"OVERVIEW OF COMPUTERS"

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* Computers :~

A computer is a machine or device that performs processes, calculations and operations based on instructions provided by a software or hardware program. It is designed to execute applications and provides a variety of solutions by combining integrated hardware and software components.
A computer is made up of multiple parts and components that facilitate user functionality.
A computer has two primary categories :-

- Hardware :~ Physical structure that house a computer's processor, memory, storage, communication ports and peripheral devices.
- Software :~ Includes operating system (OS) and software applications. A computer works with software programs that are sent to its underlying hardware architecture for reading, interpretation and execution. Computers are classified according to computing power, capacity, size, mobility and other factors.

Advantages of computers :-

1. Speed.
2. Accuracy.
3. stores huge amount of data.
4. online trading.
5. online education | Distance learning.
6. Research.
7. Forecasting weather and predicting earthquakes, volcano eruptions.
8. Produce Employment.

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Disadvantages of computers:

1. Health Issues.
2. Spread of virus and hacking attacks.
3. computer can not take their own decision NO IQ.
4. Negative effect on Environment.
5. crashed networks.
6. computer can not work on itself.
7. spread of violence, hatred.
8. Online cyber crimes.
9. Data and Information violation.
10. Spread of unnecessary videos and Images.

* Block diagrams & discriptions:-

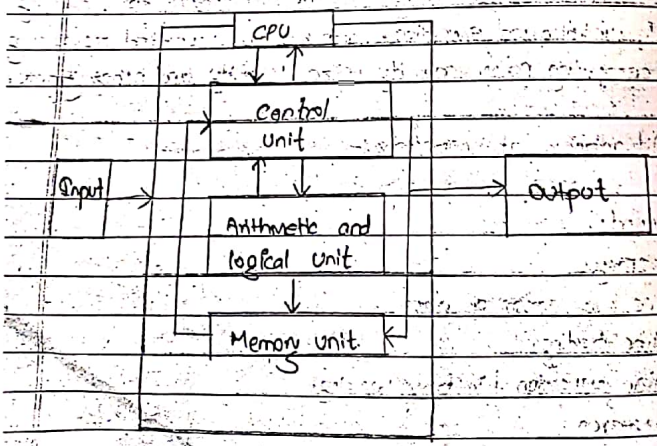

fig :- Block Diagram of computer.

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Discriptions:-

1. Input Unit :- Input unit or Input devices are the peripherals or pieces of hardware equipment used to provide as well as control signals to the information processing system. Input devices are used to translate data so that the computer is able to translate data so that and work with. In essence, input devices transform data from the form understandable by humans to the form understandable by that a computer understands.

The common input devices are:-

- Keyboard
- Scanner
- Mouse
- Webcam
- Microphone.
- Touchscreen touchpad.
- Cameras.
- Gamepad.
- Digital camera.
- Joystick.
- Pen input.
- Electronic Whiteboard.
- Video capture hardware.
- Trackballs.

2. CPU :- CPU stands for central processing unit and it's considered the brain of a computer. CPU takes care of all functions and processes. In terms of computing power, the central processing unit is the most crucial elements of the system.

The CPU is the heart and brain of a computer. It receives data input, executes instructions, and processes information. It communicates with input/output (I/O) devices, which send and receive data to and from the CPU. There are three components inside the CPU. They are;

→ Control unit.
→ Arithmetic logic unit (ALU).
→ Memory unit

To function properly, the CPU relies on the system clock, memory, secondary storage, and data and address buses.

This term is also known as a central processor, microprocessor or chip.

a) Control unit :- This hardware works to control and coordinate the components of a computer. It reads the code for the subsequent instruction to be executed. It increases the counter of the program to enable it to point to the next instruction. It reads the data required by the instruction from the memory cells. It provides the necessary data to register or arithmetic logic unit. If the instructions require specialized hardware or arithmetic logic unit to complete the control unit instructs the hardware to execute the requested operation.

b) Arithmetic logic unit - ALU :- This hardware executes the arithmetic as well as logical operations. When talking of arithmetic calculations, they are calculations like addition, multiplication, subtraction, and division. Logical operations involve comparing letters, numbers, and special characters.

c) Memory unit :- A computer has primary and secondary memory. Random Access Memory (RAM) is the found in the computer and it is used to store data temporarily to allow the processor access it as and when needed. An important thing to point out is that the data stored in the RAM scheme is erased when power supply to the storage is cut off. The reason is it called random access is because a user can directly access any given memory cell if they know the column and row that intersect at the particular cell. ROM is also a memory unit. Secondary unit are also there. Such as hard disk, optical disk drive (ODD), floppy disk, SD card etc.

3) Output devices/unit :-

These are devices or computer hardware used to relay or communicate the results obtained from the data processing activity from the information processing system or the computer. The output device converts the information to a form that is readable by humans.

Examples of output devices are;

- Monitor
- Printer
- computer output Microfilm.
- LCD projection panels.
- Speakers.
- Plotters.
- Projectors.

