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Introduction to Computers

A Computer is an electronic device that performs calculations and operations based on instructions provided by a software or hardware program.

Characteristics of Computers

1. Speed – A computer can process millions of calculations per second. The speed of computation is very high.
2. Accuracy - As computers work on inbuilt software programs, there is no scope for human errors and highly accurate.
3. Diligence – Computers are highly reliable. They can perform complex and long calculations with the same speed and accuracy.
4. Versatility - Computers are versatile in Nature. They can perform various operations at the same time.
5. Storage - Computers can store a large amount of data or instructions in its memory which can be retrieved at any point of time.

History of Computers

A Computer was intended for making a person capable of performing numerical calculations with the help of a mechanical computing device.

Abacus

Abacus was the first counting device which was developed in China. It consists of a rectangular wooden frame and beads. The wooden frame contains horizontal rods and the beads which are passed through the rods. The beads of counters represent digits. The device is used to perform simple addition and subtraction.

Napier's Bones

It was a device which contained a set of rods made of bones. It was developed by a Scottish Mathematician, John Napier. To perform multiplication and division, the device was developed. Napier also invented logarithms.

Pascaline

Pascaline was the first calculating device with a capability to perform additions and subtractions on whole numbers. It was developed by Blaise Pascal, a French Mathematician. The device made up of interlocked cog wheels having numbers 0 to 9 on its circumference. When one wheel completes its rotation, the other wheel moves by one segment.

Punched Card System

Punched Card System was invented by Herman Hollerith, an American Statistician. It was used for storing and retrieving data. In the form of punched holes, the system data could be stored.

Charles Babbage’s Calculating Engines (1792-1871)

Babbage invented the Difference Engine to solve algebraic expressions and mathematical tasks accurately. Later, he designed some improvements to his first computer. The modified machine is called the Analytical Engine. He intended to design a machine with a collection of the four basic arithmetic functions. The design principle of the Analytical Engine can be divided into Input, Output, Memory, Central Processing Unit. The parts and working principle of an Analytical engine are the same as today’s computer. Hence, Charles Babbage is known as the Father of Computer.

Hollerith Machine

A Hollerith machine was incorporated with the tabular and punched cards. The machine could census the punched holes, recognise the number and make the required calculation and store the data of census. The machine was invented by Herman Hollerith.

Mark I Computer

The first electro-mechanical computing device was developed by Howard Hathaway Aiken. He used Hollerith’s punch card and Babbage’s statements to develop Mark I computer with IBM. In Mark III computer, he used some electronic components and Magnetic drum memory. In Mark IV computer, he used all electronic components and Magnetic drum memory & Magnetic core memory.

First Un-programmable Electronic Digital Computer (ABC)

The Atanasoff-Berry Computer (ABC) was the first electronic computer. It was designed by John Vincent Atanasoff and Clifford E. Berry. It was designed to solve systems of linear algebraic equations. It was also the first to use capacitors for storage.

Electronic Numerical Integrator and Calculator – ENIAC

ENIAC was the first electronic computer used for general purposes, such as solving numerical problems. It was invented by J. Presper Eckert and John Mauchly.

Electronic Discrete Variable Automatic Computer – EDVAC

EDVAC was the successor of ENIAC. In this computer,

Binary numbers were used for arithmetic operations and the internal storage of instructions were also written in digital forms.

Electronic Delay Storage Automatic Calculator – EDSAC

EDSAC was the first practical general-purpose stored-program electronic computer. It was built according to the von Neumann machine principles.

Universal Automatic Computer - UNIVAC

UNIVAC was the first commercially available computer. It was made by the Eckert- Mauchly Computer Company. It represents the birth of the modern computers.

Micro Processor – INTEL 4004

In 1969, Intel Corporation designed the first general-purpose programmable processor INTEL 4004. It was a set of four chips known as the MCS-4. It included a central processing unit chip (the 4004) as well as a supporting read-only memory chip for the custom applications programs, a random-access memory (RAM) chip for processing data, and a shift-register chip for the input/output (I/O) port.

Quick Revision

Particulars	**Name of Person/System**
Father of Computer	Charles Babbage
Father of Modern Computer Science	Alan Tuning
First Non-programmable Electronic Digital Computer	Atanasoff Berry Computer (ABC)
First General Purpose Electronic Digital Computer	Electronic Numerical Integrator and Calculator (ENIAC)
First Micro Processor	INTEL 4004
First Commercially Available Computer	Universal Automatic Computer

Generation of Computers

First Generation Computers– (1946-1959)

The first-generation computers were used vacuum tubes as the electronic components. They occupied a very large space and performed computations in milliseconds. Machine languages are used.

Examples – EDSAC, EDVAC, UNIVAC, IBM-701, IBM-650.

Second Generation Computers – (1959-1965)

The second-generation computers replaced Vacuum Tubes with Transistors. They used assembly languages and batch processing operating system. Magnetic cores and magnetic tapes were used as storage.

Examples – IBM-1620, IBM -7094, CDC-1604, CDC-3600.

Third Generation Computers – (1965-1971)

The third-generation computers replaced transistors with integrated circuits (ICs). They performed computation in Nanoseconds. It used high-level languages like FORTRAN, COBOL, PASCAL, ALGO-68, BASIC was used. In this generation, remote processing, time-sharing, multi-programming operating system were used.

Examples - IBM-360 series, Honeywell-6000 series, PDP, IBM-370/168.

Fourth Generation Computers – (1971-1980)

The fourth-generation computers are used Very Large Scale Integrated (VLSI) circuits. Semi-conductor devices are used as primary memory. Magnetic disks are used as secondary storage. Problem-oriented fourth generation languages (4GL) are used. Multi-processing and multiprogramming operating systems are used.

Example – Apple series – I & II, IBM 4341, DEC 10, STAR 1000, PUP 11.

Fifth Generation Computers – (1980 - Present)

The fifth-generation computers use ultra large scale integrated (ULSI) chips that contain millions of components on a single chip. They are in the developmental stage which is based on the artificial intelligence. These computers can also respond to natural language input. Biochips will be used as memory devices and KIPS (Knowledge-based Information Processing System) architecture will be used.

Examples – Robots, Supercomputers.

Types of Computers

Based on Operation

- Analog Computer - An Analog computer stores data continuously in the form of physical quantities and perform calculations with the help of measures. It produces output in the form of a graph. They are used in the calculation of physical variables such as voltage, pressure, temperature, speed, etc.

- Digital Computer - A Digital computer is the most commonly used type of computer and is working with data represented in digital form, usually binary 0s and 1s. It can perform faster and give more accurate results. They are extensively used for solving complex problems in the field of engineering & technology, design, research and data processing.

- Hybrid Computer – A Hybrid computer is a combined feature of Analog and Digital computers. In large industries and businesses, a hybrid computer can be used for logical operations as well as efficient processing of differential equations.

Based on Configuration

- Micro Computer – Microcomputers are small, inexpensive computer for personal use. They are popularly used at homes for playing games and surfing the Internet.

- Mini Computer - Minicomputers possess most of the features and capabilities of a large computer but are smaller in physical size. They are used as small or mid-range operating business and scientific applications.

- Mainframe Computer – Mainframe computers are expensive and large size computers and they are capable of supporting hundreds of users simultaneously. They are used for specific large-scale applications.

- Super Computer - Supercomputers are powerful, expensive and the fastest computers. They have architectural and operational principles from parallel and grid processing for performing billions and trillions of calculations per second. They are used for applications that require large amounts of mathematical computations like weather forecasting, fluid dynamics, graphic design etc. India launched 'Mihir' supercomputer recently to improve India's weather forecasting.

Particulars	**Name of the Computer**
First Super Computer in the world	Cray CDC 6600
Fastest Super Computer in the world	Summit by the USA
First Super Computer of India	PARAM 8000
Fastest Super Computer in India	Pratyush

Based on Utility

- General Purpose Computer - A general purpose computer can perform an extensive variety of operations. It can store and execute different programs in its internal storage. All mainframes, servers, laptop and desktop computers, smartphones and tablets are general-purpose devices.
- Special Purpose Computer - Special purpose computers are designed to solve specific problems. The instructions are pre-programmed permanently in the computer. It completely controlled by automated manufacturing processes. Example – Aircraft control system, Electronic voting machines etc.

Based on Mode of Use

- Palmtop Computer – Palmtop computers are small which can fit in the palm of a hand. The electronic pen is used to give an input. They have small disk storage and can be connected to a wireless network.

- Laptop Computer – Laptop computers are portable with less weight. It can be transported easily and used in temporary space such as Airplane, Meetings etc. They are designed for low power consumption and have an attached keyboard and a touchpad.

- Personal Computer (PC) - A personal computer is a cost-effective computer that is designed for a single end-user. PC is dependent on microprocessor technology, which allows PC makers to set the entire central processing unit (CPU) on a single chip.

- Workstation - Workstation (WS) is faster than Personal Computer. It is designed for a user or group of users with better multitasking capability, additional Random-Access Memory, Higher-speed graphics adapters and drive capacity.

- Client and Server – The server is a device that manages the sharing of network resources to the users. An Application server, File server, Virtual server, Mail server are some types of server. A client is the receiving end of the service which made by the server. It requests the server and gains access with the server.

Fundamentals of Computer

A computer system has four basic components.

Parts of a computer system

- Hardware - It represents the physical and tangible components of the computer (keyboard, mouse, monitor etc.)

- Software – It is a set of electronic instructions called programs that make the computer perform tasks.

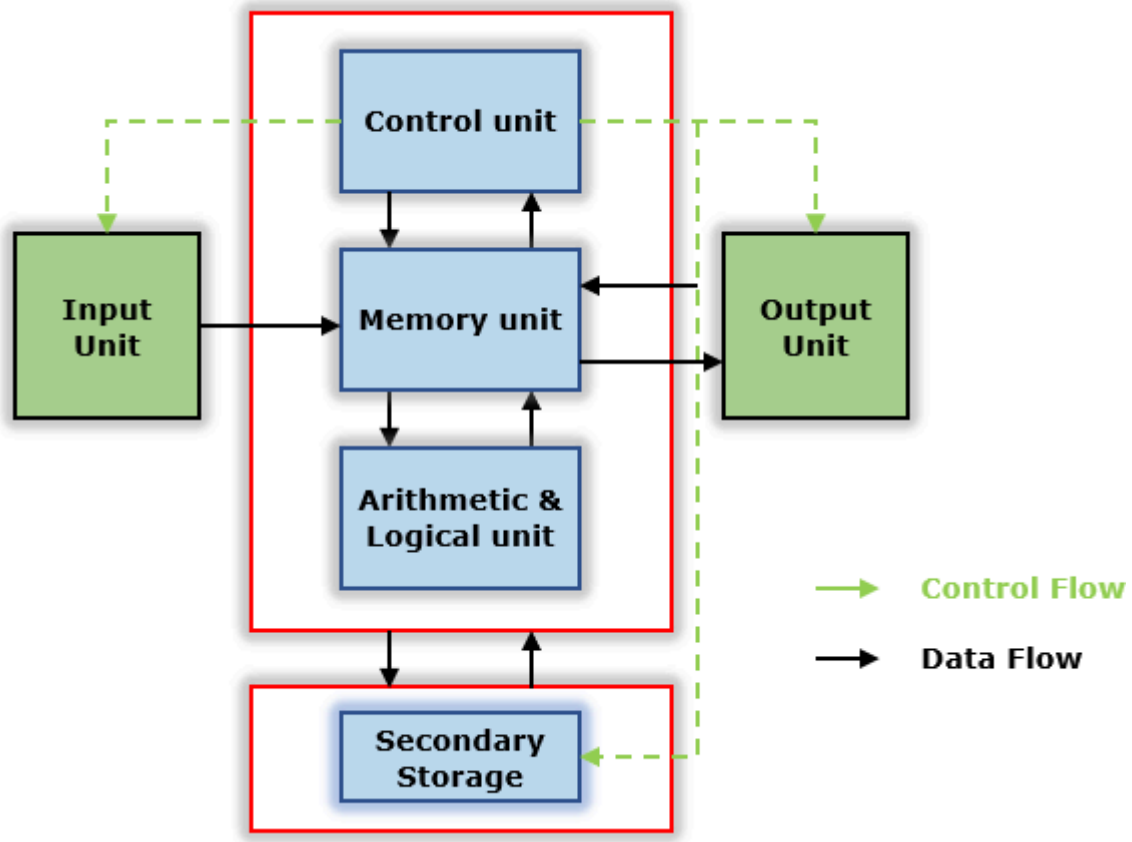
- Data – It is a set of facts, which the computer stores and reads in the form of numbers.

- Users - Users are the people who make use of a computer to obtain certain results/ outcomes.

Mother Board – It is the main printed circuit board of a computer that carries the central processing unit (CPU) chip, Read Only Memory (ROM), Random Access Memory (RAM) and the basic input output system (BIOS) chip.

Basic Computer Organization and Data processing Cycle

The Basic Diagram of the Computer consists of Input Unit, Output Unit and Central Processing ' ' ¨



Input Unit

The input unit is used for giving instructions and data by using input devices. It converts these instructions and data to the computer acceptable format and it supplies the converted instructions and data to the computer system for further processing.

Central Processing Unit

The central processing unit (CPU) performs most of the processing inside a computer. CPUs have been constructed on a single integrated circuit called a microprocessor. It consists of the control unit, the Arithmetic Logic Unit (ALU), and the memory unit.

(1) Control Unit

The control unit manages the computer's various components. It reads and interprets (decodes) the program instructions, transforming them into control signals that activate other parts of the computer.

(2) Arithmetic Logic Unit

The ALU can perform arithmetic and logical operations. The set of arithmetic operations that an ALU supports to addition, subtraction and more complex mathematical operations. Logic operations involve Boolean logic like AND, OR, XOR, and NOT. These can be useful for creating complicated conditional statements.

(3) Memory Unit

Computer main memory consists of primary and secondary memory.

Primary Memory

Primary memory holds only those data and instructions on which computer is currently working. It has limited capacity and data is lost when power is switched off. It is generally made up of the semiconductor device. It is a volatile memory. The two types of primary memory are Random Access Memory (RAM) & Read Only Memory (ROM).

RAM (Random Access Memory) - RAM is the internal memory of the CPU for storing data, program and result of the program. It is read/write memory which stores data till the machine is working. Some types of RAMs are Dynamic RAM (DRAM), Static RAM (SRAM) and Synchronous Dynamic RAM (SDRAM), etc.

Dynamic Random-Access Memory (DRAM) – Dynamic memory must be constantly refreshed, or it loses its contents. This type of memory is more economical.

Static Random-Access Memory – SRAM is faster and less volatile than DRAM but requires more power and is more expensive. It does not need to be refreshed like a DRAM.

