Chapter 1: Introduction to Computer and Programming

Introduction::

- ᚖ Computer means to compute. It is electronic device.
- ᚖ Computer takes
    - o data and instructions as an input from the user,
    - o processes data and
    - o provides information
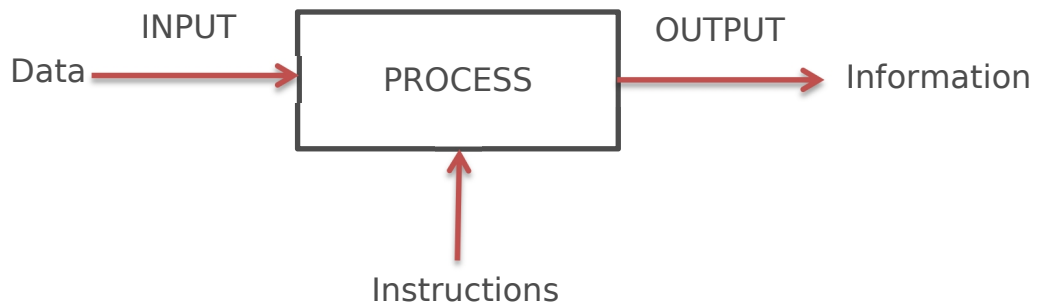- ᚖ Cycle is called Input-process-output cycle.

Fig 1: Input-Process-Output Cycle

- ᚖ Electronic Device is called Hardware and set of instructions in called Software.
- ᚖ Main fields where Computers are Widely Used
    - o Education
    - o Business
    - o Scientific
    - o Administrative
    - o Accounting
    - o Entertainment
    - o Medical

Functionality of modern computers:

- ᚖ Rapid and accurate calculation for complex and repetitive task.

- Store large amount of data.
- Hold the program of model/algorithm/design.
- Compare and make decision.
- Provide information in different forms – like graph, figures, tables, videos and audios, etc.
- Automatically modify and control system.
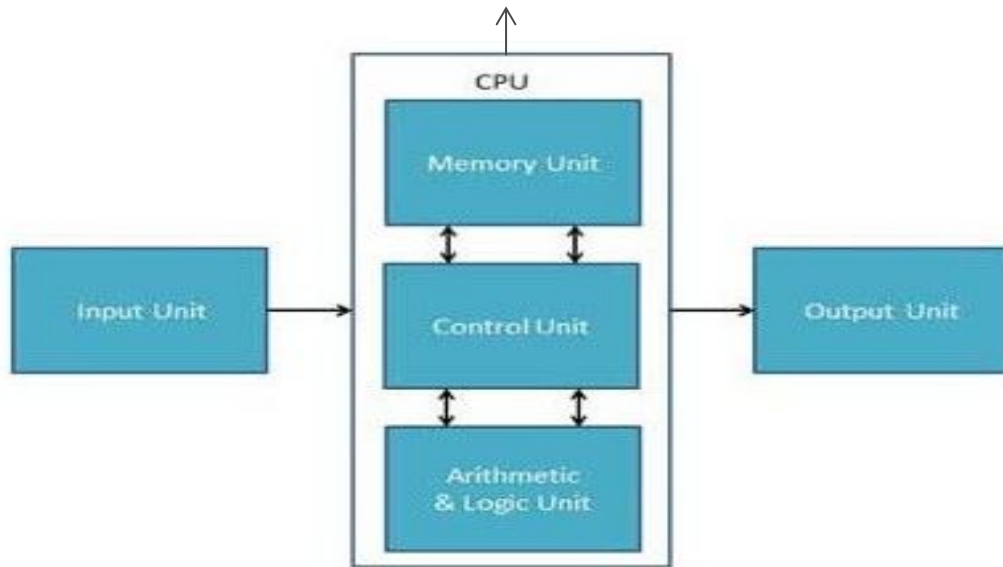- Interactive and repetitive communication with user.

Application areas of computer:

1. Data Processing
2. Numerical computing
3. Text processing
4. Communication
5. Image processing
6. Multimedia management.

