COMPUTER APPLICATION

FOR DIPLOMA STUDENTS

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Introduction

Computer is an advanced electronic device that takes raw data as an input from the user and processes it under the control of a set of instructions (called program), produces a result (output), and saves it for future use.

Functionalities of a Computer

Digital computer carries out the following five functions:

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



Computer Generation

There are five generations in computer such as

First Generation

The period of first generation: 1946-1959. Vacuum tube based.

Second Generation

The period of second generation: 1959-1965. Transistor based.

Third Generation

The period of third generation: 1965-1971. Integrated Circuit based.

Fourth Generation

The period of fourth generation: 1971-1980. VLSI microprocessor based.

Fifth Generation

The period of fifth generation: 1980-onwards. ULSI microprocessor based.

First Generation (1946-1959) (Vacuum tube)

- The computers of first generation used vacuum tubes as the basic components for memory and circuitry for CPU (Central Processing Unit).
- In this generation, mainly batch processing operating system was used. Punch cards, paper tape, and magnetic tape were used as input and output devices.

Advantages:

- It made use of vacuum tubes which are the only electronic component available during those days.
- These computers could calculate in milliseconds.

Disadvantages:

- These were very big in size.
- These computers were very costly.
- It could store only a small amount of information due to the presence of magnetic drums.

- Very less work efficiency.
- Large amount of energy consumption.

Example: ENIAC (Electronic Numerical Integrator And Computer), EDVAC (Electronic Discrete Variable Automatic Computer), UNIVAC (Universal Automatic Computer) etc.

Second Generation (1959-1965) (Transistor)

- In this generation, transistors were used that were cheaper, consumed less power, more compact in size, more reliable and faster than the first generation machines made of vacuum tubes.
- In this generation, magnetic cores were used as the primary memory and magnetic tape and magnetic disks as secondary storage devices.
- In this generation, assembly language and high-level programming languages like FORTRAN, COBOL were used.

Advantages:

- Reducing the size of a computer as compared to first generation computers.
- Less energy and not produce as much heat as the first generation.
- Assembly language and punch cards were used for input.
- Low cost than first generation computers.
- Better speed, calculate data in microseconds.

Disadvantages:

- A cooling system was required.
- Constant maintenance was required.
- Only used for specific purposes.

Example: IBM 7094, UNIVAC (Universal Automatic Computer) 1108

Third Generation (1965-1971) (Integrated Circuit)

- The computers of third generation used Integrated Circuits (ICs) in place of transistors. A single IC has many transistors, resistors, and capacitors along with the associated circuitry.
- In this generation remote processing, time-sharing, multiprogramming operating system were used. High-level languages (FORTRAN-II TO IV, COBOL, PASCAL PL/1, BASIC, ALGOL-68 etc.) were used during this generation.

Advantages:

- These computers were cheaper as compared to second-generation computers.
- They were fast and reliable.
- Use of IC in the computer provides the small size of the computer.
- This generation of computers has big storage capacity.
- Instead of punch cards, mouse and keyboard are used for input.
- They used an operating system for better resource management and used the concept of time-sharing and multiple programming.
- These computers reduce the computational time from microseconds to nanoseconds.

Disadvantages:

- IC chips are difficult to maintain.
- The highly sophisticated technology required for the manufacturing of IC chips.
- Air conditioning is required.

Example: IBM 360, IBM 370

Fourth Generation (1971-1980) (VLSI microprocessor)

- Computers of fourth generation used Very Large Scale Integrated (VLSI) circuits. VLSI circuits having about 5000 transistors and other circuit elements with their associated circuits on a single chip made it possible to have microcomputers of fourth generation.
- In this generation, time sharing, real time networks, distributed operating system were used. All the high-level languages like C, C++, DBASE etc., were used in this generation.

Advantages:

- Fastest in computation and size get reduced as compared to the previous generation of computer.
- Heat generated is negligible.
- Small in size as compared to previous generation computers.
- Less maintenance is required.
- All types of high-level language can be used in this type of computers.

Disadvantages:

- The Microprocessor design and fabrication are very complex.
- Air conditioning is required in many cases due to the presence of ICs.
- Advance technology is required to make the ICs.

Example: IBM 4341, DEC 10

Fifth Generation (1980-onwards) (ULSI microprocessor)

- In the fifth generation, VLSI technology became ULSI (Ultra Large Scale Integration) technology, resulting in the production of microprocessor chips having ten million electronic components.
- This generation is based on parallel processing hardware and AI (Artificial Intelligence) software. AI is an emerging branch in computer science, which interprets the means and method of making computers think like human beings.

Advantages:

- It is more reliable and works faster.
- It is available in different sizes and unique features.
- It provides computers with more user-friendly interfaces with multimedia features.

Disadvantages:

- They need very low-level languages.
- They may make the human brains dull and doomed.

Examples: Desktop, Laptop, ultra book

Classification of Computers

The computer systems can be classified on the following basis:

Classification on the basis of size

1. Super computers:

- The super computers are the highest performing system. A supercomputer is a computer with a high level of performance compared to a general-purpose computer.
- The actual Performance of a supercomputer is measured in FLOPS instead of MIPS. All of the world's fastest 500 supercomputers run Linux-based operating systems.
- Supercomputers actually play an important role in the field of computation, and are used for intensive computation tasks in various fields, including quantum mechanics, weather forecasting, climate research, oil and gas exploration, molecular modeling, and physical simulations.
- Examples: PARAM, CRAY-1, CYBER 205.etc

FLOPS: floating point operations per second (FLOPS, flops or flop/s) is a measure of computer performance, useful in fields of scientific computations that require floating-point calculations.
MIPS: Stands for "Million Instructions Per Second." It is a method of measuring the raw speed of a computer's processor. The MIPS measurement has been used by computer manufacturers like IBM to measure the "cost of computing." The value of computers is determined in MIPS per dollar.

2. Mainframe computers :

- These are commonly used by big organizations for bulk data processing such as statics, census data processing, transaction processing and are widely used as the severs as these systems has a higher processing capability.
- It can support multiple processors. Example IBM S/390 mainframe support 50,000 users at the same time.
- **Examples:** IBM z Series, System z9 and System z10 servers.

3. Mini computers :

- Minicomputers are smaller, cheaper and slower than mainframe computer.
- Minicomputers are widely used in business, education, hospital, government organization etc.
- It can also be used as server in a networked environment and hundreds of PCs can be connected.
- **Example:** IBM AS/400, DEC (Digital equipment Corporation) etc.

4. Micro computers:

- Microcomputer is a small, inexpensive computer with a microprocessor as its CPU. It includes a microprocessor, memory, and minimal I/O circuitry mounted on a single printed circuit board.
- The first microcomputer was designed by IBM in 1981 and named IBM-PC.
- **Examples:** Desktop PCs, Laptop, PDA (Personal Digital Assistants)

Classification on the basis of data handling

1. Analog:

- Analog computers are used to process analog data. Analog data is of continuous nature and which is not discrete or separate. Such type of data includes temperature, pressure, speed weight, voltage, depth etc. These quantities are continuous and having an infinite variety of values.
- It measures continuous changes in some physical quantity e.g. The Speedometer of a car measures speed, the change of temperature

2. Digital :

- A computer that performs calculations and logical operations with quantities represented as digits, usually in the binary number system of "0" and "1", "Computer capable of solving problems by processing information expressed in discrete form.
- It can perform mathematical calculations, organize and analyze data, control industrial and other processes, and simulate dynamic systems such as global weather patterns.
- 3. Hybrid :
 - A hybrid is a combination of digital and analog computers. It combines the best features of both types of computers, i.e. It has the speed of analog computer and the memory and accuracy of digital computer. Hybrid computers are used mainly in specialized applications where both kinds of data need to be processed. Therefore, they help the user, to process both continuous and discrete data.
 - For example a petrol pump contains a processor that converts fuel flow measurements into quantity and price values.

Basic Organization of computer (Functional unit of a system with diagram/von Neumann architecture)

- A computer organization describes the functions and design of the various units of a computer system.
- Functional units of a computer system are parts of the CPU (Central Processing Unit) that performs the operations and calculations called for by the computer program.
- A computer consists of five main components namely, Input unit, Central Processing Unit, Memory unit Arithmetic & logical unit, Control unit and an Output unit.