Synchronous Dynamic Random-Access Memory - A type of DRAM that can run at much higher clock speeds.

ROM (Read Only Memory) - ROM stores data permanently on personal computers (PCs) and other electronic devices. It performs major input/output tasks and holds programs or software instructions. It is non-volatile.

MROM (Masked ROM) - The very first ROMs were hard-wired devices that contained a pre-programmed set of data or instructions. These kinds of ROMs are known as masked ROMs which are inexpensive.

PROM (Programmable Read Only Memory) - PROM can be modified only once by a user. The user can buy a blank PROM and enter the desired contents using a PROM program.

EPROM (Erasable and Programmable Read Only Memory) - The EPROM can be erased by exposing it to ultra-violet light. EPROMs have a Quartz window in the package to expose the chip to UV light. They were widely used as the BIOS (Basic Input Output System) chips in computer motherboards.

EEPROM (Electrically Erasable and Programmable Read Only Memory) - The EEPROM is programmed and erased electrically. It can be erased and reprogrammed about ten thousand times. Both erasing and programming take about 4 to 10 milliseconds. They were also used as BIOS chips.

Secondary Memory

Secondary memory stores data on a long-term basis. It cannot be processed directly by the CPU. It must first be copied into primary storage. Secondary memory devices include magnetic disks like hard drives and floppy disks, optical disks such as CDs and CDROMs, and magnetic tapes, USB Flash drives.

Hard drive – It is a non-removable storage device containing magnetic disks or platters rotating at high speeds. The hard drives store data in segments of concentric circles. It may spin at 5,400 to 15,000 RPM.

Floppy Disk - Floppy disk is composed of a thin, flexible magnetic disk sealed in a square plastic carrier. Floppy disks were widely used to distribute software, transfer files, and create backup copies of data. To read and write data from a floppy disk, a computer system must have a floppy disk drive (FDD).

Compact Disc (CD) - A compact disc is a portable storage medium that can be used to record, store data in digital form. They are fragile and prone to scratches.

Compact disc read-only memory (CD-ROM) - It is a storage device that can be read but can’t change or delete it.

Digital Video Disc (DVD) - A device currently used to store data in large amounts and accepts high definition material. A two-layered DVD can hold approximately 17 gigabytes of video, sound, or other data.

Blue-ray Disc – The upgraded version of CD and DVD discs and drives are the Blu-ray discs. It is commonly known as BD-ROM. The Maximum capacity of BD disc is 25GB if single layer and 50 GB if dual layer.

Holographic Versatile Disc (HVD) – It is a holographic storage format and has a maximum capacity of 3.9 terabytes.

Flash Drives – Flash drives are small, ultra-portable storage device. They connect to computers and other devices via a built-in USB plug. They are often referred to as pen drives, thumb drives, or jump drives. Mostly they have a storage capacity from 8 GB to 64 GB.

Zip Disks – An advanced version of the floppy disk is known as Zip Disks. It was developed by Iomega. Zip disks are available in 100 and 250-MB and 750 MB capacities and they are used to store, share and back up large amounts of data.

Cache Memory - It is a very high-speed semiconductor memory which can speed up the CPU. It acts as a buffer between the CPU and main memory. Example: Registers

Virtual Memory - Virtual memory permits software to use additional memory by utilizing the hard disk drive (HDD) as temporary storage.

Quick Revision

Types	Examples
Semiconductor Memory	RAM, ROM
Optical Memory	CD-ROM, CD-R, DVD, HVD, Blu-ray Disc
Magnetic Memory	Hard Disk Drive (HDD), Floppy Disk Drive (FDD)
Flash Memory	Pen drive, Memory card etc (EEPROM Technology devices)

Output Unit

The output unit provides the information from the computer to an external device. It presents a soft/ hard copy of the information which can be readable by the users.

Computer Peripheral

A peripheral device links to a computer system to enhance the functionality of the computer. It is not part of the core computer architecture. Input devices, output devices, and storage devices are the types of peripheral devices.

Input Devices

Input devices serve as a link between a user and the computer. It allows users to feed instructions and data to computers for processing, display, storage and/or transmission. Some input devices are:

1. Keyboard – It is used to enter data into the computer in both alpha and numeric forms.

   Some important keys in a keyboard are:

(i) Toggle Keys - It is used to change the input mode of a group of keys on a keyboard. Caps Lock, Num Lock, Scroll Lock are toggle keys.

- Caps Lock – Capitalizes all letters.
- Num Lock – Makes sure numbers are inputs from the keypad.
- Scroll Lock - Allows the arrow keys to scroll through the contents of a window.

(ii) Modifier Keys - It is a special key (key combination) that temporarily modifies the normal action of another key when pressed together. Shift, Alt, Ctrl, Fn are modifier keys.

- Shift - used for capitalizing letters and entering different types of symbols.
- Function (Fn) - Other functions such as brightness and volume control.

- Control (Ctrl) - used for entering keyboard shortcuts, such as Ctrl+S, Ctrl+P etc.

- Alt - used in combination with the numeric keys and the Control key for entering keyboard shortcuts.

(iii) Function Keys - A key on a computer keyboard, distinct from the main alphanumeric keys, to which software can assign a function. F1 - F12 keys are known as function keys and each key performs a different function. It may be used as single key commands (e.g., F5) or combined with one or more modifier keys (e.g., Alt+F4).

(iv) Escape Key – It is located in the upper left corner of a computer keyboard. It is often used to quit, cancel, or abort a process which is running on a computer.

2. Mouse - It is a pointing and cursor-control device. A round ball at its base senses the movement of a mouse and sends corresponding signals to CPU when the mouse buttons are pressed. A mouse has two or three buttons called Left, Right, and Middle button.

3. Joy Stick – It is used to move the cursor position on a monitor screen. It is mainly used in Computer Aided Design (CAD) and playing games on the computer. It can also be helpful as an input device for people with movement disabilities.

4. Track Ball – It is mostly used in notebooks or laptops. It is a ball which is half inserted and by moving fingers on the ball, the pointer can be moved.

5. Scanner – It captures images from printed material and converts it into a digital format that can be stored within the PC. Flatbed Scanners, Hand Scanners, Sheetfed Scanner are some types of scanner.

6. Barcode Reader – It is an electronic device for reading printed barcodes. A light sensor in the barcode reader can read the barcode and translates optical impulses into electrical impulses to store the data into the computer. It is an important tool for warehouse management and operations.

7. Magnetic Ink Character Recognition (MICR) – It is a character recognition system that uses special ink and characters. It is used to verify the legitimacy or originality of paper documents, especially cheques. Information can be encoded in the magnetic characters. It provides a secure, high-speed method of scanning and processing information

8. Optical Character Recognition (OCR) - It is a technology that recognizes text within a digital image. It converts the document to an editable text file.

9. Optical Mark Recognition (OMR) – It is an electronic method that scans the document and reads the data from the marked fields and results can be transmitted into the computer.

10. Digitizer – It allows users to draw and manipulate graphics on the screen. It is also known as a graphics tablet. These kinds of tablets typically designed for CAD/CAM professionals.

11. Touch Screen - It is a computer display screen that serves as an input device. A touchscreen can be touched by a finger or stylus. Touchscreen records the event and sends it to a controller for processing.

12. Microphone – Microphone translates sound vibrations in the air into electronic signals. It enables many types of audio recording devices for purposes including communications, music and speech recording.

13. Web Camera – It captures and stores images in digital form. The stored images can be can be archived on a photographic compact disc or external hard disk.

14. Light Pen - It is a light-sensitive input device, used to select text, draw pictures and interact with user interface elements on a computer screen or monitor.

Output Devices

The Output devices are used to send data from a computer to another device. Examples are monitors, projectors, speakers, plotters, and printers etc.

1. Monitors – Monitors are the main output device of a computer. It forms images from tiny dots that are arranged in a rectangular form. The sharpness of the image depends on the number of pixels. There are two kinds of viewing screens used for monitors.

(i) Cathode-Ray Tube (CRT) - The CRT display is made up of small picture elements called pixels. CRT tube creates an image on the screen using a beam of electrons.

(ii) Flat- Panel Display - The flat-panel display refers to a class of video devices that have reduced volume, weight and power requirement in comparison to the CRT.

(iii) Liquid Crystal Display (LCD) Monitor - LCD monitors use compact fluorescent tubes to illuminate and brighten the image on the screen and produce good image quality, resolution and contrast levels.

(iv) Light Emitting Diode (LED) Monitor - LED monitors use new backlighting technology to improve picture quality. The LED monitor is more lifelike and accurate due to the improved contrast ratios and colour saturation over LCD.

(v) Organic Light Emitting Diode (OLED) Monitor – This type of monitor made up of some organic material (containing carbon, like wood, plastic or polymers) that is used to convert the electric current into light. They are directly used to produce the correct colour and there is no need for backlight which saves power and space.

2. Printers – Printers are output devices that prints information in the form of text/images on a paper. Impact Printers and Non-impact printers are the two types of printers.

(i) Impact Printers - The impact printers print the characters by striking them on the ribbon which is then pressed on the paper. Examples: Dot-Matrix Printers, Line Printers, Daisy wheel printer, Drum printer, Chain printer, Band printer.

Dot-Matrix Printers – It prints characters as a combination of dots. They have a matrix of pins on the print head of the printer which form the character. They generally have 9-24 pins. Their speed is measured in cps (Character per second).

Line Printers - A line printer is an impact printer which can print one line of text at a time. It is also known as a bar printer.

(ii) Non-Impact Printers - Non-impact printers print the characters on the paper without using ribbon. These printers print a complete page at a time, so they are also called as page printers. Examples - Laser Printers, Inkjet Printers etc.

Laser Printers - A laser printer is a popular type of personal computer printer that uses a non-impact photocopier technology. The type of ink used in a laser printer is dry. It gives high-quality output. The resolution of laser printers is measured in dpi (dots-per-inch).

Inkjet Printers - Inkjet printers work by spraying ink on a sheet of paper. The type of ink used in an inkjet printer is wet.

(iii) Other Types

Solid Ink Printer - It is a type of colour printer. It works by melting the solid ink that applies the images to the paper. It is non-toxic and convenient to handle.

LED Printer - This type of printer uses a light emitting diode instead of a laser. It starts by creating a line-by-line image of the page.

3. Plotters - A plotter is an output device used to produce hard copies of large graphs and designs on paper, such as construction drawings, architectural plans, and business charts. Drum plotters and Flatbed plotters are the types of plotters.

(i) Drum plotter – It is a pen plotter that wraps the paper around a drum with a pin feed attachment. The drum then rotates the paper as pens move across it and draw the image. It is used to produce continuous output, such as plotting of earthquake activity. It is also known as Roller Plotter.

(ii) Flatbed plotter - It plots on paper that is spread and fixed over a rectangular flatbed table. It is used in the design of cars, ships, aircrafts, buildings, highways etc. It is also known as Table Plotter.

4. Speaker - Speakers are one of the output devices used with computers. They are transducers that convert electromagnetic waves into sound waves.

5. Digital Projectors – Projector is a device that connects with a computer and projects the output onto a white screen or wall.

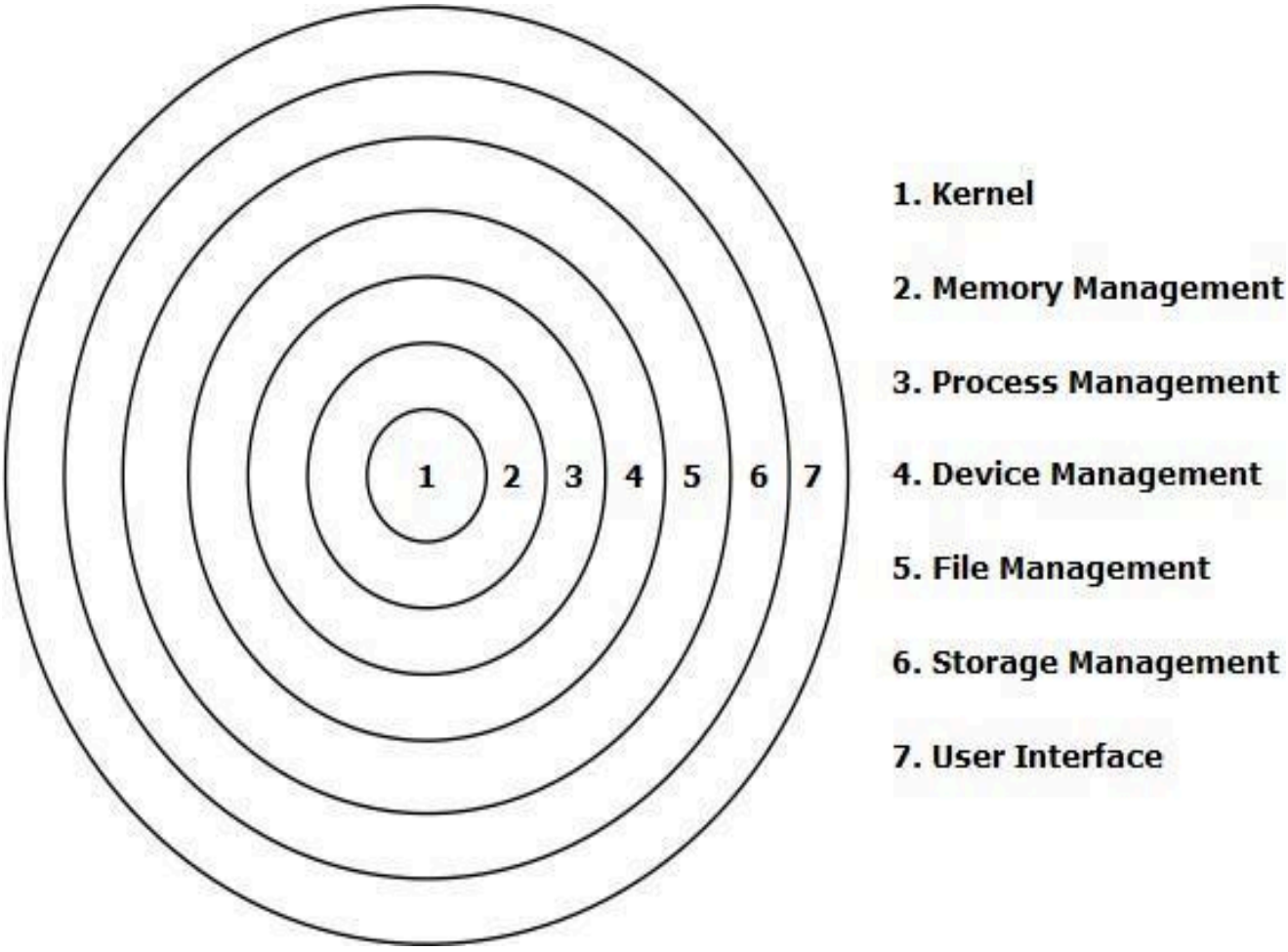
Operating System

An Operating System (OS) is a program that acts as an interface between a computer user and computer hardware. It performs all the basic tasks and controls the peripheral devices such as disk drives and printers.