Generations of computers:-

There are five generations of computers, they are

- First generation ⇒ 1940-1956
- Second generation ⇒ 1956-1963
- Third generation ⇒ 1964-1971
- Fourth generation ⇒ 1972-2010.
- Fifth generation ⇒ 2010!

1. First generation computer :- 1940-1956 is the period of first generation computer. J.P Eckert and J.W Mauchy invented the first successful electronic computer called ENIAC; ENIAC stands for "Electronic Numeric Integrated And Calculator!"

eg:- ENIAC, EDVAC, UNIVAC, IBM-701, IBM-650 etc.

Advantages:-

a) These are made of vacuum tubes which are the only electronic component available during those days.
b) These computers could calculate in milliseconds.

Disadvantages:-

a) Very big in size.
b) Based on vacuum tubes.
c) Very costly.
d) It could store only a small amount of information due to the presence of magnetic drums.
e) required a large cooling system.
f) Very less work efficiency.
g) limited programming capabilities and punch cards were used to take inputs.
h) large amount of energy consumption.
i) Not reliable and constant maintenance is required.

2. Second generation computers :- 1956-1963 is the duration for second generation computers.

2nd generation computers were based on Transistor instead of vacuum tubes.

eg; Honeywell 400, IBM 7094, CDC 1604, CDC 3600, UNIVAC 1108 etc.

Advantages :-

a) Due to the presence of transistors instead of vacuum tubes, the size of electron component decreased. This resulted in reducing the size of a computer :.
b) Less energy and not produce as much heat as 1st generations.
c) Assembly language and punch cards were used for input.
d) Low cost than 1st generation computers.
e) Better speed, calculate data in microseconds.
f) Better portability as compared to first generation.

Disadvantages :-

a) A cooling system was required.
b) constant maintenance was required.
c) only used for specific purposes.

3) Third generation computers :- (1964-1971) is the period for third generation computers. These computers were based on Integrated circuits. IC was invented by Robert Noyce and Jack Kilby in 1958-1959. IC was a single component containing number of transistors.

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examples; PDP-8, PDP-11, ICL 2900, IBM 360 etc.

Advantages

1) These computers were cheaper as compared to 2nd and 1st.
2) They were fast and reliable.
3) use of IC in the computer provides the small size of the computer.
4) IC not only reduce the size of the computer but it also improves the performance of the computer as compared to previous computers.
5) Have big storage capacity.
6) Instead of punch cards, mouse and Keyboard are used for input.
7) They used an operating system for better resource management and used the concept of time-sharing and multiple programming.
8) These computers reduce the computational time from milliseconds to nanoseconds.

Disadvantages

a) IC chips are difficult to maintain.
b) The highly sophisticated technology required for the manufacturing of IC chips.
c) Air conditioning is required.

4) Fourth generation computers :- (1972-2010) is the generation of fourth ones. This technology is based on microprocessor.
ex: Intel 4004, IBM etc. They used logged integrated circuits in the form of microprocessor.

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Advantages :-

- They were very small in size, and cost of operation was very less.
- They were very compact faster and reliable as they used very large scale integrated circuits.
- They were capable of facilitating the interactive on line remote programming on line remote programming by which one sitting at the distance place can get his programs executed by centrally located computer.

Disadvantages :-

- They are less powerful and had less speed than the main frame computers.
- They lacked thinking power and decision making ability.
- They had less storage capacity and needed further improvement.

5) Fifth Generation computers :- (2010- onwards) :- These are the computers emerging technology are considered as the fifth generation computers. These machines are designed to incorporate "Artificial Intelligence" and use stored reservoirs of knowledge to make expert judgements and design decision like human beings. They are also designed to process non numerical information like pictures and graphs using the very large scale integrated circuits.

Advantages :-

- They are oriented towards integrated data base development to provide decision models.

- They faster very cheap and have the highest possible storage capacity.
- They have thinking power and decision making capability and thereby they will be able to aid the executives in the management.

Disadvantages :-

- They need very low level languages, they may replace the human force and cause grievous unemployment problems.
- They may make the human brains dull and doomed.

Computer Hardware :-

Computer hardware is the collection of physical parts of a computer system. This includes the computer case, monitor, keyboard and mouse. It also includes all the parts inside the computer case. Basically, those components which are touchable are called computer hardware.

* Printers :-

A computer printer is a piece of hardware for a computer. It allows a user to print items on paper, such as letters and pictures. Mostly a printer prints under the control of a computer. Many can also work as a copying machine or with a digital camera to print directly without using a computer.

Types of printers :-

- Inkjet printers, also sometimes called bubble jet printers use colored ink they put on a paper.
- Plotters are large formal inkjet printers, or printers that use special pens.
- Laser printers transfer tiny particles of toner onto the paper. Most do not print colors.
- Dye sublimation printers produce very high quality images. Three colors are used. cyan, Magenta and Yellow. Each color is printed one at a time from cellophane sheets. The image is the sealed with clear top layer. some small photographic printers made by Kodak and canon use this process.

- Thermal printer is an inexpensive printer that works by pushing heated pins against heat-sensitive paper. Thermal printers are widely used in calculators and fax machines. Many 20th century computer printers worked this way.

