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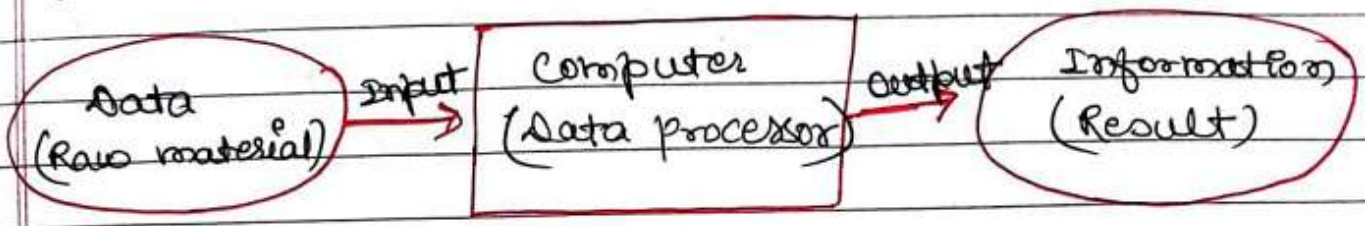
Computers → A computer is an electronic machine that takes input from users, processes the given input and generates output in the form of useful information.



A computer (also known as data processor) converts data into information.

Characteristics / Advantages of Computers

Following are the characteristics or advantages of any computer :-

(i) **Speed** → A computer is very fast device. It can do any tasks in fractions of a second. The speed of the computer is based on its hardware configuration.

(ii) **Accuracy** → Computers are very accurate. The calculations are 100% error free.

(iii) **Storage capability** → Memory is a very important characteristics of computers. A computer can store large amount of data. It can store any type of data such as images, videos, text, audio etc.

(iv) **Automatic** → An automatic machine work by itself without human interventions. Comput

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are automatic machines which finished works automatically.

(v) **Diligence** → Unlike human beings, a computer is free from monotony, tiredness and lack of concentration. It can work continuously without any error and boredom.

(vi) **Versatility** → A computer is a very versatile machine. A computer is very flexible in performing the jobs to be done. This machine can be used to solve the problems related to various fields.

(vii) **Reliability** → A computer is a reliable machine. Modern electronic components have long lives.

Disadvantages of Computers →

(i) **NO I.Q** → A computer is a machine that has no intelligence to perform any task. Each instructions has to be given to the computer.

(ii) **Dependency** → It functions as per the user's instruction, thus it is fully dependent on humans.

(iii) **Environment** → The operating environment

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of the computer should be dust free and suitable.

(iv) No Feeling → computers have no feelings or emotions. It cannot make judgement based on feeling, taste, experience and knowledge unlike human.

Data → raw details that require processing for generating useful information.

Program → set of instructions that can be executed by computer in sequential or non-sequential order.

Information → processed data on which decisions and actions are based.

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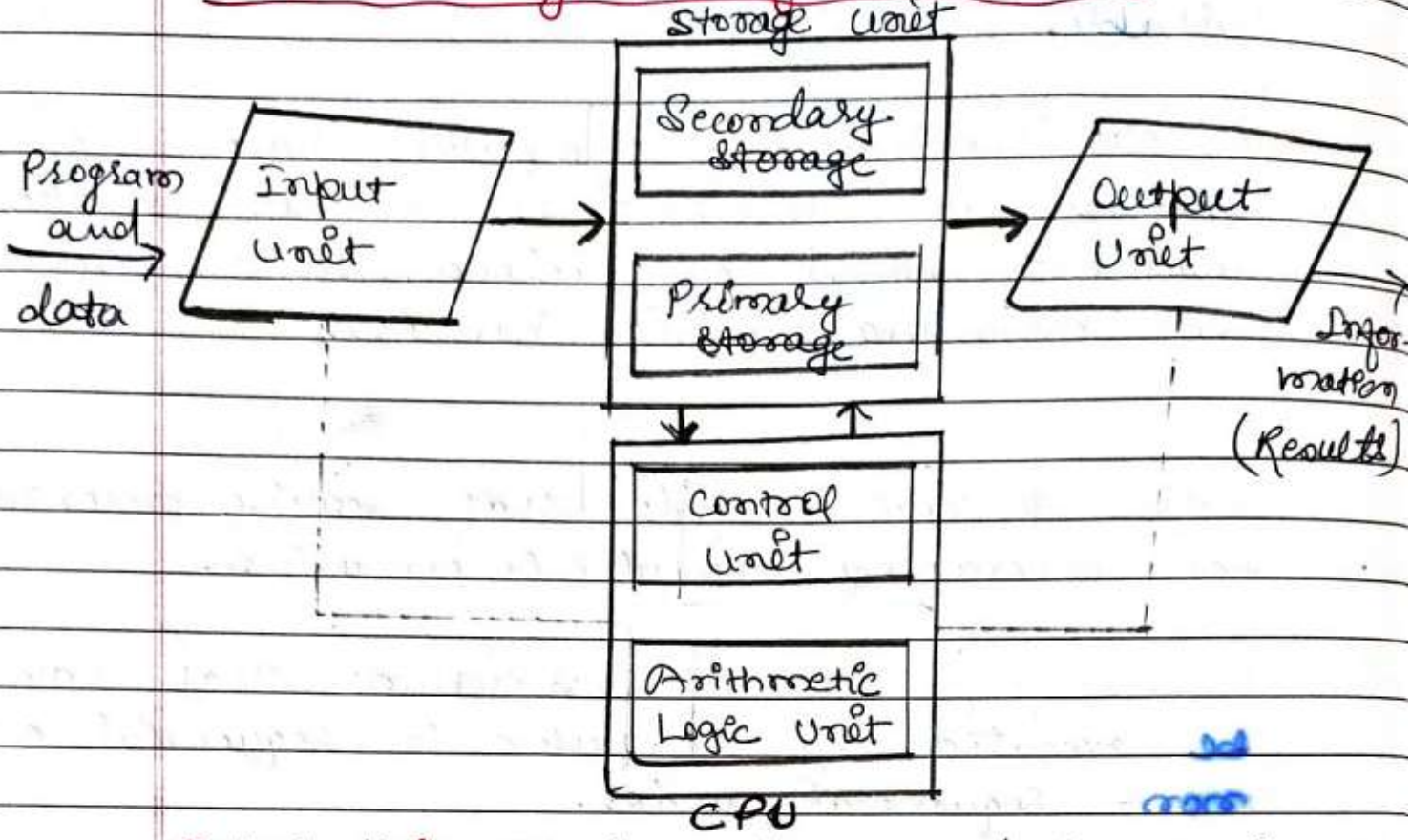
Block - Diagram of Computer



Input Unit → Computers need to receive data and instructions in order to solve any problem. Therefore, we need to input the data and instructions into the computers. The input unit consists of one or more devices. Keyboard is one of the most commonly used input device. All the input devices perform the following functions.

(a) Accept the data and instructions from the outside world.
(b) convert it to a form that the computer can understand.
(c) supply the converted data to the computer system for further processing.

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Output Unit → The output unit of a computer provides the information and results of a computation. Printer, Visual display unit (VDU) are the commonly used output devices.

Central Processing Unit (CPU)

The main unit inside the computer is the CPU. This unit is responsible for all events inside the computer. It controls all internal and external devices, performs arithmetic and logic operations.

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

(a) CPU is considered as the brain of the computer.

(b) CPU Performs all types of data processing operations.

CPU itself has following three components.

→ Memory or storage Unit
→ Control Unit
→ ALU (Arithmetic Logic Unit)

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

Functions of the memory unit are

→ It stores all the data and the instructions required for processing.

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→ It stores immediate results of processing.
→ It stores the final results of processing before these results are released to an output device.
→ All inputs and outputs are transmitted through the main memory.

Control Unit → This unit controls the operations of all parts of the computer but does not carry out any actual data processing operations.
Functions of this unit are —
(a) It is responsible for controlling the transfer of data and instructions among other units of computer.
(b) It manages and co-ordinates all the units of the computer.
(c) It obtains the instructions from the memory, interprets them, and directs the operation of the computer.
(d) It doesn't process or store data.

ALU (Arithmetic Logic Unit) The ALU performs all arithmetic operations and logic operations. Logic operations test various conditions encountered during processing and allow for different actions to be taken based on the results. The data required to perform the arithmetic and logical functions are inputs from the designated CPU registers and operands.

The ALU relies on basic items to perform its operations. This include number systems, data routing circuits, timing, instructions, operands and

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Types of Computers

Computers can be generally classified by size and power as follows -

(a) Supercomputers
(b) Mainframe Computers
(c) Mini Computers
(d) Micro Computers

(a) **Supercomputers** → The most powerful computers in terms of performance and data processing are the supercomputers. A super computer contains a number of processing unit which operate in parallel to make it faster. Supercomputers are very expensive and are employed for specialized applications that require immense amounts of mathematical calculations.

Ex→ Weather forecasting requires a super computer. Other uses of supercomputers are scientific simulation, Graphics, Quantum physics, Mechanics molecular theory.

The ability of parallel processing and their well-designed memory hierarchy give the supercomputers, large transaction processing power.

Seymour cray designed the first supercomputer "CDC 6600" in 1964.

Popular supercomputers

(a) IBM's Mira in United States
(b) NUDT Tianhe-1A in China
(c)

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(b) Mainframe Computers → These computers are having the large computing facilities and simultaneously they can perform many operations also they can control the operations of several personal computers by connecting them into network configuration. Now a days Mainframe is a very large and expensive computer capable of supporting hundreds or even thousands of users simultaneously. Large organisations use mainframes for highly critical applications such as bulk data processing and Enterprise Resource Planning (ERP). Most of the Mainframe computers have the capacities to host multiple operating systems and operate as a number of Virtual machines and can thus substitute for several small servers.

Mainframe computers can also process data at very high speed i.e hundreds of million instructions per second and they are also quite expensive. Normally they are used for Banking, airlines and railways etc. for their applications. Mainframe computers are very large and powerful computer systems that are usually at the heart of a business. The mainframe computer will have a very powerful processor, large amounts of main memory and a huge backing storage capacity. They are accessed through one or more terminals. Terminal consists of a screen, keyboard, mouse but no processor as all the processing is done by the mainframe.

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The main difference between a Supercomputer and a Mainframe is that a Supercomputer channels all its power into executing a few programs as fast as possible, whereas a Mainframe uses its power to execute many programs concurrently.

In some ways, Mainframes are more powerful than Supercomputers because they support more simultaneous programs. But Supercomputer can execute a single program faster than a mainframe.

Popular Mainframes Computers

(a) Fujitsu's ICL VME
(b) Hitachi's Z800

(c) **Mini Computer** → Mini computers are used by small business and firms. Mini-computers are also called as "Midrange computers". These are small machines. These computers are not designed for a single user. Individual departments of a large company or organizations uses Mini-computers for specific purposes.

Example → A production department can use Mini-computers for monitoring certain production process.

The PDP-8 Minicomputer of the digital Equipment

Corporation was the first successful minicomput

Popular Mini computers

→ K-202
→ SDS-92
→ IBM Midrange computers.

(d) Micro Computers → A computer with a microprocessor and its central processi unit is known as a microcomputer. They do not occupy space as much as mainframe. When suplemented with a keyboard and a mouse, microcomputers can be called as person Computers.

Desktop computers, laptops, personal digital assistant (PDA), tablets and Smart phones are all types of microcomputers. The computers are cheapest among the other three types of computers. The micro-Compu are specially designed for general usage lik entertainment, education and work purpose Well known manufacturers of micro-Computer are Dell, Apple, Samsung, Sony & Toshiba.