Examples – Linux (Ubuntu), Windows (Windows XP, Windows 7, Windows 8, Windows 8.1, Windows 10), iOS, Chrome OS, DOS etc.

Apple's latest operating system, macOS Mojave, version 10.14.

Layered Structure of Operating System



Functions of Operating systems

The operating system is the manager of all system resources. The functions of operating systems are:

- Memory Management
- Process Management
- Device Management
- File Management
- Storage Management
- Security
- Job Accounting
- Controls system performance
- Error detecting aids
- Coordination between other software and users

Memory Management - Memory management is the process of controlling and coordinating computer memory, conveying memory blocks to various running programs to enhance overall system performance.

Process Management – Process Management allocates the processor (CPU) to a process and de-allocates the processor when a process is no longer essential. It can save the tracks of the processor and the status of the process.

Device Management – Device Management keeps track of all devices. This is called the Input/output controller and it decides which process gets the device, when, and for how long.

File Management – File Management allocates and de-allocates the resources. It keeps track of information, location, uses, status etc. The collective facilities are known as a file system.

Storage Management – Storage Management provides secondary storage to backup main memory. It can store all data and program permanently. Disk scheduling, Storage allocation, Free space management are the activities in Storage Management.

Security – Security controls the unauthorized access of programs, processes and data resources by means of passwords etc. It can be used to ensure that the files, memory segment, and other resources can be operated only by authorized users.

Job Accounting – It keeps track of time and resources used by various users and

processes.

Control System Performance – Control System records delays between the request for a service and from the system.
Error Detecting Aids – Error detecting Aids ensure the consistent delivery of data across the network. Production of dumps, traces, error messages and other debugging etc are techniques that enable reliable delivery of digital data over unreliable communication channels.

Coordination between other software and users - Operating System Coordinates and assigns compilers, interpreters, assemblers and other software to the various users of the computer systems.

Types of Operating Systems

- Batch Operating System
- Multi-Programming Operating System
- Timesharing/Multitasking Operating System
- Distributed Operating System
- Real-Time Operating System
- Single-user operating System

Batch Operating System - The users of the batch operating system do not interact with the computer directly. Each user prepares his job on an off-line device like punch cards and submits it to the computer operator.

Disadvantages

- ✔ Lack of interaction between the user and the job
- ✔ The speed of the process is slow. Hence Output is time taking
- ✔ The CPU is in idle condition

Multiprogramming Operating System – The users of multiprogramming operating system can execute several programs simultaneously. The CPU keeps on processing. The processes which are running exist in main memory at a time.

Disadvantages

- ✔ The waiting time for the job is high
- ✔ Complicated schedule handling

Timesharing / Multitasking Operating System - Time-sharing or multitasking is a logical extension of multiprogramming. It is a technique which enables many people, located at various terminals, to use a computer system at the same time. The CPU executes multiple programs by switching among the programs. Unix is an example of timesharing OS.

Disadvantages

- ✔ Less Reliability
- ✔ Problem of Data Communication

Distributed Operating System – Distributed Operating System allows multiple users on different computers or terminals to access a single system with one Operating System

on it. The processors communicate with one another through various communication lines. These are referred to as loosely coupled systems.

Advantages

- ✔ Potential Operation
- ✔ Better service to the customers.
- ✔ The load on the host computer is reduced
- ✔ Delays in data processing are reduced

Single User Operating System – This type of operating system supports a single user at any given time. Single keyboard and Single monitor are used for interaction. Several programs can also run by a single user in this operating system.

Example – Windows 95, Windows XP etc

Real-Time Operating System – It is a data processing system in which the time interval required to process and respond to inputs is small. It is always online whereas online system need not be real time. They are used in scientific experiments, medical imaging systems, industrial control systems, weapon systems, robots, air traffic control systems, etc.
Examples – VRTX, RT Linux, Lynx etc

There are two types of real-time operating systems.

- ✔ Hard real-time systems - In this system, the critical tasks complete on time. Secondary storage is limited, and the data is stored in ROM. Virtual memory is almost never found.
  Examples – Industrial control applications, Robots, etc
- ✔ Soft real-time systems - In this system, the time constraint is less strict. A critical real-time task gets priority and retains the priority until it completes. It has limited utility.
  Examples – Multimedia, Virtual reality, Advanced Scientific Projects like undersea exploration and planetary rovers, etc.

Advantages

- ✔ It can be used in an embedded system
- ✔ Error-free
- ✔ Better memory allocation

Disadvantages

- ✔ Algorithm is complex

Android - Android is the name of the operating system used on many smartphones and tablets. It is owned and maintained by Google. The recent version of Android is Android 9 Pie.

Other Terms related to Operating System

Booting - When the computer starts, the operating system is first loaded (as it is essential for running all other programs), this process is known as booting.

Cold Boot – Turn ON the computer from an OFF position is called Cold Booting.

Warm Boot - A computer system starts up/reset from a complete powerless state is called Warm Booting.

Firmware - Firmware is a software program that is written to a hardware device. It allows the hardware to be updated. The contents are saved when a hardware device is

turned off or loses its external power source.

Middleware - Middleware is a software layer situated between applications and operating systems. It enables communication and data management for distributed applications.

Software

The software is a group of instructions that instructing a computer to do specific tasks. It enables the user to interact with a computer. System Software and Application Software are two types of software.

System Software

It serves as an interface between a computer user, computer hardware and application software. It is also known as background software. Four types of system software are the following.

- ✔ Operating System
- ✔ Utility Programs
- ✔ Device drivers
- ✔ Language translators.

Operating System - Operating system (OS) is the program that acts as an interface between the user and computer hardware and application software. After the boot program, OS manages all the other programs in a computer. Examples - Linux, Unix, Microsoft Windows XP etc.

Utility Programs - Utility Programs help to manage, maintain and control computer resources. They are also known as service programs. Examples of utility programs are antivirus software, backup software, disk defragment, backup, disk clean etc.

Device Drivers - A device driver is designed to enable interaction with hardware devices. It controls a device that is attached to your computer. Printers, Displays, CD-ROM readers, Disk drives etc are the examples of the device driver.

Language Translator – Language Translator translates the high-level language program (input) into an equivalent machine language program (output). It also detects and reports the error during translation. Assembler, Compiler, Interpreter are types of a Language Translator.

Assembler – It converts assembly language program into machine language.

Compiler – It converts the program in a high-level language into low-level language and reports all the errors of the program along with the line numbers. C, C++ use compilers.

Interpreter – It converts the programs in a high-level language to low-level language. It translates line by line and reports the error once after completing the translation process. It gives better error diagnostics than a compiler. Python, BASIC, and Ruby use interpreters.

Application Software

Application software is a program or group of programs designed for end users. It enables the user to complete tasks, such as creating documents, spreadsheets, databases, and publications, doing online research, sending email, designing graphics etc. There are two types of application software.

- ✔ Basic application software
- ✔ Specialized application software

Basic application software - Basic application software is also known as general purpose applications and productivity applications. These programs are widely used in every discipline and occupation. Word processors, spreadsheets, database management systems, and presentation graphics are the common types of basic application software. Example - Microsoft office 2016.

Specialized application software - Specialized application software is designed for a specific task rather for a wide application area. Graphics programs, audio and video editors, multimedia creation programs, web authoring, and virtual reality programs are common types of specialized software.

Computer Languages

The different kinds of languages have been developed to perform various types of work on the computer. The two major types of programming languages are Low-Level Languages and High-Level Languages.

Low-Level languages

It is a programming language that deals with a computer's hardware and its configuration. It is very close to the computer’s native language. It is further divided into Machine and Assembly languages.

Machine Language – It consists of binary digits or bits. It can directly understand by the computer and does not need a translator program. It is also called the machine code. It is efficient but difficult to learn.

Advantages

- Programs run fast.
- No translation program is required.

Disadvantages

- Difficult to program
- Debugging is also an issue

Assembly Language – A combination of letters and numbers forms the Assembly Language and a translator program is required to translate to the machine language. The operation codes and operands are given in the form of alphanumeric symbols which are known as mnemonic codes and can combine in a maximum of five-letter combinations e.g. ADD for addition, SUB for subtraction etc. This is also known as Symbolic Programming Language.

Advantages

- Easier to understand and minimizes effort.
- Finding and correcting the errors are easy.

Disadvantages

- It is machine dependent (program written for one computer might not run in other computers with different hardware configuration)
- Writing of code is time-consuming.

High-Level languages

A high-level language (HLL) is a programming language that enables a programmer to write programs independently. Such languages are closer to human languages. Higher level languages are simple languages that use English and mathematical symbols like +, -, %, / for its program construction.

Example – BASIC, C, C++, COBOL, FORTRAN, ALGOL, PASCAL, PROLOG.

BASIC - Beginner's All-purpose Symbolic Instruction Code (BASIC) was developed for students to write simple computer programs. It was designed by John Kemeney and Thomas Kurtz in 1963.

ALGOL - ALGOL is a short form of ALGOrithmic Language. It is a family of portable programming languages for scientific computations.

PROLOG - Prolog is used widely for artificial intelligence applications, particularly expert systems.

PASCAL - It is used to teach programming techniques. It was developed by Niklaus Wirth.

FORTRAN - It is a programming language designed for numeric computation and scientific computing. FORmula TRANslation is an acronym of FORTRAN.

COBOL - Common Business Oriented Language is the full form of COBOL. It is used for business and administrative purposes. It can be read like regular English.

C – It is a general-purpose language which is used in many scientific programming situations.

C++ - C++ is an object-oriented programming language and incorporates all the features offered by C.

Advantages

- Independent of machines and can run on any computer
- Problem-oriented rather than machine oriented
- User-friendly

Disadvantages

- Need time for translating.

Object-Oriented Programming

Object-oriented programming (OOP) is a software programming model built around objects. This model classifies data into objects and describes object contents and performance through the declaration of classes.

Simula is the first object-oriented programming language. The examples of object-oriented programming languages are Java, Python, JavaScript, C++, C#, PHP, Perl, .NET, Ruby Curl, Visual Basic, Smalltalk, Delphi, and Eiffel.

Java - Java is used for developing Mobile, Desktop, web, server-side and dynamic web applications.

JavaScript – JavaScript is designed for styling HTML Pages, interactivity to HTML Pages, Server-Side Scripting Operation, executing query related to DB on Serve.

Python - Python is a general-purpose programming language. It is used for developing complex scientific, numeric applications, data analysis, and visualization.

C# - C# is a general-purpose language was designed by Microsoft to be used for developing apps on the Microsoft platform.

PHP - PHP stands for Hypertext Pre-processor. It is a scripting language used for the development of web applications.

.Net-.Net is a programming framework developed by Microsoft, which can be used to build different types of applications such as Windows, Web application and Mobile based applications etc.

Visual Basic - Visual Basic is an approachable language with a simple syntax for building type-safe, object-oriented apps.

Computer Languages	Father/Inventor/Designed by
C/C++	Dennis Ritchie
Java	James Gosling
JavaScript	Brendan Eich
PHP	Rasmus Lerdorf
Python	Guido van Rossum
HTML	Tim Berners-Lee
.NET (Framework)	Microsoft Corporation
C#	Microsoft Corporation
Perl	Larry Wall
Ruby	Yukihiro Matsumoto

Other related terms

Language Processor – Language Processor is a software designed to perform tasks such as processing program code to machine code. Language processors are found in languages such as Fortran and COBOL.

Debugger - A debugger is a software utility that is designed to locate errors within a program's source code.

Linker - Linker is a program that combines object modules to form an executable program.

Loader – Loader brings all program objects into the memory which is essential to run a program.

Spooling - Spooling is a process in which data is temporarily held to be used and executed by a device, program or the system. Data is saved in storage until the program requests it for execution.

Memory Storage Units

S.No	Unit	Description
1	Bit (Binary Digit)	A binary digit is the smallest unit. It has the logical representation of 0 and 1.
2	Nibble	A group of 4 bits is called nibble.
3	Byte	A group of 8 bits is called byte. (1 byte = B bits)
4	Word	A computer word is a group with a fixed number of bits processed as a unit. The length of a computer word is called word-size or word length and it may be either 8 bits or 96 bits. A computer stores the information in the form of computer words.

Memory Capacity Conversion Chart

Term	Approximate Size
Byte (B)	8 bits
Kilobyte (KB)	1024 bytes / 10^3 bytes
Megabyte (MB)	1024 KB / 10^6 bytes
Gigabyte (GB)	1024 MB / 10^9 bytes
Terabyte (TB)	1024 GB / 10^{12} bytes
Petabyte (PB)	1024 TB / 10^{15} bytes
Exabyte (EB)	1024 PB / 10^{18} bytes
Zettabyte (ZB)	1024 ES/ 10 ^{21} bytes
Yottabyte (YB)	1024 ZB/ 10^{24} bytes

Number System

The Number system is a technique to represent and work with numbers. The most widely adopted number system is the Decimal number system which has 10 digits (0-9). Binary number system (0,1), Octal number system (0-7) and Hexadecimal number system (0-9, A, B, C, D, E, F) are other number systems.
The number of digits in a system is called 'radix' or 'base'. The base of decimal, binary, octal hexadecimal system is 10, 2, 8 and 16 respectively.

Comparison of Decimal, Binary, Octal and Hexadecimal system.

Decimal	Binary	Octal	Hexadecimal
0	0000	0	0
1	0001	1	1
2	0010	2	2
3	0011	3	3
4	0100	4	4
5	0101	5	5
6	0110	6	6
7	0111	7	7
8	1000	10	8
9	1001	11	9
10	1010	12	A
11	1011	13	B
12	1100	14	C
13	1101	15	D
14	1110	16	E
15	1111	17	F
16	10000	20	G

Logic Gates

These are the building blocks of any digital circuit that implement Boolean logic processes. It has only one output. Arrays of logic gates are used in digital integrated circuits (ICs). The basic logic gates and their functioning (truth table) are mentioned in the following figure.

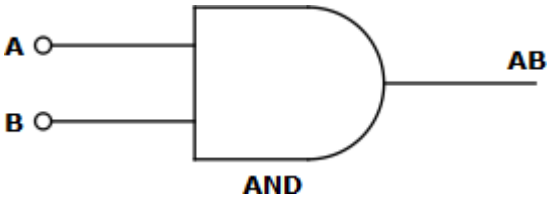
AND Gate

It is a digital logic gate with two or more inputs and one output which performs logical conjunction.

A	B	AB
0	0	0
0	1	0
1	0	0
1	1	1

OR Gate

It is a logic gate that produces inclusive disjunction. It is used in Boolean algebra and



electronic circuits like transistor-transistor logic, and complementary metal-oxide semiconductors etc.