- Impact printers worked by striking the paper with an inked ribbon. They were noisy.

→ Dot-matrix printers are now almost extinct. There were models with 9 pins and models with 24 pins.
→ Daisy wheel printers were a typewriter printer. Results looked hand-typed. They had no real graphics and very loud.

→ Line printers contain a chain of characters or pins that print an entire line at one time. Line printers are very fast, but produce low-quality print.

Producing outputs :-

Printers are programmed using a programm-

ed using a programming language. The printer interprets the program and the outputs the result. There are two big classes of such languages: Page description languages and printer control languages. A page description language describes what a page should look like. The program in a page ~~should be~~ description language is sent to the printer, which interprets them. Printer command languages are at a lower level than page description languages; they contain information that is specific to the printer model. common programming languages for printers include:-

- Esc/p.
- Postscript
- PCL
- GDI
- HPGL and HPGL/2
- PJP
- VPS

Printers Interfaces :-

→ Cat 5.
→ Firewire Mpp-1150
→ Parallel port.
→ SCSI:
→ Serial port USB
→ Wifi

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* Monitors :-

A computer Monitor is an electronic device that shows pictures for computers. Monitors often look similar to televisions. The main difference between a monitor and a television is that a monitor does not have a television tuner to change channels. Monitors often have higher display resolution than televisions. A high display resolution makes it easier to see smaller letters and fine graphics.

There are three types of computer displays:-

1. The CRT Monitor. These are big and heavy and use a lot of desk space and electricity. It is the oldest technology used by monitors and is based on the cathode ray tube technology that was developed for television. Monitors are made with better parts which give a higher display resolution and picture sharpness than a television. This type of monitor is no longer popular.

2. The LCD Monitor, the most common kind of flat panel display. It is a newer technology than CRT. LCD Monitors use much less desk space, are lightweight and use less electricity than CRT.

LED (Light Emitting Diode).

3. In the early 21st century the price of video projectors has fallen and they are now used in many places to show large images. These are various technologies to make the image including LCD – Liquid crystal displays and DLP – Digital light processing which uses very small mirrors to direct the light.

* Keyboard :-

A computer keyboard is an input device that allows a person to enter letters, numbers and other symbols (these are called characters) into a computer. It is one of the most used input devices for computers. Using a keyboard to enter lots of data is called typing.

A keyboard contains many mechanical switches called keys. When one of these are pushed, an electrical circuit is closed, and the keyboard sends a signal to the computer that tells it what letter, number or symbol it would like to be shown on the screen.

A keyboard can be joined to a computer using a wire, but can also be wireless (like those that use Bluetooth). Most 21st century keyboards that use wires connect to a USB port on the computer, but older ones use a less versatile DIN connector port.

* Mouse :-

A computer mouse is a handheld hardware input device that controls a cursor in a GUI and can move and select text, icons, files and folders. For desktop computers, the mouse is placed on a flat surface such as a mouse pad or a desk and is placed in front of your computer. The picture to the right is an example of a desktop computer mouse with two buttons and a wheel.

Uses of Mouse :-

→ Move the mouse cursor
→ Open or execute a program.
→ Selecting
→ Dragging and droping.
→ Hover.
→ Scrolling.
→ Perform other functions

By using a computer mouse, the user doesn't have to memorize commands, such as those utilized in a text-based command line environment like Ms-Dos. For example, in MS-Dos a user would have to know the cd command and dir command.

There are different parts. It has got central buttons, left and right click.

Storage devices

A storage device is any computing hardware that is used for storing, porting and extracting data files and objects. It can hold and store information both temporarily and permanently, and can be internal or external to a computer, servers or any similar computing device.

A storage device may also be known as a storage medium or storage media.

Storage devices are one of the core components of any computing device. They store virtually all the data and applications on a computer, except hardware firmware. They are available in different form factors depending on the type of underlying device. For

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There are two types of storage devices :-
They are primary storage and secondary storage :-

- Primary storage :- Known as main memory, directly or indirectly connected to CPU and executes the program.

1. RAM :-

→ It is called Random Access Memory because any of the data in RAM can be accessed just as fast as any of the other data.
→ There are two types of RAM :-
- DRAM (Dynamic Random Access Memory)
- SRAM (Static Random Access Memory)

Static RAM	Dynamic RAM
→ faster	→ slower.
→ More expensive	→ Less expensive
→ More power consumption	→ Less power consumption.
→ does not need to be refreshed	→ needs to be refreshed thousands of times per second.

2. ROM :-

→ This memory is used as the computer begins to boot up.
→ small programs called firmware are often stored in ROM chips on hardware devices (like a BIOS chip) and they contain instructions the computer can use in performing some of the most basic operations required to operate hardware devices.
→ ROM memory cannot be easily or quickly overwritten or modified.

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3. Cache :-

→ Cache is a high-speed access area that can be either a reserved of main memory or a storage device.
→ Most computers today come with L3 cache or L2 cache, while older computers included only L1 cache.

- Secondary storage :- It is not directly accessible by the CPU. computer usually uses its input/output channels to access secondary storage and transfers the desired data using intermediate area in primary storage.