Basic anatomy of computer::

Hardware + Software

Magnetic tape	Magnetic tape
External storage units	
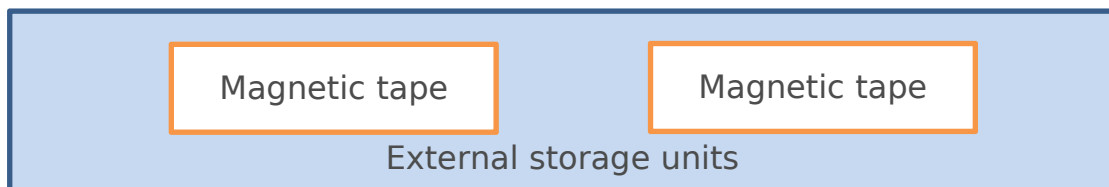
CPU to Input and output unit control instructions are passed. Memory unit to control unit instructions are loaded to control unit.

Fig 2: Block diagram of computer system

Hardware includes:

	Operation	Description
Input unit	Take Input	The process of entering data and instructions into the computer system
Memory unit	Store Data	Saving data and instructions so that they are available for processing as and when required.
Arithmetic unit	Processing Data	Performing arithmetic, and logical operations on data in order to convert them into useful information.
Output unit	Output Information	The process of producing useful information or results for the user, such as a printed report or visual display.
Control unit	Control the workflow	Directs the manner and sequence in which all of the above operations are performed.

Input unit: The devices used to enter data in to computer system are called input devices. Input unit consists of all such input devices. It converts human understandable input

to computer controllable data. CPU accepts information from user through input devices.

Processor:

- Central processing unit is a main part of the computer system.
- It contains electronics circuitry that processes the data based on instructions.
- It also controls the flow of data in the system.
- It is also known as brain of the computer.
- CPU consists of,

Arithmetic Logic Unit (ALU)

- ✓ It performs all arithmetic calculations and takes logical decision.
- ✓ It can perform add, subtract, multiply, compare, count, shift and other logical activities.
- ✓ It calculates very fast.
- ✓ It takes data from memory unit and returns data to memory unit, generally primary memory.

Control Unit (CU)

- ✓ It controls all other units in the computer system.
- ✓ It manages all operations
- ✓ It reads instruction and data from

memory.

Output unit: Output unit consists of devices with the help of which we get the information from computer. This unit is a link between computer and users. Output devices translate the computer's output into the form understandable by users.

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

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

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

- It stores intermediate results of processing.

- It stores final results of processing before these results are released to an output device.

- All inputs and outputs are transmitted through main memory.

Primary memory: It is also known as main memory. The processor or the CPU directly stores and retrieves information from it. This memory is accessed by CPU, in random fashion. Generally currently executing programs and data are stored in primary memory

Secondary Storage Devices: These usually have large storage capacity, and they store data permanently. They can be both internal and external to the computer, and they include the hard disk, compact disk drive and USB storage device.

Software includes:

Software is a set of programs, which is designed to perform a well-defined function. A program is a sequence of instructions written to solve a particular problem.

There are two types of software

- System Software
- Application Software

HARDWARE :::

Input Devices::

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

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

Keys	Description
Typing Keys	These keys include the letter keys (A-Z) and digit keys (0-9) which generally give same layout as that of typewriters.
Numeric Keypad	It is used to enter numeric data or cursor movement. Generally, it consists of a set of 17 keys that are laid out in the same configuration used by most adding machines and calculators.
Function Keys	The twelve function keys are present on the keyboard which are arranged in a row at the top of the keyboard. Each function key has unique meaning and is used for some specific purpose.
Control keys	These keys provide cursor and screen control. It includes four directional arrow keys. Control keys also include Home, End, Insert, Delete, Page Up, Page Down, Control(Ctrl), Alternate(Alt), Escape(Esc).
Special Purpose Keys	Keyboard also contains some special purpose keys such as Enter, Shift, Caps Lock, Num Lock, Space bar, Tab, and Print Screen.

- Mouse: Mouse is most popular pointing device. It is a very famous cursor-control device having a small palm size box with a round ball at its base which senses the movement of mouse and sends corresponding signals to CPU when the mouse buttons are pressed. Generally it has two buttons called left and right button and a wheel is present between the buttons. Mouse can be used to control the position of cursor on screen, but it cannot be used to enter text into the computer.

- Scanner: Scanner is an input device which works more like a photocopy machine. It is used when some information is available on a paper and it is to be transferred to the hard disc of the computer for further manipulation. Scanner captures images from the source which are then converted into the digital form that can

be stored on the disc. These images can be edited before they are printed.