A	B	A+B
0	0	0
0	1	1
1	0	1
1	1	1

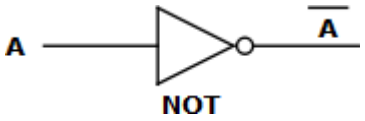
NOT Gate

NOT gate is a single input gate. It performs the inversion of given input. So, it is called Inverter.

A	$\overline{A}$
0	0
0	1
1	0
1	1

NAND Gate

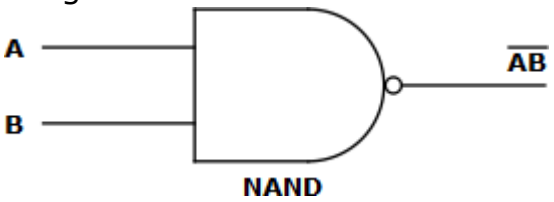
It is the combination of AND & NOT gates. It is the opposite of AND logic gate.



A	B	$\overline{AB}$
0	0	1
0	1	1
1	0	1
1	1	0

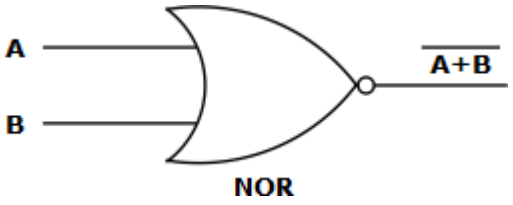
NOR Gate

It is the combination of NOT & OR gates. 'neither this nor that' is the principle of NOR gate.



A	B	$\overline{A+B}$

0	0	0
0	1	0
1	0	0
1	1	1



XOR Gate

XOR gate is a special type of gate. It is used in the half adder, full adder and subtractor and controlled inverter circuit. It is also used in the computers for implementing the binary addition.

A	B	A⊕B
0	0	0
0	1	1
1	0	1
1	1	0

XNOR Gate

It is a combination of the Exclusive-OR gate and the NOT gate. The EXOR gate has a

XOR

high output only when an odd number of inputs are high.

A	B	$\overline{A \oplus B}$
0	0	1
0	1	0
1	0	0
1	1	1

XNOR

Database Management System

A database management system (DBMS) is a computer program designed for creating and managing the database. It provides a systematic way to run operations like creating, storing, retrieving, deleting data from the database. It serves as an interface between the database and end users. It also provides protection and security to the databases.

MySQL, Oracle, SQL Server, IBM DB2, PostgreSQL, Amazon Simple DB (cloud-based) are some popularly used DBMS.

Advantages of DBMS

- ✔ Reduced Data redundancy
- ✔ Data security and consistency
- ✔ Easily accessible
- ✔ Integrity constraints

Disadvantages of DBMS

- ✔ Larger in size
- ✔ Complexity
- ✔ Licensed DBMS are costly

Architecture (Levels of Data Abstraction in DBMS)

Database systems consist of complex data structures. The process of masking irrelevant information from users is known as Data Abstraction. Data abstraction reduces the complexity of users with the database. Three levels of data abstraction are Physical Level, Logical Level, and View level.

The Architecture of commercial DBMS is based on ANSI-SPARC database architecture.

Physical Level/Internal Level - It is the lowest level of abstraction. It describes how the data is physically stored in detail. B+ tree, Hash file organization methods are used in this level.

Logical Level/Conceptual Level - It is the next level of abstraction and describes what data is stored and what is the relationship among that data. At the logical level, each record is described by a type and the interrelationship of these record types. Database administrators work at this level of abstraction. The changes which are done at this level will not affect the external or physical levels of data.

View Level/External Level - It is the highest level of abstraction and is viewed by the user in terms of tables and relations. It describes only a part of the entire database and hides the details of the logical level.

Keys in DBMS

A key is a field in the database table which is used to retrieve and sort rows in the table. Keys are used to speeding up the data accessing and creating links between different tables.

Super Key - It is a set of one or more attributes whose values uniquely determine each entity in the database table. It is a subset of a candidate key.

Candidate Key - It is a set of columns in the table from which primary key can be selected to identify each record. Every database table may have one or more candidate keys.

Primary Key - It is a special key that uniquely identifies each record in the table. It has a unique value for each row of data and it cannot contain null values.

Composite Key - It is a combination of more than one column in the table that can be used to uniquely identify each record. It is also known as a Compound key.

Alternate Key - All keys except primary key are known as Alternate. Alternate keys are also called Secondary Keys.

Foreign Key - Foreign key points to the primary key of another table. It acts as a reference between tables. It can accept the null and duplicate value.

Microsoft Office

It is an office suite of inter-related desktop applications, servers and services for the Windows operating systems introduced by Microsoft in 1989. Some important application software of the MS Office is MS Word, MS Excel, MS Power-point, MS Access, MS OneNote, MS Outlook etc.

Microsoft Word

Microsoft Word is a word processing program that was first made public by Microsoft. It is one of the most widely used word processors available for Macs and PCs. It offers a variety of features such as creating, editing and formatting etc. Some other features include spell check, mail merge and link embedding. Another feature is word wrapping, which means that the processor automatically adjusts all text within the specified margins. '.doc and .docx' are the file extension of MS word.

Title Bar

The title bar is located at the top of a window that displays the name of the window or document being used.

Quick Access Tool Bar

The quick access toolbar is a small and customizable toolbar at the top of the document window. It contains a set of commands that are independent of the tab on the ribbon that is currently displayed. It usually contains buttons to save, undo, redo and print.

Ribbon

The Ribbon is a cluster of toolbars in Microsoft Office which are used for writing, designing, formatting and reviewing different styles, adaptations, add-ins, themes etc. Every tab in the top of a given word file window displays the Ribbon toolbar.

The following are the specifications of MS office 2016 version.

File Menu

The File menu is a section on the Office ribbon that gives access to file functions such as Open, Save, Close, Properties, and Recent file options. Type of file (i.e. Text file, Word file, HTML file, etc.), file name, size of the file, file location, security on the file, time and date of creation, modification of the file can also be accessed by anyone.

Home Tab

The Home tab is the default tab in Microsoft Word, Microsoft Excel, Microsoft PowerPoint and other Microsoft Office products. It allows changing document settings, such as the font properties by using control groups on the tab. The control groups and keys are

- ✔ Clipboard Group (Copy (only one item at a time), Paste, Cut, Format Painter)
- ✔ Font Group (Font style, colour & size, Bold, Underline, Strikethrough)
- ✔ Paragraph Group (Bullets & Numbering, Alignment, Shading, Borders, Line spacing)
- ✔ Style Group (Listed Styles)
- ✔ Editing Group (Find, Replace etc).

Insert Tab

The Insert Tab is used to insert different features such as tables, pictures, clip art, shapes, charts, page numbers, word art, headers, and footers etc into a document. The availed groups and keys under this tab are:

- ✔ Pages Group (Cover page, Blank page, Page break)
- ✔ Tables Group (Tables)
- ✔ Illustrations Group (Pictures, Shapes, Smart Art etc)
- ✔ Media and Links Group (Hyperlink, Bookmark etc)
- ✔ Header and Footer Group (Page number, Header, Footer)
- ✔ Text Group (Text Box, Word Art etc)
- ✔ Symbol Group (Equation, Symbol)

Design Tab

Design Tab includes Themes (to change colours, fonts and effects for the document all at once), The Style Set gallery (to change the styles), Paragraph Spacing, Effects, The Page Background group (watermark, page colour, page borders) buttons to format the document.

Layout Tab

The Layout Tab holds the buttons which are used to arrange document pages. The control groups and keys under layout tabs are:

- ✔ Page Setup Group (Margins, Orientation, Breaks, Line numbers, Hyphenation,

Size of the page, Columns)

- ✔ Paragraph Group (Paragraph Indentation, Spacing)
- ✔ Arrange Group (Align, wrap text, Rotate etc)

References Tab

References Tab allows to now create a table of contents, footnotes, citations, cross-references. The availed control groups and keys in this tab are:

- ✔ Table of Contents Group (Customize table of contents)
- ✔ Footnotes Group (Insert footnotes)
- ✔ Research Group (Smart outlook of the text)
- ✔ Citations & Bibliography Group (Inserting and choosing a style of citation, Bibliography)
- ✔ Captions group (cross reference, insert a table of figures, Insert Caption)
- ✔ Index Group (Insert Index, Mark entry)
- ✔ Table of Authorities group (Mark Citation, Insert Table of Authorities)

Mailings Tab

Mail Merging is an ideal task in MS word by using Mailings Tab. Mail merge is used to create form letters or address labels, certificates with unique names, and more. The following group buttons are available in Mailings Tab.

- ✔ Create Group (Envelops, Labels)
- ✔ Start Mail Merge Group (Start Mail Merge, Selection of Recipients, Edit Recipient List)
- ✔ Write & Insert Fields Group (Highlighting the fields, Address Block, Greeting Line etc)
- ✔ Preview Results Group (Check for errors, Find Recipient)
- ✔ Finish Group (Finish &

Group) Review Tab

The tools in the Review Tab helps to improve the document. It contains the following control groups and keys.

- ✔ Proofing Group (Spelling & Grammar, Thesaurus, Autocorrect, word count)
- ✔ Comments Group (Add new comment, show comment, Delete comment)
- ✔ Tracking Group (Track changes, Simple mark-up, Review pane)
- ✔ Changes Group (Accept or Reject changes)

- ✔ Compare Group (Comparing the documents)
- ✔ Protect Group (Restrict editing, Block Authors)

View Tab

The View tab has the functionality to change the document views. The options in the view tab are:

- ✔ Views Group (Read mode, Print Layout, Web Layout Outline, Draft)
- ✔ Page Movement Group (Vertical and Side to side)
- ✔ Show Group (Ruler, Gridline, Navigation Pane)
- ✔ Zoom Group (Zoom {10% to 500%}, Page width, Multiple pages)
- ✔ Window Group (New window, Arrange and Split window, Switch windows etc)
- ✔ Macros group

Help Tab

The users can get help by using F1 function key anytime, Help tab and 'Tell me what you want to do'.

Status Bar

A status bar is a horizontal window at the bottom of a parent window. It displays the various kinds of status information of the document.

Dialog Box Launcher

A button in the corner of a group that launches a dialog box containing all the options within that group.

View Toolbar

A toolbar that enables, adjusts and displays different views of a document. It is located at the bottom left corner of the window.

Other Terms

Alignment – This option is used to align the text in a document adhere to the right side, left, centre or justified.

Clipboard – The clipboard saves the text temporarily. Using the Cut or Copy commands will place the text in the clipboard.

Font – It is a type of design for text. Times New Roman, Arial, Calibri, Verdana etc are the examples of font style. The maximum size of Font is 72 in a drop-down selection of MS Word.

Undo and Redo – Undo refers to delete the last action in the document. Redo can restore the changes again.

Footer and Header - The footer constantly appears on every page of a document, at the bottom of each page. It includes the page number, or a company's name and contact details in formal documents. The header sits at the very top of every page in a document. A Header contains page numbers, the document name or sub-titles within a document.

Cut, Copy, Paste - Cut is used to move a section of text from a document to clipboard. Copy refers to duplicating a section of a document and placing it in the clipboard. Paste allows to copy an object or text from one location and place it to another location.

Paste Special - Paste Special is used to paste an item from the clipboard with custom formatting.

Thesaurus - It is a software tool which is in MS Word that provides synonyms for selected words on command.

AutoCorrect - AutoCorrect is a software feature in MS Word. It automatically corrects misspellings and common errors.

Spell Check - It is a software tool for correcting spelling. It is available in word processing programs, email programs, cell phones, and a variety of other applications.

Shortcut Keys

Keys	Description	Keys	Description
Ctrl + A	Select All	Shift+F7	Thesaurus
Ctrl + B	Bold	F1	Help
Ctrl + C	Copy	F5	Refresh the page
Ctrl + V	Paste	F4	Repeat the action
Ctrl + N	New Blank Document	F7	Spell Check
Ctrl + X	Cut	F6	Go to the next pane
Ctrl + I	Italic	F8	Extend the selection
Ctrl + U	Underline	F9	Update the selected fields
Ctrl + Z	Undo	F10	Show Key tips
Ctrl + Y	Redo	F11	Go to the next field
Ctrl + O	Open	F12	Save As
Ctrl + S	Save	Shift + F3	Change the case of letters
Ctrl + K	Insert Hyperlink	Shift + F4	Repeat a find
Ctrl + L	Left Alignment	Shift + F10	Display a shortcut menu
Ctrl + E	Centre Alignment	Ctrl + F2	Choose Print Preview
Ctrl + R	Right Alignment	Ctrl + F4	Close the window
Ctrl + J	Justify the alignment	Ctrl + F10	Maximize the document window
Ctrl +F	To open find box	Ctrl + F12	Choose the open button
Ctrl + G	Find and Replace	Tab	To move to the previous object
Ctrl + W	Close document	Alt + F5	Restore the program window
Ctrl + M	Indent	Alt + F7	Find the next misspelling
Ctrl + P	Print	Alt + F10	Maximize the program window
Ctrl + Shift +>	Increase font size	F2	Rename the file
Ctrl + Shift + <	Decrease font size	Alt + F4	Exit
Alt + H	Home Tab	Alt + P	Layout Tab
Alt + N	Insert Tab	Alt + Q	Tell me box
Alt + G	Design Tab	Alt + R	Review Tab
Alt + F	File Page	Alt + W	View Tab
Alt + M	Mailings Tab	Alt + S	Reference Tab

Microsoft Excel

It is a spreadsheet program which is used to present and organise copious amounts of data in a systematic manner. It also includes performs basics arithmetic operations on data and creates graphs and charts based on the same.'.xls' is the file extension of the MS Excel. Ribbons in MS Excel are divided into logical groups called Tabs and Each tab has its own set of unique function to perform. There are various tabs – Home, Insert, Page Layout, Formulas, Date, Review and View.

The following are the features of MS Excel 2016.