Input unit

- Input units are used by the computer to read the data. The most commonly used input devices are keyboards, mouse, joysticks, trackballs, microphones, etc.
- Whenever a key is pressed, the corresponding letter or digit is automatically translated into its corresponding binary code and transmitted over a cable to either the memory or the processor.

Central processing unit

 Central processing unit commonly known as CPU can be referred as an electronic circuitry within a computer that carries out the instructions given by a computer program by performing the basic arithmetic, logical, control and input/output (I/O) operations specified by the instructions.

Memory unit

- The Memory unit can be referred to as the storage area in which programs are kept which are running, and that contains data needed by the running programs.
- The Memory unit can be categorized in two ways namely, primary memory and secondary memory.
- Primary storage is the fastest memory that operates at electronic speeds. Primary memory contains a large number of semiconductor storage cells, capable of storing a bit of information. The word length of a computer is between 16-64 bits.
- It is also known as the volatile form of memory, means when the computer is shut down, anything contained in RAM is lost.
- Cache memory is also a kind of memory which is used to fetch the data very soon. They are highly coupled with the processor.
- The most common examples of primary memory are RAM and ROM.
- Secondary memory is used when a large amount of data and programs have to be stored for a long-term basis.
- It is also known as the Non-volatile memory form of memory, means the data is stored permanently irrespective of shut down.
- The most common examples of secondary memory are magnetic disks, magnetic tapes, and optical disks.

Arithmetic & logical unit

 Most of all the arithmetic and logical operations of a computer are executed in the ALU (Arithmetic and Logical Unit) of the processor. It performs arithmetic operations like addition, subtraction, multiplication, division and also the logical operations like AND, OR, NOT operations.

Control unit

- The control unit is a component of a computer's central processing unit that coordinates the operation of the processor. It tells the computer's memory, arithmetic/logic unit and input and output devices how to respond to a program's instructions.
- The control unit is also known as the nerve center of a computer system.

Output Unit

- The primary function of the output unit is to send the processed results to the user. Output devices display information in a way that the user can understand.
- The most common example of an output device is a monitor.

Input and Output Devices

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

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

Keyboard

Keyboard is the most common and very popular input device which helps to input data to the computer. The layout of the keyboard is like that of traditional typewriter, although there are some additional keys provided for performing additional functions.



Keyboards are of two sizes 84 keys or 101/102 keys, but now keyboards with 104 keys or 108 keys are also available for Windows and Internet.

The keys on the keyboard are as follows -

SI. No.	Keys & Description
1	Typing Keys
	These keys include the letter keys (A-Z) and digit keys (09) which generally give the same layout as that of typewriters.
2	Numeric Keypad
	It is used to enter the numeric data or cursor movement. Generally, it consists of a set of 17 keys that are laid out in the same configuration used by most adding machines and calculators.
3	Function Keys
	The twelve function keys are present on the keyboards which are arranged in a row at the top of the keyboard. Each function key has a unique meaning and is used for some specific purpose.

4	Control keys		
	These keys provide cursor and screen control. It includes four directional arrow keys. Control keys also include Home, End, Insert, Delete, Page Up, Page Down, Control(Ctrl), Alternate(Alt), Escape(Esc).		
5	5 Special Purpose Keys		
	Keyboard also contains some special purpose keys such as Enter, Shift, Caps Lock, Num Lock, Space bar, Tab, and Print Screen.		

Mouse

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

Generally, it has two buttons called the left and the right button and a wheel is present between the buttons. A mouse can be

used to control the position of the cursor on the screen, but it cannot be used to enter text into the computer.

Joystick

Joystick is also a pointing device, which is used to move the cursor position on a monitor screen. It is a stick having a spherical ball at its both lower and upper ends. The lower spherical ball moves in a socket. The joystick can be moved in all four directions.

The function of the joystick is similar to that of a mouse. It is mainly used in Computer Aided Designing (CAD) and playing computer games.

Light Pen

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

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

Track Ball

Track ball is an input device that is mostly used in notebook or laptop computer, instead of a mouse. This is a ball which is half inserted and by moving fingers on the ball, the pointer can be moved.







Since the whole device is not moved, a track ball requires less space than a mouse. A track ball comes in various shapes like a ball, a button, or a square.

Scanner

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

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

Digitizer

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

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

Microphone

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

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

Magnetic Ink Card Reader (MICR)

MICR input device is generally used in banks as there are large number of cheques to be processed every day. The bank's code number and cheque number are printed on the cheques with a special type of ink that contains particles of magnetic material that are machine readable.

This reading process is called Magnetic Ink Character Recognition (MICR). The main advantages of MICR is that it is fast and less error prone.

Optical Character Reader (OCR)

OCR is an input device used to read a printed text.OCR scans the text optically, character by character, converts them into a machine readable code, and stores the text on the system memory.











Bar Code Readers

Bar Code Reader is a device used for reading bar coded data (data in the form of light and dark lines). Bar coded data is generally used in labelling goods, numbering the books, etc. It may be a handheld scanner or may be embedded in a stationary scanner.

Bar Code Reader scans a bar code image, converts it into an alphanumeric value, which is then fed to the computer that the bar code reader is connected to.

Optical Mark Reader (OMR)

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

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

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

- Monitors
- Graphic Plotter
- Printer

Monitors

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

There are two kinds of viewing screen used for monitors.

- Cathode-Ray Tube (CRT)
- Flat-Panel Display

Printers

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

There are two types of printers -

- Impact Printers
- Non-Impact Printers

Impact Printers

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

Characteristics of Impact Printers are the following -

- Very low consumable costs
- Very noisy





OMR-LT40S

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

These printers are of two types -

- Character printers
- Line printers

Character Printers

Character printers are the printers which print one character at a time.

These are further divided into two types:

- Dot Matrix Printer(DMP)
- Daisy Wheel

Dot Matrix Printer

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

Daisy Wheel

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

Line Printers

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

These are of two types -

- Drum Printer
- Chain Printer

Drum Printer

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







Chain Printer

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

Advantages

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

Disadvantages

Noisy

Non-impact Printers

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

These printers are of two types -

- Laser Printers
- Inkjet Printers

Characteristics of Non-impact Printers

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

Laser Printers

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

Advantages

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

Disadvantages

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

Inkjet Printers

Inkjet printers are non-impact character printers based on a relatively new technology. They print characters by spraying small drops of ink onto paper. Inkjet printers produce high quality output with presentable features.

They make less noise because no hammering is done and these have many styles of printing modes available. Color printing is also

possible. Some models of Inkjet printers can produce multiple copies of printing also.





Advantages

- High quality printing
- More reliable

Disadvantages

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

Classification of computer memory

A memory is just like a human brain. It is used to store data and instructions. Computer memory is the storage space in the computer, where data is to be processed and instructions required for processing are stored. The memory is divided into large number of small parts called cells. Each location or cell has a unique address, which varies from zero to memory size minus one. For example, if the computer has 64k words, then this memory unit has $64 \times 1024 = 65536$ memory locations. The address of these locations varies from 0 to 65535.

Memory is primarily of three types -

- Cache Memory
- Register Memory
- Primary Memory/Main Memory
- Secondary Memory

Cache Memory

Cache memory is a very high speed semiconductor memory which can speed up the CPU. It acts as a buffer between the CPU and the main memory. It is used to hold those parts of data and program which are most frequently used by the CPU. The parts of data and programs are transferred from the disk to cache memory by the operating system, from where the CPU can access them.

Advantages

The advantages of cache memory are as follows -

- Cache memory is faster than main memory.
- It consumes less access time as compared to main memory.
- It stores the program that can be executed within a short period of time.
- It stores data for temporary use.

Disadvantages

The disadvantages of cache memory are as follows -

- Cache memory has limited capacity.
- It is very expensive.

Register Memory

Register memory is the smallest and fastest memory in a computer. It is located in the CPU in the form of registers. A register temporarily holds frequently used data, instructions and memory address that can be quickly accessed by the CPU.