Types of scanner:

Flatbed Scanners: Flatbed scanners are some of the most commonly used scanners as it has both home and office functions. The way they scan documents is that a mechanism rolls under the document to obtain the image. For a businesses that have a need for high processing abilities, the flatbed scanner can scan any number of documents with a click of a button.

Drum Scanners: These types of scanners are used mainly for capturing a picture and producing at a very high resolution rate. There are only a few companies that make these scanners, considering the high cost of producing a scanner such as this. It is considered a tremendous upgrade to a regular flatbed scanner.

Portable Scanners: Portable scanners are designed to capture text and other data while you are on the go. The scanner is powered by batteries and once you scan the text, the content is stored on the portable scanner. Once you get home, you can transfer the content to a computer. Transferring to your computer is done by using a cable or a wireless connection.

Output Devices::

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

There are two kinds of viewing screen used for monitors.

- Cathode-Ray Tube (CRT)
- Flat- Panel Display
    - Light Emitting Diode(LED)
    - Liquid Crystal Display(LCD)

Cathode-Ray Tube (CRT)	Light Emitting Diode(LED)
Monitors that uses the cathode ray tube and offers less flexibility as its ability to transmit over the long distance is difficult and have high resolution picture and the power required by the CRT is very high as compare to the other monitors.	Light Emissive device on the o hand uses high technology s that no flickers are produced by it when connected with the lesser powe it also has high capability to sta with the less power and high of it is one of the major issue that keeps the people away from also resolution of it is also ç and thus image produces is of high quali

- Printer: "A printer is an external output device that takes data from a computer and generates output in the form of graphics / text on a paper"
    - The printer driver device converts a document to a form understandable by the computer.
    - Performance is measured in two ways : DPI and PPM.
    - DPI- Dots per inch and PPM – pages per minutes.
    - DPI decides quality of printer and PPM decides efficiency of printer.

- o Types of Printers
  - ﹄ Dot-Matrix Printers: The dot-matrix printer uses print heads containing from 9 to 24 pins. These pins produce patterns of dots on the paper to form the individual characters. The 24 pin dot-matrix printer produces more dots that a 9 pin dot-matrix printer, which results in much better quality and clearer characters. The general rule is: the more pins, the clearer the letters on the paper. The pins strike the ribbon individually as the print mechanism moves across the entire print line in both directions, i-e, from left to right, then right to left, and so on. The user can produce a color output with a dot-matrix printer (the user will change the black ribbon with a ribbon that has color stripes). Dot-matrix printers are inexpensive and typically print at speeds of 100-600 characters per second.

  - ﹄ Ink-jet printers: Ink-jet printers work in the same fashion as dot-matrix printers in the form images or characters with little dots. However, the dots are formed by tiny droplets of ink. Ink-jet printers form characters on paper by spraying ink from tiny nozzles through an electrical field that arranges the charged ink particles into characters at the rate of approximately 250 characters per second. The ink is absorbed into the paper and dries instantly. Various colors of ink can also be used. One or more nozzles in the print head emit a steady stream of ink drops. Droplets of ink are electrically charged after leaving the nozzle. The droplets are then guided to the paper by electrically charged deflecting plates [one plate has positive charge (upper plate) and the other has negative charge (lover plate)].

A nozzle for black ink may be all that's needed to print text, but full-color printing is also possible with the addition of needed to print text, but full-color printing is also possible with the addition three extra nozzles for the cyan, magenta, and yellow primary colors. If a droplet isn't needed for the character or image being formed, it is recycled back to its input nozzle. Several manufacturers produce color ink-jet printer. Some of these printers come with all their color inks in a cartridge; if you want to replace on color, you must replace all the colors. Other color ink-jet printers allow you to replace ink individually. These printers are a better choice if user uses one color more than other colors. These printers produce less noise and print in better quality with greater speed.

Laser Printer: A laser printer works like a photocopy machine. Laser printers produce images on paper by directing a laser beam at a mirror which bounces the beam onto a drum. The drum has a special coating on it to which toner (an ink powder) sticks. Using patterns of small dots, a laser beam conveys information from the computer to a positively charged drum to become neutralized. From all those areas of drum which become neutralized, the toner detaches. As the paper rolls by the drum, the toner is transferred to the paper printing the letters or other graphics on the paper. A hot roller bonds the toner to the paper. Laser printers use buffers that store an entire page at a time. When a whole page is loaded, it will be printed. The speed of laser printers is high and they print quietly without producing much noise. Many home-use laser printers can print eight pages

per minute, but faster and print approximately 21,000 lines per minute, or 437 pages per minute if each page contains 48 lines. When high speed laser printers were introduced they were expensive. Developments in the last few years have provided relatively low-cost laser printers for use in small businesses. It also have microprocessors, RAM and ROM inside it.