Home Tab

The Excel Home Tab is used to perform common commands such as bold, underline, alignment, Number, copy, and paste. It is also used to apply formats to cells in a worksheet. The Home Tab groups and their buttons are:

- ✔ Clipboard Group (Paste, Cut, Copy, Format Painter)
- ✔ Font Group (Bold, Italic, Underline, Font Style, Colour & Size {decrease and increase}, Fill colour, Borders)
- ✔ Alignment Group (Alignment {Top, Middle, Bottom, Left, Right, Centre}, Orientation, wrap text, Merger& Centre, Indent decrease & increase)
- ✔ Number Group (General, Accounting Number Format, Percent style, Comma style, Increase and decrease decimal)
- ✔ Styles Group (Conditional Formatting, Format as Table, Cell Styles)
- ✔ Cells Group (Insert cells, Delete cells, Format cells)
- ✔ Editing Group (AutoSum, Fill, Clear the format, Sort& Filter, Find & Select)

Insert Tab

Insert Tab is used to insert the picture, charts, filter, hyperlink etc. Alt+N is the shortcut Key to open Insert Tab. The Insert Tab groups and keys are:

- ✔ Tables Group (Pivot Table, Recommended Pivot Tables, Table)
- ✔ Illustrations Group (Pictures, Online pictures, Icons, Shapes, Smart Art Graphic, 3D models, Screenshot)
- ✔ Add-ins Group (Store, Insert Add-ins)
- ✔ Charts Group (Recommended charts, Maps, Pivot Chart Charts*)
- ✔ Tours Groups (3D Maps)
- ✔ Sparklines Group (Line, Column, Win/Loss)

- ✔ Filters Group (Slicer, Timeline)
- ✔ Links Group (Hyperlink)
- ✔ Text Group (TextBox, Header & Footer), WordArt, Signature line, Object)
- ✔ Symbols Group (Equation and Symbol)

*Charts – There are eight types of charts. Colum or Bar Chart, Hierarchy Chart, Line or Area Chart, Combo Chart, Statistic Chart, Bubble Chart, Pie Chart, Waterfall, Funnel, Stock, Surface or Radar Chart.

Page Layout Tab

The features under this tab used to change the look of a workbook. The groups under this tab are:

- ✔ Themes Group (Themes, Colours, Fonts, Effects)
- ✔ Page Setup Group (Margins, Orientation, Size, Print Area, Breaks, Background, Print Titles)
- ✔ Scale to fit Group (Page scale, Width and Height)
- ✔ Sheet Options Group (Gridlines, Headings)
- ✔ Arrange Group (Bring Forward, Send Backward, Align, Group, Rotate, Selection Pane)

Formulas Tab

Formulas Tab is used to make dynamic reports by using functions. In excel, 461 functions are availed from Office 2003 to 2013. Formulas Tab is divided into four groups.

- ✔ Function Library (Insert Function, AutoSum, Financial & Logical Function, Date &Time, Math& Trig, Lookup &Reference, Text, More functions {Statistical, Engineering, Cube etc})
- ✔ Defined Names group (Name Manager, Define Name, Use in Formula, Create from selection)
- ✔ Formula Auditing (Trace Precedents & Dependents, Error Checking, Evaluate Formula, Watch window)
- ✔ Calculation Group (Calculate sheet,

options) Data Tab

Data tab is used for importing a large amount of data. Importing Data can be done by connecting with the server, automatically from the web, MS Access etc. It makes easy to read vast data.

- ✔ Get & Transform Data Group (Get Data, From Text/CSV, Web, Table/Range, Existing Connections)
- ✔ Queries & Connection Group (Refresh All, Properties, Edit Links, Queries, Connections)
- ✔ Sort & Filter Group (Sort, Filter, Reapply, Clear, Advanced)
- ✔ Data Tools Group (Text to columns, Flash Fill, Remove Duplicates, Data Validation, Consolidate, Manage Data Mode, Relationships)

- ✔ Forecast Group (What-If Analysis, Forecast Sheet)
- ✔ Outline Group (Group, Ungroup, Subtotal)

Review Tab

It contains the editing feature, comments, track changes and workbook protection options. It makes to share the data easily with the proper information and ensuring the security of data.

- ✔ Proofing Group (Spell Check, Thesaurus)
- ✔ Language Group (Translate)
- ✔ Comments Group (Comment – New, Delete, Previous, Next, Hide/Show)
- ✔ Protect Group (Protect Sheet, Protect Workbook, Allow Edit Ranges, Unshared workbook)
- ✔ Ink Group (Start Inking, Hide

Ink) View Tab

View tab helps to change the view of an Excel sheet and make it easy to view the data. This tab is useful for preparing the workbook for printing. The groups and keys under this tab are

- ✔ Workbook Views Group (Normal, Page Break Preview, Page Layout & Custom View)
- ✔ Zoom Group (Zoom {range – 10% to 400%}, Zoom to selection)
- ✔ Window Group (New Window, Arrange All, Freeze Panes, View side by side, Synchronous Scrolling, Reset Window, Show/Hide, Switch Windows)
- ✔ Macros Group (Macros)

Help Tab

The user can get help using this tab, by pressing F1 Key.

- ✔ Help & Support Group (Help, Contact Support, Feedback, Show Training, What's New)
- ✔ Community Group (Community, Blog Site, Suggest a Feature)

Other Terms

Workbook – It is an Excel file which contains worksheets of rows and columns.

Worksheet – A single document or sheet in a workbook which is used to store and work with data. It consists of rows and columns. In Excel 2016, Default worksheet in a workbook is one.

Row & Column Headings – It indicates the number of rows (Left of the worksheet) and alphabet of column (Top of the worksheet). The total number of rows is 1,048,576 and

columns is 16,384 in the new version of Excel sheet. Column width is 255 characters and row height is 409 points.

Cell – Cell is a box which is the intersection of a row and column in a worksheet. It is the smallest block of the spreadsheet. The cell in which the user working is known as Active Cell. The maximum number of line feeds per cell is 253 in the new version of Excel.

Cell Address – The location of a cell is known as Cell Address. Example: C10 (Column: Row)

Autofill – Autofill fills the values in the cell according to a given pattern. (i.e. Months & Days, Even Numbers, Odd Numbers, tens, etc) This is done through the Fill Handle.

Formula – It is an expression which calculates the value of a cell. It always starts with a '='.

Formula Bar – It is located just below the ribbon. It shows the contents of the active cell and allows to create and view formulas.

Pivot Table – Pivot Table is an interactive report creation system. It is used to reorganize and summarize the data.

Flash Fill – Flash Fill is used to identify the patterns in existing data. It copies only required data from one column to another.

Freeze Panes – It is used to freeze rows/columns in place and making it visible when scrolling. Example – Header row visible

Macro – It is a sequence of instructions that replace a repetitive series of keyboard and mouse actions to execute. It is used in MS Word and MS Excel.

Status Bar – It is the Bar below the worksheet names that has a few buttons and indicators.

Wrap Text –When text exceeds a column width/Height, wrap text automatically adjust the height/width of a cell to make all text visible.

Sparklines –They are graphs that can fit into one cell and gives the information about the data.

Shortcut Keys

Keys	Description	Keys	Description
F2	Edit active cell	Shift + F11	Insert new worksheet
F5	Go to Dialog box	Shift + F9	Calculate the active worksheet
F9	Calculate worksheets	Ctrl + Shift +;	Time
F4	Create an absolute	Ctrl +;	Date
Tab	Right one Cell	F11	Create Chart
Shift + Tab	Left One Cell	Ctrl + Shift + U	Expand/Collapse formula bar
Ctrl + Home	To first Cell	Alt + =	Insert AutoSum formula
Ctrl + End	To Last Cell	Ctrl + ~	Show/hide all formula
Shift + Spacebar	Select entire row	Ctrl + Shift +@	Apply the time format
Ctrl + Spacebar	Select entire column	Ctrl + Shift + #	Apply the date format
Ctrl + 9	Hide selected rows	Ctrl + Shift + %	Apply the percentage format without decimal
Ctrl + 0	Hide selected columns	Ctrl + Shift + $	Apply the currency format with two decimals
Arrow Keys	Move between Cells	Alt + Enter	Start a new line in the same cell
Alt + Spacebar	Display control Menu	Ctrl + Shift + Home	Extend the selection of the cells
F1	Create Pivot Chart	Alt + F1	Create Pivot Chart in the same worksheet

Microsoft PowerPoint

MS PowerPoint is a popular presentation program and is used to create slideshows which comprise text, graphics, sounds and other animated media. Features such as word art, auto shapes etc. can also be added to the presentation. It is convenient for both school and office level work. '.ppt' is the file extension of MS PowerPoint. The Ribbons in MS Power-point 2016 are divided into following tabs.

Home Tab

The Home Tab includes the commands for formatting presentations. The Keys and Groups under the Home Tab are:

- ✔ Clipboard Group (Cut, Copy, Paste, Format Painter)
- ✔ Slides Group (New slide, Layout, Reset, Section)
- ✔ Font Group (Font Style & size {Max. size is 96 in dropdown selection}, Text Shadow, Bold, Underline, Italic, Strikethrough, Clear All Formatting, Character Spacing, Change case)

- ✔ Paragraph Group (Bulleting, Numbering, Align Text, Text direction, Convert to SmartArt)
- ✔ Drawing Group (Shapes, Arrange, Quick Styles, Shape Fill, Shape Outline, Shape Effects)
- ✔ Editing Group (Find, Replace, Select)

Insert Tab

It is used to add features such as tables, pictures, clip art, shapes, charts, word art, or headers, and footers into a presentation. The groups and buttons in this tab are:

- ✔ Slides Group (New Slide)
- ✔ Tables Group (Draw/Add Table)
- ✔ Images Group (Pictures, Online Pictures, Screenshot, Photo Album)
- ✔ Illustrations Group (Shapes, Icons, 3D models, Smart Art, Chart)
- ✔ Add-ins Group (Store, Add-ins)
- ✔ Links Group (Zoom, Link, Action)
- ✔ Comments (Add comment, Edit& Delete Comment)
- ✔ Text Group (TextBox, Header & Footer, Word Art, Date & Time, Slide number, Object)
- ✔ Symbols Group (Equation and Symbol)
- ✔ Media Group (Video, Audio, Screen Recording)

Design Tab

The Design tab holds commands related to the presence of slides like page setup and slide orientation. The group and Keys under this tab are:

- ✔ Themes Group (Listed Slide Themes)
- ✔ Variants Group (Listed Variants)
- ✔ Customize Group (Slide Size, Format Background)
- ✔ Designer Group (Design Ideas)

Transition Tab

Transitions tab is used to add transitions to a slide and to customize transition effects. The group and Keys of Transition Tab are:

- ✔ Preview (to view slides)
- ✔ Transition to this slide (Listed transition, Effect options)
- ✔ Timing Group (Sound in slides, Duration, Apply to all slides, Advance slide)

Animation Tab

It is used to add animation to text in a slide and to manage the animation order. The Groups and Keys are:

- ✔ Preview Group (Slide's Preview)
- ✔ Animation Group (Listed Animation, Effect Options)
- ✔ Advanced Animation (Add Animation, Animation Pane, Trigger, Animation Painter)
- ✔ Timing Group (Start, Duration, Delay of slides, Reorder Animation)

Slideshow Tab

This tab is used to finalize the slideshow details, timings, and more. The Keys and groups under this tab are:

- ✔ Start Slide Show Group (From Beginning, From Current Slide, Present Online, Custom Slideshow)
- ✔ Set up Group (Set up slideshow, Hide slide, Rehearse timings, Record Slide Show)
- ✔ Monitors Group

Review Tab

Review tab is used to check spelling, to collaborate by adding comments, and to access editor tools. The groups are:

- ✔ Proofing Group (Spelling, Thesaurus)
- ✔ Language Group (Translate, Language)
- ✔ Comments Group (New comment, Delete Previous/next Comment)
- ✔ Compare Group (Compare, Accept, Reject, End Review, reviewing Pane)
- ✔ Ink Group (Start inking, Hide ink)
- ✔ OneNote Group (Linked Notes)

View Tab

View tab is used to access the various presentation views, to show and hide the ruler and grid lines, and more.

- ✔ Presentation Views Group (Normal, Outline view, Slide Sorter, Notes Page, Reading view)
- ✔ Masters View Group (Slide Master, Handout Master, Notes Master)
- ✔ Show Group (Ruler, Gridlines, Guides, Notes)
- ✔ Zoom Group (Zoom {10% to 400%}, Fit to the window)
- ✔ Colour/Grayscale Group (Colour, Grayscale, Black &White)
- ✔ Window Group (New window, Arrange All, Cascade, Move Split)
- ✔ Macros Group (Macros)

Other Terms

Presentation – A Presentation is a collection of individual slides that contain information on a topic with audio, visual features. It makes an interaction between a speaker and an audience.

Design Template - A PowerPoint template is a pattern of a slide whose format and colour scheme is used as the basis for other presentations. It can contain layouts, theme colours, theme fonts, theme effects, background styles, and even content.

Master Slide – A slide that controls the properties such as theme, layout, background, colour, fonts, and positioning of all other slides in a presentation.

Normal View - Normal view is used for creating, editing and viewing presentation slides. It contains all three view panes such as Slides, Outline and Notes.

Greyscale - Grayscale is a variety of shades of grey (Black and white combination) without apparent colour.

Notes Pane - It is used to add notes and graphics that apply to the current slide in the presentation. It is also used to print the notes.

Slides Pane – Slide Pane displays the slides thumbnails. It allows the user to view and edit the slides.

Outline Pane – Outline Pane displays the text from the slides.

Slide Show View – It is used to display the presentation. It is the way to preview the presentation.

Slide Sorter View – It shows all the slides in a presentation as thumbnails. It is used to reorganize, insert, delete and copy the presentation slides.

Slide Timing – It is the time period that a slide seems on the screen.

Task Pane – It allows to access commands like getting started, PowerPoint help, slide, new presentation etc related to a specific task.

AutoContent Wizard - A wizard helps to create a presentation. It helps with a general structure and suggested topics based on the user's view regarding the presentation output.

Shortcut Keys

Keys	Description	Keys	Description
Alt + W, Q	Change the zoom	Alt + N, X	Insert textbox
Alt + H, F and S	Change the font size	Alt + N, W	Insert word art
Alt + H, S and H	Insert a shape	Alt + F10	Maximize window
Alt + G, H	Select a theme	Ctrl + D	Duplicate Slide
Alt + H, L	Select a slide layout	Ctrl + Shift + F	Change Font Style
Alt + N, P	Insert a picture	Shift + F3	Toggle cases
Alt + H	Home Tab	Ctrl + Shift + Z	Normal/Plain Text
Alt + N	Insert Tab	Shift + F6	Move anticlockwise among pane
Alt + S, B	Start Slideshow	Shift + F10	Display context menu
Alt + F, X	Close PowerPoint	Ctrl + F5	Restore window to previous size
Esc	End the slideshow	Alt + Q	Search
Alt + T	Transitions Tab	Alt + R	Review Tab
Alt + A	Animations Tab	Alt + G	Design Tab
F5	Slide Show	Alt + W	View Tab

File Extension

A file extension is a suffix at the end of a filename that specifies what type of file it is. It helps the operating system to understand the characteristics of the file.

Example – filename.docx is the name of the document. '.docx' is the file extension.