Primary Memory (Main Memory)

Primary memory holds only those data and instructions on which the computer is currently working. It has a limited capacity and data is lost when power is switched off. It is generally made up of semiconductor device. These memories are not as fast as registers. The data and instruction required to be processed resides in the main memory. It is divided into two subcategories RAM and ROM.

Characteristics of Main Memory

- These are semiconductor memories.
- It is known as the main memory.
- Usually volatile memory.
- Data is lost in case power is switched off.
- It is the working memory of the computer.
- Faster than secondary memories.
- A computer cannot run without the primary memory.

RAM

RAM (Random Access Memory) is the internal memory of the CPU for storing data, program, and program result. It is a read/write memory which stores data until the machine is working. As soon as the machine is switched off, data is erased.

Access time in RAM is independent of the address, that is, each storage location inside the memory is as easy to reach as other locations and takes the same amount of time. Data in the RAM can be accessed randomly but it is very expensive.

RAM is volatile, i.e. data stored in it is lost when we switch off the computer or if there is a power failure. Hence, a backup Uninterruptible Power System (UPS) is often used with computers. RAM is small, both in terms of its physical size and in the amount of data it can hold.

RAM is of two types -

- Static RAM (SRAM)
- Dynamic RAM (DRAM)

Static RAM (SRAM)

The word static indicates that the memory retains its contents as long as power is being supplied. However, data is lost when the power gets down due to volatile nature. SRAM chips use a matrix of 6-transistors and no capacitors. Transistors do not require power to prevent leakage, so SRAM need not be refreshed on a regular basis.

There is extra space in the matrix, hence SRAM uses more chips than DRAM for the same amount of storage space, making the manufacturing costs higher. SRAM is thus used as cache memory and has very fast access.

Characteristic of Static RAM

- Long life
- No need to refresh
- Faster
- Used as cache memory
- Large size
- Expensive
- High power consumption

Dynamic RAM (DRAM)

DRAM, unlike SRAM, must be continually refreshed in order to maintain the data. This is done by placing the memory on a refresh circuit that rewrites the data several hundred times per second. DRAM is used for most system memory as it is cheap and small. All DRAMs are made up of memory cells, which are composed of one capacitor and one transistor.

Characteristics of Dynamic RAM

- Short data lifetime
- Needs to be refreshed continuously
- Slower as compared to SRAM
- Used as RAM
- Smaller in size
- Less expensive
- Less power consumption

ROM

ROM stands for Read Only Memory. The memory from which we can only read but cannot write on it. This type of memory is non-volatile. The information is stored permanently in such memories during manufacture. A ROM stores such instructions that are required to start a computer. This operation is referred to as bootstrap. ROM chips are not only used in the computer but also in other electronic items like washing machine and microwave oven.

Let us now discuss the various types of ROMs and their characteristics.

PROM (Programmable Read Only Memory)

PROM is read-only memory that can be modified only once by a user. The user buys a blank PROM and enters the desired contents using a PROM program. Inside the PROM chip, there are small fuses which are burnt open during programming. It can be programmed only once and is not erasable.

EPROM (Erasable and Programmable Read Only Memory)

EPROM can be erased by exposing it to ultra-violet light for a duration of up to 40 minutes. Usually, an EPROM eraser achieves this function. During programming, an electrical charge is trapped in an insulated gate region. The charge is retained for more than 10 years because the charge has no leakage path.

EEPROM (Electrically Erasable and Programmable Read Only Memory)

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 ms (millisecond). In EEPROM, any location can be selectively erased and programmed. EEPROMs can be erased one byte at a time, rather than erasing the entire chip. Hence, the process of reprogramming is flexible but slow.

Advantages of ROM

The advantages of ROM are as follows -

- Non-volatile in nature
- Cannot be accidentally changed
- Cheaper than RAMs
- Easy to test
- More reliable than RAMs
- Static and do not require refreshing
- Contents are always known and can be verified

Secondary Memory

This type of memory is also known as external memory or non-volatile. It is slower than the main memory. These are used for storing data/information permanently. CPU directly does not access these memories, instead they are accessed via input-output routines. The contents of secondary memories are first transferred to the main memory, and then the CPU can access it. For example, disk, CD-ROM, DVD, etc.

Characteristics of Secondary Memory

- These are magnetic and optical memories.
- It is known as the backup memory.
- It is a non-volatile memory.
- Data is permanently stored even if power is switched off.
- It is used for storage of data in a computer.
- Computer may run without the secondary memory.
- Slower than primary memories.

Software

Software is a set of instructions, data or programs used to operate computers and execute specific tasks.

There are two categories of software -

- System Software
- Application Software
- Utility Software

System Software

Software required running the hardware parts of the computer and other application software are called **system software**. System software acts as **interface** between hardware and user applications. An interface is needed because hardware devices or machines and humans speak in different languages.

Machines understand only binary language i.e. 0 (absence of electric signal) and 1 (presence of electric signal) while humans speak in English and many other languages. Software is required to convert all human instructions into machine understandable instructions

Based on its function, system software is of four types -

- Operating System
- Language Processor
- Device Drivers

Operating System

System software that is responsible for functioning of all hardware parts and their interoperability to carry out tasks successfully is called **operating system (OS)**. OS is the first software to be loaded into computer memory when the computer is switched on and this is called **booting**. OS manages a computer's basic functions like storing data in memory, retrieving files from storage devices, scheduling tasks based on priority, etc.

Language Processor

An important function of system software is to convert all user instructions into machine understandable language. Languages are of three types –

- Machine-level language This language is nothing but a string of 0s and 1s that the machines can understand. It is completely machine dependent.
- Assembly-level language This language introduces a layer of abstraction by defining mnemonics. Mnemonics are English like words or symbols used to denote a long string of 0s and 1s. For example, the word "READ" can be defined to mean that computer has to retrieve data from the memory. The complete instruction will also tell the memory address. Assembly level language is machine dependent.

• **High level language** – This language uses English like statements and is completely independent of machines. Programs written using high level languages are easy to create, read and understand.

Program written in high level programming languages like Java, C++, etc. is called **source code**. Set of instructions in machine readable form is called **object code** or **machine code**. **System software** that converts source code to object code is called **language processor**. There are three types of language interpreters–

- Assembler Converts assembly level program into machine level program.
- Interpreter Converts high level programs into machine level program line by line.
- **Compiler** Converts high level programs into machine level programs at one go rather than line by line.

Device Drivers

System software that controls and monitors functioning of a specific device on computer is called **device driver**. Each device like printer, scanner, microphone, speaker, etc. that needs to be attached externally to the system has a specific driver associated with it. When you attach a new device, you need to install its driver so that the OS knows how it needs to be managed.

Application Software

Software that performs a single task and nothing else is called **application software**. Application software are very specialized in their function and approach to solving a problem. Here is some commonly used application software –

- Word processing
- Spreadsheet
- Presentation
- Database management
- Multimedia tools

Utility Software

Application software that assists system software in doing their work is called utility software. Thus utility software is actually a cross between system software and application software. Examples of utility software include –

- Antivirus software
- Disk management tools
- File management tools
- Compression tools
- Backup tools

Objectives of Operating System

- To make the computer system convenient to use in an efficient manner.
- To hide the details of the hardware resources from the users.
- To provide users a convenient interface to use the computer system.
- To act as an intermediary between the hardware and its users, making it easier for the users to access and use other resources.
- To manage the resources of a computer system.
- To keep track of who is using which resource, granting resource requests, and mediating conflicting requests from different programs and users.
- To provide efficient and fair sharing of resources among users and programs.

Functions of Operating system

- Memory Management Keeps track of the primary memory, i.e. what part of it is in use by whom, what part is not in use, etc. and allocates the memory when a process or program requests it.
- Processor Management Allocates the processor (CPU) to a process and deallocates the processor when it is no longer required.
- **Device Management** Keeps track of all the devices. This is also called I/O controller that decides which process gets the device, when, and for how much time.
- File Management Allocates and de-allocates the resources and decides who gets the resources.
- Security Prevents unauthorized access to programs and data by means of passwords and other similar techniques.
- Job Accounting Keeps track of time and resources used by various jobs and/or users.
- Control over System Performance Records delays between the request for a service and from the system.
- Interaction with the Operators Interaction may take place via the console of the computer in the form of instructions. The Operating System acknowledges the same, does the corresponding action, and informs the operation by a display screen.
- Error-detecting Aids Production of dumps, traces, error messages, and other debugging and error-detecting methods.
- Coordination between Other Software and Users Coordination and assignment of compilers, interpreters, assemblers, and other software to the various users of the computer systems.