1. Hard disk :-

→ The hard disk drive is the main, and usually largest, data storage device in a computer.
→ It can store anywhere from 160 gigabytes to 2 terabytes.
→ Hard disk speed is the speed at which content can be read and written on a hard disk.
→ A hard disk unit comes with a set rotation speed ranging from 4500 to 7200 rpm.
→ Disk access time is measured in milliseconds.

2. Magnetic tape :-

→ A magnetically coated strip of plastic on which data can be encoded.
→ Tapes for computers are similar to tapes used to store music.
→ Tape is much less expensive than other storage mediums but commonly a much slower solution that is commonly used for backup.

3. optical disc :-

→ optical disc is any storage media that holds content in digital format and is read using a laser assembly is considered optical media.

→ The most common types of optical media are Blu-ray (BD), compact disc (CD), digital versatile disc (DVD)

4. Floppy Disk :-

→ A soft magnetic disk.

→ Floppy disks are portable.

→ Floppy disks are slower to access than hard disks and have less storage capacity, but they are much less expensive.

→ Can store data up to 1.44 MB.

→ Two common sizes 5¼" and 3½".

5. Zip Diskette :-

→ Hardware data storage device developed by Iomega that functions like a standard 1.44" floppy drive.

→ capable to hold up to 100 MB of data or 250 MB of data on new drives.

→ Now it less popular as users needed larger storage capabilities.

6. USB flash Drive :-

→ A small, portable flash memory card that plugs into a computer's USB port and functions as a portable hard drive.

→ Flash drives are available in sizes like 16GB, 1GB, 5GB and are an easy way to transfer and store information.

7. Memory card :-

→ An electronic flash memory storage disk commonly used in consumer electronic devices such as digital cameras, MP3 players, mobile phones and other small portable devices.

→ Memory cards are usually read by connecting the device containing the card to your computer, or by using a USB card reader.

• Features of storage devices :-

→ Volatility.

→ Accessibility.

→ Mutability.

→ Addressability.

Addressability → Location adressing.
→ file addressing.
→ content addressing.

Mutability :- helps in overwritten, slow write and all.

Accessibility :- helps in sequencing and ordering the files.

Volatility :-

Volatile Memory.

→ Requires constant power to maintain the stored information.

→ The fastest memory technologies.

→ All contents are erased when the system's power is turned off or interrupted.

→ It has been more popularly known as temporary memory.

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Non-volatile Memory :-

→ will retain the stored information even if it is not constantly supplied with electric power.
→ Non volatile memory is the device which keeps the data even when the current is off.
→ It is suitable for long-term storage of information.

Number System

Number systems are the technique to represent numbers in the computer system architecture; every value that you are saving or getting into/from computer memory has a defined number system.

Computer architecture supports following number system:-

- Binary number system.
- Octal number system.
- Decimal number system.
- Hexadecimal (hex) number system.

Binary Number system :- A Binary number systems has only two digits that are 0 and 1. Every number (value) represents with 0 and 1 in this number system. The base of binary number system is 2, because it has only two digits.

0 and 1.

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Octal number system :- Octal number system has only eight (8) digits from 0 to 7. Every number (value) represents with 0, 1, 2, 3, 4, 5, 6 and 7 in this number system. The base of octal number system is 8, because it has only 8 digits.

Decimal number system :- Decimal number system has only ten (10) digits from 0 to 9. Every number (value) represents with 0, 1, 2, 3, 4, 5, 6, 7, 8 and 9 in this number system. The base of decimal number system is 10, because it has only 10 digits.

Hexadecimal number system :- A Hexadecimal number system has sixteen (16) alphanumeric values from 0 to 9 and A to F. Every number (value) represents with 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E and F in this number system. The base of hexadecimal number system is 16, because it has 16 alphanumeric values. Here A is 10, B is 11, C is 12, D is 13, E is 14 and F is 15.

CONVERTION of Number System :-

1 byte = 8 bits
1 nibble = 4 bits
1KB = 1024 bits 2^{10} B
1MB = 1024 KB 2^{20} B.
1TB = 1024 MB 2^{30} B.
Right LSB = lowest significant bit
Left MSB = Most significant Bit.

Binary number system is the weighted code because we can assign to different way of bit.

• $(189.20)_{10} = (?)_2$

		Remainder
2	189	1
2	94	0
2	47	1
2	23	1
2	11	1
2	5	1
2	2	1
2	1	0
	0	1

.20	
× 2	
.40	0
× 2	
.80	0
× 2	
1.60	1

$\therefore (189.20)_{10} = (10111101.001)_2$.

* From Hexadecimal ⟶ Binary.

• $(AC1)_{16} = (?)_2$

⇒ A = 1010
C = 1100
1 = 1

$\therefore (AC1)_{16} = (101011001)_2$.

* Octal ⟶ Binary

• $(72)_8 = (?)_2$

		Remainder
8	72	
8	9	0
8	1	1
	0	1

$\therefore (72)_8 \rightarrow (190)_{10}$

Now,

		Remainder
2	190	
2	895	0
2	47	1
2	23	1
2	11	1
2	5	1
2	2	1
	1	0
	0	1

$\therefore (72)_8 = (10111110)_2$ Ans

* Octal → Decimal.