- Speaker: Speakers are transducers that convert electromagnetic waves into sound waves. The speakers receive audio input from a device such as a computer or an audio receiver. This input may be either in analog or digital form. Analog speakers simply amplify the analog electromagnetic waves into sound waves. Since sound waves are produced in analog form, digital speakers must first convert the digital input to an analog signal, then generate the sound waves.

- Plotter: A plotter is a special output device used to produce hard copies of large graphs and designs on paper, such as construction maps, engineering drawings, architectural plans and business charts. The plotter is either a peripheral component that you add to your computer system or a standalone device with its own internal processor.

  o Types of plotters:

    - Drum plotter: A drum plotter is a pen plotter that wraps the paper around a drum with a pin feed attachment. The drum then rotates the paper as pens move across it and draw the image. It was the first output device used to print graphics and large engineering drawings. There are two types of drum plotters, external and internal. With an external drum plotter, the paper is wrapped around its external surface, while the internal

drum plotter uses a sheet of paper wrapped around its internal surface.

☐ Flat-bed plotter: A flat-bed plotter is a mechanical drafting device used with many CAD programs for designers. The paper remains stationary on a flat surface while a pen moves across it horizontally and vertically. This plotter may use several different pen colors to create the graphics. The size of the graphic is limited to the size of the flat-bed plotter's surface.

☐ Inkjet plotter: The inkjet plotter creates an image by spraying small droplets of ink on to paper. A popular choice for advertising agencies and graphic designers, inkjet plotters are used generally for large outputs, such as banners and billboards and large signs often seen along roadsides. They are available in thermal or piezoelectric models. Thermal inkjet plotters use heat to apply droplets of ink, while piezoelectric plotters use charged crystals to apply the ink. Inkjet plotters typically produce better quality graphics than other plotter types.

SOFTWARE:::

Software is defined as a computer program , which includes logical instruction used for performing a particular task on a computer system using hardware components. The following are two major categories of software under which different types of computer programs can be classified:

O System software: system software refers to a computer program that manages controls hardware components of a computer system. In other words, the system software is responsible for handling the functioning of the computer hardware. The system software is also responsible for the proper functioning of the application software on a computer system. The system software includes general programs, which are written to provide an environment for developing new application software using programming languages . In computer science, there are several types of system software, such as operating systems and utility programs. The operating system is the primary system software, which controls the hardware and software resources, instruction processing, and file management. The most commonly used operating systems are Ms dos, Ms windows, and unix.

O The following are the various functions of system software:
  O Process management
  O Memory management
  O Secondary storage management
  O I/o system management
  O File management

O Application software: application software is a computer program that is executed on the system software. It is designed and developed for performing specific tasks and is also known as end-user program. Application software is unable to run without the system software, such as operating system and utility programs. It includes several applications, such as word-processing and spreadsheet. The word-processing application helps in creating and editing a document. Using this application software, we can also format and print the document. For word- processing, many applications are

available, such as wordstar, word perfect , and open–source. The most commonly used word- processing application is ms word, which is a part of the Ms office suite. Spreadsheet application helps in creating a customized ledger, which has number of columns and rows for entering the data values.
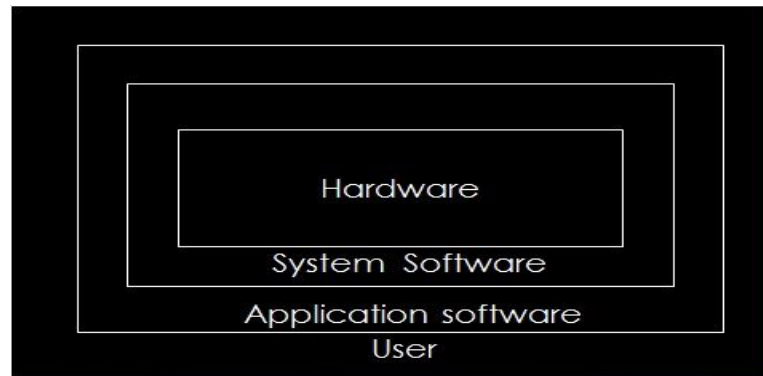
The figure shows a layered architecture, which represents different components of a computer such as hardware, system software, application , and user in a hierarchical manner.