Types of Operating System

Batch operating system

The users of a 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. To speed up processing, jobs with similar needs are batched together and run as a group. The programmers leave their programs with the operator and the operator then sorts the programs with similar requirements into batches.

The problems with Batch Systems are as follows -

- Lack of interaction between the user and the job.
- CPU is often idle, because the speed of the mechanical I/O devices is slower than the CPU.
- Difficult to provide the desired priority.

Time-sharing operating systems

Time-sharing is a technique which enables many people, located at various terminals, to use a particular computer system at the same time. Time-sharing or multitasking is a logical extension of multiprogramming. Processor's time which is shared among multiple users simultaneously is termed as time-sharing.

The main difference between Multiprogrammed Batch Systems and Time-Sharing Systems is that in case of multiprogrammed batch systems, the objective is to maximize processor use, whereas in Time-Sharing Systems, the objective is to minimize response time.

Multiple jobs are executed by the CPU by switching between them, but the switches occur so frequently. Thus, the user can receive an immediate response. For example, in a transaction processing, the processor executes each user program in a short burst or quantum of computation. That is, if 'n'users are present, then each user can get a time quantum. When the user submits the command, the response time is in few seconds at most.

The operating system uses CPU scheduling and multiprogramming to provide each user with a small portion of a time. Computer systems that were designed primarily as batch systems have been modified to time-sharing systems.

Advantages of Timesharing operating systems are as follows -

- Provides the advantage of quick response.
- Avoids duplication of software.
- Reduces CPU idle time.

Disadvantages of Time-sharing operating systems are as follows -

- Problem of reliability.
- Problem of data communication.

Network operating System

A Network Operating System runs on a server and provides the server the capability to manage data, users, groups, security, applications, and other networking functions. The primary purpose of the network operating system is to allow shared file and printer access among multiple computers in a network, typically a local area network (LAN), and a private network or to other networks.

Examples of network operating systems include Microsoft Windows Server 2003, Microsoft Windows Server 2008, UNIX, Linux, Mac OS X, Novell NetWare, and BSD.

The advantages of network operating systems are as follows -

- Centralized servers are highly stable.
- Security is server managed.
- Upgrades to new technologies and hardware can be easily integrated into the system.
- Remote access to servers is possible from different locations and types of systems.

The disadvantages of network operating systems are as follows -

- High cost of buying and running a server.
- Regular maintenance and updates are required.

Real Time operating System

A real-time system is defined as a data processing system in which the time interval required to process and respond to inputs is so small that it controls the environment. The time taken by the system to respond to an input and display of required updated information is termed as the **response time**. So in this method, the response time is very less as compared to online processing.

A real-time operating system must have well-defined, fixed time constraints, otherwise the system will fail. For example, Scientific experiments, medical imaging systems, industrial control systems, weapon systems, robots, air traffic control systems, etc.

There are two types of real-time operating systems.

Hard real-time systems

Hard real-time systems guarantee that critical tasks complete on time. In hard real-time systems, secondary storage is limited or missing and the data is stored in ROM. In these systems, virtual memory is almost never found.

Soft real-time systems

Soft real-time systems are less restrictive. A critical real-time task gets priority over other tasks and retains the priority until it completes. Soft real-time systems have limited utility than hard real-time systems. For example, multimedia, virtual realities, Advanced Scientific Projects like under sea exploration and planetary rovers, etc.

Multiprogramming

Multiprogramming is a form of parallel processing in which several programs are run at the same time on a uniprocessor. Since there is only one processor, there can be no true simultaneous execution of different programs. Instead, the operating system executes part of one program, then part of another, and so on. To the user it appears that all programs are executing at the same time.

Disk Operating System

MS-DOS is one of the oldest and widely used operating system. DOS is a set of computer programs, the major functions of which are file management, allocation of system resources, providing essential features to control hardware devices.

DOS commands can be typed in either upper case or lower case.

Features of DOS

Following are the significant features of DOS -

- It is a single user system.
- It controls program.
- It is machine independence.
- It manages (computer) files.
- It manages input and output system.
- It manages (computer) memory.
- It provides command processing facilities.
- It operates with Assembler.

Types of DOS Commands

Following are the major types of DOS Command -

• Internal Commands – Commands such as DEL, COPY, TYPE, etc. are the internal commands that remain stored in computer memory.

• External Commands – Commands like FORMAT, DISKCOPY, etc. are the external commands and remain stored on the disk.

UNIX Operating System

The Unix Operating System is the earliest operating system developed in 1970s. Let us consider the following points relating to the Unix Operating System –

- It is an operating system that has multitasking features.
- It has multiuser computer operating systems.
- It runs practically on every sort of hardware and provides stimulus to the open source movement.
- It has comparative complex functionality and hence an untrained user cannot use it; only the one who has taken training can use this system.
- Another drawback of this system is, it does not give notice or warn about the consequences of a user's action (whether user's action is right or wrong).

Programming language

A programming language is a vocabulary and set of grammatical rules for instructing a computer or computing device to perform specific tasks. The term *programming language* usually refers to high-level languages, such as BASIC, C, C++, COBOL, Java, FORTRAN, and Pascal.

Each programming language has a unique set of keywords (words that it understands) and a special syntax for organizing program instructions.

The programming language in terms of their performance reliability and robustness can be grouped into five different generations,

- 1. First generation languages (1GL)
- 2. Second generation languages (2GL)
- 3. Third generation languages (3GL)
- 4. Fourth generation languages (4GL)
- 5. Fifth generation languages (5GL)

1. First Generation Language (Machine language)

The first generation programming language is also called low-level programming language because they were used to program the computer system at the machine level. The machine language also referred to as the native language of the computer system is the first generation programming language. In the machine language, a programmer only deals with a binary number i. e. 0 & 1.

Advantages of first generation language

- They are translation free and can be directly executed by the computers.
- The programs written in these languages are executed very speedily and efficiently by the CPU of the computer system.

• The programs written in these languages utilize the memory in an efficient manner because it is possible to keep track of each bit of data.

2. Second Generation language (Assembly Language)

The second generation programming language also belongs to the category of low-levelprogramming language. The second generation language comprises assembly languages that use the concept of mnemonics for the writing program. In the assembly language, symbolic names are used to represent the opcode and the operand part of the instruction.

Advantages of second generation language

- It is easy to develop understand and modify the program developed in these languages are compared to those developed in the first generation programming language.
- The programs written in these languages are less prone to errors and therefore can be maintained with a great case.

3. Third Generation languages (High-Level Languages)

The third generation programming languages were designed to overcome the various limitations of the first and second generation programming languages. The languages of the third and later generation are considered as a high-level language because they enable the programmer to concentrate only on the logic of the programs without considering the internal architecture of the computer system.

Advantages of third generation programming language

- It is easy to develop, learn and understand the program.
- As the programs written in these languages are less prone to errors they are easy to maintain.
- The program written in these languages can be developed in very less time as compared to the first and second generation language.

Examples: FORTRAN, ALGOL, COBOL, C++, C

4. Fourth generation language (Very High-level Languages)

The languages of this generation were considered as very high-level programming languages required a lot of time and effort that affected the productivity of a programmer. The fourth generation programming languages were designed and developed to reduce the time, cost and effort needed to develop different types of software applications.

Advantages of fourth generation languages

- These programming languages allow the efficient use of data by implementing the various databases.
- They require less time, cost and effort to develop different types of software applications.
- The programs developed in these languages are highly portable as compared to the programs developed in the languages of other generation.

