
Keyboards are of two sizes 84 keys or 101/102 keys, but now keyboards with 104 keys or 108 keys are also available for Windows and Internet.

The keys on the keyboard are as follows –

<table>
<thead>
<tr>
<th>S.No</th>
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</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Typing Keys</strong></td>
</tr>
<tr>
<td></td>
<td>These keys include the letter keys (A-Z) and digit keys (09) which generally give the same layout as that of typewriters.</td>
</tr>
<tr>
<td>2</td>
<td><strong>Numeric Keypad</strong></td>
</tr>
<tr>
<td></td>
<td>It is used to enter the numeric data or cursor movement. Generally, it consists of a set of 17 keys that are laid out in the same configuration used by most adding machines and calculators.</td>
</tr>
<tr>
<td>3</td>
<td><strong>Function Keys</strong></td>
</tr>
<tr>
<td></td>
<td>The twelve function keys are present on the keyboard which are arranged in a row at the top of the keyboard. Each function key has a unique meaning and is used for some specific purpose.</td>
</tr>
<tr>
<td>4</td>
<td><strong>Control keys</strong></td>
</tr>
</tbody>
</table>
|      | These keys provide cursor and screen control. It includes four directional arrow keys. Control keys also include Home, End, Insert, Delete, Page Up, Page Down,
Control(Ctrl), Alternate(Alt), Escape(Esc).

## Special Purpose Keys

Keyboard also contains some special purpose keys such as Enter, Shift, Caps Lock, Num Lock, Space bar, Tab, and Print Screen.

### Mouse

Mouse is the most popular pointing device. It is a very famous cursor-control device having a small palm size box with a round ball at its base, which senses the movement of the mouse and sends corresponding signals to the CPU when the mouse buttons are pressed.

Generally, it has two buttons called the left and the right button and a wheel is present between the buttons. A mouse can be used to control the position of the cursor on the screen, but it cannot be used to enter text into the computer.

![Mouse Image]

**Advantages**

- Easy to use
- Not very expensive
- Moves the cursor faster than the arrow keys of the keyboard.

### Joystick

Joystick is also a pointing device, which is used to move the cursor position on a monitor screen. It is a stick having a spherical ball at its both lower and upper ends. The lower spherical ball moves in a socket. The joystick can be moved in all four directions.
The function of the joystick is similar to that of a mouse. It is mainly used in Computer Aided Designing (CAD) and playing computer games.

**Light Pen**

Light pen is a pointing device similar to a pen. It is used to select a displayed menu item or draw pictures on the monitor screen. It consists of a photocell and an optical system placed in a small tube.

When the tip of a light pen is moved over the monitor screen and the pen button is pressed, its photocell sensing element detects the screen location and sends the corresponding signal to the CPU.

**Track Ball**

Track ball is an input device that is mostly used in notebook or laptop computer, instead of a mouse. This is a ball which is half inserted and by moving fingers on the ball, the pointer can be moved.
Since the whole device is not moved, a track ball requires less space than a mouse. A track ball comes in various shapes like a ball, a button, or a square.

**Scanner**

Scanner is an input device, which works more like a photocopy machine. It is used when some information is available on paper and it is to be transferred to the hard disk of the computer for further manipulation.

Scanner captures images from the source which are then converted into a digital form that can be stored on the disk. These images can be edited before they are printed.

**Digitizer**

Digitizer is an input device which converts analog information into digital form. Digitizer can convert a signal from the television or camera into a series of numbers that could
be stored in a computer. They can be used by the computer to create a picture of whatever the camera had been pointed at.

Digitizer is also known as Tablet or Graphics Tablet as it converts graphics and pictorial data into binary inputs. A graphic tablet as digitizer is used for fine works of drawing and image manipulation applications.

Microphone

Microphone is an input device to input sound that is then stored in a digital form.

The microphone is used for various applications such as adding sound to a multimedia presentation or for mixing music.

Magnetic Ink Card Reader (MICR)

MICR input device is generally used in banks as there are large number of cheques to be processed every day. The bank's code number and cheque number are printed on the cheques with a special type of ink that contains particles of magnetic material that are machine readable.
This reading process is called Magnetic Ink Character Recognition (MICR). The main advantages of MICR is that it is fast and less error prone.