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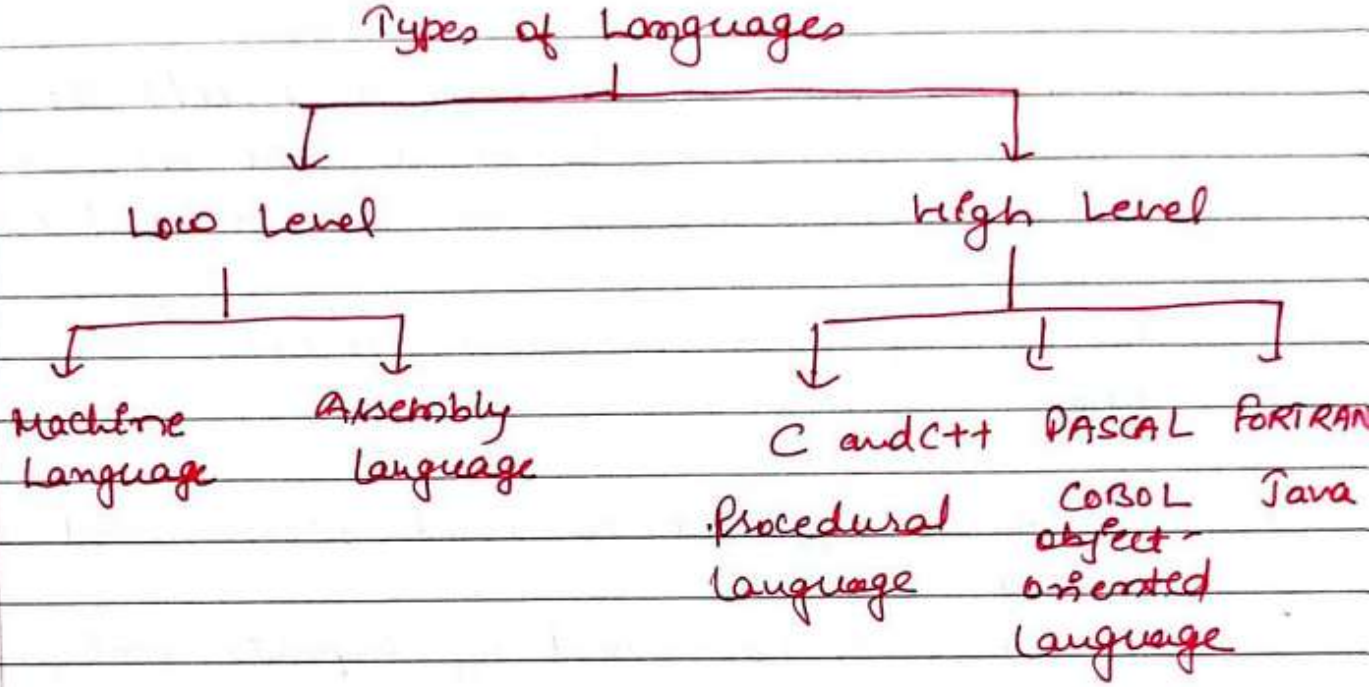
Programming Languages → A programming language is a formal language, which comprises a set of instructions that produce various kinds of output. Programming languages are used in computer programming to implement algorithms.



Low Level Language → This language is the most understandable language used by computers to perform its operations.

(1) **Machine Language** → Computer only recognize (0 and 1) binary numbers. It is the only one language, the processor directly understands. Machine language is low level language and it executes very fast. Other languages converts code into machine language then executes. After that it gives output.

Merits → (a) It is directly understood by the process

so has faster execution [speed and efficient use of primary memory.] time since the programs written in this language need not be translated.

(b) It doesn't need larger memory.

Demerits → (a) It is very difficult to program using M.L since all the instructions are to be represented by 0's and 1's.

(b) Use of this language makes programming time consuming.

(c) It is difficult to find error and to debug.

(d) It can be used by experts only.

(ii) Assembly Language → Assembly language is also low level language. Assembly language is converted into executable machine code by an assembler.
This language uses mnemonics code like ADD for addition in place of 0's and 1's. The resulting program is referred to as an object code.

Merits → (a) It makes programming easier than Machine Language (M.L) since it

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uses mnemonics code for programming.
Ex- SUB for subtraction (111)
ADD for addition etc.

(b) It makes programming process fastes.

(c) Error can be identified much easily compared to M.L (1 & 0)

(d) It is easier to debug than machine language.

Demerits → (a) Programs written in this language is not directly understandably by computers so translatess should be used.

(b) It is hardware dependent language so ~~programs written in this language are very less or not portable~~ programmers are forced to think in terms of computer's architecture rather than to the problem being solved.

(c) Being machine dependent language, programs written in this language are very less or not portable.

(d) Programmers must know the mnemonics codes to perform any task.

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② **High Level Language** → High level language are hardware independent. Main advantages with high level language are easier to read, write and maintain. Its easy to correct if there is any error. Code can be reuse. In high level language codes are first of all converts into machine language and then execute. So, it takes time to execute and takes memory to locate.

High level language can be further categorized as :

(a) Procedural - oriented language
(b) object oriented language
(d) Natural language.
(c) Non - Procedural language (4GL)

(a) **Procedural language** → Procedural language are also known as third generation languages (3GL's). In a procedural language, a program is designed using procedures.

A procedure is a sequence of instructions having a unique name. The instructions of the procedure are executed with the reference of its name.

In procedural programming Language the program instructions are written in a sequence or in a specific order in which they must be executed to solve a specific problem. It means that the order of program instruction is very important.

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Some popular procedural languages are :

(a) FORTRAN → formula translation
(b) COBOL
(c) PASCAL
(d) ADA
(e) C Language

(3GL)

(b) Object-oriented Language → In object oriented programming, the software is developed by using a set of interfacing objects. An object is a component of program that has a set of modules and data structures. The modules are also called methods and are used to access the data from the object. It is a very easy approach, in which program designed by using objects. Once an object for any program designed, it can be re-used in any other program.

Now a days, most popular and commonly used object-oriented programming languages are

(i) C++
(ii) Java
(iii) C #

4GL

(c) Non Procedural Language → Non-Procedural languages are also known as 4th generation language. In non-Procedural languages, the order of program instructions is not important. The importance is given only to, what is to

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(c) be done.

With a non-procedural language, the user/programmers writes English like instructions to retrieve data from databases. These languages are easier to use than procedural languages. These languages provide the user-friendly program development tools to write instructions. The programmers have not to spend much time for coding the program.

Ex→ SQL → It stands for structured query language. It is very popular databases access language and is specially used to access and to manipulate the data of databases. The word query represents that this language is used to make queries to perform various operations on data of databases.

Advantages or Merits of High level language

There are several advantages of high level programming languages. The most important advantages are :

(i) Easy to learn → The high level languages are very easy to learn than low level languages. The statements written for the program are similar to English like statements.

(ii) Easy to understand → The program written in high level language by one

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programmer can easily be understood by another because the program instructions are similar to the English language.

(iii) Easy to write program → In a high level language, a new program can easily be written in a very short time. The larger and complicated software can be developed in few days or months.

(iv) Easy to detect and remove errors → The errors in a program can be easily detected and removed. Mostly the errors are occured during the compilation of new program.

(v) Built-in library functions → Each high level language provides a large number of built-in functions or procedures that can be used to perform specific task during designing of new programs. In this way, a large amount of time of programmer is saved.

(vi) Machine Independence → Program written in high level language is machine independent. It means that a program written on one type of computer can be executed on another type of computer.

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Limitations of High level language

There are two main limitation of high level language are :

(i) **Less Efficiency** → A program written in high level languages has lower efficiency that one written for a machine / assembly language to do the same job. That is, program written for high level language results in multiple machine language instruction that may not be optimize, taking more time to execute and requiring more memory space.

(ii) **Less flexibility** → High level languages are less flexible than assembly languages because they do not normally have instructions or mechanism to control a computer's CPU, memory and registers.

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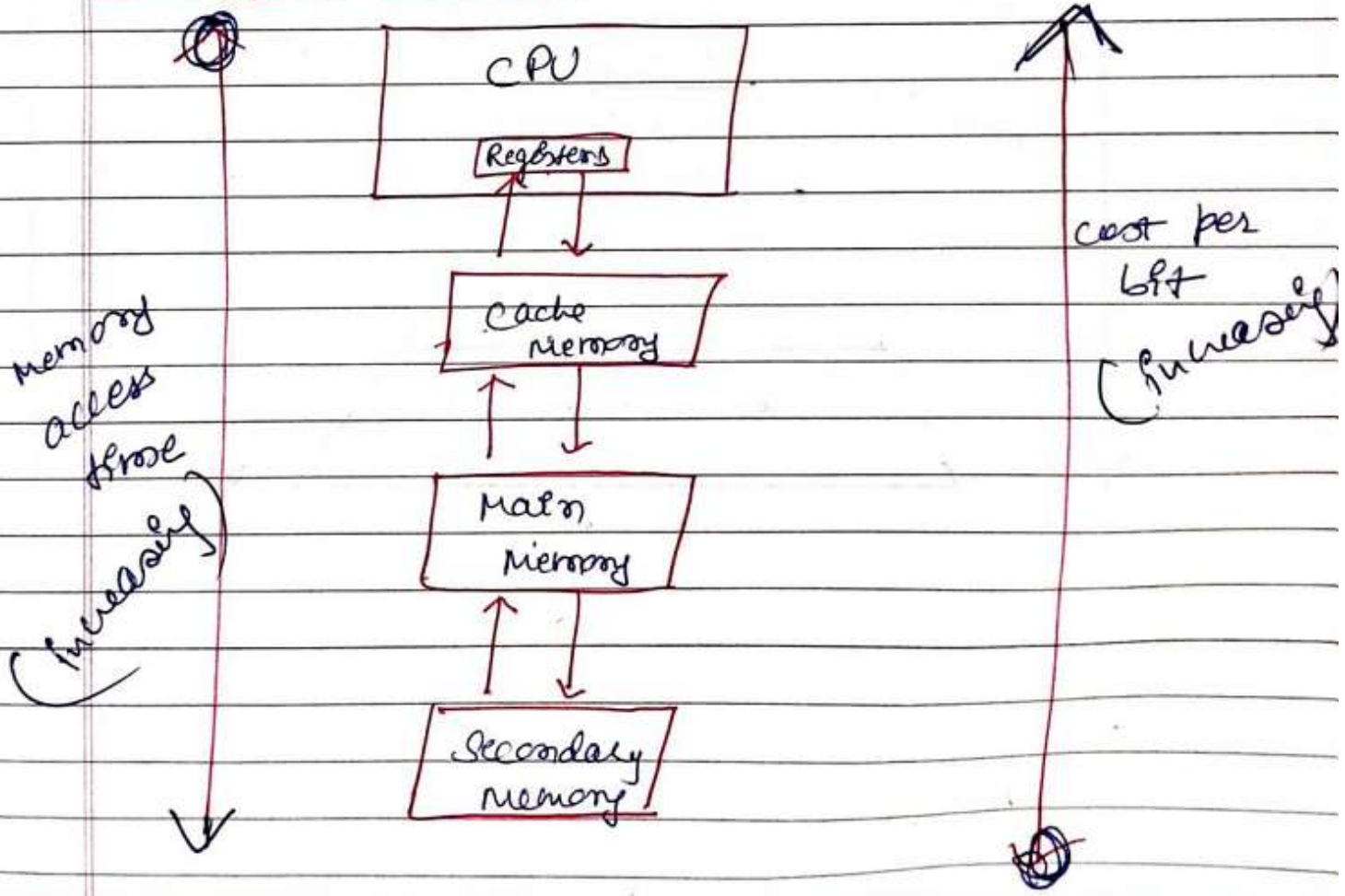
Data organisation → Data can be (organised) defined as a representation of facts, concepts or instructions in a formalized manner which should be suitable for communication, interpretation or processing by human or electronic machine.

Data is represented with the help of characters such as alphabets (A-Z, a-z), digits (0-9) or special characters (+, -, /, *, <, >, = etc.)

Memory → A memory is just like a human brain. It is used to store data and (Informations) Instructions. Computer memory is the storage space in the computer, where data and Instructions required for processing are stored. The memory is divided into large numbers of (cells) small parts called cells. Each location or cell has a unique address, which varies from zero to memory size minus one.

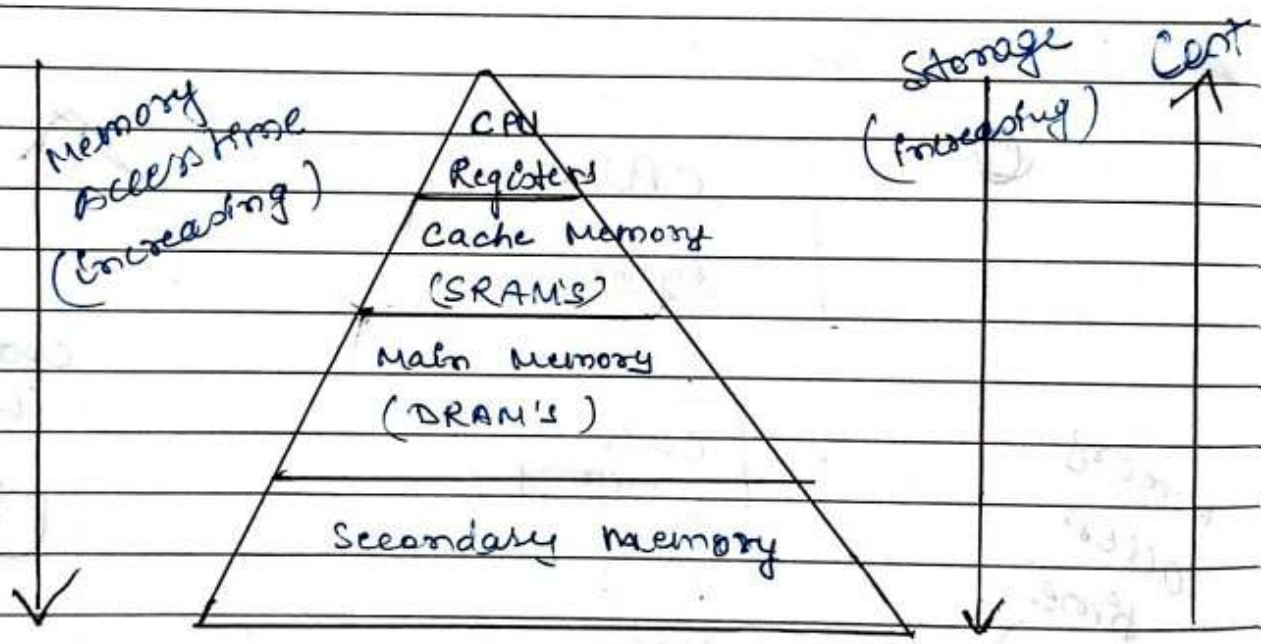
Ex → If the computer has 64 K words, then this memory unit has $64 * 1024 = 65536$ memory locations. The address of these locations varies from 0 to 65535.