Examples: SOL, CSS, ColdFusion

5. Fifth generation language (Artificial Intelligence Language)

The programming languages of this generation mainly focus on constraint programming. The major fields in which the fifth generation programming language are employed are Artificial Intelligence and Artificial Neural Networks

Advantages of fifth generation languages

- These languages can be used to query the database in a fast and efficient manner.
- In this generation of language, the user can communicate with the computer system in a simple and an easy manner.

Examples: mercury, prolog, OPS5

Compiler and Interpreter

Compiler

A compiler is a computer program that transforms code written in a high-level programming language into the machine code. It is a program which translates the human-readable code to a language a computer processor understands (binary 1 and 0 bits). The computer processes the machine code to perform the corresponding tasks.

A compiler should comply with the syntax rule of that programming language in which it is written. However, the compiler is only a program and cannot fix errors found in that program. So, if you make a mistake, you need to make changes in the syntax of your program. Otherwise, it will not compile.



Compiler characteristics:

- Spends a lot of time analyzing and processing the program.
- The resulting executable is some of machine-specification binary code.
- The computer hardware interprets (executes) the resulting code.
- Program execution is fast.

Interpreter

An interpreter is a computer program, which coverts each high-level program statement into the machine code. This includes source code, pre-compiled code, and scripts. Both compiler and interpreters do the same job which is converting higher level programming language to machine code. However, a compiler will convert the code into machine code (create an exe) before program run. Interpreters convert code into machine code when the program is run.



Interpreter characteristics

- Relatively little time is spent for analyzing and processing the program.
- The resulting code is interpreted by another program.
- The resulting code is some sort of intermediate code.
- Program execution is relatively slow.

Interpreter	Compiler
Translates program one statement at a time.	Scans the entire program and translates it as a whole into machine code.
It takes less amount of time to analyze the source code but the overall execution time is slower.	It takes large amount of time to analyze the source code but the overall execution time is comparatively faster.
No intermediate object code is generated, hence are memory efficient.	Generates intermediate object code which further requires linking, hence requires more memory.
Continues translating the program until the first error is met, in which case it stops. Hence debugging is easy.	It generates the error message only after scanning the whole program. Hence debugging is comparatively hard.
Programming language like Python, Ruby uses interpreters.	Programming language like C, C++ uses compilers.

Computer Virus

Computer viruses are unwanted software programs or piece of codes that interfere with the functioning of computer. They spread through contaminated files, data and insecure networks. Once it enters your system it can replicate to produce copies of itself. These copies of virus enable it to spreads from one program to other program of computer and from one infected computer to other computer.

Types of Computer Virus

Overwrite Virus

Overwrite virus is the simplest computer virus. It overwrites the code of infected file with its own malicious code. The content of infected file is replaced partially or completely but the size of file does not change.

Macro Virus

Macro virus alters or infects the macros of a document or data file. It is embedded as macro in a document and adds its codes to the macros of the document. The virus spreads when infected documents or data files are opened in other computers.

Boot Virus

Boot virus or boot sector virus alters the boot sector program stored in hard disk or any other storage device. It replaces the boot sector program with its own malicious version. Usually it enters into your system through corrupt media files, infected storage devices and insecure computer networks.

Resident Virus

Resident virus stays permanently in the primary memory (RAM) of computer. When you start the computer it becomes active and corrupts the files and programs running on the computer.

Multipartite Virus

Multipartite virus spreads and infects in multiple ways. It infects both the files as well as the boot sector.

File Infector Virus

It is one of the commonly found computer viruses. It particularly infects the executable files; the files with .com or .exe extensions. The virus becomes active when the infected file is executed. The active virus overwrites the file partially or completely. Thus it may destroy the original file partially or completely.

Computer Worm

Computer worm is similar to virus but is technically different from virus. It can replicate and spread like virus but unlike viruses it don't need a host program to spread. Being able to self replicate it can produce multiple copies of itself. It spreads through networks such as an email sent to an infected email id can infect your system with computer worm.

Trojan horse

Trojan horse is a malware like a virus or worm but it is technically different from both. It can't replicate like virus and worm. Trojan horse hides itself in a program. Once you install any such program the Trojan horse enters into your computer. It can provide unauthorized access to your computer, send your files to other computers and may delete files or can make other unwanted changes in your computer.

Detection of Virus

Computer may be infected with virus if it gives the following symptoms:

- It takes a lot of time for booting.
- It is restarting automatically.
- It is displaying some unusual figures/sign on the screen.
- It is performing some operations automatically without instruction of the user.
- It gives some message such as "Insufficient memory", "Disk full" etc.
- It stops the execution of a particular program.
- It harms the application software.

Prevention of virus

We can prevent our computer from virus infection by the following steps:

- Don't' allow outside CD/Floppy or pen drive to the used without proper scanning.
- Always install and update suitable antivirus software from an authorized source.
- Protect the system by the firewall to the auto protection mode.
- Always protect your computer from unauthorized user by setting a password.
- Don't' open unknown emails received in your mailbox.
- Run Regularly Scheduled Scans with Your Anti-Virus Software

Application of Computers in different Domain

Computers Aid at Education:

Computers have its dominant use in the education field which can significantly enhance performance in learning. Even distance learning is made productive and effective through internet and video-based classes. Researchers have massive usage of these computers in their work from the starting to till the end of their scholarly work.

Computers in our Health and Medicine:

Most of the medical information can now be digitized from the prescription to reports. Computation in the field of medicine allows us to offer varied miraculous therapies to the patients. ECG's, radiotherapy wasn't possible without computers.

Aid of Computers at Financial Institutions:

We know well that computers are being used by the financial institutions like banks for different purposes. The foremost important thing is to store information about different account holders in a database to be available at any time. Keeping the records of the cash flow, giving the information regarding your account,

Computers are a part of our Transport System:

With internet on computers we can know the details of the buses or trains or the flight available to our desired destination. The timings and even the updates on the delay can also be known through these computers. We can book our tickets through online. Staff of the transport system will keep a track of the passengers, trains or flight details, departure and arrival timings by using computers.

Inevitable use of Computers in Business and Corporate Stages:

Every single information shared can be recorded by using computer. Official deals and the issues were made even through online. We use email system to exchange the information. It has wide uses in marketing, stock exchanges and bank. Even the departmental stores can't run effectively without computer.

Wonders of Computer in E-Commerce:

Electronic mail is the revolutionary service offered by the computes. Video Conferencing is also another major advantage. Electronic shopping through online shopping added favor to purchaser and merchants. Electronic banking is now at your hand where every bank has online support for transaction of monetary issues. You can easily transfer your money anywhere even from your home.

Computer at our Defense:

Computers are the main tools which help in developing missiles and other equipment in the deference system. Designing and the maintenance are possible only through computers. Computer builds the links between the soldiers and commanders through the satellite. Construction of weapons and controlling their function is not possible without the aid of computers. The list of the criminals and the records of the cops are maintained regularly in the system.

Chapter-3 (Computer Network and Internet)

A computer network is a collection of computers and devices interconnected to facilitate sharing of resources such as printer, memory, information and electronic documents etc.

Protocol

A protocol is a set of rules and guidelines for communicating data. Rules are defined for each step and process during communication between two or more computers.

Connecting media

In data communication, a transmission medium is a physical path between the transmitter and the receiver i.e it is the channel through which data is sent from one place to another. Transmission Media is broadly classified into the following types:



Guided Media:

It is also referred to as wired transmission media. There are 3 major types of Guided Media:

(i) Twisted Pair Cable

It consists of 2 separately insulated conductor wires wound about each other. Generally, several such pairs are bundled together in a protective sheath. They are the most widely used Transmission Media. Twisted Pair is of two types:

• Unshielded Twisted Pair (UTP):

This type of cable has the ability to block interference and does not depend on a physical shield for this purpose. It is used for telephonic applications.

Advantages:

- Least expensive
- Easy to install
- High speed capacity

Disadvantages:

- Susceptible to external interference
- Lower capacity and performance in comparison to STP
- Short distance transmission due to attenuation

• Shielded Twisted Pair (STP):

This type of cable consists of a special jacket to block external interference. It is used in fast-data-rate Ethernet and in voice and data channels of telephone lines.