$(72)_8 = (?)_{10}$

Solution,

		Remainder
8	72	
8	9	0
8	1	1
	0	1

$\therefore (72)_8 = (1010)_{10}$.

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* Decimal → octal

• $(32)_{10} = (?)_8$

		Remainder
8	32	
8	4	0
	0	4

$\therefore (32)_{10} = (40)_8$

• $(32.10)_{10} = (?)_8$

⇒ solution,

		Remainder
8	32	
8	4	0
	0	4

.10
×8
.80 0
×8
6.40 6

$\therefore (32.10)_{10} = (40.06)_8$

* Decimal → Hexadecimal

• $(62)_{10} = (?)_{16}$

Programming Language

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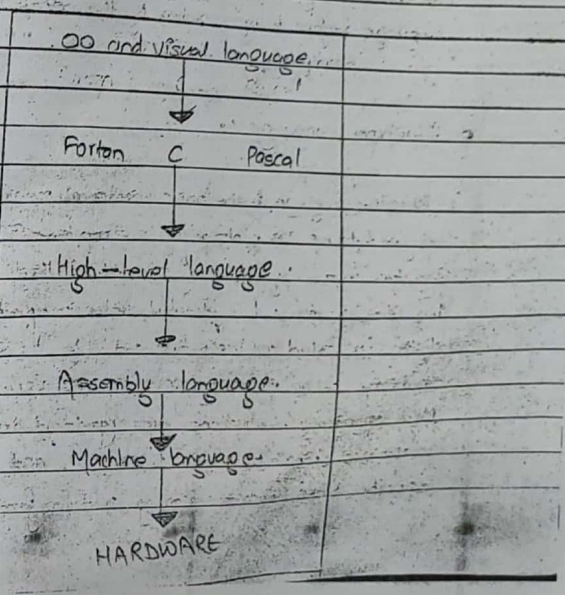
Introduction :~ A computer is a computerttional device which is used to process the data under the control of a computer program. Program A programming language is a formal language, which comprises a set of instructions used to produce various kinds of output. Programming languages are used in computer programming to create programs that implement specific algorithms. Most programming languages consist of instructions for computers, although there are programmable machines that use a limited set of specific instructions, rather than the general programming language of modern computers. Thousands of programming languages have been created, mainly in the computer field, and many more still are being created every year. The description of a programming language is usually split into the two components of syntax (form) and semantics (meaning).



- High-level languages :~ A high-level language is any programming language that enables development of a program in a much more user-friendly progra context and is generally independent of the computer's hardwa architecture. A high-level language has a higher level of abstra from the computer, and focuses more on the programming l rather than the underlying hardware components such as memor addressing and register utilization.

High-level languages are designed to be used by the human operator or the programmer. They are referred to as "closer humans." In other words, their programming style and context easier to learn and implement than low-level languages, and the entire code generally focuses on the specific program to created.

A high level language does not require addressing hardware constraints when developing a program. However, every single prog written in a high-level language must be interpreted into machi language before being executed by the computer.

Examples; C, C++, Java etc.

- Machine language :~

Machine language is the basic low-level programming language designed to be recognized by a computer. Actually the language written in a binary code of 0s and 1s that represent electric impulses or off and on electrical states respectively. A group of 8 digits is called an instruction and it is translated into a comm that the central processing unit or CPU understands.

More specifically, instructions are organized in patterns of 0s and in various length such as 16, 24, 32, and 64 digits or bits, eac specific tasks such as storing or transferring data. An instructio

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is made up of two parts; the operator or opcode and the operand. The first few bits of an instruction are the "operator or opcode." whose role is to specify the kind of operation that needs to be performed.

Another example of binary machine language is the binary-coded decimal, where decimal numbers are encoded in binary form. Each decimal digit is coded as a four-digit binary number as follows:

- 0000 = 0, 0001 = 1, 0010 = 2, 0011 = 3 etc.

- Assembly language :~

Assembly language is any low-level programming language in which there is a very strong correspondence between the program's statements and the architecture's machine code instructions. Each assembly language is specific to a particular computer architecture and operating system. In contrast, most high level programming languages are generally portable across multiple architectures but require interpreting or compiling. Assembly language may also be called symbolic machine code.

Assembly language usually has one statement per machine instruction, but assembler directives, macros and symbolic labels of program and memory locations are often also supported. Assembly code is converted into executable machine code by a utility program referred to as an assembler. The conversion process is referred to as assembly, or assembling the source code.

	Points	Low level languages	High level language
1.	Platform Dependencies	LLL are platform dependent that means programms written in LLL can run on the same hardware.	They are platform independent that means programms written in these languages run in different hardware.
2.	Speed	Faster than HLL.	bit slower than LLL.
3.	Easiness	Are not as easy as HLL.	Easier than LLL.
4.	Performance	LLL are faster so, performance of these language are better.	HLL are bit slower.
5.	Translation	Do not need any translators.	Needs compiler and interpreter.
6.	Flexibilities	Not flexible enough to read, debug etc.	flexible enough to read, debug etc.
7.	Support	these languages have less support than high level languages.	these languages have more support than low level languages.