Memory Hierarchy



Computer memory can be measured in terms of how many bits it can store. Here is a chart for memory capacity conversion.

1 byte = 8 bits
1 Kilobytes (KB) = 1024 bytes
1 Megabyte (MB) = 1024 KB
1 Gigabyte (GB) = 1024 MB
1 Terabyte (TB) = 1024 GB [1PB = 1024TB]
1 Exabyte (EB) = 1024 PB
1 Zettabyte = 1024 EB
1 Yottabyte (YB) = 1024 ZB



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Memory is primarily of 3 types :-
(a) Cache memory
(b) Primary memory / Main Memory
(c) Secondary Memory

(a) **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 CPU. The parts of data and programs are transfessed 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 :-
(a) Cache memory is faster than main memory.
(b) It consumes less access time as compared to main memory.
(c) It stores the program that can be executed within a short period of time.
(d) It stores data for temporary use.

Disadvantages → The disadvantages of Cache memory are as follows :-
(a) cache memory has limited capacity.
(b) It is very expensive.

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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 fast as registers. The data and instructions required to be processed resides in the main memory. [illegible] Memory

Characteristics of Main Memory →

(a) These are semiconductor memories
(b) It is known as the main memory.
(c) Usually it is a volatile memory.
(d) Data is lost in case power is switched off.
(e) It is the working memory of the computer.
(f) It is faster than secondary memory.
(g) A computer cannot run without the primary memory.

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Secondary Memory → This type of memory is also known as external memory of 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.

Example → disk, CD-ROM, DVD etc.

Characteristics of Secondary memory →

(a) These are magnetic and optical memories.
(b) It is known as the backup memory.
(c) It is a non-volatile memory.
(d) Data is permanently stored even if power is switched off.
(e) It is used for storage of data in a computer.
(f) computers may run without the Secondary memory.
(g) It is slower than primary memories.

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RAM (Random Access Memory)

RAM 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 →

(a) Static RAM (SRAM)
(b) Dynamic RAM (DRAM)

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(a) Static RAM → 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 uses 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 cost higher. SRAM is thus used as cache memory and has very fast access.

Characteristics of SRAM

(a) Long Life
(b) No need to refresh
(c) Faster
(d) Used as a cache memory
(e) Large size
(f) Expensive
(g) High Power consumption.

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Dynamic RAM → DRAM must be refreshed again and again 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

(a) Short life time
(b) Needs to be refreshed continuously
(c) slower as compared to SRAM
(d) used as RAM
(e) smaller in size
(f) Less expensive
(g) Less power consumption.

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ROM → Read only Memory

Rom is a non volatile memory chip in which data is stored permanently and cannot be altered by usual programs. This type of memory is active, regardless of whether the system is turned on or is switched off. As the name "read only" suggests, the contents in it cannot be changed or modified. It is an integrated circuit which is pre-programmed with important data that should necessarily be present for the computer to carry out its normal functionalities.

There are various types ROMS and their characteristics.

(a) PROM
(b) EPROM
(c) EEPROM

(a) PROM → Programmable Read only Memory

A PROM is a memory chip on which we can store a program. But once the PROM has been used, we cannot wipe it clean and use it to store something else. Like ROMs, PROMs are non-volatile.

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(b) EPROM → Erasable Programmable Read only memory

An EPROM is a special type of ROM that can be erased by Exposing it to Ultraviolet light. The UV light clears the data on the chip so that it can reprograms. For writing and erasing data on the EPROM, we need a particular device which is known as PROM programmer. The process of programming an EPROM is often called BURNING and the box into which it is plugged to program it an EPROM burner.

Compiler	Interpreter
(a) It scans the entire source program first and then translates it into machine code.	(a) Translates the program line by line.
(b) Execution time is less	(b) Execution time is more.
(c) Used for debugging	(c) Used for fast debugging
(d) Requires more main memory	(d) Requires less main memory
(e) Security of source code	(e) No security of source code.

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(c) EEPROM → Electrically Erasable 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.
Memory here means memory chips used in computers, mobile phones etc.

Advantages of ROM

(a) Non-volatile in nature
(b) cannot be accidentally changed
(c) cheapes than RAMs
(d) Easy to test
(e) More reliable than RAMs
(f) static and do not require refreshing
(g) Contents are always known and can be verified.

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Difference between RAM and ROM

Pen Drive → A new secondary storage device h USB feature is available. Storage capacity varies fr 2MB to 40 MB. In pendrive it is easy to stor read and carry. They are non-volatile and data can be rewritten on them. They are very sm in size but have very large memory space.

The pen drives are so named be cause of their size and shape. Pen drives ar inserted into the USB port of the desktop comp uters or laptop computers. Pen drives are very compact in size as compared to CDs and DVDs. The pen drives can be read as well a written. With the availability of pen drives the problems of data storage has been solved a great extent.

USB → Universal Serial Bus

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Secondary storage devices

Secondary storage is a storage medium that holds information until it is deleted or overwritten regardless if the computer has power.

So that we uses the secondary storage devices these are used for storing the data in a permanent manner means all the data will remain stored whether the power is switched on or switched off. It is also known as external memory and auxiliary memory.

Offline storage also called secondary storage

Classification of secondary storage devices

Floppy disks → It is a circular disk coated with magnetic oxide and enclosed within square plastic cover. It's available in different size, but the most commonly used floppy is 3 1/2. Data up to 1.44 MB can be stored in it. Floppy disks are available in 2 sizes, 3.5 inch and 5.25 inch. The 3.5 inch size floppy is mostly used.

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Hard Disk → Hard disks are made of aluminium or other metal alloys which are coated on both sides with magnetic material. Unlike floppy disks, hard disks are not removable from the computer. To increase the storing capacity several disks are packed together and mounted on a common drive to form a disk pack. A disk is also called a platter.

Hard disk is a rigid platter or stack of platter with a magnetized surface. Information is recorded on the hard disk in the form of tiny visible magnetized and non-magnetized spots (representing 1's and 0's) on the coated surface of the disk.

Hard disks are used to store operating system, application software and files. The hard disk drive is normally located inside the system unit.

CD (compact Disk) → Compact disc is a digital optical disc data storage format that was co-developed by Philips and Sony and released in 1982. The format was originally developed to store and play only sound recordings but was later adapted for storage of data (CD-ROM). Several other formats were further derived from these, including write once audio and data storage (CD-R), rewritable media (CD-RW), video compact disc (VCD) etc.

(i) CD-ROM → compact Disk - Read only

(b) CD - WORM (Write once, Read Many)
(c) CD - RW (Compact Disc, Rewritable)
(d) VCD (Video CD)

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Input / Output Devices → The computer will be of no use unless it is able to communicate with the outside world. Input and output devices are required for users to communicate with the computers. In simple terms, input devices bring information into the computer and output devices bring information out of a computer system. These input / output devices are also known as peripherals since they surround the CPU and memory of a computer system.

Input Devices Input devices are what is used to put data and into the computer. Without them we could not tell the computer what to do. The devices which are used to input the data and the programs in the computers are known as "Input devices". Input device can read data and convert them to a form that a computer can use.

Following devices are most commonly used input devices.

(a) Keyboard
(b) Mouse
(c) Trackball
(d) Trackpad
(e) Joystick
(f) Scanner
(g) Microphones
(h) Webcams
(i) Light Pen
(j)

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(a) **Keyboard** → The most commonly used input device. Keyboard is used in the input phase of a computer based information system. The data and instructions are input by typing on the keyboard. The message types on the keyboard reaches the memory unit of a computer. It connects to a computer via a cable.

(b) **Mouse** → It is used to control a pointer and to select items. It is a very user friendly input device. It is a pointing device. The mouse is rolled over the mouse-pad, which in turn controls the movement of the cursor on the screen.

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(c) **Scanners** → It is used to input what is on paper (hardcopy) into the computer. This includes pictures, photographs and texts. Text can be recognized by Optical character Recognition (OCR) software that examines a scanned image for letters and other characters that it recognizes and then converts it into a document that we can edit. Scanners are used to enter information directly into the computer's memory. This device works like a xerox machine.

The scanner convert any type of printed or written information including photographs into digital pulses, which can be manipulated by the computer.

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Output Devices → Output devices are through which the computer gives information out to the user. Without an output device a computer would do lots of processing but nobody could see the results.

Following devices are most commonly used output devices.

(a) Printers
(b) Monitor
(c) Plotters
(d) LCD Monitors
(e) Speakers
(f)

(a) **Printers** → Printers are used to produce a hardcopy or printout of computer output. A printer is a device that produces printed paper as output, known as hard copy in the computer industry. Some printers produce only letters and numbers whereas others can also produce graphics.

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(b) Monitor → These are sometimes called VDUs and are the most commonly used output devices.

(c) LCD Monitors → LCD stands for Liquid Crystal Display. This is a flat screen that several advantages over the older CRT (Cathode Ray Tube) monitors. These advantages include :

(i) They are much lighter and smaller than CRT monitors so they can be carried around easily and don't take up as much room on a desk.

(ii) They use much less electricity than a CRT monitor.

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(d) **Plotters** → A plotter is a special kind of output device, that like a printer that produces images on paper but does so in a different way. Plotters are designed to produce large drawings or image, such as construction plans for buildings or blueprints of mechanical objects. An array of different coloured pens in a clip rack and a robotic arm to draw with coloured pens.

Plotters receives the instructions from the computer and picks up appropriate pen through its arm, draw the images according to information.

A plotter is a special output device used to produce hardcopies of graphs and designs on the paper. This device is a printer that interprets commands from a computer to make line drawings on paper with one or more automated pens. This is typically used To print large format graphs or maps such as construction maps or engineering drawings. These devices generally connected to the computer mach-ines with a variety of standard interfaces.

plotter performance indicators are drawing plots, drawing size, resolution, interface.

Ex:- Canon and EPSON are all popular brands of plotter manufacturers.

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There are two types of plotters.
→ Drum plotters
→ Flatbed plotters.

(e) Plasma Display → Plasma display panel is a type of flat panel display often used for large television displays typically above 37 inches or 940 millimeters (mm). Many tiny cells located between two panels of glass hold an inert ( ) mixture of noble gases (neon and xenon). The gas in the cells is electrically turned into a plasma, which then excites phosphorous to emit light.

Plasma displays should not be confused with LCDs (Liquid Crystals Displays) which are also lightweight flat screen displays but are produced by a very different technology.

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Number System → A number system is a systematic way to represent numbers with symbolic characters and use a base value to conveniently group numbers in compact form.

The most common number system is decimal, which has a base value of 10 and a symbolic character set of 0, 1, 2, 3, 4, 5, 6, 7, 8 and 9.

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There are commonly four ways to represent a number associated with modern computers and digital electronics are decimal, binary, octal and hexadecimal.

(a) **Decimal System** → Most people today uses decimal representation to count. In the decimal system, they are 10 digits.

0, 1, 2, 3, 4, 5, 6, 7, 8, 9

(b) **Binary number System** → Binary number system is like decimal number system except that the base is 2 instead of 10. We can use only two symbols or digits (0 and 1) in this number system. In this system, the right most position in units (2^0) position, the second position from the right is 2's (2^1) and proceeding in this way.

Ex→ $101 \Rightarrow 1 \times 2^2 + 0 \times 2^1 + 1 \times 2^0$

$\Rightarrow$ (—

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(b) **Binary System** → Every computer stores numbers, letters and other special characters in binary form.

(c) **Octal numbes System** → In octal numbes system, the base is 8. Hence, there are only eight symbols or digits : 0, 1, 2, 3, 4, 5, 6, 7. The largest single digit is 7 (one less than 8). Each position in octal numbes represents a power of the base (8). Therefore, decimal equivalent of octal numbes 2057 is

$$2057 \Rightarrow 2\times8^3 + 0\times8^2 + 5\times8 + 7\times8^0$$
$$\Rightarrow 512\times2 + 0 + 40 + 7$$
$$\Rightarrow 1024 + 40 + 7$$
$$= 1071$$

$$2057_8 = 1071_{10}$$

Observe that since there are only 8 digits in octal numbes system, so 3 bits ($2^3 = 8$) are sufficient to represent any octal numbes in binary.