Programming Languages::

The communication between two parties, whether they are machines or human beings, always needs a common language or terminology.

- ➢ The language used in the communication of computer instructions is known as the programming language.
- ➢ Type of programming language:-

1. Machine language (low level language): As computers are made of two state electronic devices they can understand only pulse and non pulse(1 and 0) conditions. Therefore all instructions and data should be written using binary codes 1 and 0.The binary code is called the machine code or machine language.

Computers are not identical in design, therefore, each computer has its own machine language. This poses two problems for the user. First, it is difficult to understand and remember the various combinations of 1's and 0's representing numerous data and instructions. Secondly, since every machine has its own machine language, the user cannot communicate with other computers. Machine language is usually referred to as the first generation languages.

2. Assembly language: An assembly level language consists of a series of instructions and mnemonics that correspond to a stream of executable instructions. An assembly level language instruction consists of mnemonic code followed by zero or more operands. Mnemonic code is called the operation code or opcode. The assembly language, also referred to as second-generation programming language, is also a low-level language.

The main advantages of an assembly language over a machine language are:

- As one can locate and identify syntax errors in assembly language, it is easy to debug it.
- It is easier to develop a computer application using assembly language in comparison to machine language.
- Assembly language operates very efficiency.
- To initialize and test system hardware prior to booting the operating system. This assembly language code is stored in rom.
- To write patches for disassembling viruses, in anti-virus product development companies

- To attain extreme optimization, for example, in an inner loop in a processor-intensive algorithm for direct interaction with the hardware
- In extremely high-security situations where complete control over environment is required
- To maximize the use of limited resources, in a system with severe resource constraints.

3 High level language: High level languages further simplified programming tasks by reducing the number of computer operation details that to be specified. High level languages like COBOL, Pascal, FORTAIN, and C are more abstract, easier to use , and more portable across platforms, as compared to low-level programming languages. Instead of dealing with registers, memory addresses and call stacks, a programmer can concentrate more on the logic to solve the problem with help of variables, arrays or Boolean expressions. For example, consider the following assembly code:

LOAD A
ADD B
STORE C

Using FORTAIN, the above code can be represented as:

C=A+B.

The above high-level language code is executed by translating it into the corresponding machine language code with the help of a compiler or interpreter.

High-level languages can be classified into the following three categories:

- Procedure-oriented languages (third generation): Procedural programming offers many benefits over simple sequential programming since procedural code:
  o It is easier to read and more maintainable

- o facilitates the practice of good program design
- o Allows modules to be used again in the form of code libraries.

- Problem-oriented languages (fourth generation): Problem-oriented Languages were designed to solve specific problems e.g. querying databases and allowed the programmer to concentrate more on the problem rather than spending time learning the complex syntax of the language.
- Natural languages (fifth generation): A fifth-generation programming language (abbreviated as 5GL) is a programming language based on solving using constraints given to the program, rather than using an algorithm written by a programmer. Most constraint-based and logic programming languages and some other declarative languages   are fifth-generation languages. Prolog, OPS5,Lisp and Mercury are examples of fifth-generation languages.

High level languages

Procedure-oriented	Problem-oriented	Natural languages
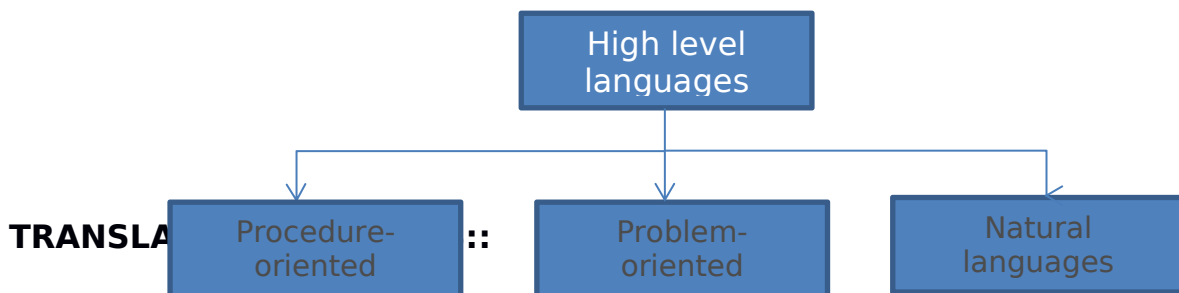
TRANSLA   **::**