Advantages:

- Better performance at a higher data rate in comparison to UTP
- Eliminates crosstalk
- Comparatively faster

Disadvantages:

- Comparatively difficult to install and manufacture
- More expensive

(ii) Coaxial Cable

It has an outer plastic covering containing 2 parallel conductors each having a separate insulated protection cover. Coaxial cable transmits information in two modes: Baseband mode (dedicated cable bandwidth) and Broadband mode(cable bandwidth is split into separate ranges). Cable TVs and analog television networks widely use Coaxial cables.

Advantages:

- High Bandwidth
- Easy to install and expand
- Inexpensive

Disadvantages:

• Single cable failure can disrupt the entire network

(iii) Optical Fiber Cable

It uses the concept of reflection of light through a core made up of glass or plastic. The core is surrounded by a less dense glass or plastic covering called the cladding. It is used for transmission of large volumes of data.

Advantages:

- Increased capacity and bandwidth
- Light weight

Disadvantages:

- Difficult to install and maintain
- High cost

2. Unguided Media:

It is also referred to as Wireless transmission media. No physical medium is required for the transmissions of electromagnetic signals. There are 3 major types of Unguided Media:

(i) Radio waves

These are easy to generate and can penetrate through buildings. The sending and receiving antennas need not be aligned. Frequency Range: 3 KHz – 1GHz. AM and FM radios and cordless phones use Radio waves for transmission.

Further Categorized as (I) Terrestrial and (ii) Satellite.

(ii) Microwaves

It is a line of sight transmission i.e. the sending and receiving antennas need to be properly aligned with each other. The distance covered by the signal is directly proportional to the height of the antenna. Frequency Range: 1GHz - 300GHz. These are majorly used for mobile phone communication and television distribution.

(iii) Infrared

Infrared waves are used for very short distance communication. They cannot penetrate through obstacles. This prevents interference between systems. Frequency Range: 300GHz – 400THz. It is used in TV remotes, wireless mouse, keyboard, printer, etc.

Data transmission mode

Transmission mode means transferring of data between two devices. It is also known as communication mode. There are three types of transmission mode:

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

Simplex Mode

In Simplex mode, the communication is unidirectional, as on a one-way street. Only one of the two devices on a link can transmit, the other can only receive. The simplex mode can use the entire capacity of the channel to send data in one direction.

Example: Keyboard and traditional monitors. The keyboard can only introduce input; the monitor can only give the output.



Half-Duplex Mode

In half-duplex mode, each station can both transmit and receive, but not at the same time. When one device is sending, the other can only receive, and vice versa. The half-duplex mode is used in cases where there is no need for communication in both directions at the same time. The entire capacity of the channel can be utilized for each direction.

Example: Walkie- talkie in which message is sent one at a time and messages are sent in both the directions.



Full-Duplex Mode

In full-duplex mode, both stations can transmit and receive simultaneously. Full-duplex mode is used when communication in both directions is required all the time. Example: Telephone Network in which there is communication between two persons by a telephone line, through which both can talk and listen at the same time.



Network Topology

The arrangement of a network which comprises of nodes and connecting lines via sender and receiver is referred as network topology. The various network topologies are:

Bus Topology:

Bus topology is a network type in which every computer and network device is connected to single cable. It transmits the data from one end to another in single direction. No bi-directional feature is in bus topology.

Star Topology:

In star topology, all the devices are connected to a single hub through a cable. This hub is the central node and all others nodes are connected to the central node. The hub can be passive in nature i.e. not intelligent hub such as broadcasting devices, at the same time the hub can be intelligent known as active hubs. Active hubs have repeaters in them.

Ring Topology

In ring topology, each host machine connects to exactly two other machines, creating a circular network structure. When one host tries to communicate or send message to a host which is not adjacent to it, the data travels through all intermediate hosts.

The following operations takes place in ring topology is:

- 1. One station is known as **monitor** station which takes all the responsibility to perform the operations.
- 2. To transmit the data, station has to hold the token. After the transmission is done, the token is to be released for other stations to use.
- 3. When no station is transmitting the data, then the token will circulate in the ring.
- 4. There are two types of token release techniques: **Early token release** releases the token just after the transmitting the data and **Delay token release** releases the token after the acknowledgement is received from the receiver.

Mesh Topology

In this type of topology, a host is connected to one or multiple hosts. This topology has hosts in pointto-point connection with every other host or may also have hosts which are in point-to-point connection to few hosts only.

Mesh technology comes into two types:





- **Full Mesh**: All hosts have a point-to-point connection to every other host in the network. Thus for every new host n(n-1)/2 connections are required. It provides the most reliable network structure among all network topologies.
- Partially Mesh: Not all hosts have point-to-point connection to every other host.

Hybrid Topology

A network structure whose design contains more than one topology is said to be hybrid topology.

This picture represents an arbitrarily hybrid topology. Hybrid topology is the combinations of Star, Ring, Bus topologies.

Internet is the best example of largest Hybrid topology.

Tree Topology

it is also known as Hierarchical Topology, this is the most common form of network topology.

This topology divides the network in to multiple levels/layers of network. Mainly network is distributed into three types of network devices. The lowermost is access-layer where computers are attached.

The middle layer is known as distribution layer, which works as mediator between upper layer and lower layer.

The highest layer is known as core layer, and is central point of the network, i.e. root of the tree from which all nodes fork.

Types of Network

A computer network is a group of computers linked to

each other that enables the computer to communicate

with another computer and share their resources,

data, and applications.

A computer network can be categorized by their size.

A computer network is mainly of four types:

- LAN(Local Area Network)
- PAN(Personal Area Network)
- MAN(Metropolitan Area Network)
- WAN(Wide Area Network)



LAN (Local Area Network)

- Local Area Network is a group of computers connected to each other in a small area such as building, office.
- LAN is used for connecting two or more personal computers through a communication medium such as twisted pair, coaxial cable, etc.
- It is less costly as it is built with inexpensive hardware such as hubs, network adapters, and Ethernet cables.
- The data is transferred at an extremely faster rate in Local Area Network.
- Local Area Network provides higher security.

Network Devices (Hub, Repeater, Bridge, Switch, Router, Gateways)

Repeater – A repeater operates at the physical layer. Its job is to regenerate the signal over the same network before the signal becomes too weak or corrupted so as to extend the length to which the signal can be transmitted over the same network. An important point to be noted about repeaters is that they do not amplify the signal. When the signal becomes weak, they copy the signal bit by bit and regenerate it at the original strength. It is a 2 port device.

Hub – A hub is basically a multiport repeater. A hub connects multiple wires coming from different branches, for example, the connector in star topology which connects different stations. Hubs cannot filter data, so data packets are sent to all connected devices. In other words, <u>collision domain</u> of all hosts connected through Hub remains one. Also, they do not have intelligence to find out best path for data packets which leads to inefficiencies and wastage.

Types of Hub

- Active Hub: These are the hubs which have their own power supply and can clean, boost and relay the signal along with the network. It serves both as a repeater as well as wiring centre. These are used to extend the maximum distance between nodes.
- **Passive Hub:** These are the hubs which collect wiring from nodes and power supply from active hub. These hubs relay signals onto the network without cleaning and boosting them and can't be used to extend the distance between nodes.

Bridge – A bridge operates at data link layer. A bridge is a repeater, with add on the functionality of filtering content by reading the MAC addresses of source and destination. It is also used for interconnecting two LANs working on the same protocol. It has a single input and single output port, thus making it a 2 port device.

Switch – A switch is a multiport bridge with a buffer and a design that can boost its efficiency (a large number of ports imply less traffic) and performance. A switch is a data link layer device. The switch can perform error checking before forwarding data that makes it very efficient as it does not forward packets that have errors and forward good packets selectively to correct port only. In other words, switch divides collision domain of hosts, but broadcast domain remains same.

Routers – A router is a device like a switch that routes data packets based on their IP addresses. Router is mainly a Network Layer device. Routers normally connect LANs and WANs together and have a dynamically updating routing table based on which they make decisions on routing the data packets. Router divide broadcast domains of hosts connected through it.





Gateway – A gateway, as the name suggests, is a passage to connect two networks together that may work upon different networking models. They basically work as the messenger agents that take data from one system, interpret it, and transfer it to another system. Gateways are also called protocol converters and can operate at any network layer. Gateways are generally more complex than switch or router.