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(d) Hexadecimal Numbes System

In hexadecimal numbes system, the base is 16. Hence, these are 16 symbols or digits. The first 10 digits are the same digits of decimal numbes system — 0, 1, 2, 3, 4, 5, 6, 7, 8, 9. The remaining six digits are denoted by the symbols A, B, C, D, E and F, representing decimal values 10, 11, 12, 13, 14 and 15 respectively. Hence the largest single diget is 15 or F (one less than 16). Each position in hexadecimal numbes system represents a power of base (16). Therefore, decimal equivalent of hexadecimal numbes $1AF_{16}$ is

$$1AF_{16} = 1 \times 16^2 + 10 \times 16^1 + 15 \times 16^0$$
$$= 256 + 160 + 1 = 431$$

$$1AF_{16} = 431_{10}$$

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Converting from one number system to another.

(1) Decimal to Binary and Vice-Versa

$8_{10} = 1000_2$

$100 =$

Binary to Decimal

$110_2 = 6_{10}$

$1101 = 13_{10}$

(2) Decimal to octal → (8)

$952_{10} = 1670_8$

8	952	0
8	119	7
8	14	6
	1	↑ 1

$15_{10} = 17_8$

8	15	7
	1	↑ 1

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RANKA

64
8
512

64
4
256
512
56
952

octal to decimal

$$16708 = 1\times8^3 + 6\times8^2 + 7\times8^1 + 0\times8^0$$
$$= 512 + 384 + 56 + 0$$
$$= 952_{10}$$

(c) Decimal to Hexadecimal

$$211_{10} = D3_{16}$$

16 | 211 | 3
13 | 13

13 3
↓
D 3

16
13
48
16
208

Hexadecimal to decimal

$$D3_{16} = D\times16^1 + 3\times16$$
$$= 13\times16^1 + 3\times16^0$$
$$= 208 + 3$$
$$= 211$$

$$D3_{16} = 211_{10}$$

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Binary to octal $2^3 \Rightarrow 3$ bit

(Q) 101 110

5 6

$101110_2 = 56_8$

(Q) 001101010

1 5 2

$101110_2 = 152_8$

octal to Binary

52
101010
$52_8 = 101010_2$

40_8
100000_2

$(100\ 000)_2$

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Binary to Hexadecimal (2^4 = 4 bits)

(9) 11010011

13 3

D 3

$11010011 = D3_{16}$

(8) $01011010110_2 \Rightarrow 5AC_{16}$

5 10 12

5 A C

Hexadecimal to Binary

5 4 2

0101 0100 0010

$(010101000010)_2$

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Relationship among Decimal, Hexadecimal, Binary and octal numbes Systems

Decimal	Hexadecimal	Binary	octal
0	0	0	0
1	1	1	1
2	2	10	2
3	3	11	3
4	4	100	4
5	5	101	5
6	6	110	6
7	7	111	7
8	8	1000	10
9	9	1001	11
10	A	1010	12
11	B	1011	13
12	C	1100	14
13	D	1101	15
14	E	1110	16
15	F	1111	17
~~16~~	~~10~~	~~10000~~	~~20~~

Unit III

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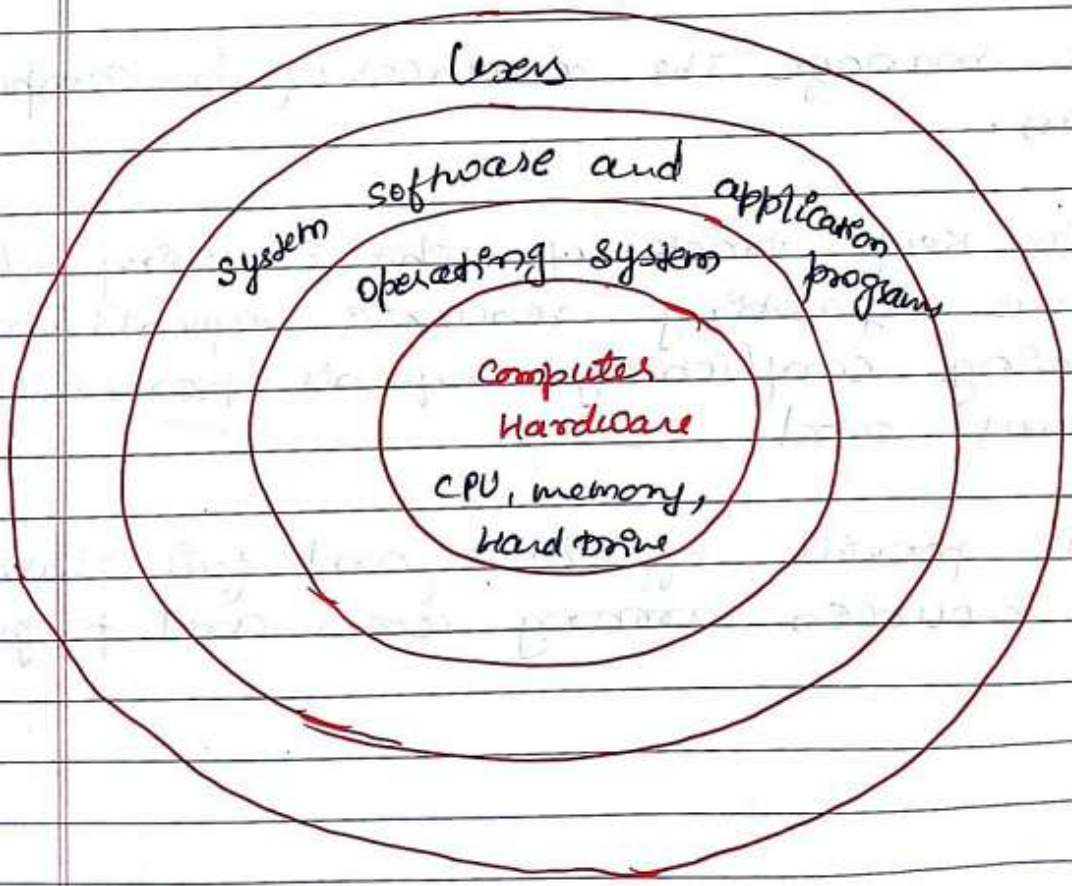
Operating System → An operating system is a collection of programs use to control a computer system.

or

An operating system is a software which acts as an interface between the end users and computer hardware. Every computer must have at least one OS to run other programs. An application like chrome, MS word, games etc. needs some environment in which it will run and perform its task.

The operating system helps us to communicate with the computer without knowing how to speak the computers language. It is not possible for the user to use any computer or mobile device without having an operating system.



start → Ready → Running → Terminated.
↑ ↓
waiting

Objectives of an operating System

The objectives of the operating System are

→ 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

History of Operating System →

(a) Operating systems were first developed in the late 1950s to manage tape storage.

(b) The General motors Research Lab implemented the first OS in the early 1950s for their IBM 704 (computer).

(c) In the mid 1960s, operating systems started to use disks.

(d) In the late 1960's, the first version of the unix OS was developed.

(e) The first OS built by Microsoft was DOS. It was built by Microsoft in 1981 by purchasing the 86-DOS software from a Seattle company.

(f) The present day popular OS windows first came to existence in 1985 when a GUI was created and paired with MS-DOS. (windows 1.01)

(g) Microsoft introduced an operating environment named windows on November 20, 1985, as a graphical operating system for MS-DOS in response to the growing interest in GUI (graphical user interfaces).

windows 7 — 48.5% then 10 → 26.28%
then Xp → 7.04%

A program in execution is process.
Process is active entity.

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Functions of Operating System

(a) **Process Management** → Process management helps OS to create and delete processes. It also provides mechanism for synchronization and communication among processes.

(b) **Memory Management** → Memory Management module performs the task of allocation and de-allocation of memory space to programs in need of this resources.

(c) **File management** → It manages all the file-related activities such as organization storage, retrieval, naming, sharing and protection of files.

(d) **Device Management** → Device management keeps tracks of all devices. This module also responsible for this task, is known as the I/O controller. It also performs the task of allocation and de-allocation of the devices.

(e) **I/O System Management** → One of the main objects of any OS is to hide the peculiarities (features and attribute) of that hardware

devices from the user.

(f) Secondary - Storage Management →

Syst have several levels of storage which includes primary storage, secondary storage and cache storage. Instructions and data must be stored in primary storage or cache so that a running program can reference it.

(g) Security → Security module protects the data and information of a computer syst against malware threat and authorized acces

(h) Communication management → co-ordination and assignment of compilers, interpreters and another software resource of the various users of the computer system.

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Sevice Functions of operating Systems

(i) Program Execution → o/s loads and executes programs, allows debugging.

(ii) I/O operation → o/s does all read and write operations which may involve a file or an I/O device like Printer.

(iii) File System Manipulation → o/s allows to read / write files as well as create and delete them.

(iv) Communication → o/s allows process to communication with each other.

(v) Error Detection → o/s needs to be constantly aware of possibe errors
→ May occur in CPU and memory, in I/O devices, in user program
→ For each type of error, o/s should take the appropriate action to correct and consistent Computing.

(vi) Resource Allocation → The o/s manages all kinds of resources using schedulers.

(vii) Security / Protection → Protection involves Ensuring that all access to system resources is controlled.
Security → Security of the system from outsider requires user authentication.

Types of Operating System →

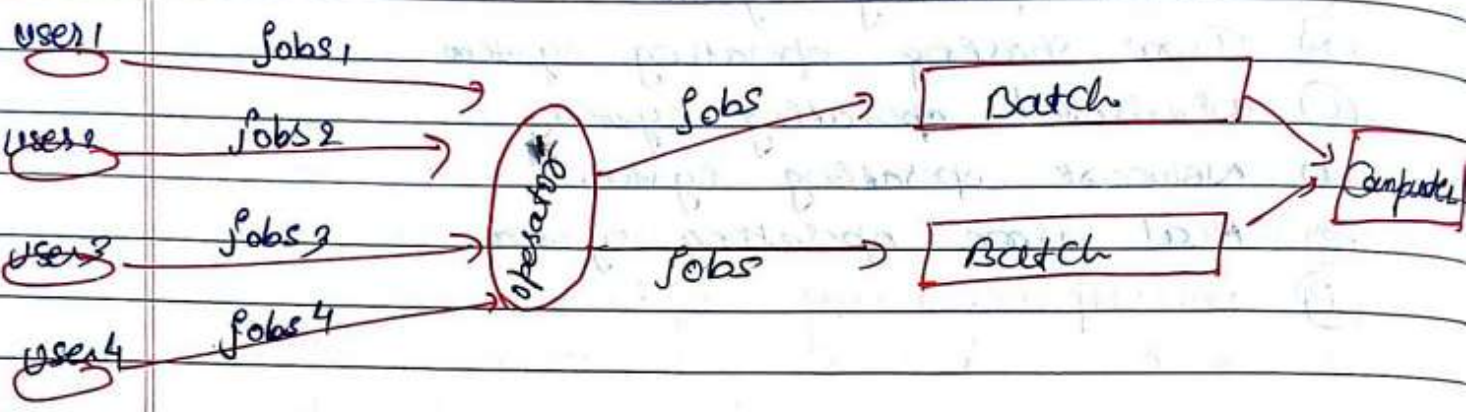
(a) Single user operating system
(b) Batch operating System
(c) Time sharing operating system
(d) Distributed operating system
(e) Network operating system
(f) Real time operating system
(g) multiprocessing o/s.

(b) **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

(a) Lack of interaction between the user and the job.
(b) CPU is often idle because the speed of the mechanical I/O devices is slower than the CPU.
(c) Difficult to provide the desired priority.
(d) It is sometimes costly.

(b) Time sharing operating systems



Advantages

(a) multiple users can share the batch systems.
(b) The idle time for batch system is very less.
(c) It is easy to manage large work repeatedly in batch systems.