Optical Character Reader (OCR)

OCR is an input device used to read a printed text.

OCR scans the text optically, character by character, converts them into a machine readable code, and stores the text on the system memory.

Bar Code Readers

Bar Code Reader is a device used for reading bar coded data (data in the form of light and dark lines). Bar coded data is generally used in labelling goods, numbering the books, etc. It may be a handheld scanner or may be embedded in a stationary scanner.
Bar Code Reader scans a bar code image, converts it into an alphanumeric value, which is then fed to the computer that the bar code reader is connected to.

**Optical Mark Reader (OMR)**

OMR is a special type of optical scanner used to recognize the type of mark made by pen or pencil. It is used where one out of a few alternatives is to be selected and marked.

It is specially used for checking the answer sheets of examinations having multiple choice questions.

Following are some of the important output devices used in a computer.

- Monitors
- Graphic Plotter
- Printer

**Monitors**

Monitors, commonly called as **Visual Display Unit** (VDU), are the main output device of a computer. It forms images from tiny dots, called pixels that are arranged in a rectangular form. The sharpness of the image depends upon the number of pixels.

There are two kinds of viewing screen used for monitors.
- Cathode-Ray Tube (CRT)
- Flat-Panel Display

Cathode-Ray Tube (CRT) Monitor

The CRT display is made up of small picture elements called pixels. The smaller the pixels, the better the image clarity or resolution. It takes more than one illuminated pixel to form a whole character, such as the letter ‘e’ in the word help.

A finite number of characters can be displayed on a screen at once. The screen can be divided into a series of character boxes - fixed location on the screen where a standard character can be placed. Most screens are capable of displaying 80 characters of data horizontally and 25 lines vertically.

There are some disadvantages of CRT –

- Large in Size
- High power consumption

Flat-Panel Display Monitor

The flat-panel display refers to a class of video devices that have reduced volume, weight and power requirement in comparison to the CRT. You can hang them on walls or wear them on your wrists. Current uses of flat-panel displays include calculators, video games, monitors, laptop computer, and graphics display.
The flat-panel display is divided into two categories –

- **Emissive Displays** – Emissive displays are devices that convert electrical energy into light. For example, plasma panel and LED (Light-Emitting Diodes).

- **Non-Emissive Displays** – Non-emissive displays use optical effects to convert sunlight or light from some other source into graphics patterns. For example, LCD (Liquid-Crystal Device).

**Printers**

Printer is an output device, which is used to print information on paper.

There are two types of printers –

- Impact Printers
- Non-Impact Printers

Impact Printers

Impact printers print the characters by striking them on the ribbon, which is then pressed on the paper.

Characteristics of Impact Printers are the following –

- Very low consumable costs
- Very noisy
- Useful for bulk printing due to low cost
- There is physical contact with the paper to produce an image

These printers are of two types –

- Character printers
- Line printers
Character Printers
Character printers are the printers which print one character at a time. These are further divided into two types:

- Dot Matrix Printer (DMP)
- Daisy Wheel

Dot Matrix Printer
In the market, one of the most popular printers is Dot Matrix Printer. These printers are popular because of their ease of printing and economical price. Each character printed is in the form of a pattern of dots and head consists of a Matrix of Pins of size (5*7, 7*9, 9*7 or 9*9) which come out to form a character which is why it is called Dot Matrix Printer.

Advantages
- Inexpensive
- Widely Used
- Other language characters can be printed

Disadvantages
- Slow Speed
- Poor Quality

Daisy Wheel
Head is lying on a wheel and pins corresponding to characters are like petals of Daisy (flower) which is why it is called Daisy Wheel Printer. These printers are generally used for word-processing in offices that require a few letters to be sent here and there with very nice quality.
Advantages

- More reliable than DMP
- Better quality
- Fonts of character can be easily changed

Disadvantages

- Slower than DMP
- Noisy
- More expensive than DMP

Line Printers

Line printers are the printers which print one line at a time.

These are of two types –

- Drum Printer
- Chain Printer
**Drum Printer**

This printer is like a drum in shape hence it is called drum printer. The surface of the drum is divided into a number of tracks. Total tracks are equal to the size of the paper, i.e. for a paper width of 132 characters, drum will have 132 tracks. A character set is embossed on the track. Different character sets available in the market are 48 character set, 64 and 96 characters set. One rotation of drum prints one line. Drum printers are fast in speed and can print 300 to 2000 lines per minute.