Nic- network interface card (NIC) is a hardware component without which a computer cannot be connected over a network. It is a circuit board installed in a computer that provides a dedicated network connection to the computer. It is also called network interface controller, network adapter or LAN adapter.

Purpose

- NIC allows both wired and wireless communications.
- NIC allows communications between computers connected via local area network (LAN) as well as communications over large-scale network through Internet Protocol (IP).
- NIC is both a physical layer and a data link layer device, i.e. it provides the necessary hardware circuitry so that the physical layer processes and some data link layer processes can run on it.

Types of NIC Cards

NIC cards are of two types:



Internal Network Cards

In internal networks cards, motherboard has a slot for the network card where it can be inserted. It requires network cables to provide network access. Internal network cards are of two types. The first type uses Peripheral Component Interconnect (PCI) connection, while the second type uses Industry Standard Architecture (ISA).

External Network Cards

In desktops and laptops that do not have an internal NIC, external NICs are used. External network cards are of two types: Wireless and USB based. Wireless network card needs to be inserted into the motherboard; however no network cable is required to connect to the network. They are useful while traveling or accessing a wireless signal.

Internet services

E-Mail (Electronic Mail):

Electronic mail or e-mail is a means of transmission of messages electronically over communication networks. Companies that are fully computerized make extensive use of an e-mail because it is fast, flexible and reliable.

Anyone who has an e-mail account can send an e-mail to any other person who also has an e-mail account.

Usally the structure of the e-mail can be given as: "*username*@domain name". The user will be prompted to enter the following fields:

To : In this field, the e-mail address of the recipient should be typed.

Subject: In this field, anything illustrating the content of the message can be keyed in. The length of this field is limited.

Body: This field contains the content of the message.

CC & BCC: Filling up these fields is optional.similarly to the To field, these fields also contain email addresses of recipints. While CC refers to carbon copy, BCC on the other hand means blin carbon copy.

File Transfer Protocol (FTP):

File transfer protocol (FTP) is one of the oldest appliocation of the internet, which is basically used for transferring files from one computer to another, such as from a user's personal computer to a web server.

It is the preferred method of exchangeing files because it is faster and reliable. It is usually used to :

- Enable the users to share files, computer programs nad data.
- Enhance the use of remote computers.
- Provide authentication and security to the stored files and programs.
- Transfer data reliably and efficiently.





Chatting:

chatting is a very popular service of the internet that allows two or more online users to come together to talk using an instant messenger. Chatting helps users to stay connected with concerned people in business or family who live many miles way.

To chat with users on the internet, every usrer must have an account with a username and password to enter the website. Chatting involves the exchange of typed-in messages between a group of users who take part from anywhere on the internet.

Internet Conferencing:

The evolution of the internet has changed the way in which business house arrange conference among the concerned parties. Organizations are increasingly switching to the internet conferencing to reduce the extra cost involved in travelling and making telephone calls.

Internet conferencing is quite similar to traditional teleconferencing. The difference id that, during an internet conference call, the participants will sit at their respective offices while being connected to each other through the internet.

Electronics Newspaper:

An online newspaper, also known as a web newspaper or an electronic newspaper on the internet. Online newspaper are almost similar to the hardcopy newspaper and have the same legal boundries, such as laws regarding privecy and copyright issues.

World Wide Web (WWW):

The technical defination of the worl wide web (WWW) can be given as all the resources and users on the internet that are using the hypertext transfer protocol (HTTP). On the web, all the documents are formatted in a special markup language called *hypertext markup language* (HTML), which supports links to other documents, graphics, audio and video files.

WWW was created in 1989 by Tim Berners-Lee. The web, in easy terms, is the user part of the internet. Users make use of the web to communicate and access information for business and recreational purpose.

Online Shopping

Online shoping refers to buying goods and services from merchants who sell on the internet. The popularity of the web gave an excellent opportunity to merchants to sell their products to people who surf the internet. Shoppers can now visit web stores 24X7 as per their convenience, that too while sitting in their home, office or even while traveling.

Different Types of Internet Connectivity and ISP

There are many ways a personal electronic device can connect to the internet. They all use different hardware and each has a range of connection speeds. As technology changes, faster internet connections are needed to handle those changes. I thought it would be interesting to list some of the different types of internet connections that are available for home and personal use, paired with their average speeds.

Dial-Up (Analog 56K).

Dial-up access is cheap but slow. A modem (internal or external) connects to the Internet after the computer dials a phone number. This analog signal is converted to digital via the modem and sent over a land-line serviced by a public telephone network. Telephone lines are variable in quality and the connection can be poor at times. The lines regularly experience interference and this affects the speed, anywhere from 28K to 56K.

DSL

DSL stands for Digital Subscriber Line. It is an internet connection that is always "on". This uses 2 lines so your phone is not tied up when your computer is connected. There is also no need to dial a phone number to connect. DSL uses a router to transport data and the range of connection speed, depending on the service offered, is between 128K to 8 Mbps.

Cable

Cable provides an internet connection through a cable modem and operates over cable TV lines. There are different speeds depending on if you are uploading data transmissions or downloading. Since the coax cable provides a much greater bandwidth over dial-up or DSL telephone lines, you can get faster access. Cable speeds range from 512K to 20 Mbps.

Wireless

Wireless, or Wi-Fi, as the name suggests, does not use telephone lines or cables to connect to the internet. Instead, it uses radio frequency. Wireless is also an always on connection and it can be accessed from just about anywhere. Wireless networks are growing in coverage areas by the minute so when I mean access from just about anywhere, I really mean it. Speeds will vary, and the range is between 5 Mbps to 20 Mbps.

Satellite

Satellite accesses the internet via a satellite in Earth's orbit. The enormous distance that a signal travels from earth to satellite and back again, provides a delayed connection compared to cable and DSL. Satellite connection speeds are around 512K to 2.0 Mbps.

Cellular

Cellular technology provides wireless Internet access through cell phones. The speeds vary depending on the provider, but the most common are 3G and 4G speeds. A 3G is a term that describes a 3rd generation cellular network obtaining mobile speeds of around 2.0 Mbps. 4G is the fourth generation of cellular wireless standards. The goal of 4G is to achieve peak mobile speeds of 100 Mbps but the reality is about 21 Mbps currently.

ISP

An ISP (Internet service provider) is a company that provides individuals and other companies' access to the internet and other related services such as web site building and virtual. An ISP has the equipment and the telecommunication line access required to have a point-of - presence on the internet for the geographical area served. The large ISPs have their own high-speed leased lines to their customers.

Concept of File & Folder

A **file** is the common storage unit in a computer, and all programs and data are "written" into a file and "read" from a file.

A folder holds one or more files, and a folder can be empty until it is filled. A folder can also contain other folders, and there can be many levels of folders within folders. Folders within a folder are technically known as "subfolders," but this distinction is often disregarded.

Folders provide a method for organizing files much like a manila file folder contains paper documents in a file cabinet. In fact, files that contain text are often called documents.

File Extensions

Files are identified by a short "extension" following a period at the end of their name. For example, ABC.JPG is a JPEG image, ABC.DOC is a Microsoft Word document file, and ABC.EXE is an executable application in Windows. Although extensions can be added to folder names, extensions are primarily a file convention.

COMPARISON FILE FOLDER Files can have extensions. Extensions A folder does not have any extensions. Organizations Single directory per user and Serial, sequential, indexed sequential and direct file multiple directory per user organizations. organization. Collection of data. A place to store a group of Basic related files and folders. There is a specific size of a file. Space Folder does not consume space consumption in the memory. Properties It has Name, Extension, Date, It has Name, Date, Time and Protection attributes. Time, Length and Protection attributes.

Difference between File and Folder:

File Access Methods

When a file is used, information is read and accessed into computer memory and there are several ways to access this information of the file. Some systems provide only one access method for files. Other systems, such as those of IBM, support many access methods, and choosing the right one for a particular application is a major design problem.

There are three ways to access a file into a computer system: Sequential-Access, Direct Access, Index sequential Method.