Disadvantages →

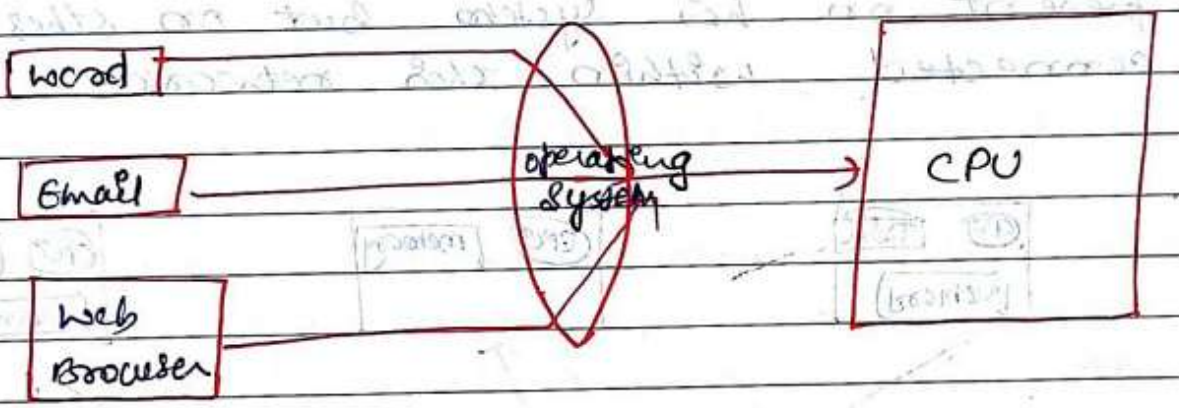
(a) The computer operators should be well known with batch systems.
(b) Batch system are costly.
(c) The other jobs will have to wait for an unknown time if any job fails.

Ex → Payroll system, Bank statements etc.

→ IBM's OS360 is a popular batch operating system.

(2) Time sharing operating system

In time sharing operating system, each task is given some time to execute, so that all the tasks work smoothly. Each user gets time of CPU as they use single system. These systems are also known as Multitasking systems. The task can be from single user or from different users also. The time that each task gets to execute is called quantum. After this time interval is over, OS switches over to next task.



Advantages of Time - sharing O/S →

(a) Each task gets an equal opportunity
(b) CPU idle time can be reduced.

Disadvantages →

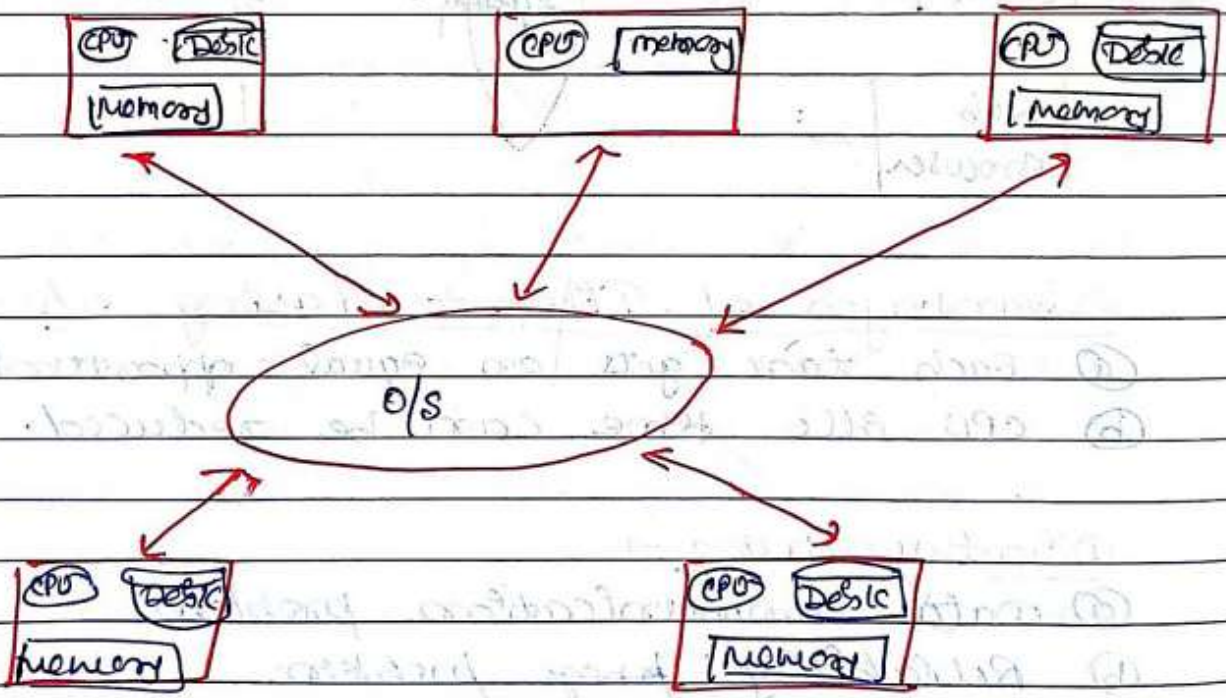
(a) Data communication problem
(b) Reliability prog. problem

Example of T.S. O/S →

Unix O/S, Windows XP, Linux etc.

(4) Distributed operating System →

In distributed o/s, various autonomous Interconnected computers communicate each other using a shared communication network. Independent systems possess their own memory unit and CPU. These are referred as loosely coupled systems or distributed systems. Remote access is enabled within the devices connected in that network means it is always possible that one uses can access the files or software which are not actually present on his system but on other system connected within this network.



Distributed operating system are extension of network operating system.

Advantages

(i) Failure of one will not affect the other network communication, as all systems are independent from each other.
(ii) Electronic mail increases the data exchanged speed.
(iii) Since resources are being shared, computation is highly fast and durable
(iv) Load on host computer reduces
(v) These systems are easily scable as many systems can be easily added to the network.
(vi) Delay in data processing reduces.

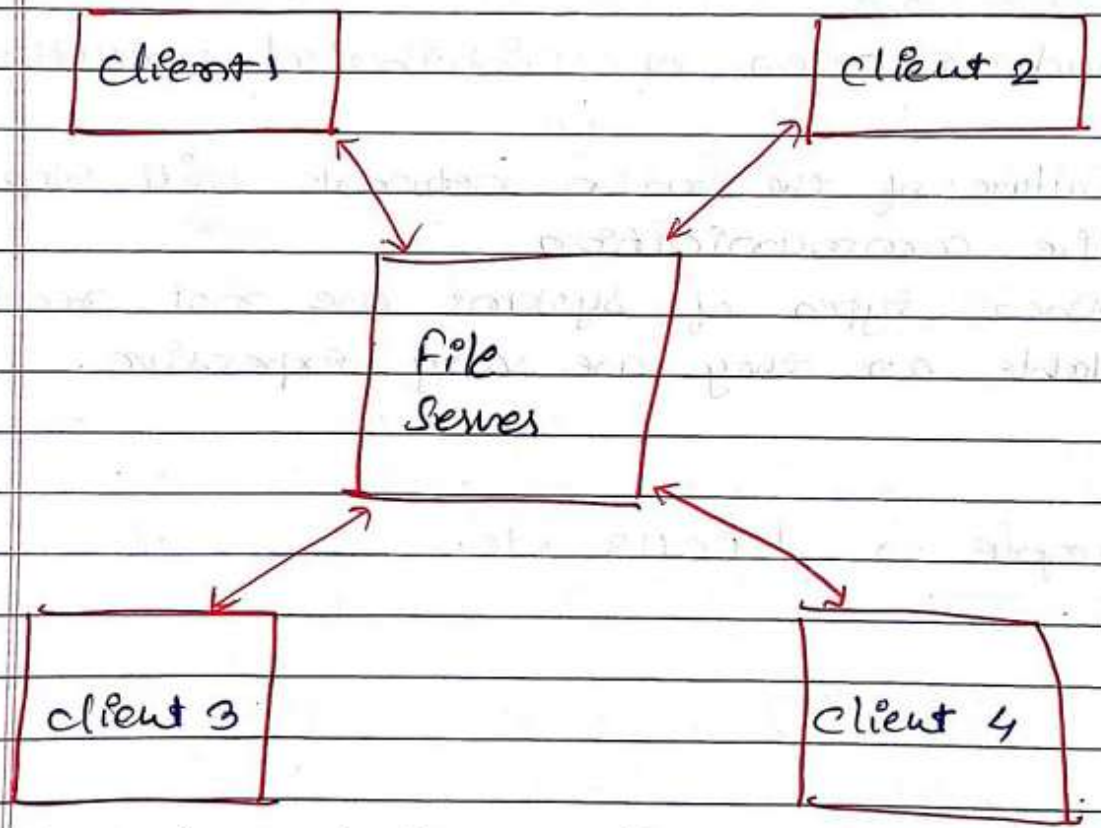
Disadvantages of Distributed operating sys

(i) Failure of the main network will stop the entire communication
(ii) These types of systems are not readily available as they are very expensive.

Example → Locus etc.

5) Network operating System

These systems run on a server and provide the capability to manage data, users, groups, security, applications and other networking functions. These type of operating systems allow shared access of files, printers, security applications etc. These systems are known as tightly coupled systems because all the users are well aware of the underlying configuration of all other users within the network, their individual connections etc.



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), a private network or to other networks.

Advantages

(i) Highly stable centralized servers
(ii) Security concerns are handled through servers.
(iii) New technologies and hardware upgradations are easily integrated to the system.
(iv) Server access are possible remotely from different locations and types of systems.

Disadvantages

(i) Severs are costly.
(ii) User has to depend on central location for most operations.
(iii) Maintenance and updates are required regularly.

Examples of Network Operating System

(i) Microsoft windows Server 2003
(ii) Microsoft windows Server 2008
(iii) UNIX
(iv) LINUX
(v) BSD etc.

@ server is a computer or system that provides resources, data, services or programs to other computer, known as clients, over a network.
→ may be mainframe
→ may be mini computers.

(6) Real - Time o/s

These type of o/s serves the real-time systems. The time interval required to process and respond to inputs is very small. This time interval is called response time.

Real-time systems are used when there are time requirements are very strict like missile systems, air traffic control systems, robots etc.

Two types of Real-time operating Systems are →

(a) Hard Real-Time systems → These OSs are meant for the applications where time constraints are very strict and the shortest possible delay is not acceptable.

(b) Soft Real-Time Systems → The OSs are for application where for time-constraint is less strict.

Examples of Real-time operating systems are → Scientific Experiments
→ Weapon systems.
→ Robots
→ Air traffic control systems etc.

→ TRON, Lynx OS
→ Windows CE
→ RT Linux etc.

Advantages of RTOS →

(i) Maximum Consumption → Maximum utilization of devices and system thus more output from all the resources.

(ii) Focus on Application → Focus on running applications and less importance to applications which are in queue.

(iii) Error Free → These types of systems are error free.

(iv) Memory Allocation → Memory allocation is best managed in these type of systems

Disadvantages →

(i) Limited tasks → Very few tasks run at the same time and their concentration is very less on few applications to avoid errors.

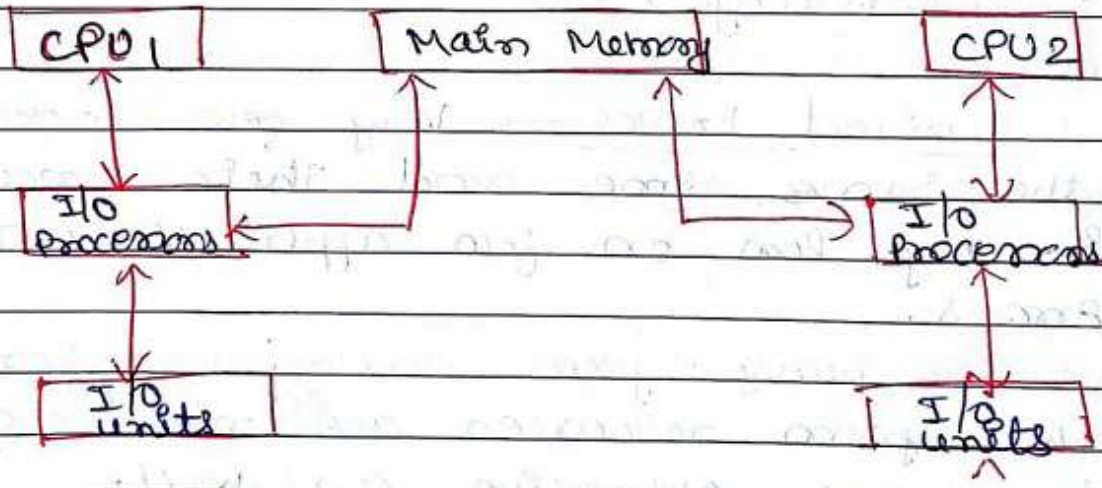
(ii) Use heavy System resources → Sometimes the system resources used by RTOS are not so good and they are expensive as well.

(iii) Complex Algorithms → The algorithms are very complex and difficult for the designer to write on.

(3) Multiprocessing operating System

Multiprocessor operating System refers to the use of two or more central processing units (CPU) within a single computer system. These multiple CPUs are in a close communication sharing the computer bus, memory and other peripheral devices. These systems are referred as tightly coupled systems.

These types of systems are used when very high speed is required to process a large volume of data. These systems are generally used in environment like satellite control, weather forecasting etc. The basic organization of multiprocessing system is shown in fig.