List of File Extension

File Extension	Meaning	File Extension	Meaning
.apk	Android Package file	.bin	Binary file
.txt	Plain text file	.py	Python file
.wks / .wps	Microsoft Works Word Processor Document file	.wsf	Windows Script file
.ods	OpenOffice Calc spreadsheet file	.exe	Executable file
.xlr	Microsoft Works spreadsheet file	.com	MS-DOS command file
.xls	Microsoft Excel File	.mp3	MP3 audio file
.xlsx	MS Excel Open XML spreadsheet file	.wma	Windows media audio file
.pptx	PowerPoint Open XML presentation	.wpl	Windows Media Player Playlist
.ppt	PowerPoint presentation	.mpg/.mpeg	MPEG Video file
.db/.dbf	Database file	.avi	Audio Video Interleave file
.sql	SQL Database file	.flv	Adobe Flash video file
.tar	Linux / Unix tarball file archive	.mp4	MPEG-4 video file
.bak	Backup file	.odt	Open office writer doc file
.tmp	Temporary file	.pdf	PDF file
.htm/.html	HTML/Hypertext Markup Language file	.js	JavaScript file
.png	Portable Network Graphic image	.php	PHP Source file code
.gif	Graphical Interchange Format image	.ps	PostScript file
.psd	Adobe Photoshop Document image	.max	3ds Max Scene File
.jpg/.jpeg	JPEG image	.jsp	Java Server Page file

.sys	Windows system file	.cfg	Configuration file

Computer Network

A computer network or data network is a telecommunications network which allows computers to exchange data using a data link. The connections between nodes (computers on networks called nodes) are established using either cable media or wireless media. Vint Cerf and Bob Kahn are known as fathers of the Internet.

The five components of a computer network are:

- ✔ Sender (Device)
- ✔ Sender Equipment (Encoder)
- ✔ Communication Channel (Cables, Wireless)
- ✔ Receiver Equipment (Decoder)
- ✔ Receiver (Device)

Sender - Sender is a device that sends a message which can consist of text, numbers, pictures etc. It is also called source or transmitter.

Sender Equipment - The encoder is a device that converts digital signals in a form that can pass through a transmission medium.

Communication Channel - It is the physical path that connects the sender and the receiver. It is used to transmit data. It is also called Medium. The channel can be a copper wire, a fiber optic cable, microwaves etc

Receiving Equipment - The decoder is a device that converts the encoded signals into digital form. The receiver can understand the digital form of message.

Receiver – Receiver is a device that receives the message. It is also called a sink. It must be capable of accepting the message.

Types of Computer Network

The Network allows computers to connect and share resources with other devices through a medium.

Based on the area coverage, there are three types of computer networks.

- ✔ LAN – Local Area Network
- ✔ MAN – Metropolitan Area Network
- ✔ WAN – Wide Area Network

Local Area Network

LAN is a computer network covering a small geographical area and is privately owned. The Communication medium used for LAN has twisted pair cables and coaxial cables. LAN offers high-speed communications data rates up to 1000 Mbps. The fault tolerance of a LAN is more, and congestion is less in this network. LAN can be used for

an office building, home, hospital, schools, etc.

Metropolitan Area Network

MAN covers a large geographical area than LAN. It is designed for customers who need a high-speed connectivity and it is usually owned by large organizations to interconnect its various branches across a city. The fault tolerance of a MAN is less and congestion in the network is more. Modem and Wire/Cable are used as transmission devices. It may serve as an Internet Service Provider (ISP).

Wide Area Network

WAN covers the large geographical area and it might be restricted within the bounds of a state or country. It could be a connection of LAN connecting to other LAN through telephone lines and radio waves. The technology is high speed and relatively expensive.

The Speed of WAN ranges from few kilobits per second (Kbps) to megabits per second (Mbps). Public packet networks, Large corporate networks, Military networks, Banking networks, Stock brokerage networks, and Airline reservation networks are constructed by WAN.

Other types

Wireless Local Area Network (WLAN) - WLAN is a wireless network communication over short distances. This distribution method uses high-frequency radio waves and often include an access point to the Internet. It is also called Local Area Wireless Network (LAWN).

Example - A mobile user can connect to LAN via wireless connection.

Storage Area Network (SAN) - SAN is a high-speed special-purpose network. It supports data storage, retrieval, and sharing of data, multiple disk arrays, data migration from one storage device to another and uses Fibre Channel interconnection technology.

Campus Area Network (CAN) - CAN is a computer network of interconnected local area networks. It is larger than a LAN but smaller than MAN or WAN. It can also stand for Corporate Area Network.

Example - Massachusetts Institute of Technology’s (MIT) Project Athena has CAN network.

Personal Area Network (PAN) - PAN refers to the interconnection of telecommunications devices or gadgets such as a laptop, mobile phones, printers etc around an individual person. It can cover a network range of 30 feet (approximately 10 m). It can be constructed by using cables or it may be wireless.

Wireless Personal Network (WPAN) – WPAN is a type of personal area network. It uses wireless communication to transfer data between the connected devices of the user. It is also known as short wireless distance network.

Network Architecture

It is the physical and logical design which denotes to the software, hardware, protocols and the media of transmission of data. Peer-to-Peer (P2P) and Client/Server or tiered are the two types of widely used network architecture.

Peer-to-Peer Architecture - Tasks are allocated to all the devices of the network. There is no hierarchy among the computers and all of them are considered equal. All computer can able to use resources available on this network. This is also known as a distributed architecture. It doesn't use a server that controls network activity. Peer-to-peer is mostly used for file sharing.

Client/Server Architecture – The server acts as a hub in which other computers (clients) are connected. The server manages and provides resources to any client that requests them.

Other Terms used in networks

Protocol - Protocol is a set of guidelines for exchanging data over a computer network, such as local area network, Internet, Intranet, etc.

Ethernet - Ethernet is the most widely used LAN technology that defines wiring and signalling standards for the physical layer of TCP/IP. Ethernet was standardized as IEEE 802.3.

Token Ring - It is a local area network topology where nodes are arranged in a ring topology. The data passes between nodes on the network until it returns to the source station. A token ring topology uses a token to ensure that only one node on the line is used at a time to prevent congestion and collision. The token ring LAN system was standardized as IEEE 802.5.

Fiber distributed data interface (FDDI) - FDDI is an optical data communication standard used for long distance networks provides communication with fiber optic lines. This protocol is based on the token ring protocol.

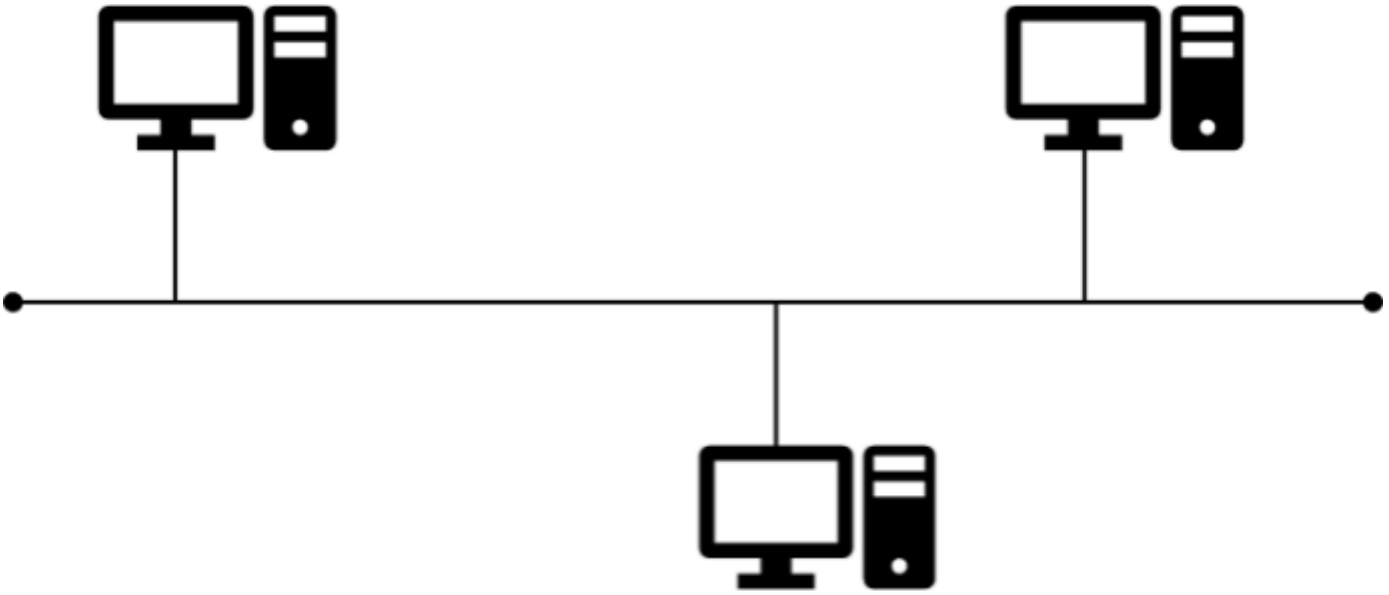
Network Topology

A network topology is the arrangement of a network, nodes and connecting lines. The physical topology and the logical (or signal) topology are the types of network topology.

Physical Topology

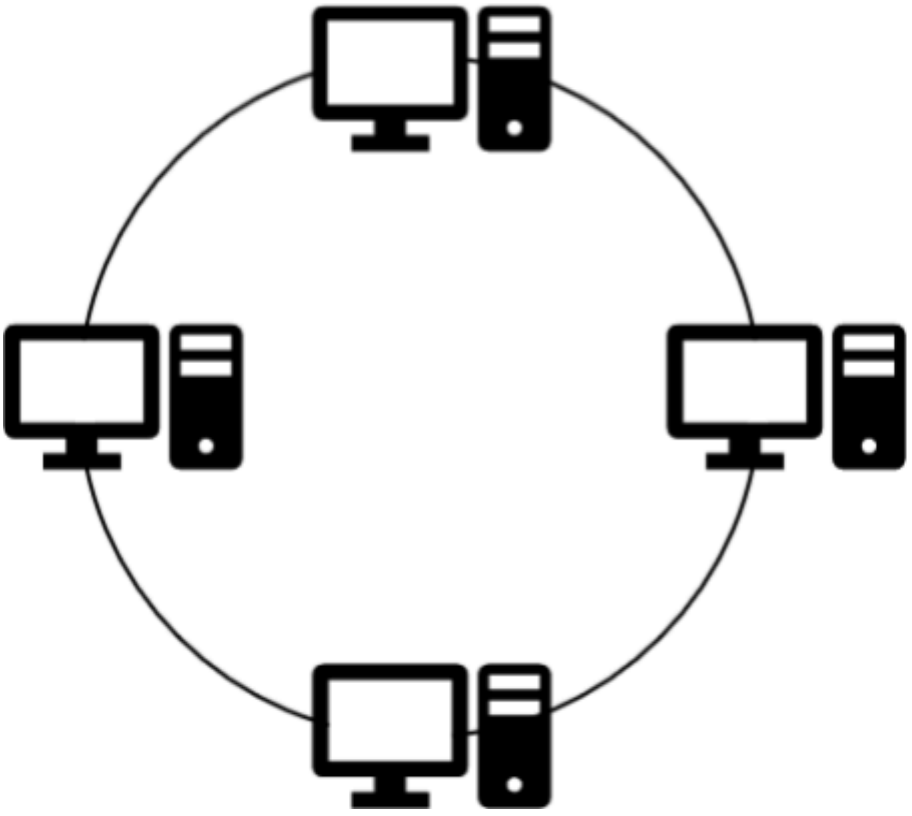
The physical topology refers to the geometric layout of the connected network. Bus Topology, Ring Topology, Tree Topology, Mesh Topology, Star Topology, and Hybrid Topology are several forms of Physical Topology.

Bus Topology



In the Bus topology system, every computer and network are connected by using a single cable. The cable is known as Bus. It transmits the data from one end to another end only in a single direction. When it has exactly two endpoints, then it is called Linear Bus topology. A network that uses a bus topology is referred to as a bus network. Bus networks were the original form of an Ethernet network.

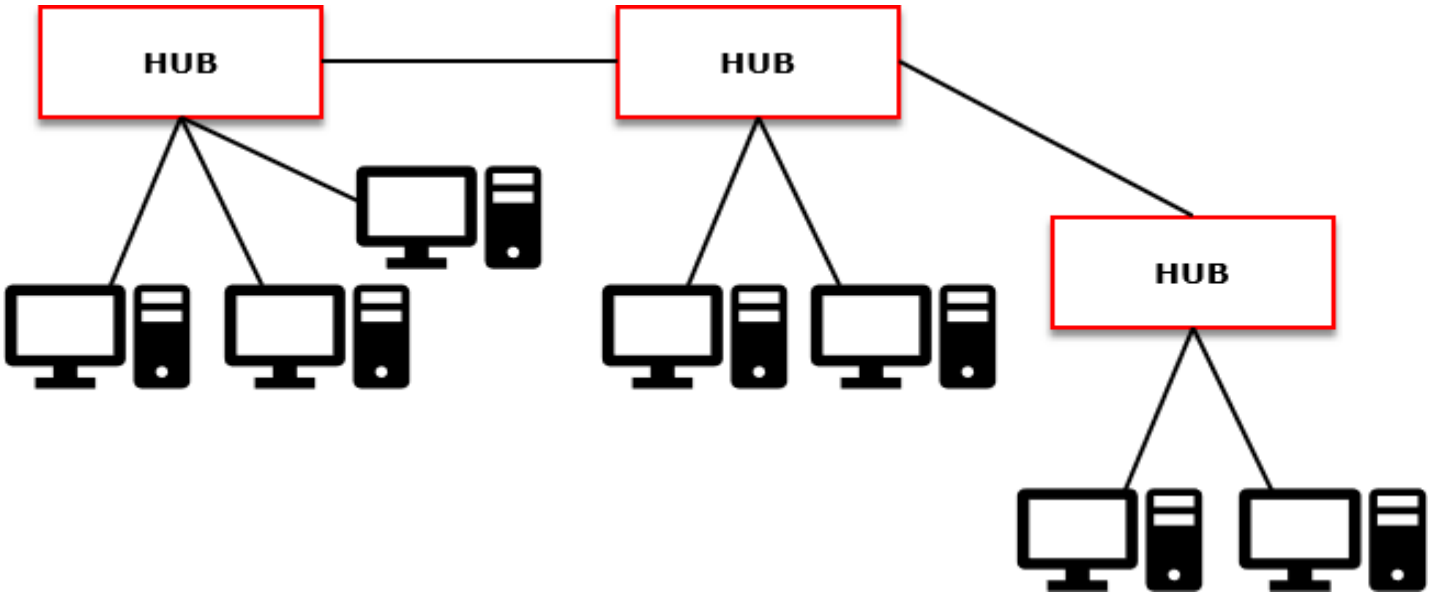
Ring Topology



In ring Topology, network nodes are connected in a closed loop configuration. Each node has directly connected with its adjacent node on both sides. The Others are indirectly connected and the data passing through one or more intermediate nodes.