Compiler And Interpreter

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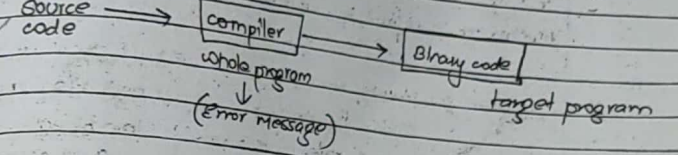
* **Compiler :-** A compiler is a program that reads a program written in the high-level language and converts it into the machine or low-level language and reports the errors present in the program. It converts the entire source code in one go or could take multiple passes to do so, but at last, the user gets the compiled code which is ready to execute.

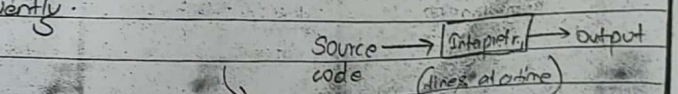


* **Interpreter :-**

The interpreter is an alternative for implementing a programming language and does the same work as a compiler. Interpreter performs lexing, parsing and type checking similar to a compiler. But interpreter processes syntax tree directly to access expressions and execute statement rather than generating code from the syntax tree.

An interpreter may require processing some syntax tree more than once that is the reason why interpretation is comparatively slower than executing the compiled program.

Employing an interpreter is advantageous during program development, where the most important part is to be to test a program modification rapidly rather than run the program efficiently.



*	Points	compiler	Interpreter.
1.	Input	It takes an entire program at a time.	It takes a single line code or instruction at a
2.	output	It generates intermediate object code.	It does not produce a intermediate object cod
3.	working Mechanism	The compilation is done before execution.	compilation and execu take place simultaneo
4.	speed	Memory requirement is more due to the creation of object code. (less speed)	It requires less mem as it does not create Intermediate obj cod (more speed)
5.	Errors	Display all errors after compilation, all at the same time.	Displays error of each line one by one
6.	Error detection	Difficult	Easier comparatively
7.	Memory	It takes more memory due to generation of obj code or binary code or machine code.	It takes less memory.
8.	Pertaining Programming languages	C, C++, C#, Scala, typescript, uses compiler.	PHP, Perl, Python, Ruby uses an Interpreter.

* Debuggers :-

A debugger is a computer program used by programmers to test and debug a target program. Debuggers may use instruction-set simulators, rather than running a program directly on the processor to achieve a higher level of control over its execution. This allows debuggers to stop or halt the program according to specific conditions. However, use of simulators decreases execution speed.

When a program crashes, debuggers show the position of the error in the target program. Most debuggers also are capable of running programs in a step-by-step mode, besides stopping on specific points. They also can often modify the state of programs while they are running.

* Linker :-

There are certain programs which are large its size and cannot be executed at one go simultaneously. Such programs are divided into subprograms also known as modules. The linker is used to link such small programs to form one large program.

Function of linker :- For most compilers, each object file is the result of compiling one input source code file. When a program comprises multiple object files, the linker combines these files into a unified executable program, resolving the symbols as it goes along.

They are used in libraries (library function).

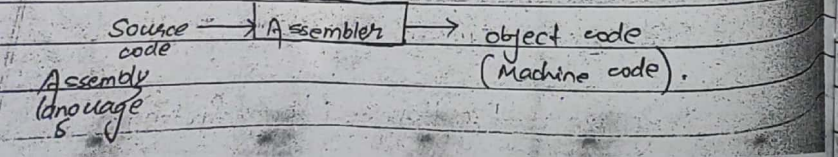
* Loader :- A loader is a major component of an operating system that ensures all necessary programs and libraries are loaded, which is essential during the startup phase of running a program. It places the libraries and programs into the main memory in order to prepare them for execution. Loading involves reading the contents of the executable file that contains the instructions of the program and then doing other preparatory tasks that are required in order to prepare the executable for running; all of which takes anywhere from a few seconds to minutes depending on the size of the program that needs to run. It validate the program for memory requirements, permissions etc. It also copy necessary files, copy required command-line etc. It also initialize the registers.

* Assembler :-

An assembler is a type of computer program that interprets software programs written in assembly language into machine language, code and instructions that can be executed by a computer.

An assembler enables software and application developers to access, operate and manage a computer's hardware architecture and components.

An assembler is sometimes referred to as the compiler of assembly language. It also provides the services of an interpreter.



* Difference between linker and loader.

	Basis	Linker	Loader
1.	Basic	It generates the executable module of a source program.	It loads the executable module to the main memory.
2.	Input	It takes as input, the object code generated by an assembler.	It takes executable module generated by a linker.
3.	Function	It combines all the object modules of a source code to generate an executable module.	It allocates the addresses to an executable module in main memory for execution.
4.	Type/ Approach.	Linkage editor, dynamic linker.	Absolute loading, Relocatable loading and dynamic run-time loading.

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Algorithms :-

An algorithm is a step by step method of solving a problem. It is commonly used for data processing, calculation and other related computer and mathematical operations. Technically, computers use algorithms to list the detailed instructions for carrying out an operations. For example, to compute an employee's paycheck, the computer uses an algorithm. To accomplish this task, appropriate data must be entered into the system. In terms of efficiency, various algorithms are able to accomplish operations or problem solving easily and quickly.

Process of writing algorithms :-

Step 1 :- obtain a description of the problem. This step is much more difficult than it appears.
Step 2 :- Analyze the problem
Step 3 :- Develop a high-level algorithm.
Step 4 :- Refine the algorithm by adding more detail.
Step 5 :- Review the algorithm.

- Examples :-

1) Algorithm to print 1 to 20.

⇒

Step 1 :- Initialize X as 0.
Step 2 :- Increment X by 1.
Step 3 :- Print X.
Step 4 :- If X<20, go to step 2.
Step 5 :- Exit.

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2. Algorithm to find the largest number of positive numbers and the

⇒

step 1 :- Set max to 0.
step 2 :- for each number x in the list L, compare it to max. If x is larger set max to x.
step 3 :- Max is now set to the largest number in the list.

3. Algorithm of adding three numbers :-

step 1 :- Enter any three integers a, b, c
step 2 :- Add three numbers
step 3 :- Store the result in integer d.
$d = a+b+c$
step 4 :- Execute d.

Algorithm to find greatest of three numbers :-

step 1 :- Enter the three numbers a, b, c.
step 2 :- compare any two number a and b.
step 3 :- If a is greater than compare it with c else compare b with c.
step 4 :- Store the result in integer d.

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Flowcharts :-

A flow chart is a type of diagram representing a process using different symbols containing information about steps or a sequence of events. Each of these symbols is linked with arrows to illustrate the flow direction of the process. Flowcharts are a methodology used to analyze, improve, documents and manage a process or program. flowcharts are helpful for :-

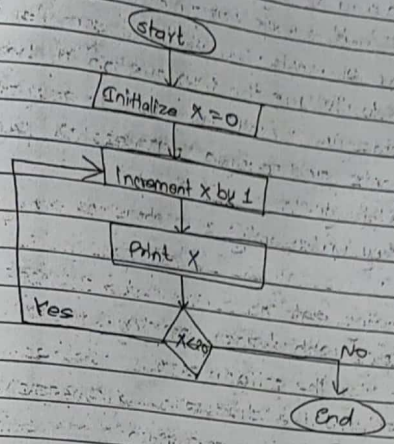
1. Aiding understanding of relationships among different process steps.
2. collecting data about a particular process.
3. Helping with decision making.
4. Measuring the performance of a process.
5. Depicting the structure of a process.
6. Tracking the process flow.
7. Highlighting important steps and eliminating the unnecessary steps.

A flowchart in computer science typically has the following types of symbol to represent a process a program.

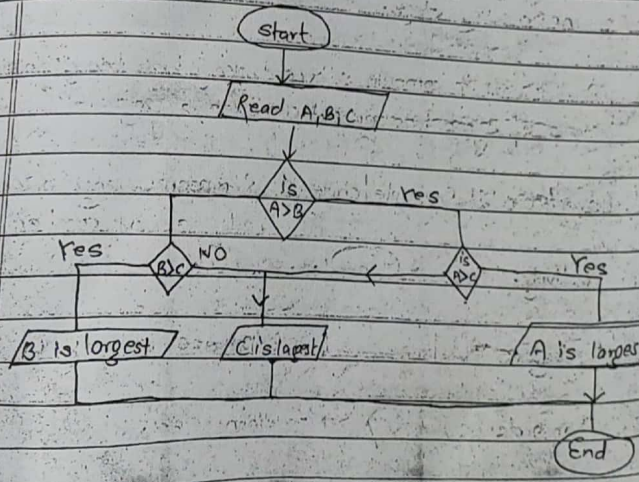
1. oval/Rounded Rectangle/circle :- Represents any process having a start and an end activity. ⬭.
2. Rectangles :- ▭ → process activity or step.
3. Diamonds :- ◇ → condition check.
4. Arrow lines :- ⟶ → shows the flow/connector.
5. parallelograms :- ▱ → used to represent input/output

* Examples of flowchart :-

1. Flowchart to print 1 to 20.



2. Flowchart to find the greatest of 3 numbers.



Operators :-

C language supports a rich set of built-in operators. An operator is a symbol that tells the compiler to perform a certain mathematical or logical manipulation. Operators are used in programs to manipulate data and variables.

Operators can be classified into following types :-

1. Arithmetic operators :- C supports all the basic arithmetic operators.

   Unary ⇒ works with single operand {++, --}

   binary ⇒ works with two operands {+, -, *, /, %}

operator	Description
+	adds two operands
-	subtract second operands from first.
*	Multiply two operand.
/	divide numerator by denominator.
%	remainder of division
++	Increment operator - increases integer value by one.
--	Decrement operator - decreases integer value by one.