Advantages of multiprocessing O/S

(a) Higher performance due to parallel processing.
(b) If one CPU get failed then other CPU are used to do that CPU's job.

Disadvantages of multiprocessing O/S

(a) very expensive.
(b) Large main memory Required.

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MS-DOS

MS-DOS is a "Disk operating System". It means "a system for operating the disks". It enables the user to organize data, files, load and execute (run) program files and control the input and output devices attached to the computer.

It is the first o/s used with the PC. It was developed by Microsoft. It was the most commonly used member of the Dos family of o/s and was the main o/s for IBM PC compatible personal computers during the 1980s to the mid 1990s until it was gradually superseded by o/s offering a graphical user Interface by Microsoft windows operating System.

Dos uses a command line or text-based Interface that allows the user to type commands. By typing simple instructions such as CD (change Directory), the user can browse the files on the hard drive, open files and run programs. While the commands are simple to type, the user must know the basic commands in order to use DOS effectively.

Dos is still included with windows but is run from the windows operating System. The Dos command prompt can be opened in windows by selecting "Run" from the start menu and typing cmd.

Booting → To run DOS on a computer, it should be the first program to be executed when the switched on. This led to a problem for the designers. "How can DOS be loaded and executed when there is no DOS program running to load and execute it. The computer manages and the term "bootstrapping" or 'booting up" is applied to this process.

Files in DOS

In a computer, data is stored in files. When we run a program, MS-DOS processes the data stored in the file and passes it to the system.

In MS-DOS a file can be any size. However the file name is more restricted, it can only have a maximum length of 8 characters plus 3 for the extension.

Furthermore, the files can only contain the following characters

→ letter A to Z

→ numbers 0 to 9

→ The following special characters, #, %, &, —, $, {, ...

Thus filename must not contain
→ spaces
→ commas
→ backslash
→ dot

ex→ program.exe
data.exe

Directories → A directory is a location for storing files on (your) our computer. Directories are found in a hierarchical file system. So every disk drive has a root directory which can have subdirectories which are named in the same format as file-names.

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Batch Files →

DOS Commands → DOS commands are small programs which are made to perform a particular job. Every DOS command performs different tasks. It is not possible to work on the computer without these commands. There are two types of DOS command.

ⓐ Internal command
ⓑ External command

ⓐ **Internal Commands →** These commands enter into the computer memory during computer booting. These commands are not in the form of any file. So neither can be viewed in the form of any file nor can be edited or deleted.

→ These are the commands which are contained in command.com files of MS-DOS.

→ These are the functions that are built into the command interpreter.

→ There is no need of any external file in computer to load Internal MS-DOS command.

→ These commands can be used as long as running on the system.

→ Internal commands do not vary from system to system.

→

Some most commonly used External commands are

→ ver ✓
→ time ✓
→ tree ✓
→ cal ✓
→ copy con ✓
→ cls ✓
→ date ✓
→ vol ✓
→ ren ✓
→ copy
→ expt ✓
→ ren ✓
→ tree
→ ~~xcopy~~
→ type ✓
→ notepad
→ ~~chkdsk~~
→ color ✓
→ comp
→ Path ✓
→

External commands → These are those Commands which are not in-built in MS-DOS. These are those which are not included in the interpreter. There is a need of an internal file in the computer to read external MS-DOS command. External command may vary from system to system. This means any two computers with same version of MS-DOS may have same external commands. These are

- → Edit
- → Tree
- → Xcopy
- → desk - copy
- → more
- → print
- → Label
- → Diskcopy
- → CHKDSK
- → DOSKEY
- → DELTREE
- → FIND
- → SORT
- → RESTORE

So, these external commands are for performing advanced tasks and they do need some external file support as they are not stored in command.com.

Internal Commands

(a) DATE → This command is used to display the system current date setting and prompt us to enter a new date. The syntax is

```
C:\> date

C:\> date /t
     Tue 03/29/2011
```

(b) Time → This command is used to displays or set the system time. The syntax is

```
C:\> Time

C:\> time /t
     01:42 PM
```

Typing time with no parameters displays the current time and a prompt for a new one.

(c) Copy CON → It is used to create a file in the existing directory. Here CON is a DOS reserved word which stands for Console. syntax is

C:\> copy con Roshan ↵ for Dos file.
Hi & How are you.
I am good.

Then press key F6 to save and exit.
C:\> copy con Roshan.doc (word file)
C:\> copy con Roshan.xls (Excel file)

(d) Type → This command is used to display the contents of a text file or files. The syntax is

Type [d:] [path] [name.extention]

C:\> Type abc.~~txt~~

(e) CLS → It is used to clear screen. syntax is

C:\> CLS

(e) REN → This command is used to change or modify the name of a file or files. Syntax is

C:\> Ren [drive:] [path] filename1 filename2

C:\> ren abc xyz

Here file-name1 is source file for which we wanted to change the name and file name2 is our new file name. Also note that we cannot specify a new drive or path for our destination file.

+h → for hide the file
-h → not hide
+r → (property)
-r →

(f) DIR → The DIR command is used to list the contents of a directory. The DIR command typed by itself, displays the disk volume label and serial number, one directory or filename per line, including the file-name extension, the file size in bytes and the date and time the file was last modified and the total number of files listed, their cumulative size and the free space remaining on the disk. Syntax is

C:\> DIR [drive] [Path] [filename] [parameters]

Most commonly used parameters of DIR include

/A : attributes → Displays files with specified attributes

/B : → displays in base format with no heading information or summary.

/D : → Displays wide format but sorted by column

/P : → Pause at every Page

/S : → Also looks in subdirectories.

/O : → Displays the owners of a file or files

(g) PATH → This command displays the path that how we have come to present position or sets a search path for executable files. Its syntax is

C:\> Path [d:] path

Typing PATH without any parameters displays

the current path under current directory. Typing Path ; clears all search path setting and direct Cmd.exe to search only in the current directory and including %PATH% in the new PATH setting causes the old PATH to be appended to the new setting.

(h) VER → This command displays the version of the Microsoft Windows running on our computer. Syntax is

C:\> VER

(i) VOL → It displays the disk volume label and serial number, if they exist for the drive specified. If no drive is specified, it displays for the active drive. Syntax is

C:\> vol

C:\> vol e:

(j) DEL / ERASE → It is used to delete one or more files. Syntax is

C:\> del abc.txt /p

/p → Prompts for (Y)es and (N)o, confirmation before deleting each files.

/F → used to force delete read-only files.

/S → Delete specified files from all subdirectories.

(K) Copy → The copy command is used to copy files from one location to another. The destination defaults to the current directory. If multiple sources files are indicated, the destination must be a directory or an error will results. Its syntax is

C:\> copy [source/filename] [destination/folder]
C:\> copy abc.txt new.txt

Ex→ C:\> copy abc + xyz
C:\> type abc

Ex→ copy abc.txt d:\new.txt
(when we want to copy a file from one drive to another drive)

(M) MD (MKDIR) → MD command stands for make directory and it is used to create a directory. syntax is

C:\> MD [d:] [Path] [dir name]

C:\> MD D:\ Roshan

(N) CH (CHDIR) → CD stands for create or change directory and it allows to display the name of or change the current directory or rather we can say come out of a directory. Syntax is

CD [Path] [dirname]

C:\> CD Roshan

C:\> Roshan > cd.. (to again move to parent directory.

(o) RD (RMDIR) → RD command removes or deletes a directory. There are two conditions to remove any directory —
(i) Directory to be removed should be empty and
(ii) we should be outside the directory we are commanding to delete.

RD [d:] [Path] [dirname]

D:\> RD Roshan
C:\> RD D:\Roshan (from C:\)

(p) PROMPT → This changes the cmd.exe command prompt. By default the prompt is always to set to name of current drive followed by > sign.

Set PROMPT = (from the command line)

Android → 52%
Windows → 30%
IOS → 9%

To display the current date, time and drive on separate lines

set PROMPT D_T_NG

Change Color in Dos command Prompt

Right click on the apps title bar → select properties then click on the colors tab at the top of the window.

C:\> color z to get the list of all colors

C:\> color 6 (Yellow text)
color 4 (Red text)

Exit Command → Exit command is an internal command which is used to (withdrawal) quit from the current running application and the Ms-Dos session.

C:\> exit

attrib command →

External Commands

(a) CHKDSK → The command CHKDSK returns the configuration status of the selected disk. It returns the information about the volume, serial number, total disk space, space in directories, space in each allocation unit, total memory and free memory.

Syntax → C:\> CHKDSK C:

If drive name is not mentioned by default current drive is considered.

Switches

/f: → correct errors found in the directory of file allocation table and converts them into a file.

/v: → allows chkdsk to display series of messages indicating its progress and providing details about each error.

(b) Diskcopy → Desk copy command is used to make duplicate copy of the desk like xerox copy. It first formats the target desk and then copies the files by collection. from the source disk and copied to the target desk.

Syntax — C:\> desk copy <source path> <destination path>

Ex→ C:\> deskcopy A:B:

properties

/V → To verify while copying
/I → make a copy one side

The x copy command is used to copy one or more files or folders from one location to another location.

(c) Xcopy → When we need to copy a directory instant of a file from one location to another then uses xcopy command. This command is much faster than copy command.

syntax : C:\> xcopy [source] [destination]

Ex→ C:\> xcopy C:\files E:\files

Ex→ C:\> xcopy abc XYZ ↵
C:\> xcopy E:\abc.doc

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(d) Format → This command creates a new root directory and a file allocation Table (FAT) for the disk. In order for MS-DOS to be able to use a new disk we must use this command to format the disk.

Format is one of the most dangerous of all the commands in Dos because it can wipe out an entire disk's worth of data / programs at one go.

C:\> format A: ↵

The following are the different switches which can be used in format command

/1 → to format only one side of disk
/8 → use to format the floppy disk having 8 sector per track.

(e) TREE → This command is very useful to view the list of directories and sub-directories present on the disk in graphical form. If we wanted to include files also with directories and subdirectories, then we will have to give the command line as tree which presents the tree view of all the content on our disk. Here is the syntax for this command is

C:\> Tree [drive:path][/F][/A]
C:\> Tree /F ↵

/F switch include the names of files located in each of the directories in the tree.

(f) DELTREE → This command is used to remove a directory along with its contents. Syntax is

C:\> deltree [drive:path]

Here [drive:path] specifies the directory name to be deleted. All the sub-directories and files in this directory will be deleted without prompt and these is not getting back. So, keep caution while using this command.

(g) Find → This command searches for a specific text string in a file or files. Syntax is

C:\>Find [/V] [/C] [/N] [/I] [/OFF]

where

/V → Display all lines not containing the specific string

/C → Displays only the count of lines containing the string.

/N → Displays the line numbers with the displayed lines.

/I → Ignores the case of characters when searching for the string.

Ex: C:\> find "hope" abc.txt ↵

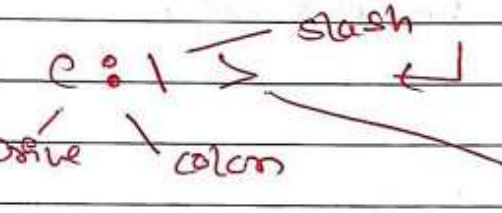
(h) **Restore** → The restore command restores files that were backed by using BACKUP command. syntax is

C:\> Restore drive 1 drive 2 : path

Here drive 1 specifies the drive on which back up files are stored.
drive 2 : path specifies the path to which those backup files will be restored.

(P)

Dos Prompt → once DOS is loaded into the RAM from the disk, it displays a prompt on the screen, indicating that it is ready to accept instructions from us. This prompt is our route to the pocess of DOS. We type all our commands at this prompt. The most common (prompt) appearance of the commands prompt is as shocon in the following figure.



The first character tells us which disk drive is currently active. DOS normally refers to the hard disk drive as drive C.

If we are working on the floppy drive A, then the prompt would appear as follows:

A:\>

Shell script → A shell script is a script written for all shell or command line interpreter, of an operating item. The shell is often considered a simple domain-specific programming language. Typical operations performed by shell scripts include file manipulation, program execution and printing text.

Attribute command →

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MS – Windows → Microsoft's line of windows operating systems is the most used in the world. Microsoft windows includes a wide array of features, tools and applications to help get the most out of windows and our computers.

Features of MS- windows

windows offers several features that can make the computer easier and more comfortable to use. Some of the features are described below →

(a) **Make the computer easier to See**

Several Settings are avilable to help in making the information on the screen easier to understand.

(b) **Make the mouse easier to use →** We can change the size and colour of the mouse pointer as well as the keyboard to control the mouse.

(c) **Make the keyboard easier to use →** We can adjust the way windows responds to mouse or keyboard input so that key combinations are easier to press.