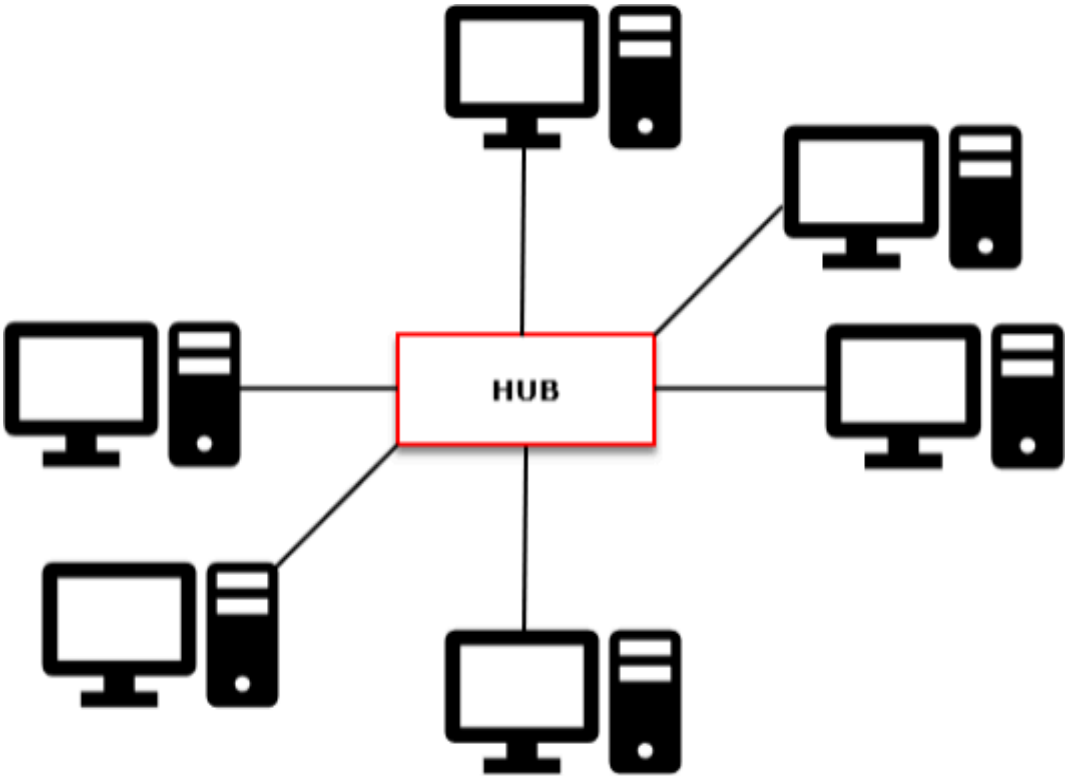
- Dual Ring Topology - When the transmission is bidirectional by having two connections between each network node, it is called Dual Ring Topology. It is a network redundant topology where nodes are connected using two concentric rings with four branches. If one ring fails, the second ring can act as a backup, to keep the network up.

Tree Topology



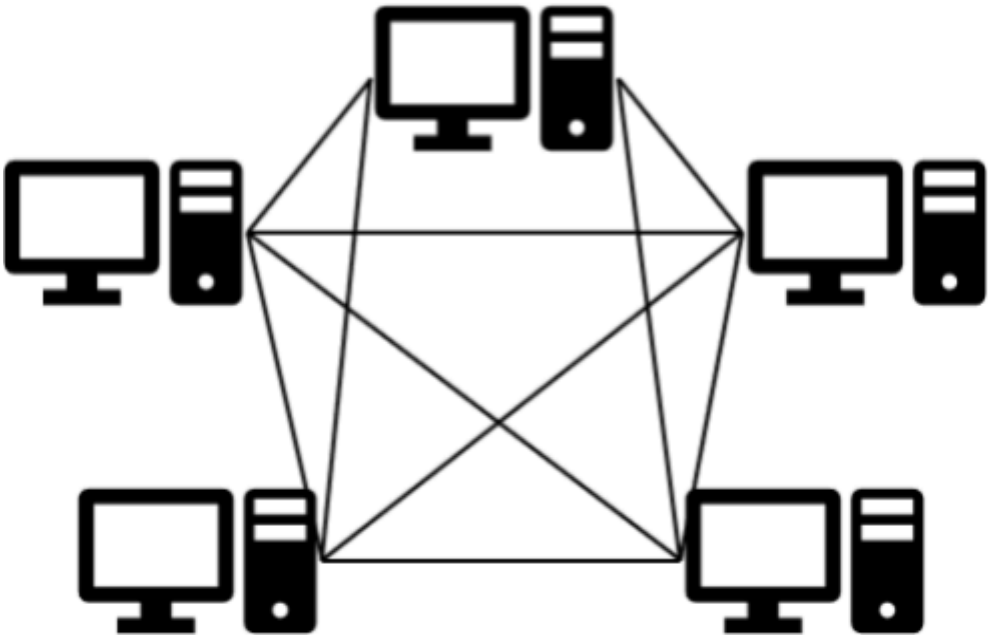
In Tree Topology network, two or more-star networks connected with a root node and all other nodes are connected to it forming a hierarchy. It is also called hierarchical topology. It should at least have three levels to the hierarchy. This type of topology used in Wide Area Network. Tree topology is valued for its scalability and accessibility for troubleshooting.

Star Topology



In a star topology, all the nodes are connected to a single hub through a cable. This hub is the central node. The data can send from one node to another through the hub. Hub acts as a repeater for data flow. It can be used with twisted pair, Optical Fibre or coaxial cable.

Mesh Topology



In Mesh Topology, every node carries traffic only between the two nodes it connects (point-to-point connection). Mesh has n(n-1)/2 physical channels to link n devices.

Example - Each telephone regional office needs to be connected to every other regional office.

There are two techniques to transmit data over the Mesh topology. They are Routing, Flooding.

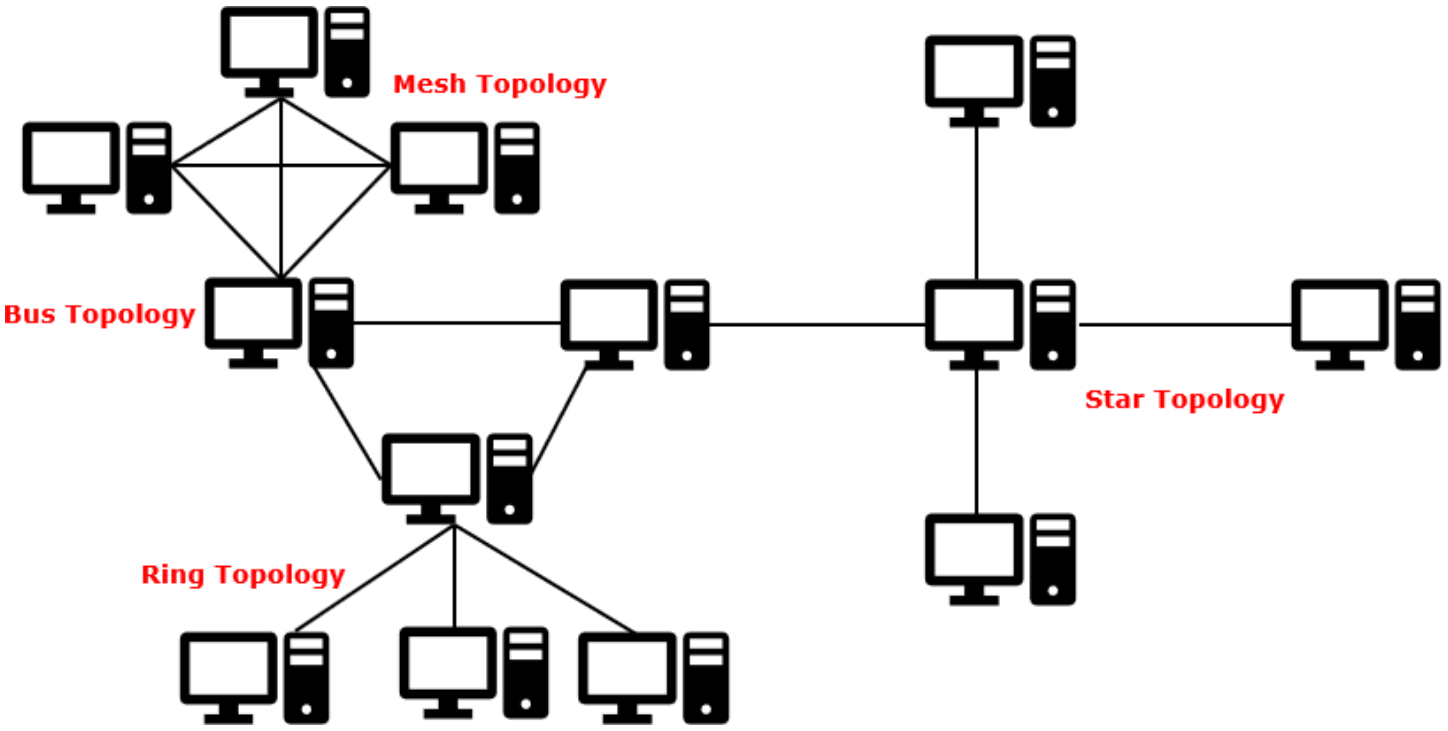
- ✔ Routing – The nodes have a routing logic to direct the data to reach the designation using the shortest distance.
- ✔ Flooding – The data is transmitted to all the nodes in the network, hence no routing is required.

Types of Mesh Topology

Partial Mesh Topology - In this topology, some of the nodes are connected to all nodes and some nodes are connected only to some nodes.

Full Mesh Topology - Every node is connected to each other.

Hybrid Topology



It is a group of two or more topologies. It is a scalable topology and it can be expanded easily. It is reliable.

Logical/Signal Topology

Logical Topology denotes how the signals transmitted from node to node across the system. Broadcast and Token Passing are the two types of Logical topology.

- ✔ In Broadcast, there is no need for instructions. Ethernet is working in Broadcast transmission.
- ✔ In Token Passing, electronic token is passed to each node. When a token is received by the node, the node can send data on the network. Token Ring and Fibre Distributed Data Interface (FDDI) are using Token Passing. Arc net is token passing on a bus topology.

Open System Interconnection Model (OSI Model)

The Open Systems Interconnection (OSI) Model is an intangible and logical arrangement that describes network communication between two systems by using different layer protocols. The OSI model developed by the International Standards Organization (ISO). It has seven layers to transmit data from one to another.

Layers in The OSI Model

Physical Layer (Layer 1)

It is the lowest layer in the OSI model. It deals with the bit-level transmission between the devices. It supports mechanical and electrical specifications of the interface and transmission medium. Hub, Repeater, Modem, Cables are Physical Layer devices. The data unit of this layer is Bit. It converts the signal into 0s and 1s and sends them to the next layer. Simplex, half-duplex and full-duplex are the transmission modes for this layer.

Protocols used - ATM, RS232, and Ethernet.

Data Link Layer

It is used for the encoding, decoding and logical organization of data bits. It makes the physical layer appear error-free. It converts the bits into the frames depending on the frame size of Network Interface Card (NIC). Switch and Bridge is Data Link Layer devices. HDLC, LSL, and ATM are the implemented protocols on this layer. It has two sub-layers.

- Media Access Control (MAC) – It is responsible to the physical address of the sender and/or receiver in the header of each frame. CSMA/CD, Ethernet are used as protocol.
- Logical Link Control (LLC) – It is responsible for frame management, error checking, and flow control of data.

Network Layer

This network provides the shortest path for transmitting data for network communication to avoid congestion. Data is transmitted in the form of packets through the logical network path. The IP address of the sender/receiver is placed in the header. Routers are used as networking devices. The IPX and TCP/IP are the implemented protocols on this layer. Routing and Logical Addressing are the functions of this layer.

✔ Routing – Finding the shortest path for data transmission.

✔ Logical Addressing – Placing the IP address of the sender/receiver in the header.

Physical Layer, Data Link Layer, and Network Layer are also known as Hardware Layer.

Transport Layer

This layer is called as Heart of OSI model. It is responsible for end-to-end network communication, flow control of data, error recovery and reliability and quality of data. The data in the transport layer is referred to as Segments. It is operated by the Operating System. SPX, TCP/IP's, DNS are examples of implemented protocols on this layer.

Session Layer

This layer is responsible for the establishment of the connection, maintenance of sessions, synchronization and ensures security. It allows adding checkpoints (synchronization points) into the data to identify the error. This layer is the network dialog controller which allows two systems into the dialog in either half duplex or full duplex mode. RPC, PPTP, SCP, SDP are some protocols of this layer.

Presentation Layer

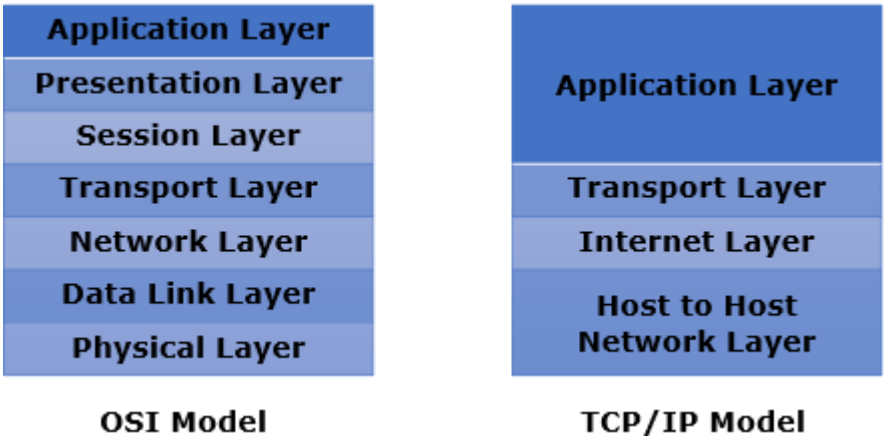
This layer performs encryption and decryption of data. It gives the data in a readable format from an application layer perspective. It reduces the number of bits that need to be transmitted on the network. It offers liberty from compatibility troubles. It is called the Translation layer and Syntax layer.

Example - ASCII code to EBCDIC coded text file.

Application Layer

This layer focuses on process-to-process communication across an IP network and provides a firm communication interface and end-user services. It supports services such as electronic mail, remote file access, and transfer, shared database management, Web chat and surfing, Directory services and Network Virtual Terminal. HTTP, FTP, Telnet, SMTP, and DNS have used protocols of this layer. It is also called as Desktop Layer.

Session Layer, Presentation Layer, and Application layer are also known as Upper Layers or Software Layers.



TCP/IP Model

TCP model is a tangible, client-server model. It is one of the most used protocols in digital network communications. It has only four layers in a data communication network.

Host-to-Network Layer – In this layer, the host has connected to the network using the protocol to send IP packets. Ethernet, Token Ring, FDDI, X.25, Frame Relay are used.

Internet Layer – It transfers the Internet Protocol packets (IP datagrams) to the destination. IP, ICMP, ARP, RARP, and IGMP have used protocols.

Transport Layer – It is like as transport layer in the OSI model. Two end-to-end transport protocols are used. Transmission Control Protocol (TCP) and Use Datagram Protocol (UDP).

Application Layer – It contains high-level protocols. TELNET, FTP, SMTP, DNS, HTTP, NNTP, DHCP are used.

Data Transmission Modes

Data Transmission modes refer to the way of transferring the information or data between two connected devices. Three types of transmission modes are:

- ✔ Simplex Mode
- ✔ Half Duplex Mode
- ✔ Full Duplex Mode

Simplex Mode – In this type, the data can be transferred in only one direction. The only one can transmit and the other can receive the data.

Example – Keyboard (Input) and Monitor (output), Loud Speaker, Television, Fire alarm system etc.

Half Duplex Mode – In this type, the data can be transferred in both directions, but not at the same time. Example – Walkie-talkie

Full Duplex Mode – In this type, the data can be transferred in both direction on the same transmission path. Two lines are used for sending and receiving the data.

Example – Telephone network

Data Transmission Media

Data or information is transferred to one place from another through the physical/wireless media which is known as Transmission Media. Guided Media and Unguided Media are two types of Transmission Media.

Guided Media/Bounded Media

The signals are transmitted through the narrow path which made by physical links. Twisted Pair cable, Coaxial Cable and Fibre-Optic Cable are the types of Bounded Media. Twisted-pair and coaxial cable accept signals in the form of electric current. Optical fibre accepts signals in the form of light.

Unguided/Unbounded Media

The signals are transmitted without using any cables. This type of transmission is known as wireless communication. Radio waves, Infrared, Micro waves are some popular type of unbound transmission media.

- ✔ Microwave – Mobile phone, Satellite networks, Wireless LANs.
- ✔ Radio Wave – Radio, Television and Paging system
- ✔ Infrared – Short range communication (TV remote control, IRD port etc)

Network Devices

Hub - Hub is a networking device which connects multiple network hosts. It is used to transfer data. The hub sends data packets (frames) to all devices on a network. Active Hub (Repeaters) and Passive Hub are two categories of Hub.

Switch - Switch is a small hardware device that works at the layer of LAN (Local Area Network). It receives incoming data packets, filters the packet and sends only to the interface of the intended receiver. It maintains a CAM (Content Addressable Memory) table and has own system configuration and memory. CAM table is also known as forwarding table or forwarding information base (FIB).

Modem (Modulator-Demodulator) - It is a hardware component that allows a computer to connect to the Internet. It converts analog signal to digital signal.

Router – It is a hardware device which is responsible for routing traffic from one to another network. It is designed to receive, convert and move packets to another network.

Bridge – Bridge is a network device that connects a local area network to another local area network that uses the same protocol.

Gateway - A gateway is a network node that connects two dissimilar networks using different protocols together.

Repeater – It is an electronic device that magnifies the signal it receives. It is implemented in computer networks to expand the coverage area of the network. It is also known as signal boosters.

Firewall - A firewall is a network security system that monitors and controls overall incoming and outgoing network traffic based on advanced and a defined set of security rules.

Internet

It is the global computer network providing a variety of information and communication facilities, consisting of interconnected networks using standardized communication protocols (TCP/ IP).

ARPANET was the world's first fully operational packet switching computer network, developed by the Advanced Research Projects Agency of the U.S. Department of Defense in 1969. It connected with only four computers. ARPANET adopted TCP/IP in 1983 and the "network of networks" became the modern Internet.

World Wide Web - WWW is one of the services interconnected over the internet. It is a collection of all information, resources, pictures, sounds, multimedia on the internet which is formatted in HTML and accessed through HTTP.

Web Server – A web server stores, processes and delivers web pages to the users. The intercommunication between users and servers is done using Hypertext Transfer Protocol (HTTP).

Web Page – It is a document was written in HTML that can be accessed through the internet by using the web browser. It is identified by Uniform Resource Locator.

Web Browser - It is a software application that allows users to access the websites. Internet Explorer, Google Chrome, Opera, Mozilla Firefox, UC Browser, Apple Safari are some examples of a web browser.

Home Page – Homepage is the default page of the website.

Hypertext Mark-up Language (HTML) – HTML is used to create web pages that are displayed on the Internet.

Hypertext Transfer Protocol (HTTP) - This protocol is used to transfer data over the web. It runs on top of the TCP/IP set of protocols. It uses a server-client model.

Transmission Control Protocol/Internet Protocol (TCP/IP) – It is a set of communication protocols which is used to access the internet. TCP/IP was developed by Bob Kahn and Vint Cerf in 1978.

Internet Host – Host is a computer or application which is used to transfer the data on the internet. Each host has a unique IP address called Hostname.

Internet Protocol Address (IP Address) – It is a logical numeric address that is used to identify the host over the internet network.

- ✔ The stable version of IP – IPv4 (32 bits). It is written in decimal and separated by periods.
- ✔ Latest Version of IP – IPv6 (128 bits). It is written in Hexadecimal and separated by colons.

Uniform Resource Locator (URL) - A uniform resource locator (URL) is used to locate the address of a resource and protocol.

Domain Name - A domain name serves as an address which is used to access the website. It can be universally understood by Web servers and online organizations.

Top Level Domains are following.

Domain Name	Description
.com	Commercial
.net	Network-oriented
.org	Non-Profit Organization
.edu	Education
.gov	Government
.mil	Military
.int	International Treaties

Domain Name System (DNS) – DNS translates domain names into IP addresses. It has a large database of domain names and its IP addresses.

Uploading – It refers to the transmission of data or files from the computer to the internet server. Uploaded file can be retrieved by anyone.

Downloading – It is the process of copying files from the internet to the user's computer.

Email - Electronic mail is the transmission of messages over the internet. In an email, the user can attach documents, pictures, videos etc.

Carbon copy (CC) – It is used to share e-mail with one or more recipients. Both the main recipients and other (CC) recipients can see all the mail addresses.

Blind Carbon Copy (BCC) – In this, the recipients of the message and other recipients (BCC) cannot see the persons who all receive the e-mail.

Computer Hacking

Hacking is an attempt to exploit a computer system or a private network inside a computer. It is the unauthorized access to or control over computer network security systems for some illicit purpose. Viruses, Keyloggers, Rootkit, Spoofing attack, Packet Sniffer, Trojan horse, Password cracking are various of techniques for hacking.

Computer Virus - A computer virus is a malicious software program loaded onto a user's computer without the user's knowledge and performs malicious actions. Stuxnet, Petya, Wanna cry, Code red, Melissa, Sasser, Zeus, Mydoom, Crypto Locker, Flashback are some example of Viruses.

The Elk Cloner virus was the first self-replicating computer program to spread on a large scale. It was created by a 15-year-old Rich Skrenta in 1982. Ryuk, Troldesh are ransomware family of newly discovered viruses.

Computer Worm - A computer worm is a malicious, self-replicating software program (malware) which affects the functions of software and hardware programs. Stuxnet is the most famous computer worm.

Ransomware - Ransomware is a type of malware program that infects and takes control of a system. It infects a computer with the intention of extorting money from its owner.

Botnet – Botnet is a set of networks connected computers/devices that are used for malicious purposes. Each computer in a botnet is called Bot. It is also known as Zombie.

Trojan horse – It is a type of malware that presents itself as legitimate software. It may perform actions on a computer that is genuine but will install malware actions.

Keylogger - A keylogger is a type of malware that stores all keystrokes of a computer. It can record all sorts of personal information, such as usernames, passwords, credit card numbers, and personal documents such as emails and reports.

Rootkit - A rootkit is a secret computer program designed to provide continued access to a computer while actively hiding its presence. Rootkits are associated with malware such as Trojans, worms, viruses.

Spyware - Spyware is a software that is installed on a computing device without the end user's knowledge. It steals internet usage data and sensitive information such as usernames and passwords, activating the microphone or camera on a computer to record physical activity.

Adware - Adware is unwanted software designed to display advertisements on the computer screen to generate income. This type of ads cannot be removed easily.

Phishing – Phishing is a cyber-attack that used to steal user data, including login credentials and credit card numbers. They use email as a weapon and trick the email recipient into believing that the message is received from real companies such as banks, Amazon etc to harvest the recipient's details. Email Phishing, Spear Phishing (targets special person/organization) are techniques of Phishing.

List of Abbreviations

Abbreviation	Full Form
ASCII	American Standard Code For Information Interchange
ALU	Arithmetic Logic Unit
ALGOL	Algorithmic Language
ARP	Address Resolution Protocol
API	Application Program Interface
ATM	Asynchronous Transfer Mode
AI	Artificial intelligence
BASIC	Beginner's All-purpose Symbolic Instruction Code
BIOS	Basic Input Output System
Bit	Binary Digit
BCC	Blind Carbon Copy
BIU	Bus Interface Unit
BIS	Business Information System
BPS	Bits Per Second
BCR	Bar Code Reader
BIPS	Billion Instruction Per Second
BRD	Blu-Ray Disc
CAD	Computer Aided Design
CAM	Computer Aided Manufacturing
CADD	Computer Aided Design and Drafting
CAN	Campus Area Network
CC	Carbon Copy
CD	Compact Disk
CDROM	Compact Disk Read Only Memory
CD -R	Compact Disk - Recordable
CD – RW	Compact Disk Rewritable
CD – WO	Compact Disk - Write Once
COBOL	Common Business Oriented Language
CPI	Clock / Cycle Per Instruction
CPU	Central Processing Unit
CRT	Cathode Ray Tube
CASE	Computer-Aided Software Engineering
CPS	Characters Per Second.
CROM	Control Read-Only Memory
DVD	Digital Versatile Disk

DVI	Digital Visual Interface
DVDR	Digital Versatile Disk Recordable
DVDRW	Digital Versatile Disk Rewritable
DRAM	Dynamic Random-Access Memory
DBMS	Data Base Management System

DNS	Domain Name System
DHTML	Dynamics Hyper Text Mark-up Language
DPI	Dots Per Inch
DVR	Digital Video Recorder
DOS	Disk Operating System
DTP	Desk-Top Publishing
EDP	Electronic Data Processing
EDSAC	Electronic Delay Storage Automatic Calculator
EEPROM	Electronically Erasable Programmable Read Only Memory
EFS	Encrypted File System
ENIAC	Electronics Numerical Integrator And Calculator
EPROM	Erasable Programmable Read Only Memory
EROM	Erasable Read Only Memory
ESDI	Enhanced Small Device Interface
FORTRAN	Formula Translation
FTP	File Transfer Protocol
FDD	Floppy Disk Drive
FDC	Floppy Disk Controller
FPS	Frames Per Second
FLOPS	Floating Point Operations Per Second
FAT	File Allocation Table
FAX	Far Away Xerox/ facsimile
GDI	Graphical Device Interface
GIF	Graphic Interchangeable Format
GIS	Geographic Information System
GML	Geography Mark-up Language
GPRS	General Packet Radio Service
GUI	Graphical User Interface
GSM	Global System for Mobile Communication
HTTP	Hyper Text Transfer Protocol
HTTPS	Hyper Text Transfer Protocol Secure
HTML	Hyper Text Mark-up Language
HVD	Holographic Versatile Disc
HD	Hard Disk
HDD	Hard Disk Drive
ISP	Internet Service Provider
IP	Internet Protocol
IOP	Input Output Processor
IBM	International Business Machines
IC	Integrated Circuit
ICT	Information Communication Technology
IMAP	Internet Message Access Protocol

ISO	International Standards Organisation
INTEL	Integrated Electronics
IVR	Interactive Voice Response
JPEG	Joint Photographic Expert Group
JSP	Java Server Page
LAN	Local Area Network
LCD	Liquid Crystal Display

LED	Light Emitting Diode
LPI	Lines Per Inch
LSI	Large Scale Integration
MAN	Metropolitan Area Network
MIPS	Million Instructions Per Second
MICR	Magnetic Ink Character Recognition
MPEG	Motion Picture Experts Group
MMS	Multimedia Message Service
NAT	Network Address Translation
NIC	Network Interface Card
NTP	Network Time Protocol
OMR	Optical Mark Reader
OSI	Open Systems Interconnection
OSS	Open Source Software
OOP	Object Oriented Programming
OCR	Optical Character Recognition
PAN	Personal Area Network
PDA	Personal Digital Assistant
PDF	Portable Document Format
PHP	Hypertext Pre-processor
PNG	Portable Network Graphics
PPM	Pages Per Minute
PROM	Programmable Read Only Memory
PCB	Printed Circuit Board
PIN	Personal Identification Number
POS	Point Of Sale
PPP	Point-to-Point Protocol
PSTN	Public Switched Telephone Network
POST	Power On Self Test
PING	Packet Internet Gopher
PSU	Power Supply Unit
RAM	Random Access Memory
ROM	Read Only Memory
RIP	Routing Information Protocol
RPM	Revolutions Per Minute
RDMS	Relational Data Base Management System
RARP	Reverse Address Resolution Protocol
SAN	Storage Area Network
SDRAM	Synchronous Dynamic Random Access Memory
SIM	Subscriber Identity Module
SIMM	Single In-line Memory Module
SIU	Serial Interface Unit

TCP	Transmission Control Protocol
TBPS	Tera Bytes Per Second
TIPS	Trillion Instruction Per Second
UNIAC	Universal Automatic Computer
UPS	Uninterruptible Power Supply
URL	Uniform Resource Locator
USB	Universal Serial Bus
ULSI	Ultra Large-Scale Integration
VAN	Value Added Network
VGA	Video Graphics Array
VDU	Visual Display Unit
VIRUS	Vital Information Resource Under Seized
VCD	Video Compact Disk
VGA	Video Graphics Array
VOIP	Voice Over Internet Protocol
VPN	Virtual Private Network
WAN	Wide Area Network
WAP	Wireless Application Protocol
WIFI	Wireless fidelity
WMV	Windows Media Video
WPM	Words Per Minute
WORM	Write Once Read Many
XML	Extensible Mark-up Language
XMF	Extensible Music File
XHTML	Extensible Hyper Text Mark-up Language
SMPS	Switch Mode Power Supply
SMS	Short Message Service
SMTP	Simple Mail Transfer Protocol
SNAP	Sub Network Access Protocol
SNMP	Simple Network Management Protocol
SQL	Structured Query Language
SRAM	Static Random Access Memory