**Advantages**

- Very high speed

**Disadvantages**

- Very expensive
- Characters fonts cannot be changed

**Chain Printer**

In this printer, a chain of character sets is used, hence it is called Chain Printer. A standard character set may have 48, 64, or 96 characters.

**Advantages**

- Character fonts can easily be changed.
- Different languages can be used with the same printer.

**Disadvantages**

- Noisy

**Non-impact Printers**

Non-impact printers print the characters without using the ribbon. These printers print a complete page at a time, thus they are also called as Page Printers.

These printers are of two types –

- Laser Printers
- Inkjet Printers

**Characteristics of Non-impact Printers**

- Faster than impact printers
- They are not noisy
- High quality
- Supports many fonts and different character size

**Laser Printers**
These are non-impact page printers. They use laser lights to produce the dots needed to form the characters to be printed on a page.

**Advantages**

- Very high speed
- Very high quality output
- Good graphics quality
- Supports many fonts and different character size

**Disadvantages**

- Expensive
- Cannot be used to produce multiple copies of a document in a single printing

**Inkjet Printers**

Inkjet printers are non-impact character printers based on a relatively new technology. They print characters by spraying small drops of ink onto paper. Inkjet printers produce high quality output with presentable features.
They make less noise because no hammering is done and these have many styles of printing modes available. Color printing is also possible. Some models of Inkjet printers can produce multiple copies of printing also.

**Advantages**

- High quality printing
- More reliable

**Disadvantages**

- Expensive as the cost per page is high
- Slow as compared to laser printer

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An Operating System (OS) is an interface between a computer user and computer hardware. An operating system is a software which performs all the basic tasks like file management, memory management, process management, handling input and output, and controlling peripheral devices such as disk drives and printers.

Some popular Operating Systems include Linux Operating System, Windows Operating System, VMS, OS/400, AIX, z/OS, etc.

**Definition**

An operating system is a program that acts as an interface between the user and the computer hardware and controls the execution of all kinds of programs.
Following are some of important functions of an operating System.

- Memory Management
- Processor Management
- Device Management
- File Management
- Security
- Control over system performance
- Job accounting
- Error detecting aids
- Coordination between other software and users

Memory Management

Memory management refers to management of Primary Memory or Main Memory. Main memory is a large array of words or bytes where each word or byte has its own address.

Main memory provides a fast storage that can be accessed directly by the CPU. For a program to be executed, it must in the main memory. An Operating System does the following activities for memory management –

- Keeps tracks of primary memory, i.e., what part of it are in use by whom, what part are not in use.
• In multiprogramming, the OS decides which process will get memory when and how much.
• Allocates the memory when a process requests it to do so.
• De-allocates the memory when a process no longer needs it or has been terminated.

Processor Management

In multiprogramming environment, the OS decides which process gets the processor when and for how much time. This function is called **process scheduling**. An Operating System does the following activities for processor management –

• Keeps tracks of processor and status of process. The program responsible for this task is known as **traffic controller**.
• Allocates the processor (CPU) to a process.
• De-allocates processor when a process is no longer required.

Device Management

An Operating System manages device communication via their respective drivers. It does the following activities for device management –

• Keeps tracks of all devices. Program responsible for this task is known as the **I/O controller**.
• Decides which process gets the device when and for how much time.
• Allocates the device in the efficient way.
• De-allocates devices.

File Management

A file system is normally organized into directories for easy navigation and usage. These directories may contain files and other directions.

An Operating System does the following activities for file management –

• Keeps track of information, location, uses, status etc. The collective facilities are often known as **file system**.
• Decides who gets the resources.
• Allocates the resources.
• De-allocates the resources.

Other Important Activities

Following are some of the important activities that an Operating System performs –
• **Security** – By means of password and similar other techniques, it prevents unauthorized access to programs and data.

• **Control over system performance** – Recording delays between request for a service and response from the system.

• **Job accounting** – Keeping track of time and resources used by various jobs and users.

• **Error detecting aids** – Production of dumps, traces, error messages, and other debugging and error detecting aids.

• **Coordination between other softwares and users** – Coordination and assignment of compilers, interpreters, assemblers and other software to the various users of the computer systems.