(d) **Use the Computer without a Mouse or Keyboard →** windows includes on screen

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keyboard that we can use to type. We can also use speech recognition to control our computer with voice commands.

(e) Make it easier to focus on reading and typing tasks

These are number of settings that can help make it easier to focus on reading and typing.

(f) Make it user friendly for users

Windows is considered more user-friendly than MS-DOS. It can support long file names as compared to the 8 letters file names supported by DOS. Starting in Windows, starting in Windows files could have names up to 255 characters long.

(g) Availability of Internet explorer →

A web-browser called with Internet explorer comes as part of Windows. It offers us to access to a vast collection of world knowledge through a world-wide (conglomerate) clusters of numerous computer networks.

(h) availability of outlook express →

(5)

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Windows has another important features called outlook express. With outlook express, we can send and receive electronic mail messages. outlook express also provides facility for managing these messages.

(17) Provides Security → Windows provides us with security zones feature. This feature helps to assign security option to websites.

(4)

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Control Panel → The control Panel is a part of the Microsoft Windows which allows users to view and manipulate basic system settings and controls such as adding hardware, adding and removing software, controlling user accounts and changing accessibility options.

The control Panel is used to configure and manage almost all aspects of windows, including keyboard and mouse functionality, users and password, power options, network settings, desktop background, display settings, sound settings, hardware and software options, installation and removal of programs etc.

It is a part of Microsoft Windows graphical Interface.

Features of control Panel → As control Panel is the main place where a user can changes all default settings.

(a) **Personalise** → The first tab shown in control Panel is Personalise. From here, we can change the background on each feature and even add a couple of applications that will display content to the lock screen.

(b) Users → This is the place, where we can create or modify a uses account. login, password etc.

(c) Privacy → The privacy menu settles how app's use personal information in their data, like the location, our name, the account picture etc.

(d) General → One of the most important tabs in the control panel, the general menu, allows us to (tweak) [pull (tolst)] touch keyboard options and offers error recovering tools.

(e) Ease of Access → The ease of access is a category shown when viewing the control Panel as categories that adjust the vision, hearing speech recognition and mobility settings.

Devices, Devices Manager

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Task Bar → A bar located at the bottom of the screen that was first introduced with Microsoft Windows 95 and found in all versions after that. The task bar allows the user to locate and launch programs through the start button, see any program that is currently open, display the time or date, items running in the background. [through the]

Role of Task Bar → The purpose of the taskbar is to provide the user with an easy way of opening and managing programs installed on the computer.

(a) The start button will provide easy access to just about every program located on our ~~programs~~ system or computer.

(b) The small icons, we are referring to beside the clock are in what is called the "system Tray". They are icons that help us manage programs that are running in the background.

(c) If we place our mouse pointer over the time and leave it there for a short period,

it will display the full date in another message box.

(d) If we right-click any thing (including different parts of the taskbar, we will be given extra features in a context menu which could be helpful for customising the way something looks, acts or access advanced features of it.

Features of Task Bar

(1) The 'start' Button - opens the menu.
(2) The Quick launch bar contains shortcut to commonly used applications.
(3) The main taskbar displays icons for all open applications and files.
(4) The system - Tray contains the clock and icons for some of the programs running in the background.

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Windows applications

Windows comes with several useful applications already installed. These applications ~~already installed~~ can help us with many common tasks, including browsing the internet, managing our calendar etc.

[Example of applications of Windows are the Microsoft outlook, Internet explorer, snipping tool and numerous others.]

Windows applications are run on the users computer. Programs like Microsoft Word, Excel, and Power Point are windows applications.

Windows applications may use but don't require internet access. They may be designed to run totally alone, or may share information over a local area network.

Alt+Fu → close

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Difference between Notepad and WordPad

Both are text editors that are included with the windows operating system.

Notepad is the most basic text, editor, which allows us to open and create text files. In notepad, we don't have options for formatting.

WordPad is similar to Notepad, but gives more formatting options. We can use bold and Italics formatting and change the font, size and color of the text. We can also create bulleted lists and centre and justify paragraphs.

Function Keys → The function keys or F-Keys on a computer keyboard are keys that have a special function defined by the operating system or by a current running program. They may be combined with Alt or Ctrl keys.

F1 → Used as the help key in almost every program.
F2 → Renames a highlighted icon, file or folder.
F3 → opens a search feature for many programs
F4 → open find window in 95 to XP.
F5 → Refresh or reload the page
F6 → Move the cursor bar to the address bar in IE.
F7 → Commonly used to spell check
F8 → Enters the windows startup menu.
F9 → Refresh document in MS-Word.
F10 → activates the menu bar.

F_{11} → enter and exit full screen

F_{12} → open the save as window in MS-Word.

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Paint Brush → Paintbrush is a tool found in image editing and paint programs that allows users to digitally "paint" on an image file. This feature enables users to make edits to an image.

Paintbrush is a simple little image editing application for Mac OS X. The developers intent it to fill the space that used to be filled by MacPaint when apple launched. It might also be compared to paint, the basic image editing application that Microsoft include with their windows operating system.

Some of main features of Paintbrush include,

(a) Very simple and accessible user Interface
(b) open and save to the most common image formats.
(c) selection of drawing tools
(d) Reasonable range of options for adding text.

Paintbrush is also the name of a free, open source raster image (pixel) editing program, similar to Microsoft Paint.

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ICON → An icon is a graphic image, a small picture or a program that represents a file, program, web page or command. Icons helps us to execute commands, open programs or documents quickly. Icons are are very useful in applications that use windows because the click of a mouse button, we can shrink an entire window into a small icon (it is also called minimising). To execute a command by using an icon, click or double-click on the icon.

Icons are a principal feature of graphical user Interfaces.

Windows Accessories → the Accessories folder, accessible through the windows start menu.

click the start menu → Now click all apps → we will see alphabetical list of apps ← after scroll down, we can see windows accessories → then click the little arrow next.

Some important accessories are —

- → Calculator
- → Notepad
- → Wordpad
- → Snipping tool
- → Paint
- → command prompt
- → Internet Explorer
- → Calendar

Installation Process of Printer for the windows →

Suppose we have purchased a printer of any company and we have to attached it to the computer using its cable. Now, we have to install its drives before printing something on it. Following steps are taken :-

Step 1 :- Click "start" => Printers and Faxes. Now click on "Add a Printer" option. Now, "Add Printer wizard" starts.

Step 2 :- In "add Printer wizard" dialog box, click on the "next" button. Then one more screen will appear. In it, select the option "Local Printer attached to this computer". Then click on next button.

Step 3 :- Now operating system will try to detect a printer attached to the computer and displays a message in the window.

"Windows is Searching for new Plug and play printers to install. Searching" Now we have to click on Next button.

Step 4 :- Now select the manufacturers of Printer (HP etc.) and then model (like HP office Jet Pro 1170c) and

click the "Next Button".

Step 5 : Now it will ask to print a test Page or not. If we want to confirm that the printer is working properly or not, we may choose "Yes" option. Now click the next Button.

Step 6 : After Pressing the "Finish" Button, the drives program of the printer will get installed.

Windows Explorer → Windows Explorer is the file manager used by Windows 95 and later versions. It allows user to manages files, folders and network connections. Windows Explorer has also grown to support playing videos and audio etc. The desktop and the taskbar also form part of windows Explorer. The look, feel and functionalities of windows explorer have been enhanced with each version of windows.

Starting with Windows 8.0, windows Explorer has been called File explorer. It provides a graphical user Interface for accessing the file systems.

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MS- Office → Windows and MS-office are two most popular programs by Microsoft. Windows is an operating system and MS- office is a collection of programs and packages. We can say MS- office is packages contains a MS- word (word- processor), MS- Excel (spreadsheet MS- Powerpoint (graphical presentation program), MS- Access (relational database) MS- outlook, MS- publisher and MS- Front page.

Why there is need of MS- office → We need MS-office for following reasons →

(a) **Word Processing →** MS- word

(b) **For tabulation →** MS- Excel

(c) **Graphics →** MS- Power point

(d) **Database Management →** MS- Access

(e) **MS- outlook →** outlook express

(f) **MS - Publishes →**

Excel } Power point

Desktop Publishing ⟶ Desktop Publishing is the creation of documents using page layout software on a personal computer. Desktop publishing is also known as computer - aided publishing. Desktop publishing refers to the use of a digital desktop for laying out and constructing documents. The term is sometimes used to refer to processes that allow printing out paper copies of documents in a localized hardware scenario. it may also refer simply to the creation and construction of digital documents on a desktop.

There are two types of pages in desktop publishing, electronic pages and virtual paper pages.

DTP Software

(a) Adobe PageMaker
(b) Adobe FrameMaker
(c) Microsoft office Publisher
(d) Corel ventura
(e) CorelDRAW.

Desktop publishing allows an individual to combine text, numeric data, photographs, charts and other visual elements in a document that can be printed on a laser printer or more advanced type setting machine.

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MS- Excel → Microsoft excel is a spreadsheet program that runs on a window operating system and is developed by Microsoft Corporation. It is a spreadsheet s/w.

MS- Excel and some other s/w (such as MS- word, MS- PowerPoint, MS- Access) come collectively in package known as Microsoft office.

To run the MS- Excel software, click on 'start' button then on "All programs" and then on "Microsoft Excel" option.

Features of MS- Excel

Some of the most important features of MS- Excel are :-

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MS- Word → Microsoft Word or Ms- Word is a graphical word processing program that users can type with. It is made by the ~~computer~~ company Microsoft. Its purpose is to allow users to type and save documents. Similar to other word processors, it has helpful tools to make documents.

Features of MS- Word →

(a) **Robust Formatting Tools →** In order for users to create more impactful documents, Ms-word offers robust formatting tools. They will be able to adjust paragraph alignment, change the spacing and font style / size, create bulleted and numbered lists, add headers and footers and insert items in a document such as pictures and tables.

(b) **Work with PDFs →** This program also supports editing of documents with PDF file format. Thus users can edit the content of a PDF file in Ms- word like paragraphs, lists and tables.

(c) **Advanced Proofing Tools →** Ms- word is also equipped (provide) with advanced

tools that enable users to polish their documents. With these tools, they will be able to fix grammar errors and misspelling etc.

(d) Mail Merge → Mail-Merge is an advanced feature and a powerful tool in Ms-word. Mail merge is used to create multiple copies, labels, envelopes and name tags that have the same lay out, formatting, text and graphics but contain sections that are personalised for each recipient.

This feature is very useful in sending out bulk e-mails or in creating printed letters.

(e) Real-time Collaboration → Ms-word offers collaboration tools and features, one of them is the capability of to make discussion by enabling team members, co-workers and stakeholders to add comments right next to the documents they are working on.

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Features of MS- Excel

(a) **Windows based application** → Microsoft Excel has an interface similar to windows operating system. Like all other windows applications, Excel has toolbars, shortcut menu, Autocorrect, online help and wizards. This make Excel easier to learn for users of windows.

(b) **Workbooks** → Workbooks are containers that hold one or more worksheets. Keeping all sheets that are related to a project in one file reduces the need to maintain different files.

(c) **Auditing** → Worksheet auditing is a feature that checks a worksheet for errors. Auditing can be used to relate formulas in different cells and locate the source of a calculation error.

(d) **OLE support** → Excel worksheets can contain any object, like a document, a picture or a video clip. This feature is known as object Linking and Embedding (OLE). This capability can be used to integrate Excel with all other applications.

(e) **Data entry forms** → We can create data entry forms within a worksheet. Validation rules and formatting can be included within a form.

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① Large data management Capacity → Excel can maintain large volumes of data at a time. A worksheet can contain 65,536 rows and 256 columns. A single cell can contain a maximum of 255 characters. One workbook can contain a maximum of 255 worksheets. Such data management capacities make Excel a powerful spreadsheet application.

② Data Analyses Features → Excel contains powerful tools that help in data analyses. Pivot tables, Microsoft Query and Data Map tools allow users to present data in different ways to facilitate analyses.

Role of Formulas in MS-Excel

A function is a predefined formula that performs calculations using specific values in a particular order. Excel includes many common functions that can be used to quickly find the sum, average, count, maximum value and minimum value for a range of cells.

There are variety of functions available in excel. Some of the most common functions are —

@ Sum → This function add all of the values

of the cells in the argument.

(b) Average → This function determines the average of the values included in the argument. It calculates the sum of the cells and then divides that value by the of cells in the argument.

(c) Count → This functions counts the number of cells with numerical data in the argument. This function is useful for quickly counting items in a cell range.

(d) Max → This function determines the highest cells [~~with [numerical data in the argument~~] ↳ value included in the argument.

(e) Min → This function determines the lowest cell value included in the argument.

Cells → In MS-Excel, a cell is a ~~re~~rectangular box that occurs at the intersection of a vertical column and a horizontal row in a worksheet. Verticals columns are numbered with alphabetic values such as A, B, C.

	A	B	C
1			
2			
3			

A cell can only store 1 piece of data at a time. We can store data in a cell such as a formula, text value, numeric value, or date value.

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Applications of MS- Excel one of the best use of MS-Excel is that we can analyze larges amounts of data, ~~for discover trends~~. With the help of graphs and charts, we can summarize the data and stored it in an organized way so that we can use easily.

→ For billing pupose
→ data management
→ Analyses
→ Inventory
→ Finance
→ Finance
→ Business tasks
→ complex calculations

Spreadsheets → A spreadsheet in MS-Excel is basically a worksheet which is divided into rows and columns to store data related to business inventories, income and expenses, debits and credits.

A spreadsheet or worksheet is a file made of rows and columns that help sort data, arrange data easily and calculate numeric data. What make a spreadsheet software program unique is its ability to calculate values using mathematical formulas and the data cells.

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Relationship between worksheet and spreadsheet Or Difference between worksheet and spreadsheet

A spreadsheet has a collection of worksheets that combine to form a workbook whereas a worksheet is one page present within the workbook.

A spreadsheet file can contain multiple worksheets whereas a worksheet is the "grid" that becomes useful for the purpose of filling information.

Use of spreadsheet → A spreadsheet is used to prepare list, to produce different types of summary, such as product-sale details, balance sheet, list of items in the stock etc. A spreadsheet is a software using which, we can calculate, manipulate and analyze numeric data.

Purpose of using the spreadsheet → Mostly spreadsheets software are used for the following purpose :-

(a) **Speed** → using spreadsheets, most of the tasks can be done very quickly. This saves a large amount of time and labour.

(b) **Automation of Recalculation** → If we

have implemented some formula on some numbers for some calculation. If the numbers have been changed then the re-calculation will be happening automatically. We don't need to give any command to it.

(c) Formatting → We can bold, italic, underline etc. on any text on the sheet.

(d) Copy and Reuse our worksheet → We can make the copy of our worksheet and save it with a new name and we make changes in it, if we want.

(e) Reverse changes → If we have removed some data accidentaly from the worksheet then the undo the feature in spreadsheet enables us to restore that data with a simple command (Ctrl + Z in MS-Excel).

(f) Creation of charts → Charts or pictorial representation of data can be easily created.

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Features of spreadsheets → There are number of features that available in Excel to make our task easies. Some of the main features are —

(a) **Autosum** → Help us to add the contents of a cluster of adjacent cells.

(b) **List AutoFill** → Automatically extends cell formatting when a new item is added to the end of the list.

(c) **AutoShapes** → Tool bar will allows us to draw a number of geometrical shapes, arrows, flow chart elements, stars and more. With these shapes we can draw our own graphs.

(d) **Drag and Drop** → It will help us to reposition the data and text by simply dragging the data with help of mouse.

(e) **Charts** → It will helps us in presenting a graphical representation of our data, in the form of pie, bar, line charts and more.

(f) **Pivot table** →

(g) **Shortcut Menu** → To commands that are appropriate to the task that we are doing will appear by clicking the right mouse button.

developed by Microsoft. Powerpoint is a presentation program that is commonly used for both business and classrooms.

MS- PowerPoint → PowerPoint is a presentation tool that helps create an effective presentation. A presentation or slides comprises of individual slides arranged in a sequential manner. Normally, each slide would cover a brief topic.

Need of PowerPoint → If we want to give speeches or we want to explain some topics to others or we need to create information that is to be presented live by a computer or on a web site, then we have need of presentation graphics. MS- PowerPoint is a very powerful presentation graphics software.

PowerPoint Views → In MS- PowerPoint, we can view our presentation in 6 different ways. The description of all the six views are as follows :-

(a) **Normal View →** When we open a presentation, it opens in Normal view, by default. In normal view, ~~we see the three panes that show that~~ outline, the slide and an area into which we can enter speakers note where we can write and design our ppt.

(b) **Outline View →** This view can display only the text of the slides in outline form, allowing us to do operations like cut, copy, paste etc. easily with the contents.

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Sorter

(c) Slide Sorter → In this view, we can see our entire set of slides in small size on the screen at once. So, we can easily arrange the slides in order and see all the slides on one screen.

(d) Slide View → In this view, we can see only the current slide and its contents. It is the easiest view to use if we are designing our presentation slide by slide.

(e) Slide Show View → In this view, we can see our entire set of slides in small size on the screen at once. So, we can easily arrange the slides in order and see all the slides one one screen.

(f) Notes Page → To open this view, click on the "View" menu ⇒ "Notes Page" option. In this view, we can enter and edit speakers notes for the speakers.

Slide Show View → Slide show view occupies the full computer screen, exactly like an actual presentation. In this view, we can see our presentation the way, our audience will.

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Use of PowerPoint → PowerPoint is a computer program that allows us to create and show slides to support a presentation. We can combine text, graphics and multi-media content to create professional presentations.

→ Uses in school to discuss topics

→ In Business to creating a plan, Executive, marketing strategies and making system easier to follow and integrate.

→ Professional can use for their views.

→ To Create Interactive Quiz.

→ To web design with hyperlink and Interactivity.

→ To create a chart etc.

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MS-ACCESS → MS-Access is a database management system from Microsoft that combines the relational Microsoft Jet Database Engine with a graphical user Interface and software development tools. It is a member of the Microsoft office suite of Applications.

Use of MS-ACCESS → MS-Access stores data in its own format based on the Access Jet database Engine. It can also import or link directly to data stored in other applications and databases. Software developers, data architects and power users can use MS-Access to develop application software.

→ It is used by small business, departments of large corporations, and by amateurs ( ) to create applications on their desktop for data applications.

→ Access is very useful for small web based database applications hosted on IIS and using ASP.NET Pages.

→ In school, it is very useful for library. It can use to create, edit and maintain database.

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Parts of MS-Access

→ Tables
→ Relationships
→ Queries
→ Forms
→ Reports
→ Macros
→ Modules

Field types (Data types) used in MS-Access

→ text
→ Memo → for storing large information such as notes etc
→ Numbers
→ Date / Time
→ Currency
→ Autonumber
→ Yes/No
→ OLE object

Ms-table → A table is where data is stored and a table lives within a database. Without a database, there can be no tables. A table is a grid made up of rows and columns and allows for direct data entry into their grids. The row is the record that contains the individual data pieces making up an individual record.

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Ways to create a Table in MS-Access

We can create a table by creating a new database, by inserting a table into an existing database, or by importing or linking to a table from another data source — such as MS-Excel, MS-Word document, a text file or another database.

(a) Create a new table in a new database

(b) Create a new table by using a table template

(c) Create a table by importing and/or linking to external data.

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History and Generations of Computers →

By 1822, the English mathematician Charles Babbage was proposing a steam driven calculating machine the size of a room, which he called the Difference Engine.

It is the first mechanical computers. The machine would be able to computer tables of numbers, such as logarithm tables.

In 1837, charles Babbage started work with Analytical Engine that was the advanced form of Difference Engine. In which Arithmetic logic unit, Basic flow control, punch cards and integrated memory was added but due to funding issues, it was not completed.

In 1840, Augusta Ada Byron suggests to charles babbage that he use the binary system. She writes the program for the Analytical Engine. So Augusta Ada is known as first Computer programmer.

In 1890, Herman Hollerith developed the first electromechanical punch card tabulas. This machine could read information punched into cards.

John Von Neuman developed the idea of the central processing unit (CPU).

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Electronic Digital Computer

Classification of generations of Computers

Generations of Computers	Generation timeline	Evolving hardware
First generation	1942 – 1955	Vacuum tube based
Second generation	1955 – 1964	Transistors based
Third generation	1964 – 1975	Integrated Circuit based
Four generation	1975 – 1989	Microprocessor based
Fifth generation	1989 to present	Artificial Intelligence based

Basic terms →

Vacuum tube → An electronic device that controls the flow of electrons in a vacuum. It used as a switch, amplifier or display screen in many older model radios, televisions, computers etc.

Transistors → An electronic component that can be used as an amplifier or as a switch. It is used to control the flow of electricity in radios, televisions, computers etc.

Integrated Circuit → A small electronic circuit printed on a chip that contains many its own circuit elements (i.e transistors, capacitors, resistors, diodes etc.)

Microprocessor → An electronic component held on an integrated circuit that contain

a computers Central processing unit (CPU) and another associated circuits.

Magnetic Drum → A cylinder coated with magnetic material, on which data and programs can be stored.

Magnetic core → uses arrays of small rings of magnetized material called cores to store information.

Artificial Intelligence → (AI) An area of computer science that deals with the simulation and creation of intelligent machines or intelligent behave in computers (they think, learn, work and react like humans).

Memory → A physical device that is used to store data, information and program for a computer.

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First Generation Computers (1942 – 1955)

Main electronic component → Vacuum tube

Main Memory → Magnetic drums and Magnetic tape

Programming Language → Machine Language

Power → consume a lot of electricity and generate a lot of heat.

Speed and Size → very slow and very large in size (often taking up entire room)

Input / output devices → punch cards and paper tape.

Examples → ENIAC, UNIVAC 1, IBM 650 etc.

Second Generation Computers (1955 – 1964)

Main electronic component → Transistors

Memory → Magnetic Core and magnetic tape/disk

Programming Languages → Assembly language

Power and size → less power consumption, generated less heat and smaller in size (in comparison with the first generation computers)

Speed → Improvement of speed and reliability (Comparison to first generation Computers)

Input / output devices → punched cards and magnetic tapes

Examples → IBM 1401, IBM 7090 and 7094 etc.

Third Generation Computers (1964-1975)

Main electronic component → Integrated circuits (ICs).

Memory → Large magnetic core, magnetic tape or disk.

Programming Language → high level language (C, FORTRAN, PASCAL, BASIC etc.)

Size → Smaller, cheaper and more efficient than 2nd generation computers

Speed → Improvement of speed and reliability (in comparison with 2nd generation computers)

Input / output devices → magnetic tape, keyboard, monitor, printer etc.

Examples → IBM 360, UNIVAC 1108 etc.

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Fourth Generation of Computers → 1975-1980

Main electronic component → Very large-scale integration (VLSI) and microprocessor

VLSI → thousands of transistors on a single microchip

Memory → Semiconductor memory (such as RAM, ROM etc.

RAM → Random access memory

ROM → Read only memory

Programming Language → high level language (Python, C#, Java, Javascript etc.)

Size → Smaller, cheaper and more efficient than 3rd generation computers.

Speed → Improvement of speed, accuracy and reliability (in comparison to 3rd generation computer)

Input / output devices → Keyboard, pointing devices, scanner, monitor, printer etc.

Network → A group of two or more computer systems linked together.

Examples → IBM PC, STAR 1000, APPLE II etc.

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Fifth Generation of Computers (1989 to present)

Main electronic component → based on Artificial Intelligence, uses the Ultra Large-Scale Integration (ULSI) technology and parallel processing method.

ULSI → millions of transistors on a single microchip

Parallel processing Method → use two or more microprocessors to run tasks simultaneously.

Language → understand natural language

Power → consume less power and generate less heat

Speed → remarkable improvement of speed, accuracy and reliability

Size → portable and small in size and have a huge storage capacity.

Input/output devices → keyboard, monitor, mouse, trackpad, touchscreen, pen, speech input (recognise voice / speech), light scanner, printer etc.

Example → Desktops, laptops, tablets, smartphones etc.

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Uses of Computers → computers are playing a vital role in almost every field and making our day-to-day tasks more manageable. We have elaborated the most common uses of computers in different fields:

(a) Business
(b) Science
(c) Government
(d) Health and Medical
(e) Education
(f) Industry
(g) Industry
(h) Banking
(i) Entertainment
(j) Training
(k) Arts
(l) Sports
(m) Robotics
(n) Safety and security
(o) Publishing
(p) Weather forecasting
(q) Communication
(r) Home
(s) Library
(t) Defence
(u) Space technology

(5)

1) Binary addition

0	0	1	
0	+1	+0	1
+0			+1
0	1	1	10

ex →

```
  111  → 7
  101    5
 1100   12
```

2) Binary subtraction →

0-0 = 0
1-1 = 0
1-0 = 1
0-1 = 1 (with a transfer, borrow of 1)

(a)

```
  11
- 01
  10
```

(b)

```
  100
- 011
  001
```

3) Binary multiplication →

0×0 = 0 , 0×1 = 0
1×0 = 0 , 1×1 = 1

(a)

```
   101
 ×  11
   101
  101
  1111
```

(b)

```
     1011
   × 1010
     0000
    1011×
   0000××
  1011×××
  1101110
```

4) Division →

```
       10.1
110 ) 1111
      110
       110
       110
       000
```

```
      10
11 ) 110
     11
     00
     00
     ××
```

```
      100
11 ) 1100
     11
     00
     00
      00
      00
      00
```