1. Sequential Access :

It is the simplest access method. Information in the file is processed in order, one record after the other. This mode of access is by far the most common; for example, editor and compiler usually access the file in this fashion.

Read and write make up the bulk of the operation on a file. A read operation *-read next*read the next position of the file and automatically advances a file pointer, which keeps track I/O location. Similarly, for the write next append to the end of the file and advance to the newly written material.

Key points:

- Data is accessed one record right after another record in an order.
- When we use read command, it move ahead pointer by one
- When we use write command, it will allocate memory and move the pointer to the end of the file
- Such a method is reasonable for tape.

2. Direct Access

Another method is *direct access method* also known as *relative access method*. A filedlength logical record that allows the program to read and write record rapidly. The direct access is based on the disk model of a file since disk allows random access to any file block. For direct access, the file is viewed as a numbered sequence of block or record. Thus, we may read block 14 then blocks 59 and then we can write block 17. There is no restriction on the order of reading and writing for a direct access file.

A block number provided by the user to the operating system is normally a *relative block number*, the first relative block of the file is 0 and then 1 and so on.

3. Index sequential method

It is the other method of accessing a file which is built on the top of the direct access method. These methods construct an index for the file. The index, like an index in the back of a book, contains the pointer to the various blocks. To find a record in the file, we first search the index and then by the help of pointer we access the file directly.

Key points:

- It is built on top of Sequential access.
- It controls the pointer by using index.

Data Capture

Data capture is the process of identification and extraction of data from a scanned document, often to be sent to a workflow for routing and action as part of a business process. Multiple methods are available for capturing data from unstructured documents.

Methods of capture from document in electronic format are given below:

Single-click

Single-click is an Optical Character Recognition (OCR) tool that can be used to capture machine produced characters in low volume ad-hoc capture applications and populating a line of business application.

OCR (Optical Character Recognition)

OCR as a technology provides the ability to successfully capture machine produced characters in preset zones or, full page. OCR systems can recognize many different OCR fonts, as well as typewriter and computer-printed characters. Dependent upon the capabilities of the particular OCR product, this can be used to capture low to high volumes of data, where the information is in consistent location(s) on the documents.

ICR (Intelligent Character Recognition)

ICR is the computer translation of hand printed and written characters. Data is entered from hand-printed forms through a scanner, and the image of the captured data is then analyzed and translated by sophisticated ICR software. ICR is similar to optical character recognition (OCR) but is a more difficult process since OCR is from printed text, as opposed to handwritten characters.

Bar code recognition

Dependent upon the type of barcode that is used, the amount of metadata that can be included is high, as is the level of recognition. The application of single or multiple bar codes to particular document types such as Proof of Delivery notes, membership forms, application forms, gift aid etc, can dramatically increase the effectiveness of a business process.

Intelligent Document Recognition (IDR)

The level of capability is dependent upon the individual product. These applications are used to capture metadata from documents that is rules based. For example, the product will identify post codes, logos, key words, VAT registration numbers and, through an ongoing learning process, capture information from multiple document types.

Data storage

Data storage is the holding of data in an electronic form for access by a computer processor. There are two kinds of storage:

- Primary storage is data that is held in random access memory (RAM) and other memory devices that are built into computers.
- Secondary storage is data that is stored on external storage devices such as hard disks, tapes, CD's.

Following are some main devices that are used to store the data:

Hard Disk: A hard disk drive is the device used to store large amounts of digital information in computers and related equipment like iPods and games console such as Xbox 360, and PS3 etc and provides relatively quick access to large amounts of data.

The information is stored on electromagnetically charged surfaces called 'platters'. Hard disk drives are used to store operating system, software and working data.

Floppy Disk: A floppy disk is a type of magnetic disk memory which consists of a flexible disk with a magnetic coating having memory 1.44 MB. Floppy disks are portable and are very popular for transferring software from one PC to another.

Optical Disk: An optical disk storage medium that can be write and read using a lowpowered laser beam. A laser reads the dots and dots are converted to an electrical signal, finally converted into the original data.

USB Flash Drive: These are typically removable and rewritable. Storage capacities typically range from 64MB to 128 GB.

Memory Card: It is a solid state electronics flash memory data storage device used with digital camera, handheld and mobile computers, telephones, music players, video game etc.

Data Processing and Retrieval

Data Processing:

Data must be processed in order to convert it into information. so different operation may be performed on data. Therefore data processing is defined as "a sequence of operation on data to convert it into useful information".

The data processing can be accomplished through following methods:

- Manual Data Processing
- Mechanical Data Processing
- Electronic Data Processing

Manual Data Processing:

In this method, data is processed manually without using any machine or tool to get required results. In this process, all the calculations and logical operations are performed manually on the data. This method of data processing is very slow and errors may occur in the output. This type of processing mostly used in small business firm, government office, educational institutions etc.

Mechanical Data Processing

In this method, data is processed by using different devices like typewriters, mechanical printers or other mechanical devices. This method of data processing is faster and more accurate than manual data processing.

Electronic Data Processing

It is the modern technique to process data. The data is processed by computer. Data and instruction are given to the computer as input and the computer automatically processes the data according to the given set of instructions. The computer is also known as electronic data processing machine. This method of processing data is very fast and accurate.

Data retrieval

It is the process of recovery or restoring data that has been lost, accidentally deleted, corrupted or any reason.

Following are some different methods of Data Recovery

• Physical damage to storage devices:

Different failures can cause physical damage to your storage media. This could range from breaking of tapes to the metallic subtract or dye layer of CD-ROM being scratched or hard disk suffering mechanical failures like motors and head crushed among other damage. When physical damage occurs, some form of data loss may not be possible for end users to repair physical damage, data recovery techniques may involve replacing parts in the hard disk or recovering every readable bit form the surface through a specialized disk imaging procedure.

• Media errors and corrupt partitions file system:

In some cases, media errors or damage to the file system or partition table can make the data on a hard drive to be unreadable. Some data recovery software like Test Disk can be used to repair the damaged file system or partition table.

• Online Data Recovery

It is a method of data recovery that is performed over the internet. When using this method your data is regularly backup online so that if any data is lost, then you are able to recover from the last backup files.

Algorithm

"An algorithm can be defined as a step by step method for writing the various steps of the solution to a problem".

Characteristics:

- Algorithm should be defined.
- Algorithm should have finite number of steps.
- Algorithm should mention the input required for the program clearly.
- Algorithm should give an idea of output that will be obtained.

Examples:

Write an algorithm to find out sum of two no.

Step-1: read a, b

Step-2: set c=0

Step-3: c=a+b

Step-4: print c

Step-5: exit

Decision in algorithm

Decision statements are used when the execution of a process depends on the outcomes of some condition.

A decision statement can also be stated in the following manner:

If condition

Then process1

Else process2

Example:

Write an algorithm to check the equality of two numbers.

- Step-1: read a, b
- Step-2: if a=b

then print "Equal"

else

print "Not Equal"

Step-3: Exit

Repetition in algorithm

Repetition, which involves executing one or more steps for a number of times, can be implemented using construct such as 'While', 'Do-While' and 'For' loops.

These loops execute one or more steps until some condition is true.

Example:

Write an algorithm to print the first 10 natural numbers.

Step-1: set i=1, n=10

Step-2: Repeat steps 3 and 4 while i<=10

Step-3: print i

Step-4: set i=i+1

Step-5: Exit

Flowchart

A flowchart is a graphical or symbolic representation of a process. It is basically used to design and document to visualize the logic of the process.

Symbols of flowchart

Symbol	Name	Function
	Start/end	An oval represents a start or end point
	Arrows	A line is a connector that shows relationships between the representative shapes
	Input/Output	A parallelogram represents input or output
	Process	A rectangle represents a process
\bigcirc	Decision	A diamond indicates a decision

Example: Draw a flowchart to add two numbers.



Pseudo code

Pseudo code is a form of structured English that describes algorithm. It facilitates designers to focus on the logic of the algorithm without getting bogged down by the details of language syntax.

Pseudo codes are an outline of a program that can easily be converted into programming statement.

Examples:

• If student's grade is greater than or equal to 60

```
Print "passed"
else
Print "failed"
```