- Assembler: A program which translates an assembly language program into a machine language program is called an assembler. Assemblers are further divided into two types: One Pass Assembler and Two Pass Assembler. One pass assembler is the assembler which assigns the memory addresses to the variables and translates the source code into machine code in the first pass simultaneously. A Two Pass Assembler is the assembler which reads the source code twice. In the first pass, it reads all the variables and assigns them memory addresses. In the second pass, it reads the source code and translates the code into object code.

- Compiler: The compiler is a computer program that translate the source code written in high-level language into the corresponding object-code of the low level language. The translation process is called complication. The entire high-level program is converted into the executable machine code file. A program that tranlates from a low-level language to a high-level one is a decompiler. Compiled languages include COBOL, FORTAIN, C, C++,etc. Compilers are also classified as single-pass compilers and multi-pass compilers. Through single-pass compilers are generally faster than multi-pass compilers, for sophisticated optimization, multi-pass assemblers are required to generate high-quality code.

- Interpreter: The interpreter is a translation program that converts each high-level program statement into the corresponding machine code. This translation process is carried out just before the program statement is executed. Instead of the program, one statement at a time is translated and executed immediately. The commonly used interpreted language is BASIC and PERL. Although interpreters are easier to create as compared to compilers, the compiled languages can be executed more efficiency and are faster.



Compilation

Interpretation
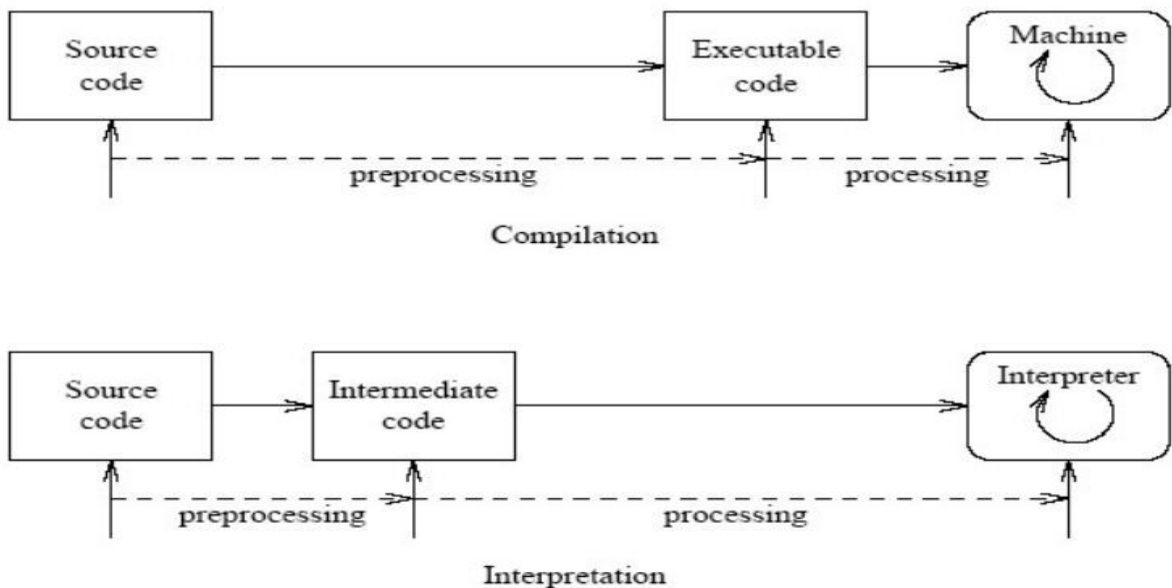
Structured Programming::

Structured programming is a programming paradigm aimed at improving the clarity, quality, and development time of a computer program by making extensive use of subroutines, block structures, for and while loops—in

contrast to using simple tests and jumps such as the go to statement, continue statement or break statement.