2. Relational operators :- They are used for comparision of value of two operands.

operator	Description
==	check if two operand are equal.
!=	check if two operand are not equal.
>	check if operand on the left is greater than on right.
<	check if operand on the left is smaller " " " .
>=	check left operand is greater than or equal to right operand
<=	" if " " on left is smaller than or equal to right operand.

3. logical operators :-

operator	Description	Example
&&	logical AND	(a&&b) is false
||	logical OR	(a||b) is true
!	logical NOT	(!a) is false

4. Bitwise operators :

   Bitwise operators perform manipulations of data at bit level. These operators also perform shifting of bits from right to left. Bitwise operators are not applied to float or double (These are one datatypes we will learn about them in the next tutorial).

operator	Description
&	Bitwise AND
|	Bitwise OR
^	Bitwise exclusive OR
<<	left shift.
>>	right shift.

Example,

a	b	a&b	a|b	a^b
0	0	0	0	0
0	1	0	1	1
1	0	0	1	1
1	1	1	1	0

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5. Assignment operators :

operator	Description	Example
=	assigns values from right side operands to left side operand	a=b.
+=	adds right operand to the left operand and assign the result to left.	a+=b is same as a=a+b
-=	Substracts right operand from the left operand and assign the result to left operand.	a-=b is same as a=a-b.
*=	multiply left operand with the right operand and assign the result to left operand.	a*=b is same as a=a*b
/=	divides left operand with the right operand and assign the result to left operand	a/=b is same as a=a/b.
%=	calculate modulus using two operands and assign the result to left operand	a%=b is same as a=a%b

6. Conditional operator :

Expression 1? Expression 2 : Expression 3.

Expression 1 is a condition if that condition is true then expression two is returned. If it is false expression three is returned.

eg:-

b = (x>y) ? 3:4

b=4

x = 10, y = 11

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eg:- 2) z = (a>=b)?(a+b):(a-b)

19 : 3

a = 11, b = 8

⇒ 19.

7. Special operator.

operator	Description	Example
size of	Returns the size of an variable	size of(x) return size of the variable x.
&	Returns the address of an variable	&x; return address of the variable x.
*	Pointer to a variable	*x; will be pointer to a variable x.

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* Binary operations :-

Addition :-

0 + 0 = 0
0 + 1 = 1
1 + 0 = 1
1 + 1 = 0 with carry 1

•		•		•		•	
10011		101		10011		10011	
+ 1001		+ 10		+ 1011		+ 1101	
11100		111		11110		100001	

Subtraction :-

0 - 0 = 0
0 - 1 = 1 with borrow from next column.
1 - 0 = 1
1 - 1 = 0

•		•	
10101		10101	
- 01110		- 11111	
00111		- 10110	

* Compliment of a number :-

For a number having n digits, it's compliment is defined as the difference between the number and the base raised to the n^{th} power of minus 1.

$(226)_{10}$ = 999 − 226

$(226)_8$ = 779 − 226

$(6)_8$ = 7 − 06

$(6)_8$ = 77 − 16

* Additive subtraction of Numbers :-

Step 1 :- find compliment of number you are substracting.
Step 2 :- Add this to the number from which you are taking away.
Step 3 :- If there is a carry of 1, add it to the obtained results.
If there is no carry recompliment the sum and attach a negative sign to obtain the result.

• substract 35 from 18 using compliment method.

99
− 35
64
+ 18
82
↓
99 (becomes no carry)
− 82
− 17

* Compliment of a binary numbers :-

eg :- 10101010100
↓
compliment = 01010101011

• 1011100
− 0111000
↓
compliment = 1000111

Now,
adding 1011100
So, 1000111
+ 1011100
10100011
+1
01000100

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- 010010
  − 100011
  ↓ compliment = 011100
  Now, adding 010010
  011100
  + 010010
  101110 (because no carry)
  ↓
  compliment = 010001.

- 10101
  − 01110
  ↓ 10001
  + 10101
  100110
  → +1
  00111

* 2's compliment
step 1:- find 1's compliment of binary number.
step 2:- Add 1 to it.

eg:- 100011	01110
↓	↓
011100	10001
+1	+1
011101	10010

* Errors are of two types :-
→ Syntax error :- compiler checks only syntax error.
→ Semantic error :- compiler does not check semantic error.

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Operating System :-

- An OS is a program that acts as an interface between the s/f & comp
- It is an integrated set of specialized programs used to manage overall resources and operations of the computer.
- It is a specialized software that controls and monitors the execution of all other programs that reside in the computer, including application programs and other system software.

* Objectives of operating system :-
- To make the computer system convenient to use in an efficient manner.
- To hide the details of the hardware resources from the users.
- To provide users a convient interface to use the computer system.
- To act as an intermediary between the hardware and its users.
- To manage the resources of a computer system.
- To keep track of who is using which resource.
- To provide efficient and fair sharing of resources among users & programs.

* Characteristics of operating system :-
- Memory Management
- Processor Management
- Device Management
- File Management.
- Security
- Job Accounting
- control over system performance
- Interaction with the operators.
- Error-detecting Aids.
- coordination between other software & users.