- ☼ "Sequence" :: ordered statements or subroutines executed in sequence.
- ☼ "Selection" :: one or a number of statements is executed depending on the state of the program. This is usually expressed with keywords such as if..else if..else.
- ☼ "Iteration" :: a statement or block is executed until the program reaches a certain state, or operations have been applied to every element of a collection. This is usually expressed with keywords such as while, repeat, for or do..while.

Sequence   Selection   Iteration
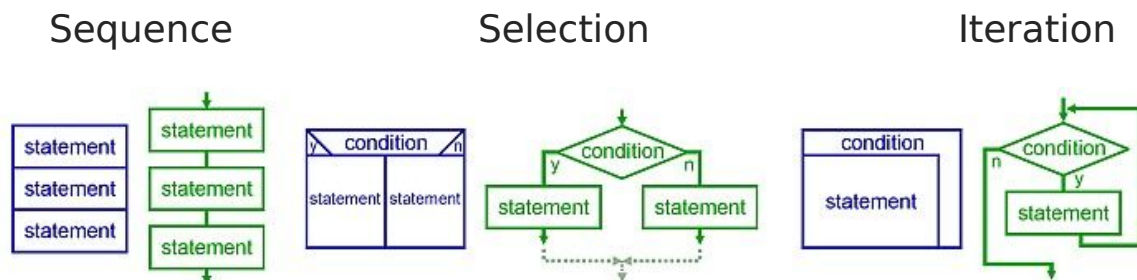
Problem Solving Approaches::

Algorithm:

- ➢ An Algorithm is the finite set of sequential instruction to accomplish a task. It is a step by step solution of given task.
- ➢ An algorithm is an effective method that can be expressed within a finite amount of space and time and in a well-defined formal language for calculating a function.
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Characteristics of Algorithms

The typical characteristics that are necessary for a sequence of instruction to qualify as an algorithm are the following:

- ☼ The instruction must be in an ordered form,

- The instruction must be simple and concise. They must not be ambiguous.
- There must be an instruction for program termination.
- The repetitive programming constructs must possess an exit condition. Otherwise, the program might run infinitely.
- The algorithm must completely and definitely solve given problem statement.

Advantages of Algorithm

- It provides the core solution to a given problem. This solution can be implemented on a computer system using any programming language of user's choice.
- It faculties program development by acting as a design document or a blueprint of a given problem solution.
- It ensures easy comprehension of a problem solution as compared to an equivalent computer program.
- It eases identification and removal of logical in a program.
- It faculties algorithm analysis to find out the most efficient solution to a given problem.

Disadvantages of Algorithm

- In large algorithms, the flow of program control becomes difficult to track.
- Algorithms lack visual representation of programming constructs like flowcharts; thus, understanding the logic becomes relatively difficult.

Algorithm to add two integers and display the result:

Algorithm :-

Step 1 – accept the First integer as

input from the user.(num 1)

Step 2 – Accept the second integer as

input from the user. (num 2)

Step 3 – Calculate the sum of the two

integers. (sum=num1 + num2)

Step 4 – Display sum as the result.

> **Flowchart**: A flowchart is a type of diagram that represents an algorithm, workflow or process, showing the steps as boxes of various kinds, an their order by connecting them with arrows. This diagrammatic representation illustrates a solution model to a given problem.
> Flowchart is a Graphical representation of an Algorithm.

There are many symbols to show particular types of statements. They are as below

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

◆ **Flowchart for finding the average of two numbers.**
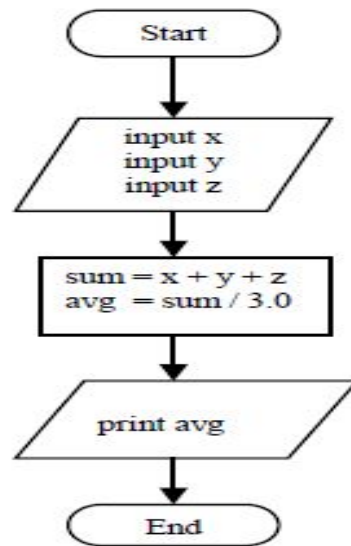
Finding a year is leap or not::

Algorithm:

Step 1 : START
Step 2 :Take integer variable year
Step 3 : Assign value to the variable
Step 4 : Check if year is divisible by 4 but not 100, DISPLAY "leap year"
Step 5 : Check if year is divisible by 400, DISPLAY "leap year"
Step 6 : Otherwise, DISPLAY "not leap year"
Step 7 : STOP

Flowchart: