LECTURE NOTES

ON

COMPUTER APPLICATION

CHAPTER - 1
COMPUTER ORGANISATION

1.1 What is computer

The word “computer” comes from the word compute, which means to calculate. People usually consider a computer to be a calculating device, which can perform arithmetic operations at high speed.

The word "computer" was first recorded as being used in **1613** and was originally was used to describe a person who performed calculations or computations. In **1971**, Blaise Pascal invented the First Mechanical Adding Machine.

The original objective for inventing a computer was to create a fast calculating machine. But today, more than 80% of work done by computers is of non-mathematical or non-numerical nature.

We can define a computer as a device that operates upon data. Data can be anything. Data can come in various shape and size depending upon the type of computer’s application.

A computer can *store, process* and *retrieve* data as and when required. It is an *electronic device with **memory**, capable to accept data as **input**, **process** data as per the instruction and produce the desired result as **output**.*

It can be defined as a device that can operate upon some information or data. The information is processed based on the set of instructions provided to generate the output.

Hence, a computer can be defined as a machine, which performs a specified sequence of operations as per the set of instructions (programs) given on a set of data (input) to generate desired information (output). As a machine, it will not perform independently. It will work only when, what is instructed to do.

A computer system is a combination of 05(five) elements. These are :

a) Hardware b) Software c) People d) Procedure e) Data/Information

1.2 Data and It’s Form

A computer can not work of its won. It work based on some prior instructions and data (data). Data can be anything depending upon the type of computer and nature of its application. Computer takes data as input, manipulates the data to produce some sensible/ meaningful information.

Data are the raw or unorganized facts, figures suitable for processing by a computer. Data input may be in the form of

a) Typed Data b) Non-typed Data

a) Typed Data: Typed data can be Numeric, Alphabetic, Alpha-Numeric. Then these data are converted into computer language (i.e. code)

b) Non-typed Data: Non-typed data may be audible, visual, audiovisual, graphics, etc.

A computer can process information in accordance with the program. Any information not presented in accordance to program, is not executed. Therefore, information must be presented that both input and output units may translate it in a form that a computer can handle.

1.3 Data Processing

Data processing is the process of manipulating data in some predefined manner. As a result of processing, data are getting some meaning. For data processing, the data is regarded as input and the information is the output.

It is the series of operations that converts the input / abstract data into meaningful / useful information.

Information is the output of data processing. Information carries some meaning. Without processing, data itself is useless. They should be interrupted and processed to determine some meaning, which is information.

Therefore, data are processed, organized and structures in a given context to make them useful. The meaning data is known as information.

1.4 Characteristics of Computer

A computer has various characteristics like :

a) Speed

Computer is a very fast device. It enable us to process large amount of data very quickly. Computer takes factions of seconds for many calculations. For computer, the time is expressed in fraction of seconds. The units of time for computers are :

- millisecond (ms) - 1000 of a second (1/1000)
- micro second (μs) - 1millionth of a second (1 / 1 000 000 = 1 / 10^6)
- nanosecond (ns) - 1billionth of a second (1 / 10^9)
- picoseconds (ps) - 1trillionth of a second (1 / 10^{12})

b) Accuracy

Computers are highly accurate machine. They produce error free results. Any error shown is the result of wrong input entered or wrong program/instruction given to the computer. This is called GIGO. If the input data and instructions are correct, then the output will be correct.

c) Storage

The computer is capable of storing large amount of data or information in it. This can be done through computer memory. To store huge amount of input data and output information, we need huge memory space. A computer can store huge amount of data in correct form, which can be accessed quickly as and when require. The storage unit can be measured in Byte.

d) Automatic

The word automatic means, capable of working without or minimum human intervention. We may need to start the processing. Once, the process is started, human intervention is not required. The computer works as per the programs. So, once the program is started, it performs the operation automatically based on the program.

e) Versatility

Computer is a versatile machine. It has a wide variety of skills. We use computer for almost everything. For every purpose, we have different computer programs. These programs can be developed to handle just about any information processing task.

f) Diligence

We may make mistake, get bored/tired if performing the routine work again and again. We need rest after a specific period. Computers are free from all these weaknesses. It doesn't get tired and don't need rest. Computers can work 24 X 7 without any break. It can perform the job for several hours with the same speed and accuracy.

g) Lack of Emotion

Computers do not have any emotion. Therefore, they are not biased and hence take suitable objective decisions.

h) Lack of IQ (intelligence quotient)

Computer have no IQ. Computer on its own can not react to some action. It react only to the situation and in the manner, it is programmed for. Computers do not have any intelligence. Now – a – days, scientists are adding artificial intelligence (AI) in the computer.

1.5 Evolution of computers

Computers were invented to the people's search for fast and accurate calculating device. Blaise Pascal invented the 1st mechanical adding machine in 1642. Later in 1671, Baron Gottfried Wilhelm Von Leibniz of Germany invented the first calculator for multiplication. Keyboard machines originated un US around 1880, which is used even today.

Charles Babbage, Prof., Cambridge University, considered the father of modern digital computer. in order to have a better idea of evolution of computer, it is necessary to discuss some of the well-known early computers.

The following are some major milestones of mechanization of counting and calculations :

ABACUS

ABACUS is considered as the oldest calculating device. It was invented around 600BC. Now, it is still used. It is a manually operated digital calculating machine.

PASCAL's Adding Machine

The first mechanical calculating device is PASCAL's adding machine. It was invented by French Blaise Pascal in 1642. It is able to work in addition and substraction.

LEIBNIZ's Machine

German scientist Baron Gottfried Von Leibniz modified the Pascals's adding machine to perform multiplication in 1671.

First Mass Produced Calculating Machine

In 1820, Charls Xavier Thomas built the first commercially successful adding machine, which was named as "Thomas Arithmometer".

Babbage's Differential and Analytical Machine

Charls Babbage, Prof. Mathematics, Cambridge University, considered as father of computer. In 1821, he started to design a machine known as "Difference Engine". This table could produce mathematical table upto 20. In 1842, he built a machine named "Analytical Engine", which can perform all the basic arithmetical functions. The analytical machine has the following 04 (four) major parts :

a) Input / Output Unit b) Store c) Mill d) Control Unit

All these computing devices are manual and mechanical. With electricity, scientists started to design electrical & electronic devices which can compute. Some of them are :

Atanasoff-Berry Computer

In 1939, Dr. John Atanasoff and his assistand Berry worked together to make 1st electronic computer to solve some mathematical problems. This computer is named as "Atanasoff-Berry Computer" (ABC) and 45 vacuum tubes were used in it.

Mark-1

Mark-1 was an electronic device built by Howard A. Aiken in 1943. Some people consider it as a calculator where some consider as computer. it as a very reliable and accurate machine having about 3000 switches to control the operation. It was considered as world's first automatic programmable computer.

ENIAC

Electronic Numerical Integration And Calculator (ENIAC) was built at Moore School of Engineering, USA. It was built by Dr. John Mauchly and Prof. J. Presper Eckert. ENIAC was considered as world's successful electronic computer.

This computer used about 18000 vacuum tubes, 6000 switches and 500 terminals. The machine was completed in 1945 and was developed keeping the need of IInd World War. This ENIAC was 100 times faster than MARK-1.

EDVAC

Electronic Discrete Variable Automatic Computer (EDVAC) was designed by John Von Neumann and became operational in 1949.

Due to some drawbacks in ENIAC, Von Neumann used “Store Program Concept” in EDVAC. The stored program concept states “prior to execution of the program, the program has to be stored in the computer memory”.

Von Neumann also the first person to suggest the use of binary numbers in computer. His concepts i.e. “stored program concept” and “binary number system” are still being used in all the computers.

EDSAC

Electronic Delay Storage Automatic Calculator (EDSAC) was developed by a group of scientists, headed by Prof. Mauric Wilkes, Cambridge University, UK. It executed its first program in 1949.

UNIVAC-1

Universal Automatic Computer (UNIVAC) was the first digital computer that was not “one of a kind”

Dr. John Mauchly and Presper Eckert form a company named “UNIVAC”. Many UNIVAC machines were produed and in 1951 the first machine was installed in Census Bureau, which was continuously used for 10 years.

Total 46units of UNIVAC were sold for over 1 million dollar. This laid the foundation for commercial production of computers.

World’s First Programmer

A lady mathematician named Ada Augusta Lovelace planned and solved many computational problems. She suggested the way of solving problems in Babbage’s analytical engine. Therefore, Ada Lovelace considered as world’s first computer programmer.

1.6 Generation of computers

The term “Computer Generation” is used to distinguish the different hardware technologies and the components used to build the computer. there are 05 generation of computers. They are :

a) First Generation (1942 - 1955) b) Second Generation (1955 – 1964)
c) Third Generation (1964 - 1975) d) Fourth Generation (1975 – 1989)
e) Fifth Generation (1989 – Present)

a) First Generation (1942 – 1955)

In first generation, vacuum tubes were used as the basic components. A vacuum tube is made up of glass; therefore, it is fragile (*easily broken*). The vacuum tubes are bigger in size and consume high electricity. Every vacuum tube consumed about ½ of a watt of electricity.

The vacuum tube radiate much of the electric energy as heat, therefore, extra cooling arrangements were made for cooling. It had a shorter life period. Therefore, the 1st generation computers were not much reliable. The main characteristics are :

- Relied on vacuum tube for operation
- High size ((ENIAC weight is more than 18tones & occupied 15000 sq.ft.)
- Required heavy electricity
- Not reliable
- Used by specialists
- Programming was very difficult
- High cost
- Mainly used by scientists and defense purpose
- Machine codes were used to program

  Example : ENIAC, EDVAC, EDSAC, UNIVAC and IBM

b) Second Generation (1955 – 1964)

In 1947, 03 scientists William Shockley, John Bardeen and Walter Brattain invent a new switching device known as “Transistor” in Bell Lab. For this, they got Nobel Prize in 1956.

Like vacuum tube, transistors can be used as a switch or amplifier. It has many advantages over vacuum tubes. These are :

- Very small in size
- Made up of semiconductor material
- Highly reliable, as there is no filament
- Consume less power
- Less heat emitted
- Works faster than vacuum tube
- Long life
- Low cost and easy manufacturing

Due to small size of transistors, the size of 2nd generation computer reduced. Some 2nd generation computers are : IBM7094, CDC-3600, IB700, UNIVAC-1108, etc. The characteristic features are :

- Smaller size
- Transistors are used as switching device
- Work faster (10 times faster than 1st generation computer)
- Less electricity consumption
- More reliable
- Generate less heat
- High level programming language are used
  (FORTRAN, COBOL, ALGOL, etc.)
- Used for commercial purpose.

c) Third Generation (1964 - 1975)

During this period, scientists proved that, the physical size of the transistor has no bearing of its ability to work as a switching device. This led to the reduction of size of transistor. The ability of semiconductor to act as conductor as insulator, forced to putting the switching device and the circuit in one silicon chip. This led the idea of integrated circuit (IC).

ICs are circuits consists of several electronic components like : transistors, registers and capacitors grown on a single chip of silicon eliminating wired interconnection between components. The IC was invented in 1958 by Jack Kilpy.

The 3rd generation computers were built using ICs. The ICs are very rugged, small in size, reliable and worked faster compared to transistors.

During this period, a log of development also took place in software. User friendly OS were developed for smooth operation of computer. Time sharing OS, FORTRAN, COBOL, etc. were popular software and programming languages, the IBM360 is the very popular 3rdgeneration computer.

The characteristic features of this third generation computer are :

- ICs are the basic construction block
- ICs increase the processing power of PC
- Reduce the size of computers
- Consume less power and emitting less heat
- More reliable and faster than 2nd generation computer
- Low maintenance cost

d) Fourth Generation (1975 – 1989)

The success of IC led to put more and more components in the IC. Depending on the no. of components in the IC, the ICs are termed as : SSI *(contains few transistors in a chip),* MSI *(contains 100s of transistors in a chip),* LSI*(contains 1000s of transistors in a chip),* VLSI *(contains about 1millions in a chip)*

This process led to a dramatic development i.e. creation of microprocessor. A microprocessor contains all circuits needed to perform arithmetic logic and control functions, the core activities of all computers, on a single chip. It became possible to build a complete computer with a microprocessor, which started a new social revolution – PC revolution. The 4th generation computers became personal computers.

The microprocessor Intel 4004 was developed in 1971. Now, we have more powerful processor of Intel i7. Considering the computing power, the OS become more friendly and powerful. The GUI OS makes the computers user friendly. The use of computer mouse, communication methods (LAN, WAN) were used in this 4th generation.

Most of the computers we see today are the 4th generation computers. The basic characteristic features of this generation computer are :

- Use of microprocessor
- Reduce size (to desktop)
- Microprocessors consumes less power
- Generate less heat
- Communicate with wide range of different I/O devices
- Very reliable
- Minimum maintenance
- Use of VLSI technology
- New H/w can be added
- High speed

e) Fifth Generation (1989 – Present)

The process of reducing the size of computer continued. Scientists designed small but extremely powerful microprocessors. These processors could communicate with high speed I/O devices. For this ULSI is required.

The ULSI is considered as 5th generation technology. An ULSI chip contains more than 10million electronic components. It reduces the size and increasing the working power.

The 5th generation computers are mainly future computer. the aim of these computer is to understand and respond to natural language and capable of self-learning and self-organsation.

The power of this computer resulted in faster and reliable network. It can be effectively used in many areas like : multimedia, many areas in new and innovative manner as : mobile commerce, virtual classroom, wireless internet, etc.

The 5th generation technology is not only used in PC, but also used in super and mainframe computers. So the 5th generation mainframe and super computers are smaller in size but much more powerful.

The fifth generating computers are made to have ;

- Artificial Intelligence
- Parallel Processing
- Voice Reorganization
- Use of Super conductors
- Quantum computing
- Molecular and Nano Technology

The basic characteristics are :

- Used very small and powerful microprocessor along with other chips designed in ULSI
- Smaller in size
- Consumed less power
- More powerful and reliable than 4th generation computers
- Low rate of failure and Low maintenance
- Very user friendly
- Powerful multimedia processors
- Ease of access to internet and www.

1.7 Classification of computer

Computer can be classified on the basis of its size and processing power as :
a) Micro Computer b) Mini Computer
c) Mainframe Computer d) Super Computer

a) Micro Computer

Micro computers are small and low cost computers. It follows a set of instructions called program to perform the input, processing, output and storage function.

These are meant for a single individual i.e. in a given time, only one person can operate the computer. it is made from microprocessor chips which are : Intel 8080 / 8088 / 80286 / 80382 / 80486, etc. Programs like : DOS, Unix, Windows, etc. can be run effectively on these computers.

The characteristics of this computer are :
Speed - 100 kilo instruction p/s
Word length - 8 to 16 bit
Functions - Word Processing, Graphics, etc.
Peripherals use – FDD, HDD, KB, VDU, Printer, etc.

b) Mini Computer

These computers are designed and developed for general purpose. The size of this computer varies from desk computer to large computer. these computers have more storage capacity than micro computer. presently these computers are of 32 bits.

The characteristics of this computer are :

Speed - 500 kilo instruction p/s

Word length - 16 bit

Functions - Engineering, Scientific, Time Sharing, etc.

Peripheral use - HDD, Magnetic Tape, Line Printer, etc.

c) Mainframe Computer

These are more powerful as compared to micro and mini computers. These are the machines of 32bits. It can work on 2bytes and 8bytes. The programs developed by the manufacturers are generally for mainframe computers. All high level languages are available for this computer like : Air, Rail, etc.

The characteristics of this computer are :

Speed - 1000 to 2000 kilo instruction p/s

Word length - 32 to 64 bit

Functions - Engineering, Scientific, Design, Railway, Airway reservation, etc.

Peripheral use - HDD, Line Printer, Laser Printer,
Mini computer with frontend processor, etc.

d) Super Computer

It is the most powerful computer. these computers are very fast in operations and are expensive. These are designed for complicated scientific works. In comparison to mainframe computers, these are 5times faster.

The characteristics of this computer are :

Speed	- 10,000 kilo instruction p/s
Word length	- 64 to 96 bit
Functions	- Engineering, Scientific, Design, Space Research, Weather, etc.
Peripheral use	- HDD, Line Printer, Laser Printer, Very high speed printers, etc.

According the purpose, computers can be devided into :

a) Digital computer b) Analog Computer c) Hybrid Computer

a) Digital Computer

A digital computer is a counting device. All the expressions are coded in binary digits inside the computer and it manipulate them at a very high speed. This type of computers works on addition only. The work of multiplication and division, etc. are performed on the lines of addition. Widely it is used for commercial purpose like : Graphics, Analysis, Payroll, Washing Machine, etc.

b) Analog Computer

The analog computers are works by measuring voltage and currents. They works on supply of continuous electrical signals and displays output continuously. Although these are very fast as compared to digital computers, their accuracy is very low.

c) Hybrid Computer

A hybrid computer is a combination of both digital and analog computer. it can work on both digital and analog data. Generally it is used in scientific applications and in industrial control process.

1.8 Limitations of computer

a) No Thinking Capacity

b) Computer Crime

c) Virus

d) Machine Dependency

e) Risk of equipment failure

f) Equipment downtime and recovery

g) Mismatch between technological advancement and their implementation.

COMPUTER ARCHITECTURE AND FUNCTIONAL BLOCK DIAGRAM

2.1 Computer Architecture

The architecture of a computer consists of different units and subunits of computer and their interconnection. The architecture of a computer can be of three main functional units i.e.

a) Input Unit b) CPU c) Output Unit

a) Input Unit :

The data and programs are entered to the computer through the input device. There are many input devices. Keyboard is a common input device. This means, the computer has a special way to represent data.

Consider the example of alphabet “X”. The alphabet “X” is not stored in this form. Computer stores it in binary number. There is a special code known as ASCI code. A computer stores the ASCII code of X. Before storing “X”, it has to be converted to ASCII code. This is done by the input device.

The basic function of input units are :

i) Accepts in human readable form
ii) Convert to computer code (ASCII)
iii) Sends the converted data to computer

b) Central Processing Unit (CPU) :

The CPU is the heart and nerve centre of the computer. it performs all kind of computation, calculation and data manipulation. CPU also performs different logical operation. It is the most complex and powerful part of the computer. The CPU consists of :

i) ALU ii) MU iii) CU

The different units of the CPU are connected with each other using two types of connections. These connections are referred to as *BUS*. BUS is a common communication path or line or way. Different types of BUSes are :

a) Contol Bus b) Data Bus

i) Arithmetic Logic Unit (ALU)

As the name suggests, all the arithmetic and logical calculations are made here. It performs all arithmetical operations on numbers as directed by the control unit.

To perform arithmetic operation, the operands must be transferred to the ALU. It is essential that the command must be present in the memory prior to the execution. The process of transferring the data from memory to ALU is known as *data transfer*.

The ALU is capable of taking logical decision based on Boolean logic. The Boolean logic uses the logical relationship i.e. AND, OR and NOT among others.

ii) Memory Unit (MU)

The CPU contains a memory unit to store information or data. There are few registers in the memory unit. The no. of registers differ from processor to processor.

Registers

Registers are small no. of memory present with the microprocessor. These register memories are very fast and are used for temporary store of data and instructions. As registers are built in the processor, the no. of storage registers has a specific purpose where as other have many purposes. Registers are not referenced by address. They have a specific name and accessed by names.

iii) Control Unit (CU)

The control unit can be regarded as the manager of the computer. It controls all the operations of all other components of the computer.

The main function of the control unit is to select particular instruction for execution from the program. It understands the meaning of the instruction and instructs all other devices to perform operations.

It doesn’t process data, but it acts as the nervous system for other components meant for manipulating data.

c) Output Unit :

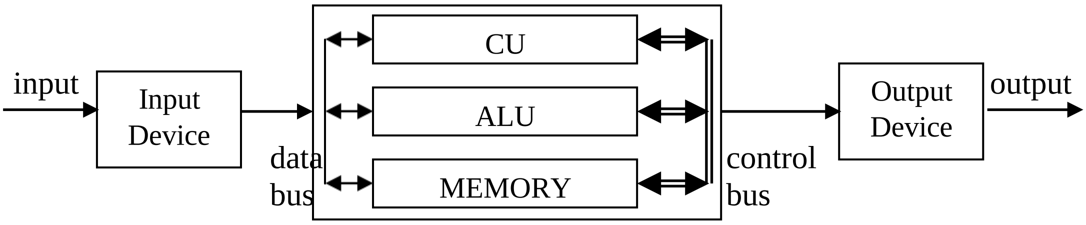
The output unit functions in the reverse way to input unit. This unit convert the result from binary code to human readable language. The main functions of these output units are :

i) Accepts processed data (information)
ii) Convert the processed data to human readable form
iii) Gives the final output

There are many output devices like : Monitor, Printer, etc.

2.2 Functional Block Diagram of A Computer System

The different units of computer interconnected to facilitate data processing. The Data Bus and Control Bus connect the devices. The Data Bus is used for transformation of data among different units, while, the Control Bus transfers control signal from the control unit. The functional diagram of the computer is :



2.3 Input Devices

The input unit or input devices are the electromechanical devices that accepts data from outside world and translate them into a form, that computer can understand. There are several input devices, which can broadly classified into :

1) Keyboard
2) Mouse
3) Scanner
4) Touchpad
5) Barcode Reader
6) Touch Screen
7) OCR (optical character recognition)
8) MICR (magnetic-inc character recognition)

1) Keyboard

A computer keyboard is the most popular input device. It consists of an array of switches, each of which sends a unique signal (ASCII code of character) to the PC when it is pressed. The keys in a keyboard can be grouped into :

i) Arithmetic operators such as +, -, *, /
ii) Numeric digits 0–9
iii) Alphabet Keys
iv) Alpha-Numeric Keys
v) Cursor arrow keys
vi) Enter Key (carriage return)
vii) Navigation keys
(Home, End, PgUp, PgDown)
viii) Num Lock button
used to enable/disable the numeric pad
ix) Functional Keys
x) Control,Shift,Tab,CapsLock, Escape

2) Mouse

Mouse is the most popular point-and-draw device. It is a small hand held device that its in user's palm. It becomes essential for PCs running the GUI based program. There are two types of mouse. They are :

a) Mechanical Mouse
b) Optical Mouse

a) Mechanical Mouse

It has a rubber coated ball. As it rotates, it drives 2 rollers, one of each for x and y displacement. When a mechanical mouse moves, the ball rotates.

As the ball rotates, it touches and turn 2 rolls mounted at 90^0 angle to each other. One roller responds to X movement and other to Y movement. Each roller is attached to a wheel, known as encoder. As the roller turns in response to the movement of the ball, the encoder turns.

b) Optical Mouse

The Optical mouse as a LED light source. It focused into a very narrow beam that shines through a hole in the bottom of the case and strikes a special mouse mat.

The mat has a series of reflective grid lines, which reflects the light beam back into the mouse through another lens. The light beams then falls onto a mirror inside the mouse and is reflected onto an array of light sensitive sensors that detect movement.

There are different terminologies are associated with mouse, they are :

Click, Double Click, Right Click, Drag, Drop, etc.

3) Scanner

A scanner is another popular input device. It works on the principle of reflection. The image is placed before the carriage, consists of a light source and sensor.

The light source is exposed to the document to be scanned. The amount of light reflected, picked up by the sensor, is converted to a voltage proportional to the light intensity. This analogue-to-digital conversion (ADC) is a sensitive process.

4) Touchpad

The touchpad is a plane surface of square size. The user has to move his/her finger tip on the surface the mouse pointer on the screen will shows the direction of finger tip.

5) Barcode Reader

The barcode scanner is also called s Price Scanner or Point-of-Sale terminal. It is a device used to read and capture the information written in a special code. Many information about the product is written in the barcode.

The barcode reader consists of a light source, a lens or a photo conductor. It works by redirecting a beam of light across the barcode. The dark bars on a barcode reflect the less light than the white space between them. The scanner converts the received light into electrical energy, which is then converted into data by the decoder.

6) Touch Screen

A touch screen is a computer input device, which works by simply touching the display screen. The touch screen interface is the most simple and easy input device. It becomes the interface of choice for a wide variety of applications.

7) Optical Character Recognition (OCR)

OCR is one of the most popular ways of data input. It is capable of recognizing optical characters. There are 2 categories of OCRs. They are :

a) Printed character recognition
b) Hand written character recognition

Out of the two, the printed character recognition system is easy. The OCR is used to convert the paper document into searchable files. Modern OCR can read typewritten data into computers more than 2400 wpm. OCR has the following characteristics:

i) Reduce data entry error
ii) Consolidated data entry
iii) Automated data entry

8) Magnetic Ink Character Recognition (MICR)

MICR is a character recognition technology mainly adopted by bank to facilitate the processing of cheques and drafts.

A line of number and symbols are located at the bottom of the cheques and drafts. This knows as MICR line. It contains many vital information like : Account No., Branch No., etc.

In addition to special fonts, the characters are printed with a special magnetic ink. The magnetic printing is done in such way that, the characters can be read by the system even if the stamps and pen writing goes over it.

2.4 Output Devices

An output deice is an electromechanical device that accepts data from computer, translate them into human readable form and gives us the final output. There are many output devices like :

1) VDU 2) Printer 3) Plotter
4) Projector 5) Voice Response System 6)

1) Video Display Unit (VDU)

A VDU is like a TV screen with higher resolution. The resolution of a VDU is a function of number of picture elements on the screen itself (pixel). Most of the VDUs are :

a) CRT Monitor b) TFT Monitor

a) CRT Monitor :

Cathode Ray Tube (CRT) monitors are the oldest form of display for PC computer systems. These monitors are high resolution monitors. It contains glass vacuum tubes into which an electron gun emits a flow of electrons.

The electron gun is made up of cathode (negatively charged) and one anode (positively charged). A heating element in CRT heats the cathode and the cathode emits electrons.

b) TFT Monitor

A TFT monitor uses *thin-film transistor* technology for the ultimate LCD display. LCD monitors, also called flat panel displays. Nearly all LCD monitors today use TFT technology in which, each pixel is controlled by one to four transistors.

TFT is found in Laptop, Palmtop and other PDAs. It consume very low power in comparison to CRT. This type of output devices are lighter, flatter, thinner and give no radiation. It produces less light emission.

In TFT monitor there is a separate tiny transistor for each pixel on the display. As the transistors are so small, the amount of charge needed to control it is also small. This allows for very fast re-drawing of the display, as the image is refreshed several times per second.

An image is displayed by scanning the electron beam across the screen and needs to be refreshed continually. In order to avoid any kind of fluctuation or flicker of screen, most monitors refresh the screen at a 60Hz rate.

2) Printer

Printers are the most popular out devices used for producing hardcopy output. Printers may be classified in a number of different ways like :

a) by amount text (character / line / page)
b) by character formation (matrix/non-matrix)
c) by method of printing (impact/non-impact)
d) by color (color/b-w)

The sped of printer can be measured in :

a) cps b) lpm c) ppm

Types of printers are :

a) Dot-matrix Printer (line / pin printer)
b) Ink-jet Printer (360 dots per inch)
c) Laser printer (600 dpi and more)

3) Plotter

Plotters are the output devices, used for printing high quality graphical output. These can be used in engineering design, architectural design, layouts, complex drafting jobs, etc. Plotters are available in different sizes ranging from small desk model to big. The plotter is useful to designers, engineers and scientists to get the hardcopy of drawings.

4) Projector

Projector is also known as screen projector. It is an out device, used to project information from a computer on a large screen. It is very useful for making presentations to a group of people. It can be plugged to a computer system directly. Like monitor, it provides a temporary softcopy output.

5) Voice Response System

Just like a speech recognition system, it enables a computer to talk to a user. It has an audio response device that produce audio output. Like monitor, the output is temporary, softcopy output. It is of two types i.e. :

i) voice reproduction system ii) speech synthesizer

2.5 Memory

Memory is a place where the data and programs are stored. The performance of a computer system depends on the size of the memory. The memory is used to store data and instructions. This concept is known as stored program concept. It states that, before execution of a program, the program must be transferred to the memory of the computer. Depending on accessibility of the computer, the memory can be :

1) Primary Memory 2) Cache Memory 3) Secondary Memory

Units of Memory : The Basic unit of memory in bit

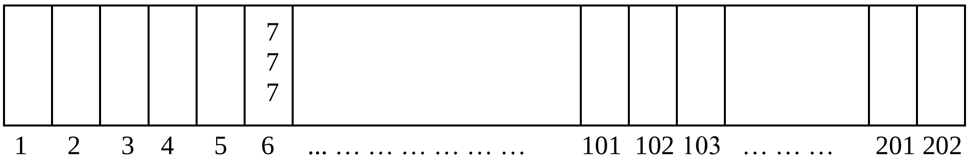
Bit	:	Space taken to store 1 binary digit i.e. 0 or 1
Byte	:	Space taken to store upto 8bits i.e. any character on K/B takes 1byte
KB	:	1KB = 1024 bytes (2^{10} bytes)
MB	:	1MB = 1024 KB (2^{10} KB)
GB	:	1GB = 1024 MB (2^{10} MB)
TB	:	1TB = 1024 GB (2^{10} GB)
PB	:	1PB = 1024 TB (2^{10} TB)

1) Primary Memory

The primary memory is also known as the main memory or internal memory of a computer system. The CPU access data directly from this main memory.

The main memory can be visualized as a series of continuous memory location. Each location is capable of storing data and is identified by an address. Each memory location is also known as cell. The memory is associated with :

a) address of the memory location b) content of the memory location



A primary memory can be:

A) Read Only Memory (ROM)
B) Random Access Memory (RAM)

A) ROM :

ROM is used to only ready data or instructions that have been permanently stored in the chip. Nothing can be written to this memory by the user.

In ROM, data are stored permanently. Therefore, it is non-volatile memory. It means, even if power is switched off, it will not loose data. The BIOS is stored in ROM. There are different types of ROM. They are :

a) FPGA (Field Programmable Gate Array)
b) P-ROM (Programmable ROM)
c) EP-ROM (Erasable Programmable ROM)
d) EEP-ROM (Electrically Erasable Programmable ROM)

B) RAM :

Every computer must have RAM. The name Random Access, because, any of the location in this memory can be randomly selected to directly store and retrieve data and instructions.

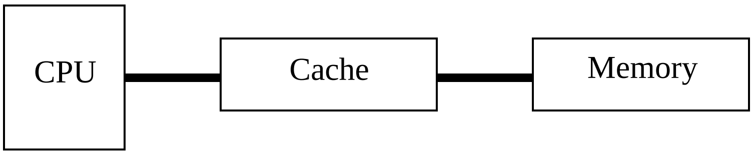
RAM is a volatile memory. It means, all data will be lost when power is switched off. Therefore, it is used for temporary storage of program and data. Data can be read (retrieved) from or written (store) to RAM just by giving memory address. If data are not required, then they can be erased. RAM is of two types i.e.
a) Static RAM and b) Dynamic RAM

a) *Static RAM :*
This memory is base on the transistor technology. It takes 6 transistors to store a bit (1bit). Therefore, the circuits of Static RAM is more complicated and takes more space. It does not need to refresh as long as power supply is there. It is more expensive and used in specialized applications.

b) *Dynamic RAM:*
Dynamic RAM is based on capacitor technology. The contents of each storage cell within the chip require periodically to be refreshed. When a capacitor is charges, gradually it losses the charge. To retain the charge at the original level, the capacitor is periodically recharges. This processing is known as refreshing. The periodic recharge is essential for D-RAM, otherwise, it will loose the store value. It consumes little power but suffer from slow access time.

2) Cache Memory :

A cache memory is a very small and fast memory located between the CPU and the main memory. It is used to keep the processor speed high and to reduce the number of wait for data from memory. The CPU can access the data/instructions, stored inside the cache at a faster rate than those stored in system memory. It increases the speed of processing



3) Secondary Memory

Secondary memory is also called as external memory or auxiliary memory. It allows the permanent storage of large volume of data. This is also known as back-up memory. There are 2 main ways of storing data s backup i.e. a) Serial Access, b) Direct Access. The capacity of this memory is expressed as the number of bytes, characters or bits can store at one time. Some of the secondary memories are :

a) Hard Disk Drive

The term Hard Disk is used to distinguish the disk from a soft disk. The FDD is the softdisk due to it floppy nature. The capacity of HDD is more than the FDD. The capacity of a standard HDD is 160GB. Some characteristics are :
i) Online storage device ii) Available with difference capacity
iii) Read-Write head for each surface iv) Very sophisticated.

b) *Magnetic Disk*

It is the most popular type of secondary device. Here data are recorded on the magnetic plate coated on both sides with magnetic materials. These plates are very thin and put in a protective cover. The metal plate contains circles, known as track. Data are recorded in these tracts. The track is divided into sectors.

Each track is an unique number. The numbering starts from edge of the disk. The outer most track is numbered as 000 and the number continuously increase towards the center of the tract the number of tracks vary from 35 to 77 on FDD and 200 to over 800 on HDD. Some terminologies associated with disk storage are :

i) Data Density   ii) Bits per inch   iii) Tracks per inch

c) *Floppy Disk Drive*

FDD is also called as diskette. It was common media for computer storage. It is compact, flexible, magnetic oxide and plastic covered. There are different sizes of FDD i.e. 8”, 5¼ ” and 3½” (1.4mb). The rotation speed is about 300 to 400 rpm and data transfer rate is about 10 to 30 kbps. It’s advantages are :

i) easy to carry, store and mail   ii) reusable   iii) accessed any time

d) *Optical Disk*

Optical disks use special light known as laser for reading and writing purpose. The optical disks are available with different size and capacity. The capacity varies from 650MB to 17GB and use direct access mechanism to access the data. Data can be permanently stored. There are many Optical Disks like :

a) *Compact Disk (CD)*

CD is very popular and reliable storage media. It is an optical disk used to store digital data. There is a aluminum layer which protect it from corrosion and damage by a lacquer (a special liquid which is painted on metal to protect it and to make it shiny) on which a disk label can be printed.

A player reads information from the CD’s spiral track of pits and lands, starting form the centre of the disk and moving to the outer edge. It does by firig an infrared laser. CDs can rotates between 200 to 250rpm.

CD-ROM drives are available with different speed. The most popular speed drive is 52X, where “X” stands for 150 kbps. So, 52x CDROM means, the data transfer rate speed is 52 x 150kbps = 7.8mbps.

There are two different CD available i.e. i) CD-ROM and ii) RD-R/W. The process of writing information to CD is known as CD Burning. It names so, because, the powerful laser ray produces enough energy to melt the material and make pit.

b) *Digital Versatile Disk (DVD)*

DVD was originally designed for storing digitized representation of video. Therefore, some call it as Digital Video Disk. DVDs are capable of storing more data than CDs i.e. 4.7GB (single layered single side), 8.5GB (double layer single side and 17GB (double side). CD drive can not read / write DVDs. It can be read or write by drive called DVD Drive. DVD is also of two types i.e. i) DVD ROM and ii) DVD R/W. Now-a-days, combo drive is very popular for following operations :

i) CD Read ii) DVD Read iii) CD Burn iv) DVD Burn

Advantages of Optical Disks are :
i) Store large volume of data ii) Less expensive
iii) Storre random and sequential data iv) Very light weight and easy to carry
v) Highly versatile and portable medium

e) Portable Storage Devices

i) Pen Drive

It is a very popular general purpose portable storage device. It's name is so, because it resembles or similar to a pan. The correct technical name is flash drive.

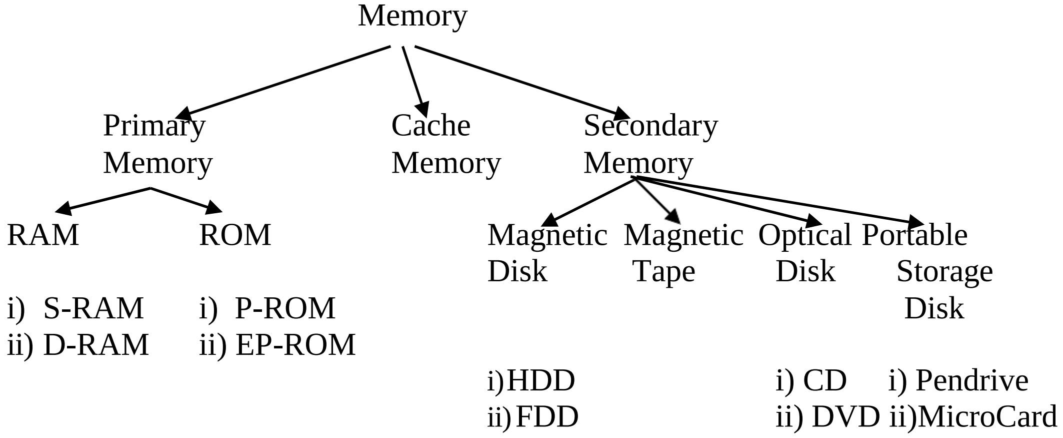
It contains flash memory to store data. Pen drives comes in different shape and memory size. The flash memory is also known as flash ROM. It is a non-volatile memory that can be erased and reused. Therefore, it keeps data even if power is removed. So, it is a form of EPROM.

Advantages of Pen Drive :
i) Small and easy to carry ii) Easy to operate
iii) Shock, Dusk and Water Proof iv) Low Price
v) Available in various capacity

ii) Memory Card

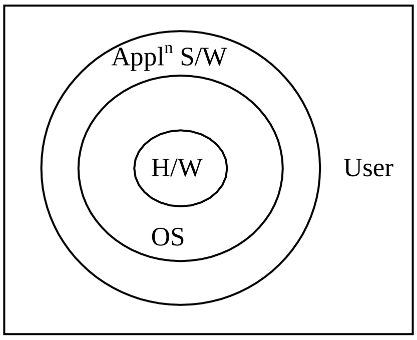
A memory card is based on solid state flash memory technology. It is a form of small card, known as memory card. The memory card is easy, fast and reliable way to store and transfer digital files. This memory card is also a non-volatile memory which can be available in different storage capacity and transfer speed.

The first memory card was introduced in 1990 by the name PCMCIA (Personal Computer Memory Card International Association) and later on called PC Card.



CHAPTER - 2
SOFTWARE CONCEPT

The software is a set of instruction, procedures, program, that instructs the computer system to perform specific function. Hardware and Software are complemented to each other. Software makes hardware functionable. Therefore, it is said that, Software is the life of computers.



Classification of Software
Software can be classified as :

1) System Software
2) Application Software

3.1 System Software

The system software helps the computer system to function properly. It is the software to act as an interface between the application software and computer. It perform some vital functions like: starting up the computer, displaying information in computer screen, retrieving information from secondary media, etc.

The system software is a collection of programs designed to manage computer resources, operate, control and extend the processing capability of the computer. it first interrupt and then carryout the command necessary to run an application program.

The system software is also considered as low-level programs that support execution of all application software. There are different types of system softwares like:

A) Operating Software
B) Network Software
C) Development Tools
D) Language Translator

A) Operating Software

Operating Software is an organized collection of programs that controls and coordinates the different components of computer and the overall operations of a computer.

It is a special category of software essential for making the computer suitable to work. The overall function of OS is to control all the activities of the computer system.

All computer requires OS for smooth functioning. The OS is so essential that, we can not use a computer unless it is installed or loaded in the computer. When we power-on the computer, the first thing it does that, it loads the OS to the memory of the computer. This processing is known as booting. Once the OS is loaded, the computer is ready to work.

Booting is the process of loading OS into the memory of the computers from the backing storage. The roll of OS can be divided into :

a) Control
b) Coordinate

Objectives of OS :
The objectives of OS are :

i) Convenient and proper use of resources
ii) Efficiency

Functions of OS :

OS are of different size and complexity. All OS perform some basic functions like :

i) Managing Resources
ii) Providing user Interface
iii) Execution of Application Programs
iv) Support for Utility Program
v) Control hardware

i) Managing Resources :

The user do not need to know the details of the hardware or of the detailed operations of the CUP. The user can use simple command to execute something. The basic functions of OS as resource manager are :

a) Memory manager
b) Process manager
c) Device manager
d) Fine manager
e) Network manager

ii) Providing user Interface :

User interacts with the computer through user interface. If OS changes, the manner in which we interact may same. OS can be CLI or GUI.

CLI is a form of interface where the user types commands for the computer to carryout. Whereas, GUI is an interface, where the user issues commands by using a pointing device (mouse) to point and click on icons, buttons, menus, list, etc. on screen to do something.

iii) Execution of Application Programs

When the user requests to run a program, the OS locates the program/application and loads it to the main memory. As more and more programs are loaded, the memory allocation becomes crucial. For this reason, multiprogramming OS is complex.

iv) Support for Utility Program

There is another category of programs known as Utility program. It is a specialized program that makes computing easier. Some utility programs are provided by the OS where some others can be purchased or downloaded.

Some common utility in windows are : Disk Defragmentation, Scandisk, etc. Some purchase/downloaded utilities are : various kinds of Angi-viruses.

v) Control Hardeare

In every computer, there is BIOS, which stands for Basic Input Output System. It controls hardware. The OS present in between the BIOS and the Application software. All application programs which needs the hardware must request the OS for it. The OS can access the hardware using BIOS or special device drivers.

Different types of OS :

i) General Purpose OS
ii) Special Purpose OS
iii) Batch Processing OS
iv) Interactive Processing OS
v) Single User OS
vi) Multi-user OS
vii) Multi-Programming OS
viii) Multi-Processing OS
ix) Multi-Tasking OS
x) Multi-Threading OS

i) *General Purpose OS*

The OS we see in computer are general purpose OS. It provides the ability to run a number of different programmes like : game, word processing, painting, business application, etc.

Ex.: DOS, Windows, Linux, Unix

ii) *Special Purpose OS*

These OS are loaded into special purpose computers. It do not manage user progrm. The special computers are generally found in different devices like : ATM, Washing Machine, DVD Player, etc. The OS we use in our mobile phone is special purpose OS

iii) *Batch Processing OS*

The first OSs were primarily batch processing operating systems. The initial function was to facilitate the running of series of programs one after another.

The operating systems performed some kind of sequential processing job. Such OS were known as batch oriented OS. The name batch processing because, the jobs were grouped in batches and executed in computer.

Ex.: Unix, Windows, Mac OS, Smart Phone

iv) *Interactive Processing OS*

It differs from batch processing. This OS interacts with the user in conversational manner as the program is running. The word ‘interactive’ suggests both the computer and user are active. They can talk to each other. The user types the instructions and the program is executed immediately.

Both batch and inteeractive processing are used to describe the timeing of the processing of application.

v) *Single User OS*

As ghe name suggestgs, in single user OS, only one person can work with the computer at a time. The working of these OS is simple and can be easily understood. All the resources of the computer is given to he user, and the memory management is very easy.

Ex.: MS-DOS

vi) *Multi-user OS*

The multiuser OS allows many users to access the computers at the sametime. All the resources are allocated to the different users as they need. If 2 useres want a particular resource at the same time, the OS uses some policy to avoid conflicts.

Ex.: Unix, Linux, Windows 2000 / 2003 server *vii) Multi-Programming OS*

Multiprogramming means, more than one program are executed at the same time. The modern operating systems are multi programing OS. In multiprograming, the idle state of the processor can be used to execute another program. These OS arre very complex.

Ex.: Windows XP, Linux, Unix, etc.

viii) Multi-Processing OS

There can be more than one in independent rocessor (CPU) in a computer. These different processors may be used for execution of different programs/instructions.

In multiprocessing system, 2 or more processing instructions are processed simultineously or in parallel. Due to this, the multiprocessing systems are known as parallel systems.

It is the OS that able to support and utilise more than one computer processor. The capability of OS to deal with more than one processor makes it complex.

Ex.: Mac OS, Win XP, Win 2000, Unix, Linux, etc.

ix) Multi-Tasking OS

The multigtasking is similar to multi-programming. Generallym it is used when the jobs that are being used by the CPU belongs to different users. It is said to be multi-tasking when a single usere performs multiple jobs at a time.

x) Multi-Threading OS

A thread can be defied as a semi-process with a definite starting point, an execution sequence and a terminating point.

Multi-threading is the ability of the OS to execute the different parts of the process called thrread simultaneously. A process, therefore, may consists of many threads.

Therefore, multithreading OS must be able to execute the threads simultineously. To make the multi-threading possible, the program have to be designed well so the different threads do not interferre with each other.

Some common Operating Systems are :

i) MS-DOS
ii) MS-Windows (93,95,98,2000,2003,XP,Vista,7,8)
iii) Unix (bell lab of AT&T)
iv) Linux (another Unix like OS)
iv) OS / X (apple macintosh OS, based on BSD Unix)
v) Solarix (unix operating system by Sun Microsystem)

B) Network Software

Most computer now work in network environment. To connect a computer to a network, we need some hardware devices and some software. The software which helps us to connect the computers to a network is known as network software.

This is used to control, monitor, manage and communicate with operating systems, networks, network services, databases, storage, network applications, etc.

Ex.: N/W management software, Server Software, Security Software, etc.

C) Development Tools

Softwares are programs. While writing programs, we need some tools which helps us to prote better program. It helps the professionals to design, develop and implement various software and solutions. It also includes all testing tools.

D) Language Translator

Software developers use high level programming languages for developing software. These high level languages have to be converted to machine code. The software which translate the high level language to machine code is known as language translator.

Ex.: Assembler, Compiler, Interpreter, etc.

3.2 Application Software

Application software or application programs are developed for /more specific purposes.
There are two types of application softwares.

a) Single Function Application Software b) Integrated Function Application Software

a) Single Function Application Software

This software can perform a single task for the user. The program which is used for writing single function application software is called special purpose application program.

The software which is used by specific purpose is called special purpose and which is used in general is called general purpose single function application software.

Ex.: Chess, Paint, WinAmp, AutoCad, etc.

b) Integrated Function Application Software

The integrated function packages perform a wide variety of works. Mostly they are general purpose software. The software developers puts together some frequently used software. They are also called suits. A software suit consists of many general purpose software.

Ex.: MS-Office

Most commonly used application softwares are : i) Word Processor, ii) Spread Sheet, iii) Database, iv) Presentation Software, v) Web Browser, vi) Graphic Software, etc.

Windows Vs. DOS

Windows		**DOS**	
i)	Multi User	i)	Single User
ii)	Multi Tasking	ii)	Single Tasking
iii)	GUI	iii)	CLI
iv)	No need to remember commands	iv)	Remember commands
v)	No need to remember syntax	v)	Remember syntax
vi)	No need to type	vi)	Commands to be typeed
vii)	Easy to use	vii)	Difficult to use
viii)	Supports Graphics	viii)	Not supports Graphics
ix)	Supports Multimedia	ix)	Not supports Multimedia
x)	Support Icons	x)	Does not support Icon
xi)	Extensive Networking support	xi)	Limited/No Extensive Networking
xii)	More Powerful	xii)	Less Powerful
xiii)	Costlier than DOS	xiii)	Software is less costly
xiv)	Support All DOS commands	xiv)	Does not support Win. commands
xv)	High Hardware requirement	xv)	Low Hardware requirement
xvi)	Booting is slower	xvi)	Booting is faster

CHAPTER - 4
PROGRAMING LANGUAGES, COMPILER AND INTERPRETER

Computer software is a collection of computer programs which is developed for some purpose. The programs are developed by persons known as programmers. The process of development of program is known as programming.

Programming means writing a set of instructions in a sequence using a programming language which produces desired result when executed in computer.

Each programming language has a particular set of instructions or commands, which can be used to perform a specific task. A programming language has very specific rules. These rules are known as syntax of the language. The syntax of a particular language has to be followed exactly. Otherwise, the computer will not be able to understand anything.

4.1 Classification of Programming Languages :

There are many programming languages, which are divided into :

1) Low Level Language and 2) High Level Language

1) Low Level Language

The low level languages are the languages that the computer can understand. There are 2 types of low level languages. These are :

a) Machine Language and b) Assembly Language

a) Machine Language (1st GL)

Machine Language is the most basic programming language. It is also known as 1st generation language. The computers can understand only machine language which is 0 and 1.

The instruction prepared in machine language have to parts i.e. OP-Code (operation code) and Operand.

The machine language differs from computer to computer. Both the command and data are written in binary digits. The programmer has to remember the actual memory address of data and instructions.

Disadvantages :

i) Codes are unique to each computer
ii) Programming is very difficult
iii) Write long sequence of detailed instruction
iv) Error and difficult to find error.

Ex.: To add the value which is stored in memory location 184, we could write :

000100000000000000000000000010111000

b) Assembly Language (2nd GL)

Assembly language uses mnemonics instead of long binary OP-Code and it considered as 2nd generation language. It does not use the long sequence of 0 and 1.

Mnemonics are some letter symbols used for operations. The term mnemonic is used because; it is easy to remember the symbolic code instead of binary OP-Code.

"Assembler is a program that converts programs written in assembly language to machine code". Assembly languages can not understand by the computer. we need to convert it to machine codes, so that, it can be executed. This is done by Assembler.

Ex.:	"ADD	052	800"
	Mnemonic	Address of 1st operand	Address of 2nd operand

Advantages :

i) Use symbolic coded instruction
ii) Simplified program
iii) Greater control and flexibility
iv) Programmers produce more efficient software
v) Compact Instructions

2) High Level Language (3rd GL – 1950)

A high level language closely resembles with human language. There are many high level languages. The first high level programming languages were designed in 1950. Some of the high level languages are :

FORTRAN	-	Formula Translation (1957)
COBOL	-	Common Business Oriented Language (2nd half of 1959)
BASIC	-	Beginners All Purpose Symbolic Instruction Code (1964)
C, C++	-	(Dennis Ritchie at Bell Lab in 1972)
JAVA	-	(Sun Micro System and run in JVM)

3) Very High Level Language (4th GL)

This 4th General Language brings the programming languages closer to the natural languages as we use. It lies in between the high level language and the natural language. It need to mention what you want and not, how to do the job.

Ex.: SQL

4) Fifth Generation Language

The aim of 5GL is to bring programming language and natural language together. In 5th GL, we interact with the computer in the same manner in which we interact with our friends and relatives. To understand these languages, computer should have A.I.

Advantages of High/Very High level languages:

i) Easy to remember instructions
ii) Easier to understand
iii) Few instruction required to write
iv) Easy development
v) Easily converted

4.2. Translation

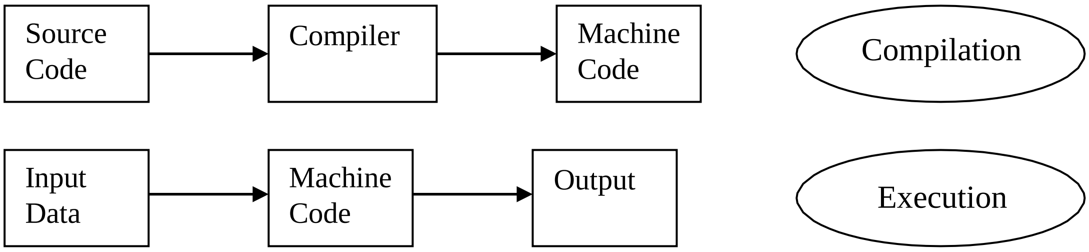
To execute a program, the source code should be converted into machine code. This conversion is known as translation and is done by a software, known as translator.

There are broadly two methods for translating High Level Language to Machine Language. These are :

a) Compilation b) Interpretation

a) Compilation

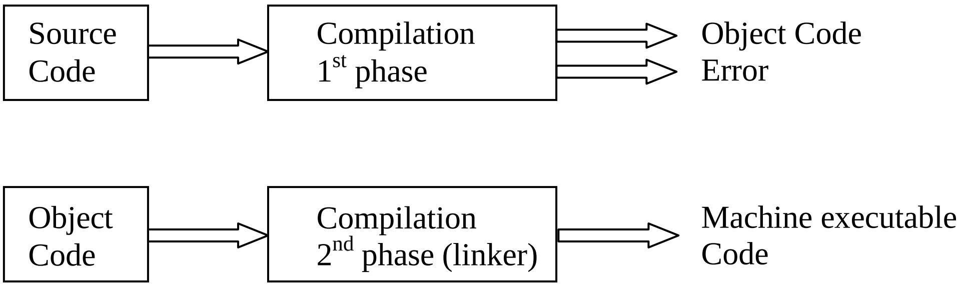
Compilation is the process that translate program written in HLL to equivalent machine code. For this, a translator program is required, which is known as compiler software. The machine code thus generated by this process can be executed independently. This process is known as compilation.



execution is different from compilation

First, the compiler acts on the source code to produce equivalent machine code. After the machine code is produced, it is saved and executed. There is clear separation of compilation and execution.

The C programs are compiled. So, it is a compiled language. There are two phases in compilation i.e.



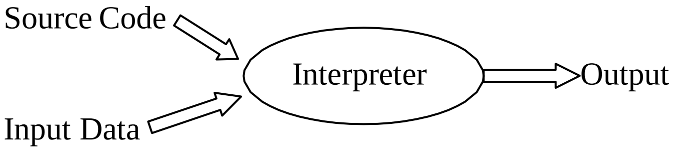
After the second phase, we get the executable version of machine code. This code generally has extension name i.e. ".exe". Once we get the executable code, we don't need the source code. The compiler for different languages are different.

b) Interpretation

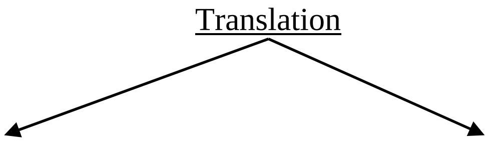
Interpreter is a translating software that performs interpretation. In this mode, the translation is not separated from execution. They go simultaneously. For interpretation, we need a interpreter.

The programming languages like : BASIC, is interpreted. For this, there are two popular interpreters. i.e. i) BASICA and ii) GWBASIC

The interpretation process is :



In this case, no separate executable is produced. Each time you want to execute, you need to interpret again. Therefore, if you have any error in same line, you can not proceed further. You have to first correct the error.



Compiler	Interpreter
i) Translates entire text at once	i) Translates line by line
ii) Execution is separate from translation	ii) execution is not separate from translation

(two modes of translation)

CHAPTER - 5
COMPUTER VIRUS

The power of computer lies in its hardware and software. Computers work by and on programs. All programs may not good programs. Some of them may cause harm to other programs or data in a computer. Such programs are known as Malicious Software Programing or Malware. Some of the malware are :

The malware is unwanted, uninvited and are potentially dangerous programs.

i) Virus   ii) Trojan Horses   iii) Worms   iv) Spy Wares

i) Virus

The word virus means, infection or dieses caused by bacteria. These virus natural and cause dieses to living beings.

But in computer language, virus means, a small program, that attach itself to another program without the permission and knowledge of the user and attacks the computer software by making copies of itself.

The term computer virus was first given by Fred Cohen in 1984.

A virus can spread from one computer to another by a user, when an infected file/program is copied to the un-infected computer. It happens without the knowledge of the user.

A computer virus is a program / set of instruction. Creating of computer virus is a crime. It is deliberately (intentionally/purposely) created, propagates (spread) and does unwanted things.

Characteristics of Virus

i) Attached to the programs unknowingly
ii) Spread when the infected file/program is executed
iii) Every virus has an incubation period
iv) After incubation period, it starts showing unusual behavior
v) Many cause damage to software, program, data, file, etc.

How it Spread

i) Floppy/CD/Flash Memory   ii) Pirated Program or Softwares
iii) E-mail   iv) Internet

What a Virus can Do

i) Delete data files
ii) Format HDD destroying all data
iii) Corrupt OS
iv) Presents a flash advertisement message (stoned virus)
v) Corrupt FAT, so OS can not detect HDD
vi) Computer refuses to load genuine programs or softwares
vii) Send personal data (including password) to others
viii) Use your computer to attach other websites
ix) Disable hardware (CIH, known as Chernobyl tries to modify the BIOS on April 26)
x) HDD going bad

Signs of Computer Infection

i) Functionality becomes slow
ii) Computer responses slowly and often freezes
iii) Computer automatically restart
iv) Uncommon error message
v) Distored menus and display box
vi) Applications does not work aproperly
vii) Can not print properly
viii) Failure of correct installation

Types of Viruses

The types of virus can be divided depending on technique, infection type, hidden type, damage type, OS reside, etc. Some common viruses are :

i) Boot Sector Virus
ii) Application Program Infector
iii) Stealth Virus
iv) Multipartite Virus
v) Resident Virus
vi) FAT Virus
vii) Macro Virus
viii) ActiveX and Java Control

i) Boot Sector Virus

A Boot Sector Virus infects diskette and HDD. It cause harm to the Master Boot Record (MBR), so that, computer will not be able to boot and start.

ii) Application Program Infector

These viruses got attached to any executable files like : .exe, .bin, .ovl., .dat, etc. When the file is executed the virus makes copies of itself and infect other programs.

iii) Stealth Virus

It clearly hides its presence. It uses certain techniques to prevent being detected. These techniques include changing the date, file size of the infected files.

iv) Multipartite Virus

It is a hybrid virus of Boot Sector Virus and Program Infector. It infects the program files. When the infected file is open, it copies itself to the boot record. So when we boot next time, it will infect other programs.

v) Resident Virus

A resident virus remains in RAM. When program and data passes through RAM, it infect the program and may destroy data / program. Example : Randex, CMJ , Mave, etc.

vi) FAT Virus

FAT is vital for normal functioning of computer. It tells, which file is stored where. If the FAT is modified, we may not able to locate certain file. The FAT virus destroy the FAT, making the file not available.

vii) Macro Virus

These viruses infect data files. Many programs allows the use of macros for better performance. So, it attach the file as macro. Once the file is affected, it replaces one of the standard macro with an infected version, which can infect other documents. Example : Bables WM NICE day.

viii) ActiveX and Java Control

These are latest type of viruses. MI-Internet Explorer has Active X control and Java Control. By managing these Active X and Java Control, we tell the web browser to allow or prohibit certain functions. This is very important. Specially when the computer is connected with the internet.

By leaving computer without Active X and Java Control, we expose our computer to the unwanted software.

Some Misconception about Virus

i) It originates from programming error
ii) It comes to existence of its own
iii) E-mail text contains virus
iv) Computers gets virus if put in dusty atmosphere
v) Computer is not used for a long period

ii) Trojan Horses

Trojan Horses are programs that carry harmful function. They can not replicate themselves. A Trojan Horses will spread only if the program executes. It may be infected by downloading attachments. Generally, such programs are games.

iii) Worm

A worm is similar to virus but different in some manner. It does not need a program / document and action to spread. They are capable of creating copies of itself and use computer network to spread.

The work takes the advantage of file transfer feature, which allows to travel it independently. So, it consumes much of the system resources. The worm in a computer looks for other connected computers and try to infect them.

Ex.: Xerox Park Work(1982), Internet Worm(Nov.,1988)-Robort Morvies,CSE, Cornel Univ.

iv) Spywares

Spyware is a type of malware, installed on computers that collect information about user without their knowledge. The presence of spyware is typically hidden from the user and can be difficult to detect.

Many internet users were introduced to spyware in 1999, when a popular freeware game called “Elf Bowling” came bundled with tracking software.

Detection and Prevention of Virus

When we connected to internet/intranet, copy files, etcc., there is every possibility of virus attach. The solution to the virus related problem is anti-virus. Anti-virus is a software that can detect virus and prevent access to infected files and even eliminate infection.

The basic aim of anti-virus is to detect the file(s) infected and disinfect them. The aim is :
i) To detect Virus
ii) To ascertain the Virus Type
iii) Remove the virus without causing damage to files

The methods for virus detection used by most anti-virus software are :
i) Search for virus signature ii) Heuristic Algorithm

Detection of Virus

1) Run Anti-Virus regularly
2) Run Anti-Spy scan regularly
3) Check if computer becomes slow suddenly
4) Compare the name and size of copied files from the original one
5) Check, if the folder has many files even if the copied one
6) Shut-Down Problem
7) Any other suspected computer behavior

Prevention of Virus

1) Do not use pirated software
2) Disconnect internet / intranet when not use
3) Install good anti-virus software
4) Install good firewall
5) Update anti-virus regularly
6) Install good anti-spy software
7) Always use “username” and “password” to login
8) Use good “Password” that is difficult to guess
9) Always take backup of important data / documents / files
10) Never open E-mail from unknown persons
11) Make proper scan of FDD, CD, Flash Memory before use
12) Never disclose password
13) Change password regularly
14) Always use security patches.

Removal of Virus

1) Be aware of risks
2) Install anti-virus software
3) Use software patches to close security loopholes
4) Keep backup of data
5) Use firewall

CHAPTER - 6
APPLICATION OF COMPUTERS IN DIFFERENT DOMAINS

In today’s world, computer can be used in every sectors like :

- Use in Business
    - In Finance
        - Tally
        - Win CA
        - Payroll
        - Accounts Payable
        - Accounts Receivable
        - General Ledger
        - Trial Balance
        - Balance Sheet
    - In Marketing
        - Keep track of dealers, sub-dealers and retailers
        - Advertisement
        - Planning and Execution
        - Customer satisfaction
        - After Sale Service – by special computer system i.e customer relationship management (CRM)
    - In Production and Sales
        - Designing of a product (CAD)
        - Control Manufacturing Process
        - CAM
        - Keep record of Raw Material and Finished Goods
    - In R & D
        - Making Models
        - Making Experiments
- Use in Education
    - AV Teaching
    - AV & Text form stored material
    - Education on Demand
    - Experiments in Labs
    - Learning other Languages
    - Maintain students database
- Use in Medical Science
    - Hospital Administration
    - Patient Monitoring System (ICU / CCU)
    - Computer Assisted Surgery
        - Laparoscopy
        - Robotic Surgery
        - Tele Medicine
        - Remote Diagnosis
        - Tele Surgery

- Use in Entertainment
  - Graphics
  - Multimedia
  - Special Sound Effects
  - Computer Game
  - Animation
  - Song, Music, Film, Video, etc
  - Digital graph and piectures

- Use in Office Automation
  - Word Processing
  - E-communication
  - E-mail
  - Teleconferencing
  - E-banking
  - Presentation
  - Database
  - Bio-matcix

CHAPTER - 7
NETWORK CONCEPT

A computer network is defined as a collection of different independent computers connected together for the purpose of exchange and sharing of resources and are based on some common technology.

It means, a group of connected computers are communicating with each other. The components of a computer network are :

1) Different individual computers
2) Data communication line or medium
3) Message or data to be transferred
4) Software associated with data communication
5) Set of rules, which governs the data transmission process.

7.1 Types of Network

A common network can be varying. It may be small, consists of two computers or very big network, consists of more than thousands of computers. Mainly, there are three types of networks. These are :

i) LAN (Local Area Network)
ii) MAN (Metro Area Network)
iii) WAN (Wide Area Network)

i) LAN (Local Area Network)

The LAN is the network of computers in a small localized area. It may be within a room, building, a campus or an area. LANs are basically used to connect personal computers and workstations in an organization for sharing resources.

Example : Network of a computer lab

The LANs are distinguished from other networks by following factors :
i) size ii) transmission technology iii) topology (physical structure)

LAN were developed in 1970s and are very popular even today. It is very easy and economical to set. Different types of media used for LAN are :
a) Twisted Pair Cable b) Co-aixal Cable c) Optical Fiber Cable d) Wireless

In a LAN, all the computers are connected to the cable. The traditional LANs runs at the speed of 10mbps to 100 mbps. Newer LANs sometimes known as Gigabit Ethernet, has speed upto 10gbps

ii) MAN (Metro Area Network)

A Metropolitan Area Network is bigger than LAN. It may cover entire city or multiple cities. The MANs were developed in 1980s, which use optic-fiber cables as the medium of communication.

Example : Television network in cities, Local Cable Connection, etc.

iii) WAN (Wide Area Network)

The WAN covers a large geographical area. It may be a country or even whole world. The computers can be connected to WAN like any other network.

Apart from computers, many other network enable devices can also be connected to the network. All such devices that can be connected to a network are called hosts or nodes.

Sometimes satellites used WAN as a medium of communication. The WAN technology is different from LAN technology. A LAN can be a part of WAN. Almost all WANs are packet-switched networks.

In packet-switch, the data is divided into small fragments/chunks, known as packets. Each packet is transmitted from source to destination independently.

In WAN, there may many different possible paths from source to destination. In some network, all the packets follow the same path and in some others, each packet is treated independently and may take different path. All WANs are not packet switched.

7.2 Network Topology

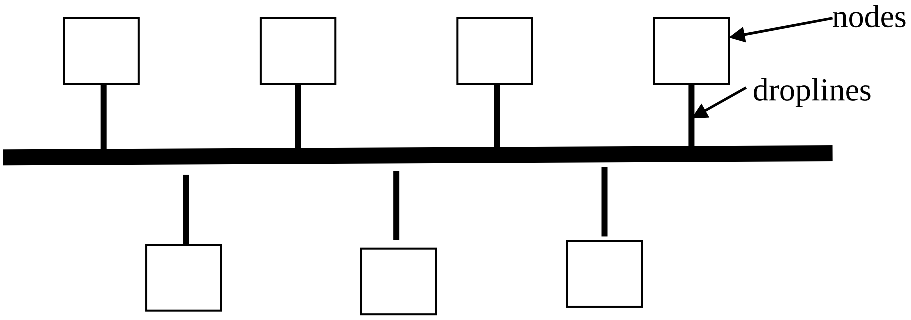
The network topology is defined as the physical structure of the network including physical arrangement of the devices, cables, etc. The performance of a network can be influenced by the network topology. The topology can be :

i) BUS Topology
iii) STAR Topology
iv) MESH Topology
ii) RING Topology
iv) TREE Topology
v) Hybrid Topology

i) BUS Topology

In BUS topology, all data transmissions are carried out by a single common cable. The single common cable is known as BUS. All communication from one computer to another is done by the common cable or BUS.

Due to this, only one computer can transmit data at a given time. If two computers tries to send data at the same time, then collision occurs and both the computers retract back and try after sometime. There are rules or protocols that determine which computer has right to transmit.



Each communicating device is connected to the BUS with the help of special line, called dropline.

Characteristics of BUS Topology

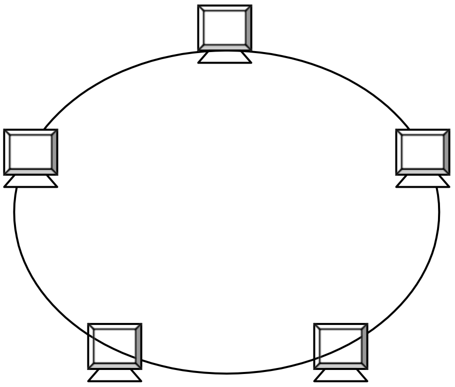
i) Easy to add or remove computer without disturbing others
ii) One message can be sent at any point of time
iii) It uses broadcast system (n sender sends data to all other hosts of the network)
iv) Economical and easy to setup
v) Mainly Co-Axial Cable is used
vi) Used in LANs

ii) RING Topology

In a Ring Topology, the communicating devices are connected with each other to form a circle. As they are in circle, every node has two neighbors. Every host is connected to its neighbors. In this topology, messages can travel only in one direction.

It functions by passing packets from one node to another until it reached the destination. When a node receives a packet, it checks the destination address. If the address of the node matches with the address of the packet, then the node receives the packet.

After receiving the packet, the node marked the packet as received and retransmits to the sender so that, the sender sees the packet back and check if the mark "received" is present.



Characteristics

1) Each node connected to the network via repeaters.
2) Shared resources can be attached to any host
3) Most rings have a monitor station, which has the task of removing corrupted / unwanted packets from the network.

Advantages

1) Reliable.
2) Each node is connected with two neighbors
3) It is each to install and configure

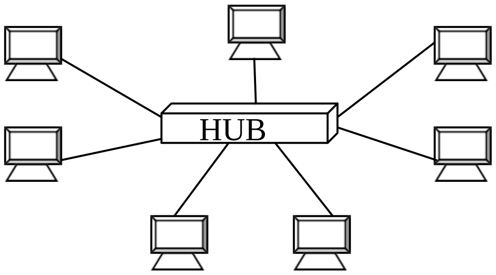
Disadvantages

1) Untraditional (data can transmit only in one direction)
2) If cable between two hosts damaged, the entire network goes down.

iii) STAR Topology

Star Topology is probably most popular topology that is used for setting up of LANs. In this topology, there is a central device known as Hub or Switch. Every host is connected to the central device. All communication goes through the central hub.

Ex – Public telephone network



Characteristics

1) It has a central device (hub / switch)
2) Data transfers through the switch
3) Each node is connected to the central device
4) Twisted pair cable is used.

Advantages

1) Less expensive
2) Easy to install and reconfigure
3) Nodes can be added or removed easily
4) Data transmission is bidirectional
5) If one link fails, then only that node is affected
6) Easy fault identification
7) High speed
8) Many simultaneous use

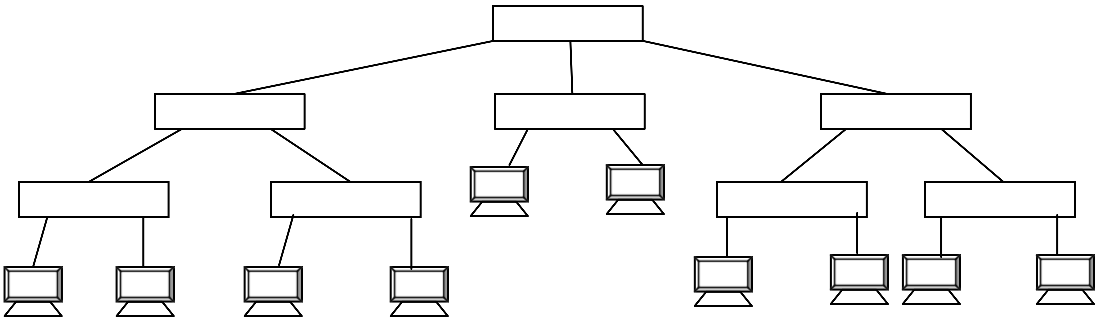
Disadvantages

1) If the central hub is down, then the entire network goes down
2) Requires more cabling than RING or BUS

iv) TREE Topology

The TREE Topology joins different star network into a single network. It also known as extended STAR topology.

It can be extended in such a manner that, instead of the node, a Hub can be connected to another Hub. One Hub is the main hub whereas other are sub-hubs. It gives the flexibility to increase the number of nodes in a network.



Advantages

1) Different networks can be connected to form a single network
2) Maintenance is easy
3) Easy to add or remove at/from bottom of the tree

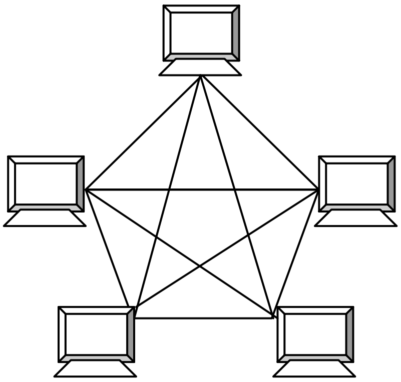
Disadvantages

1) If the top node is overloaded, then the network performance will become slow
2) If the top is down, then the whole network will be down

v) MESH Topology

In MESH Topology, there exists multiple paths between hosts. Some hosts are directly connected to some other nodes.

There exists multiple paths between the sender and the receiver. This mesh topology can be connected in two forms i.e. (i) partially and (ii) fully. In this mesh topology, there is no break in communication



Advantages

1) Reliable and no traffic problem
2) Privacy and Security is maintained
3) No failure of data transmission

Disadvantages

1) Require extensive cabling
2) High cost

vi) Hybrid Topology

A network that contains a combination of different topologies is considered as Hybrid topology. The exact size, shape and the combination depends on the requirement.

7.3 Protocol

A protocol is a set that governs/contains data communication. It is an agreement between the communication devices. The protocol defines what is, how and when to be communicated.

If the protocol is not strictly observed, then the data sent by one computer to another may be interpreted differently. There are many protocol suits that governs data communication. Some common protocols are : TCP/IP, FTP, HTTP, etc.

The new devices are made by different manufacturers. Therefore, there must be a standard rules for data communication.

The protocols include mechanism for the devices to identify and make connection with each other. It also specifies how data is sent and received. Some protocols also support message acknowledgement. Different protocols developed for specific purpose and environment.

There are mainly 2 sets of network protocols. Modern computer networks are layer designed. For network designing OSI (Open System Interconnection) is used. OSI has 7 layers i.e.

i) Physical Layer   ii) Data Link Layer   iii) Network Layer
iv) Transport Layer   v) Session Layer   vi) Presentation Layer
vii) Application Layer

Each layer has its own protocol. They accomplish a particular subtask and interacts with other parts of protocol in well defined ways.

Internet Protocol

The Internet Protocol is another set of protocols used in Internet. It is commonly referred as TCP/IP. The TCP/IP protocol is a complete protocol suit consisting of many different protocols. Some common protocols are :

IP	: Internet Protocol	TCP	: Transmission Control Protocol
UDP	: User Datagram Protocol	HTTP	: Hyper Text Transfer Protocol
FTP	: File Transfer Protocol		

7.4 Internetworking

The internetworking is connecting individual networks into a single large network. The interconnected network is called internet. The technique to interconnect different networks together is called internetworking.

The different networks of the internet are based on different hardware, software, standards and protocols. All these different networks are unified by an internetworking protocol standard known as Internet Protocol suit (TCP/IP)

Needs of Internetworking

- Access data from anywhere
- Network software helps to access application software
- No need to know the technical details of all OS. There is a common way of interacting with all computers.

Ex. – use of UBI ATM card in other bank’s ATMs

7.5 Components

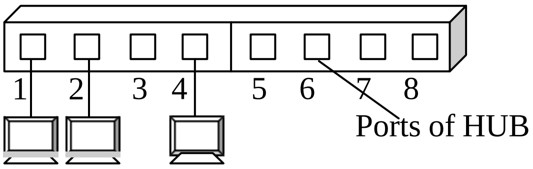
For smooth operation of computer network, apart from computer and the transmission medium, some other different devices are required. Some of the network devices used in computer network are :

i) Hub	ii) Switch	iii) Repeaters
iv) Bridge	v) Router	vi) Gateway

i) Hub

A hub is a very common network device found in Star network topology. Computers are connected to each one of the ports. A server can also be connected to one such port

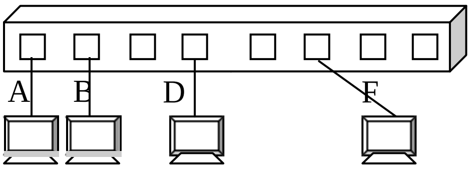
When a hub receives a packet of data from one computer, it transmits the packet to all of its ports, making it available to all computers in the network. It works in broadcast mode



(8port HUB)

ii) Switch

Like a HUB, a switch connects different nodes. It receives a data packet from a particular node, reads the destination address and sends data packet only to the destination computer. For this, it creates a temporary connection between source and the destination and the connection is terminated after sending the data packets.

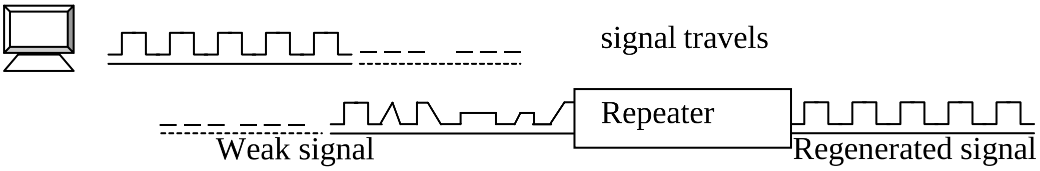


(A Switch having 8 ports where “A” sends data to “F” and “F” receives data from “A”)

iii) Repeater

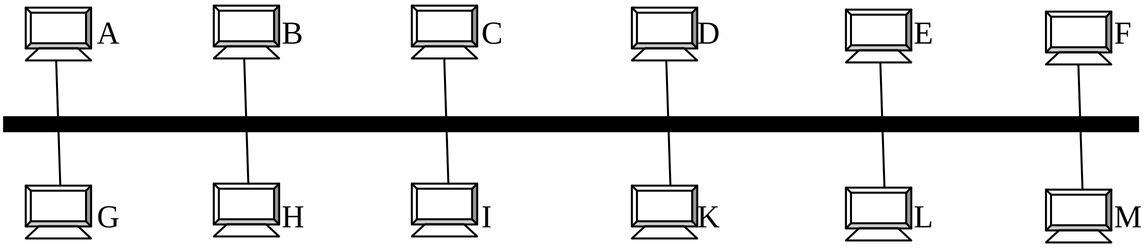
When signal travels in an medium, the medium offers resistance. The resistance causes the signal to lose its strength and becomes weak. Every signal can travel some fixed distance in some medium. After that, it becomes weak.

In networking, repeaters receives the weak signal and regenerates the entire signal, so that, the signal can travel further.



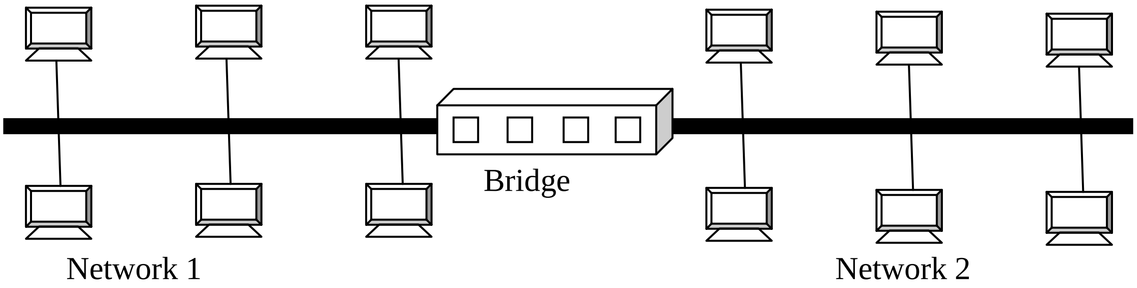
iv) Bridge

A bridge is used in big networks. The bridge is used to break or divide a large network into smaller and more efficient networks.



As the number of compute increases, the bandwidth decreases, as the same is used by more number of computers.

Suppose, A sends data to H, then the data travels in the common cable. During this transmission, no other computer can use the medium to transmit data.



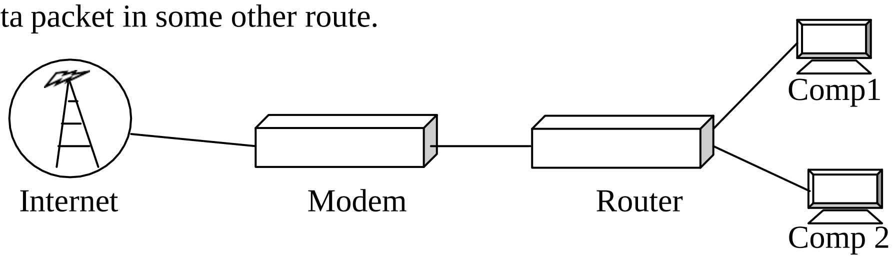
After attaching the bridge, the bridge knows that which computer sends data to which computer and in which network they are. Therefore, it blocks the packet data to enter into other networks.

When data packets reached at bridge, it reads the destination address and sends to the destination node. The main advantage of bridge is to reduce network traffic between two networks. The main jobs of a bridge are :

i) Examine the destination address of data packet
ii) Decide whether to pass or not to pass the data packet through it to the other side

v) Router

Like bridge, a router passes data packets through it. It comes in different shapes and sizes. It not only passes the data, but also determine/select the best way/path from source to destination. It knows which route is busy. If it feels a particular route is busy, then it sends the data packet in some other route.



vi) Gateway

A gateway is a point in network that acts as an entrance to another network. It is used to connect 2 different types of networks.

In these 2 different networks, there is a problem when we try to connect one network on windows to another on Linux. In this case, the basic job of the routers is to convert one network standard to another, so that the other network can understand the data sent by the network.

The gateway works on the network and transports layer. Due to this gateway, we can send messages to any computer from our computer.

Bandwidth

Bandwidth can be defined as the range of frequencies that a medium can pass without being strongly weakened. It is a physical property of the transmission medium. Usually, it depends on the construction, thickness and length of the medium.

Bandwidth can be measured as how much information or bits can flow from one place to another in a given time. In digital system, it is measured as bits per second i.e. bps.

The units of bandwidth are :

bps, kbps (1000 or 10^3bps) mbps (appx 10^6bps)
gbps (appx 10^9bps) tbps (appx 10^{12}bps)

CHAPTER - 9
PROBLEM SOLVING METHODOLOGY

Programming is very systematic activity. Using program, the programmer instruct the computers to do certain things. Programming is considered as an art. A good programmer must have done the followings:

- Think logically
- Draw attention to every minute level
- Tell the computer very precisely what it should do
- Every command must be unambiguous

There are different tools available to help the programmer for writing better program. The common tool used by the programmers are :

a) Algorithm and b) Flowchart

a) Algorithm

The algorithm describes the steps that should be performed to solve a problem. The algorithm is the process or broad steps that should be performed to get the result.

Not only have the mathematical problems had algorithm. Every work we do has an algorithm. It consists of different steps. These steps are needed to get the job done.

The 2 formal definitions of algorithm are :

i) Algorithm – A series of precise steps, needed to accomplish a specific task
ii) Algorithm – A series of steps that describes the logic to solve the problem

Characteristics

- Unambiguous
  The operation that can be carried out without any further explanation or simplification

- Well ordered
  It should be always clear what instruction to be carried next. The ordering of the instruction should be clear.

- Produce result
  The algorithm must produce result. It must have at least one output. If the algorithm does not produce result, then it is useless.

- Eventually end
  The algorithm must be over or complete after some time. Later or sooner, it must reach an ending point.

Presenting Algorithm

The algorithm generally lengthy and therefore difficult to understand. For better understanding, it can be presented in following manner:

i) Pseudo code   ii) Flow Chart

i) Pseudo Code

Pseudo code is an artificial and informal language that helps programmers to develop algorithm. It is a text based detailed design tool. The rules of pseudo code are reasonably straight forward. All statements showing “dependency” are to be indented. The pseudo code use English like keywords to describe the logic to solve a program. The pseudo code generally use some popular programming commands like : IF, THEN, ELSE, DO, WHILE, etc.

Advantages

1) Converting the pseudo code to program is easier
2) The pseudo code can be written using the notation
3) A programming language written pseudo code needs less effort than to draw a flowchart.

Disadvantages

1) No standard rule for writing pseudo code
2) In the beginning pseudo code writing may be difficult than even programming writing
3) Pseudo code may be lengthy
4) May be difficult to understand

Example – 1

Write an algorithm to find out the minimum of 2 numbers i.e. A and B

Ans :

```
1) Read A
2) Read B
3) If A > B, then
        “B” is lowest
5) Else
        “A” is lowest
6) End
```

Example – 2

Write an algorithm to find out the largest number among 3 numbers

Ans :

```
              1) Read A, B and C
              2) If A > B then
              3) If A > C then
                      “A” is largest
4)               Else
                      “B” is largest
5)               End
              6) If C > B then
                      “C” is largest
              7) Else
                      “B” is largest
              8) End
```

Example – 3

Write an algorithm to convert the temperature given in centigrade to Fahrenheit

Ans :

```
1) Read C
2) F = 1.8 * C + 32
3) Output : F
4) End
```

Example – 4

Write an algorithm for awarding division student based on aggregate marks as per the following criteria.
(a) >60% - 1st div (b) >50% - 2nd div (c) >35% - 3rd div (d) <35% - fail

Ans :

```
1) Read mark as "M"
2) if M>=60, then
       1st division
       End
3) else if M>=50, then
       2nd division
       End
4) else if M>=35, then
       3rd division
       End
5) else
       Fail
       End
```

Example – 5

Give 5nos. Write an algorithm to find out the total and average of 5nos.

Ans :

```
1) C = 0 (C can be used as a counter to count 5nos.)
2) S = 0 (Let sum of number is "0")
3) C = C + 1
4) Input Cth number as X
5) S = S + X
6) If C < 5, then goto step-3
7) Avg = S/5
8) Output : S
9) Output : Avg
10) End
```

b) Flow Chart

Flow chart is the graphical representation of the algorithm. To express the algorithm in flow chart, we take the help of some geometrical figures. "It is a diagrammatical representation of algorithm that shows the solution logic for a problem".

A flow chart is simple and unambiguous pictorial view of how the computer will solve the problem. The total collection of the symbols used in flow chart is large. Most common symbols used are :

1)	Oval shaped Box	start end	to denote the start/end of the program
2)	Parallelogram Box	I/P O/P	entering data or displaying output
3)	Rectangle Box	Processing	basic operations like: calculation/manipulation
4)	Diamond Box	decision box	A choice of path to take based on some condition
5)	Arrow	→	Shows logical flow. It connects different boxex
6)	Circle	○	Used to link parts of flow chart on some or different pages
7)	Open End Box	…	Additional comment on the purpose of an attached symbol

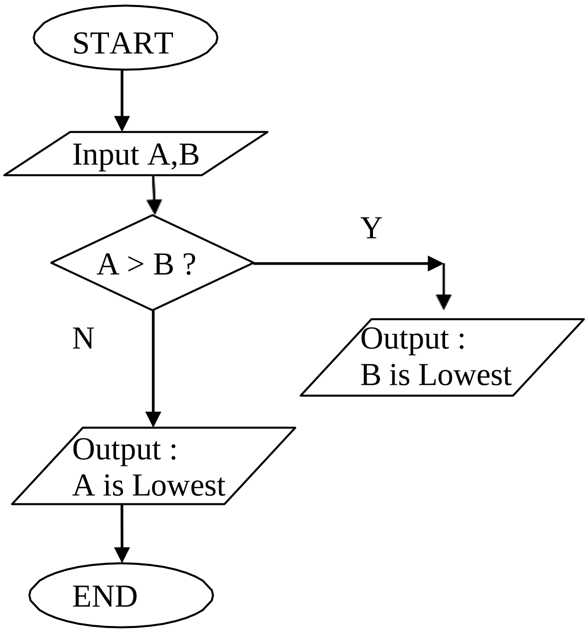
Advantages
1) Better representation
2) Efficient and effective coding
3) Easy debugging
4) Program updating and maintenance
5) Documentation

Disadvantages
1) Difficult
2) Complex Logic
3) Reproduction
4) What and How
5) No detail standard

Example – 1

Draw a flow chart to find out the lower of two numbers

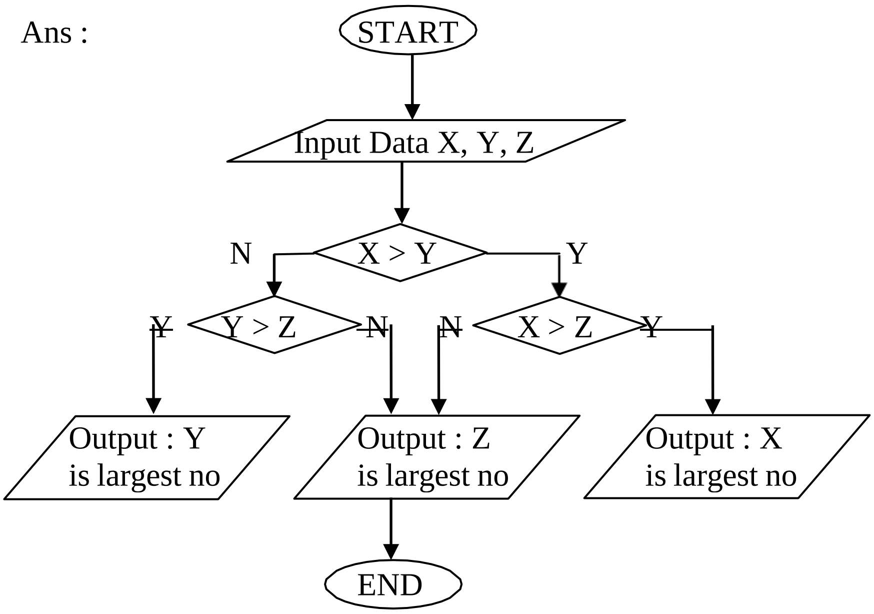
Ans :



Example – 2

Draw a flow chart to find out the largest number among given 3 numbers

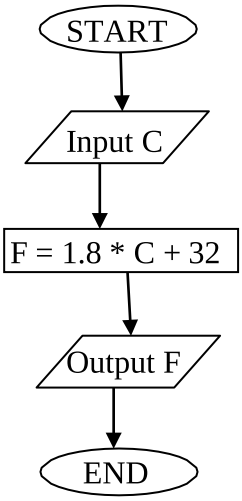
Ans :



Example – 3

Draw an flow chart to convert the temperature given in Centigrade to Fahrenheit.

Ans :

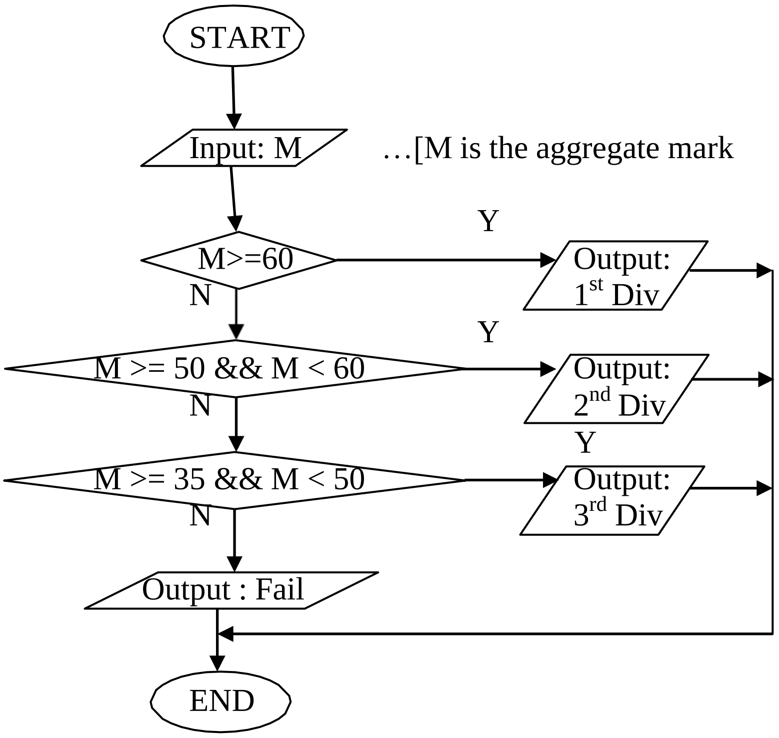


Example – 4

Draw a flow chart to award the division based on the aggregate marks based on following criteria.

1) If aggregate mark is >=60, then award “1st division”
2) If aggregate marks is >=50 and <60, then award “2nd division”
3) If aggregate marks is >=35 and <50, then award “3rd division”
4) If aggregate mark is <35, then award “Fail”

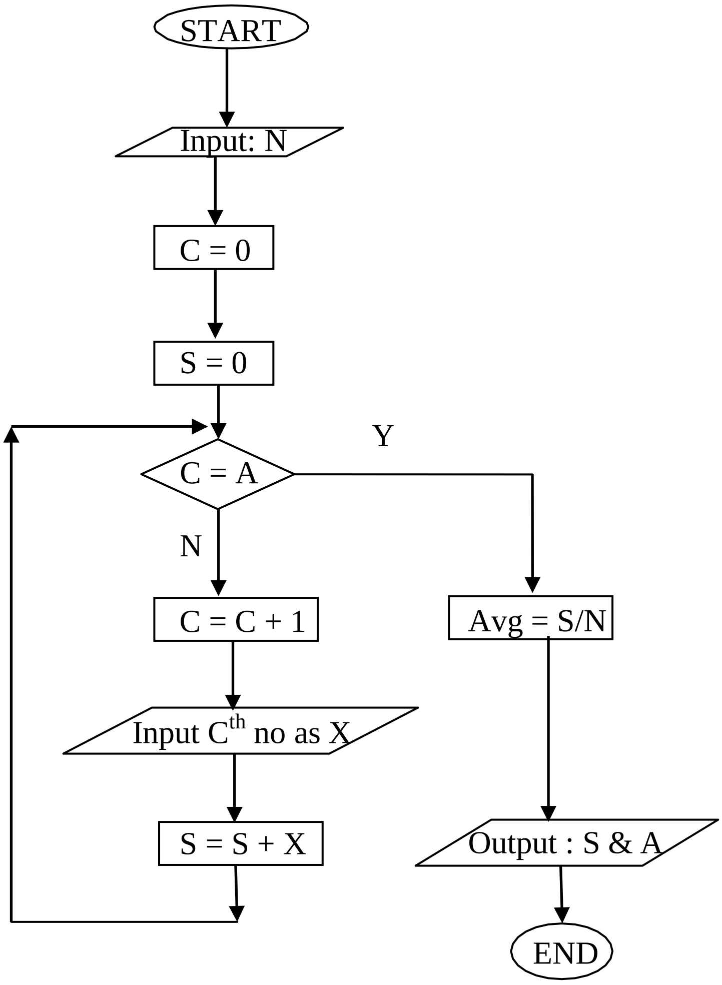
Ans :



Example – 5

Give “N” numbers. Find out the Sum and Average of the numbers. In this case, “N” is given and the numbers are given

Ans :



CHAPTER - 10
OVERVIEW OF “C” PROGRAMME

In 1970s, most system software were written using assembly language. The assembly language is long, difficult to use, non-portable, difficult to find error and even difficult to change.

The C programming language evolved(developed) from 2 other languages i.e. **BCPL** (Basic Combined Programming Language – 1967) and **B** (1970) by Deniis Ritchie at Bell Lab in 1972, who also known as father of C.

By 1978, Brain Kernihan feel the potential of C language and tries to write the UNIX using C programming. He successfully use the C Language as an alternative to assembly language for writing Unix OS. He also suggested some important and vital improvement to the C Language that could make it easy to write programs of different types.

Kernighan and Ritchie teamed together and published the most famous book “The C Programming Language”. In 1983, ANSI (American National Standard Institute) established a committee to provide a modern, comprehensive definition of C, which is known as ANSI standard or “ANSI C”.

Character Set of C

Every language has its own character set. The character set of C consists of :

- Letter - A – Z, a – z
- Digit - 0 to 9
- Under Score - _
- Special Characters - ! “ # % & ‘ ( ) * + - , . / ; : < > = ? [ ] \ ^ { } | ~
- Additional Characters -
    - Space - Leave blank space
    - BEL - BELL (signal an alert)
    - BS - Back space
    - FF - Form feed (Go to top of the page)
    - NL - New Line (Go to start of next line)
    - CR - Carriage Return (Go to start of this line)
    - HT - Go to next horizontal tab stop
    - VT - Go to next vertical tab stop

Comments

Comments have nothing to do with the compilation and execution process. But they are very much part of any language. The comments are meant for the users.

In C, comments starts with “ /* ” and ends with “ */ ”

Example :

```
/* this is an
/*   Exmple                    OR

/* this is
        an
        example */
```

Identifier

Identifiers give name to anything, that is use in a program. To identify something, it has to be named. Identifier helps to do this. The common identifiers used in C are :

a) Variable   b) Consonant

a) Variable

A variable is an entity that can take on different values. Anything that changes its valu can be considered as variable.

When a variable is declared, the computer reserves the required memory space to store it's value. A variable has the following parts :

i) Data type   ii) Value

Rules for creating variables:

1) First character can not be a digit
2) Special characters are not allowed
3) Blank space is not allowed
4) Should not more than 31 characters
5) Reserved words can not be used

b) Consonant

Consonants are like variables. But it's value can not be changed. It is a programmer defined entity with an associated value, which can not be changed during execution of the program.
Example : int const x = 5;   const int a = 6;

Types of Constants

- Integer Constant - It contains only integer value
  Example : +123 -123 123u 123L 123UL
  12.0 12 342 1234a 1,234 – (all are invalid)

- Character Constant - It contains only a particular character. The character should be enclosed by a single quote mark i.e. ' '
  Example : 'r' 'D' 'a' 'K'
  'Ab' 'ab' 'AB' 'aB' 'a1' '1A' – (all are invalid)

- Float Constant - It stores a float type value i.e. real numbers
  Example : 123.00 12.345 0.123
  1,234.30 21.00.0 1 23.13 – (all are invalid)

- String Constant - It stores a collection of characters. A string is generally put in double quote i.e. " "
  Example : "memory" "COMPUTER" "Odisha"
  'memory" "COMPUTER' 'Odisha' – (all are invalid)

Data Type

A computer can process different types of data. Different types of data are processed differently. Therefore, it is important to declare the type of data.

The data type of a variable determines a set of values of operations that can be applied to those values. Different data types are :

i) Primary Data Type

Primary data types are variables in the programming language for use
Ex – int (short, long, signed, unsigned), float, double, void, char

ii) Derived Data Type

Derived data types are derived from the primary data types. Array is a collection of similar elements of a particular data. So, it is derived data type.
Ex – array, asting, pointer

iii) User Defined Data Type

User defined data types are defined by the user, depending upon the requirement.
Ex – structure, union, enum

Table (Data Type)

Type	Bytes(bits)	Range
Short Int	2 (16bits)	-32768 to +32767
U Short Int	2 (16bits)	0 to +65535
U Int	2 (32bits)	0 to +4294967295
Int	4 (32bits)	-2147483648 to +2147483647
L Int	4 (32bits)	-2147483648 to +2147483647
Signed Char	1 (8bits)	-128 to +127
U Char	1 (8bits)	0 to 255
Float	4 (32bits)	1.E-36 to 1.E+36
Double	8 (64bits)	1.E – 303 to 1.E + 303
L Double	12 (96bits)	

Variable Declaration

It means, informing the computer the name of variable and the type of data it can take. Primarily, there are 4 primary data types associated with variables. They are : int, float, double, char

In C, a variable must be declared before it can be used. As C is case sensitive, one name declare more than one time, small letter, again in capital letter and again in combination of both are not possible. Because all are different variables.

Example : variable, VARIABLE, Variable

6.1 *Operators, Expressions, Type conversion & Typecasting*

6.3.1 Operators

An operator is a symbol used to perform arithmetic and logical operations in a program. That means an operator is a special symbol that tells the compiler to perform mathematical or logical operations. C programming language supports a rich set of operators that are classified as follows.

- Arithmetic Operators
- Relational Operators
- Logical Operators
- Increment & Decrement Operators
- Assignment Operators
- Bitwise Operators
- Conditional Operator
- Special Operators

Arithmetic Operators (+, -, *, /, %)

The arithmetic operators are the symbols that are used to perform basic mathematical operations like addition, subtraction, multiplication, division and percentage modulo. The following table provides information about arithmetic operators.

Operator	**Meaning**	**Example**
+	Addition	10 + 5 = 15
-	Subtraction	10 - 5 = 5
*	Multiplication	10 * 5 = 50
/	Division	10 / 5 = 2
%	Remainder of the Division	5 % 2 = 1

- The addition operator can be used with numerical data types and character data type. When it is used with numerical values, it performs mathematical addition and when it is used with character data type values, it performs concatenation (appending).
- The remainder of the division operator is used with integer data type only.

Relational Operators (<, >, <=, >=, ==, !=)

The relational operators are the symbols that are used to compare two values. That means the relational operators are used to check the relationship between two values. Every relational operator has two results TRUE or FALSE. In simple words, the relational operators are used to define conditions in a program. The following table provides information about relational operators.

Operator	Meaning	Example
<	Returns TRUE if the first value is smaller than second value otherwise returns FALSE	10 < 5 is FALSE

>	Returns TRUE if the first value is larger than second value otherwise returns FALSE	10 > 5 is TRUE
<=	Returns TRUE if the first value is smaller than or equal to second value otherwise returns FALSE	10 <= 5 is FALSE
>=	Returns TRUE if the first value is larger than or equal to second value otherwise returns FALSE	10 >= 5 is TRUE
==	Returns TRUE if both values are equal otherwise returns FALSE	10 == 5 is FALSE
!=	Returns TRUE if both values are not equal otherwise returns FALSE	10 != 5 is TRUE

Logical Operators (&&, ||, !)

The logical operators are the symbols that are used to combine multiple conditions intoone condition. The following table provides information about logical operators.

Operator	Meaning	Example
&&	Logical AND - Returns TRUE if all conditions are TRUE otherwise returns FALSE	10 < 5 && 12 > 10 is FALSE
||	Logical OR - Returns FALSE if all conditions are FALSE otherwise returns TRUE	10 < 5 || 12 > 10 is TRUE
!	Logical NOT - Returns TRUE if condition is FLASE and returns FALSE if it is TRUE	!(10 < 5 && 12 > 10) is TRUE

- Logical AND - Returns TRUE only if all conditions are TRUE, if any of the conditions isFALSE then complete condition becomes FALSE.

- Logical OR - Returns FALSE only if all conditions are FALSE, if any of the conditions isTRUE then complete condition becomes TRUE.

Increment & Decrement Operators (++ & --)

The increment and decrement operators are called unary operators because both need only one operand. The increment operators add one to the existing value of the operand and the decrement operator subtracts one from the existing value of the operand. The following table provides information about increment and decrement operators.

Operator	**Meaning**	**Example**	

++	Increment	Adds one to existing value	int a = 5;a++; ⇒ a = 6
--	Decrement	Subtracts one from existing value	int a = 5;a--; ⇒ a = 4

The increment and decrement operators are used in front of the operand (++a) or afterthe operand (a++). If it is used in front of the operand, we call it as pre-increment or pre- decrement and if it is used after the operand, we call it as post-increment or post-decrement.

Pre-Increment or Pre-Decrement

In the case of pre-increment, the value of the variable is increased by one before the expression evaluation. In the case of pre-decrement, the value of the variable is decreased by one before the expression evaluation. That means, when we use pre-increment or pre-decrement, first the value of the variable is incremented or decremented by one, then the modified value is used in the expression evaluation.

Example Program

```
#incl
ude<
stdio.
h>
#incl
ude<
conio
.h>
void
main
()
{
int i = 5,j;
j = ++i; // Pre-
Increment
printf("i = %d, j
= %d",i,j);
}
```

Post-Increment or Post-Decrement

In the case of post-increment, the value of the variable is increased by one after the expression evaluation. In the case of post-decrement, the value of the variable is decreased by one after the expression evaluation. That means, when we use post-increment or post- decrement, first the expression is evaluated with existing value, then the value of the variableis incremented or decremented by one.

Example Program

```
#incl
ude<
stdio.
h>
#incl
ude<
conio
```

```
.h>
void
main
()
{
int i = 5,j;
j = i++; // Post-
Increment
printf("i = %d, j
= %d",i,j);
  }
```

Assignment Operators (=, +=, -=, *=, /=, %=)

The assignment operators are used to assign right-hand side value (Rvalue) to the left- hand side variable (Lvalue). The assignment operator is used in different variants along with arithmetic operators. The following table describes all the assignment operators in the Cprogramming language.

Operator	Meaning	Example
=	Assign the right-hand side value to left-hand side variable	A = 15
+=	Add both left and right-hand side valuesand store the result into left-hand side variable	A += 10⇒ A = A+10
-=	Subtract right-hand side value from left-hand side variable value and store the result into left-hand side variable	A -= B⇒ A = A-B
*=	Multiply right-hand side value with left-hand side variable value and store theresult into left-hand side variable	A *= B⇒ A = A*B
/=	Divide left-hand side variable value with right-hand side variable value and store the result into the left-hand side variable	A /= B⇒ A = A/B
%=	Divide left-hand side variable value with right-hand side variable value and storethe remainder into the left-hand side variable	A %= B⇒ A = A%B

Bitwise Operators (&, |, ^, ~, >>, <<)

The bitwise operators are used to perform bit-level operations in the c programming language. When we use the bitwise operators, the operations are performed based on the binary values. The following table describes all the bitwise operators in the C programming language.

Let us consider two variables A and B as A = 25 (11001) and B = 20 (10100).

Operator	**Meaning**	**Example**
&	the result of Bitwise AND is 1 if all the bits are 1 otherwise it is 0	A & B⇒ 16 (10000)
|	the result of Bitwise OR is 0 if all the bits are 0 otherwise it is 1	A | B⇒ 29 (11101)
^	the result of Bitwise XOR is 0 if all the bits are same otherwise it is 1	A ^ B⇒ 13 (01101)
~	the result of Bitwise once complementis negation of the bit (Flipping)	~A⇒ 6 (00110)
<<	the Bitwise left shift operator shifts all the bits to the left by the specified number of positions	A << 2⇒ 100 (1100100)
>>	the Bitwise right shift operator shifts all the bits to the right by the specified number of positions	A >> 2⇒ 6 (00110)

Conditional Operator (?:)

The conditional operator is also called a ternary operator because it requires three operands. This operator is used for decision making. In this operator, first we verify a condition, then we perform one operation out of the two operations based on the condition result. If the condition is TRUE the first option is performed, if the condition is FALSE the second option is performed. The conditional operator is used with the following syntax.

Condition ? TRUE Part : FALSE Part;

Example

A = (10<15)?100:200; ⇒ A value is 100

Special Operators (sizeof, pointer, comma, dot, etc.)

The following are the special operators in c programming language.

sizeof operator

This operator is used to find the size of the memory (in bytes) allocated for a variable.

This operator is used with the following syntax.

sizeof(variable Name);

Example

sizeof(A); ⇒ the result is 2 if A is an integer

Pointer operator (*)

This operator is used to define pointer variables in c programming language.

Comma operator (,)

This operator is used to separate variables while they are declaring, separate the expressions in function calls, etc.

Dot operator (.)

This operator is used to access members of structure or union.

Operator Precedence and Associativity

What is Operator Precedence?

Operator precedence is used to determine the order of operators evaluated in an expression. In c programming language every operator has precedence (priority). When thereis more than one operator in an expression the operator with higher precedence is evaluated first and the operator with the least precedence is evaluated last.

What is Operator Associativity?

Operator associativity is used to determine the order of operators with equal precedence evaluated in an expression. In the c programming language, when an expression contains multiple operators with equal precedence, we use associativity to determine the order of evaluation of those operators.

In c programming language the operator precedence and associativity are as shown inthe following table.

Precedence	Operator	Operator Meaning	Associativity
1	() [] -> .	function call array reference structure member access structure member access	Left to Right
2	! ~ + - ++ -- & * sizeof (type)	negation 1's complement Unary plus Unary minus increment operator decrement operator address of operator pointerreturns size of a variable type conversion	Right to Left
3	* / %	multiplication division remainder	Left to Right
4	+ -	addition subtraction	Left to Right
5	<< >>	left shift right shift	Left to Right

6	< <= > >=	less than less than or equal to greater than greater than or equal to	Left to Right
7	== !=	equal to not equal to	Left to Right
8	&	bitwise AND	Left to Right
9	^	bitwise EXCLUSIVE OR	Left to Right
10	|	bitwise OR	Left to Right
11	&&	logical AND	Left to Right
12	||	logical OR	Left to Right
13	?:	conditional operator	Left to Right
14	= *= /= %= += -= &= ^= |= <<= >>=	assignment assign multiplication assign division assign remainder assign addition assign subtraction assign bitwise AND assign bitwise XOR assign bitwise OR assign left shift assign right shift	Right to Left
15	,	separator	Left to Right

In the above table, the operator precedence decreases from top to bottom and increases from bottom to top.

6.3.2 Expressions

What is an expression?

In any programming language, if we want to perform any calculation or to frame any condition etc., we use a set of symbols to perform the task. These set of symbols makes an expression.

In the C programming language, an expression is defined as follows.

An expression is a collection of operators and operands that represents a specific value.

In the above definition, an operator is a symbol that performs tasks like arithmetic operations, logical operations, and conditional operations, etc.

Operands are the values on which the operators perform the task. Here operand can bea direct value or variable or address of memory location.

Expression Types in C

In the C programming language, expressions are divided into THREE types. They are asfollows...

- Infix Expression
- Postfix Expression
- Prefix Expression

The above classification is based on the operator position in the expression.

Infix Expression

- The expression in which the operator is used between operands is called infix expression.
- The infix expression has the following general structure.

Operand1 Operator Operand2

Postfix Expression

- The expression in which the operator is used after operands is called postfix expression.
- The postfix expression has the following general structure.

Operand1 Operand2 Operator

Prefix Expression

- The expression in which the operator is used before operands is called a prefix expression.
- The prefix expression has the following general structure.

Operator Operand1 Operand2

6.3.3 Type Conversion and Type Casting

In a programming language, the expression contains data values of the same datatype ordifferent data types. When the expression contains similar datatype values then it is evaluated without any problem. But if the expression contains two or more different datatype values then they must be converted to the single datatype of destination datatype. Here, the destination isthe location where the final result of that expression is stored. For example, the multiplication of an integer data value with the float data value and storing the result into a float variable. In this case, the integer value must be converted to float value so that the final result is a float datatype value.

In a c programming language, the data conversion is performed in two different methods

- Type Conversion
- Type Casting

Type Conversion

The type conversion is the process of converting a data value from one data type to another data type automatically by the compiler. Sometimes type conversion is also called implicit type conversion. The implicit type conversion is automatically performed by the compiler.

For example, in c programming language, when we assign an integer value to a float variable the integer value automatically gets converted to float value by adding decimal value
0. And when a float value is assigned to an integer variable the float value automatically gets converted to an integer value by removing the decimal value. To understand more about type conversion observe the following...

i
n
t
i
=

1
0

```
; float x = 15.5 ; char ch = 'A' ;
i = x ; =======> x value 15.5 is converted as 15 and assigned to variable i
x = i ; =======> Here i value 10 is converted as 10.000000 and assigned to
variable xi = ch ; =======> Here the ASCII value of A (65) is assigned to i
```

Example Program

```
#include<stdio.h>
#include<conio.h>
void main()
{
int i = 95 ;
float x = 90.9
9 ;
ch
ar
ch
=
'A'
;
i = x ;
printf("i
        value
        is
        %d\n"
        ,i);x =
        i ;
printf("x
        value
        is
        %f\n",
        x);i =
        ch ;
printf("i value is %d\n",i);
}
```

In the above program, we assign i = x, i.e., float variable value is assigned to the integer variable. Here, the compiler automatically converts the float value (90.99) into integer value
(90) by removing the decimal part of the float value (90.99) and then it is assigned to variable i.Similarly, when we assign x = i, the integer value (90) gets converted to float value (90.000000) by adding zero as the decimal part.

Typecasting

Typecasting is also called an explicit type conversion. Compiler converts data from one data type to another data type implicitly. When compiler converts implicitly, there may be a data loss. In such a case, we convert the data from one data type to another data type using explicit type conversion. To perform this we use the unary cast operator. To convert data from one type to another type we specify the target data type in parenthesis as a prefix to the data value that has to be converted.

The general syntax of typecasting is as follows.

Example

```
int totalMarks = 450,
maxMarks = 600 ;float
average ;
average = (float) totalMarks / maxMarks * 100 ;
```

In the above example code, both totalMarks and maxMarks are integer data values. When we perform totalMarks / maxMarks the result is a float value, but the destination (average) datatype is a float. So we use type casting to convert totalMarks and maxMarks into float data type.

Comments

Comments in C are enclosed by slash/star pairs: /* .. comments .. */ which may cross multiple lines. C++ introduced a form of comment started by two slashes and extending to the end of the line:

```
// comment until the line end
```

The // comment form is so handy that many C compilers now also support it, although itis not technically part of the C language.

Along with well-chosen function names, comments are an important part of well written code. Comments should not just repeat what the code says. Comments should describe what the code accomplishes which much more is interesting than a translation of what each statement does. Comments should also narrate what is tricky or non-obvious about a sectionof code.

6.2 *Decision Control and Looping Statements (If, If-else, If-else-if,Switch, While, Do- while, For, Break, Continue & Goto)*

Control Structures

C uses curly braces ({}) to group multiple statements together. The statements execute in order. Some languages let you declare variables on any line (C++). Other languages insist thatvariables are declared only at the beginning of functions (Pascal). C takes the middle road -- variables may be declared within the body of a function, but they must follow a '{'. More modern languages like Java and C++ allow you to declare variables on any line, which is handy.

What is Decision Making Statement?

In the C programming language, the program execution flow is line by line from top to bottom. That means the c program is executed line by line from the main method. But this type of execution flow may not be suitable for all the program solutions. Sometimes, we make some decisions or we may skip the execution of one or more lines of code. Consider a situation, where we write a program to check whether a student has passed or failed in a particular subject. Here, we need to check whether the marks are greater than the pass marks or not. If marks are greater, then we decide that the student has passed otherwise failed. To solve such kind of problems in c we use the statements called decision making statements.

Decision-making statements are the statements that are used to verify a given conditionand decide whether a block of statements gets executed or not based on the condition result**.**

In the c programming language, there are two decision-making statements they are as follows.

1. if statement
2. switch statement

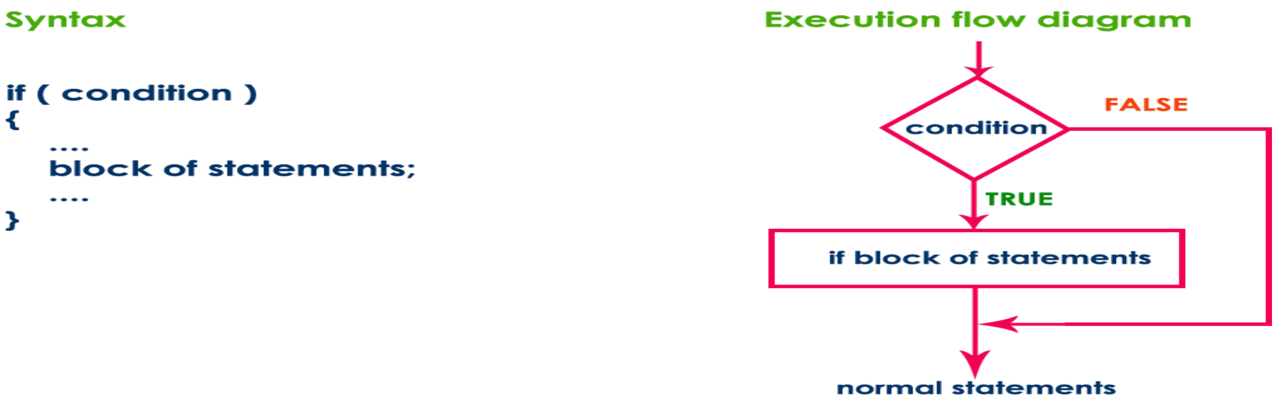
if statement in c

In c, if statement is used to make decisions based on a condition. The if statement verifiesthe given condition and decides whether a block of statements are executed or not based onthe condition result. In c, if statement is classified into four types as follows...

1. Simple if statement
2. if-else statement
3. Nested if statement
4. if-else-if statement (if-else ladder)

Simple if statemen

Simple if statement is used to verify the given condition and executes the block of statements based on the condition result. The simple if statement evaluates specified condition. If it is TRUE, it executes the next statement or block of statements. If the condition is FALSE, it skips the execution of the next statement or block of statements. The general syntax and execution flow of the simple if statement is as follows.



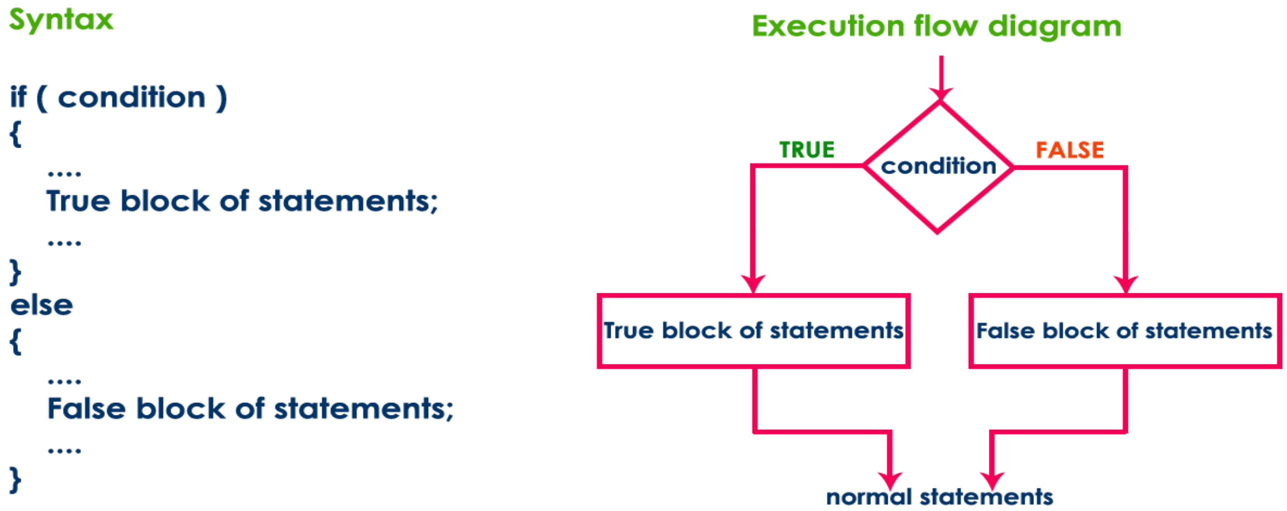
Syntax

```
if ( condition )
{
    ....
    block of statements;
    ....
}
```

Simple if statement is used when we have only one option that is executed or skipped basedon a condition.

if-else statement

The if-else statement is used to verify the given condition and executes only one out of the two blocks of statements based on the condition result. The if-else statement evaluates the specified condition. If it is TRUE, it executes a block of statements (True block). If the conditionis FALSE, it executes another block of statements (False block). The general syntax andexecution flow of the if-else statement is as follows.



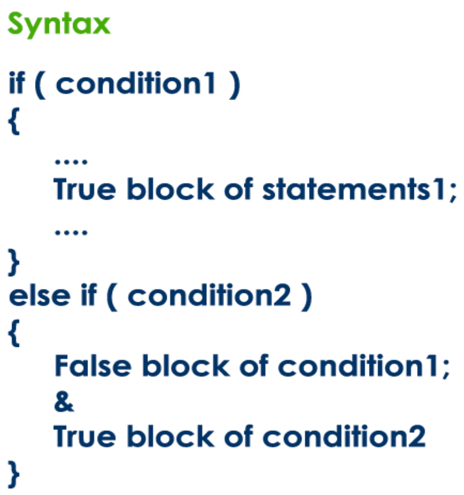
Syntax

```
if ( condition )
{
    ....
    True block of statements;
    ....
}
else
{
    ....
    False block of statements;
    ....
}
```

The if-else statement is used when we have two options and only one option has to be executed based on a condition result (TRUE or FALSE).

Nested if statement

Writing a if statement inside another if statement is called nested if statement. Thegeneral syntax of the nested if statement is as follows.



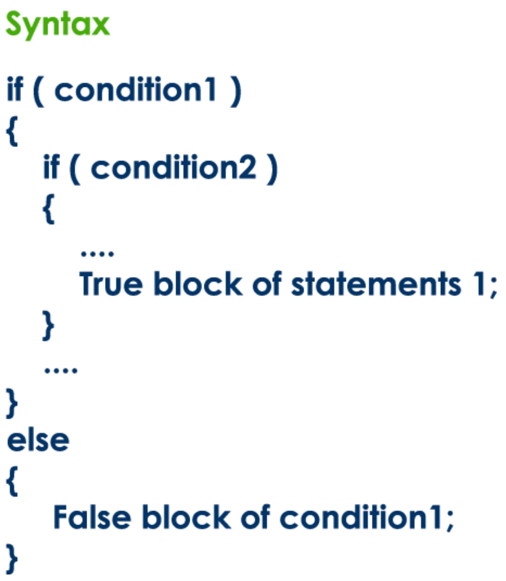
Syntax

```
if ( condition1 )
{
    ....
    True block of statements1;
    ....
}
else if ( condition2 )
{
    False block of condition1;
    &
    True block of condition2
}
```

The nested if statement can be defined using any combination of simple if & if-else statements.

if-else-if statement (if-else ladder)

Writing a if statement inside else of an if statement is called if-else-if statement. Thegeneral syntax of the if-else-if statement is as follows...



Syntax

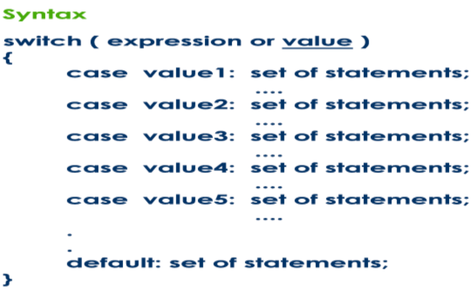
```
if ( condition1 )
{
   if ( condition2 )
   {
      ....
      True block of statements 1;
   }
   ....
}
else
{
    False block of condition1;
}
```

The if-else-if statement can be defined using any combination of simple if & if-else statements.

'switch' statement in C

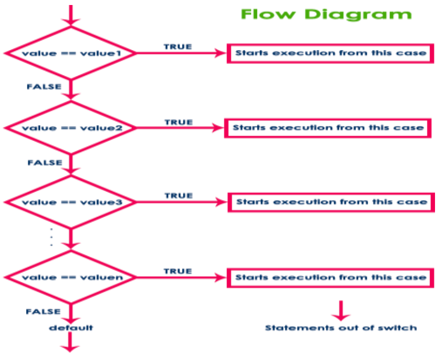
Consider a situation in which we have many options out of which we need to select only one option that is to be executed. Such kind of problems can be solved using nested if statement. But as the number of options increases, the complexity of the program also gets increased. This type of problem can be solved very easily using a switch statement. Using the switch statement, one can select only one option from more number of options very easily. Inthe switch statement, we provide a value that is to be compared with a value associated with each option. Whenever the given value matches the value associated with an option, theexecution starts from that option. In the switch statement, every option is defined as a case.

The switch statement has the following syntax and execution flow diagram



Syntax

```
switch ( expression or value )
{
        case  value1:  set of statements;
                       ....
        case  value2:  set of statements;
                       ....
        case  value3:  set of statements;
                       ....
        case  value4:  set of statements;
                       ....
        case  value5:  set of statements;
                       ....
        .
        .
        default: set of statements;
}
```



The switch statement contains one or more cases and each case has a value associated with it. At first switch statement compares the first case value with the switchValue, if it gets matched the execution starts from the first case. If it doesn't match the switch statement compares the second case value with the switch Value and if it is matched the execution starts from the second case. This process continues until it finds a match. If no case value matches with the switchValue specified in the switch statement, then a special case called default is executed. When a case value matches with the switch Value, the execution starts from that particular case. This execution flow continues with the next case statements also. To avoid this, we use the "break" statement at the end of each case. That means the break statement is used to terminate the switch statement. However, it is optional.

Looping statements

Consider a situation in which we execute a single statement or block of statements repeatedly for the required number of times. Such kind of problems can be solved using looping statements in C. For example, assume a situation where we print a message 100 times. If we want to perform that task without using looping statements, we have to either write 100 printf statements or we have to write the same message 100 times in a single printf statement. Both are complex methods. The same task can be performed very easily using looping statements.

The looping statements are used to execute a single statement or block of **statements**

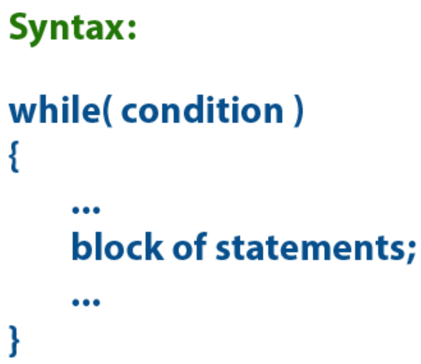
repeatedly until the given condition is FALSE.

C language provides three looping statements...

- while statement
- do-while statement
- for statement

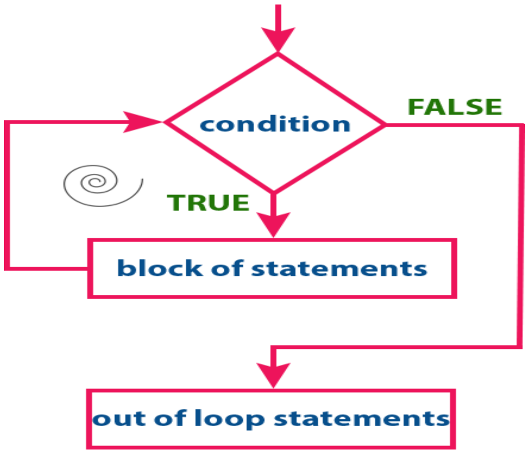
while Statement

The while statement is used to execute a single statement or block of statements repeatedly as long as the given condition is TRUE. The while statement is also known as Entry control looping statement. The while statement has the following syntax... The while statement has the following execution flow diagram...
At first, the given condition is evaluated. If the condition is TRUE, the single statement or block of statements gets executed. Once the execution gets completed the condition is evaluated again. If it is TRUE, again the same statements get executed. The same process is repeated until the condition is evaluated to FALSE. Whenever the condition is evaluated to FALSE, the execution control moves out of the while block.



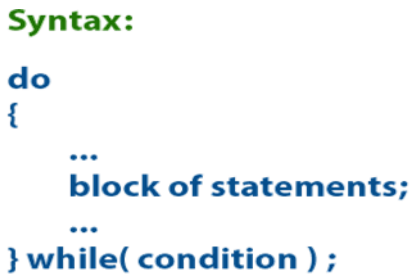
Syntax:

```
while( condition )
{
      ...
      block of statements;
      ...
}
```



'do-while'
statement

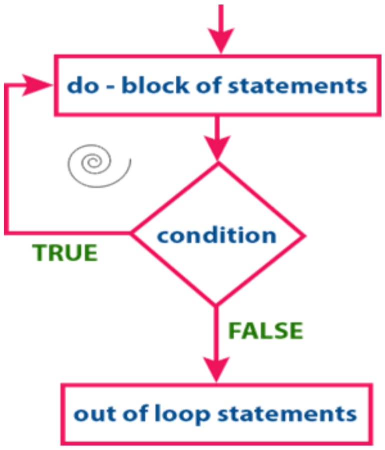
The do-while statement is used to execute a single statement or block of statements repeatedly as long as given the condition is TRUE. The do-while statement is also known as the Exit control looping statement. The do-while statement has the following syntax...



```
Syntax:

do
{
      ...
      block of statements;
      ...
} while( condition ) ;
```

The do-while statement has the following execution flow diagram...

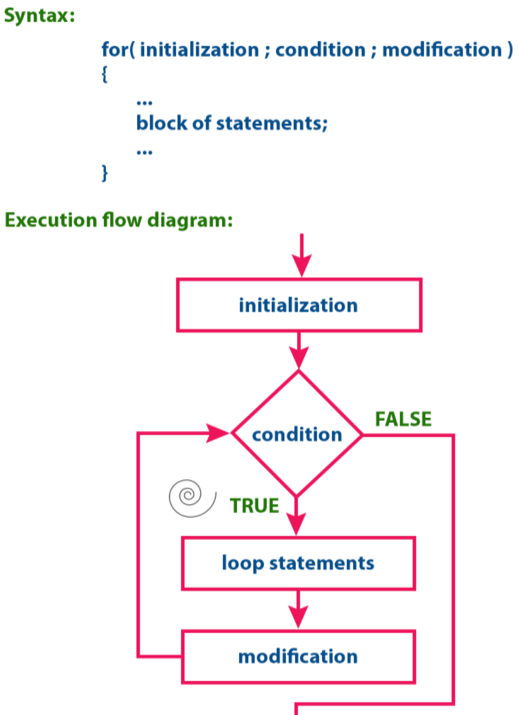


At first, the single statement or block of statements which are defined in do block are executed. After the execution of the do block, the given condition gets evaluated. If the conditionis evaluated to TRUE, the single statement or block of statements of do block are executed

Once the execution gets completed again the condition is evaluated. If it is TRUE, again the same statements are executed. The same process is repeated until the condition is evaluated to FALSE. Whenever the condition is evaluated to FALSE, the execution control moves out of the while block.

Thefor statement is used to execute a single statement or a block of statements repeatedly as long as the given condition is TRUE.The for statement has the following syntax and execution flow diagram...

At first, the for statement executes initialization followed by condition evaluation. If the condition is evaluated to TRUE, the single statement or block of statements of for statement are executed. Once the execution gets completed, the modification statement is executed and again the condition is evaluated. If it is TRUE, again the same statements are executed. The same process is repeated until the condition is evaluated to FALSE. Whenever the condition is evaluated to FALSE, the execution control moves out of the for block.



```
Syntax:

        for( initialization ; condition ; modification )
        {
             ...
             block of statements;
             ...
        }
```

break, continue and goto in C

In c, there are control statements that do not need any condition to control the program execution flow. These control statements are called as unconditional control statements. C programming language provides the following unconditional control statements...

- break
- continue
- goto

The above three statements do not need any condition to control the program execution flow.

“break” statement

In C, the break statement is used to perform the following two things...

- break statement is used to terminate the switch case statement
- break statement is also used to terminate looping statements like while, do-whileand for.

When a break statement is encountered inside the switch case statement, the execution control moves out of the switch statement directly. For example, consider the following program.

continue statement

The continue statement is used to move the program execution control to the beginning of the looping statement. When the continue statement is encountered in a looping statement, the execution control skips the rest of the statements in the looping block and directly jumps to the beginning of the loop. The continue statement can be used with looping statements like while, dowhile and for.

When we use continue statement with while and do-while statements the execution control directly jumps to the condition. When we use continue statement with for statement the execution control directly jumps to the modification portion (increment/decrement/any modification) of the for loop.

goto statement

The goto statement is used to jump from one line to another line in the program. Using goto statement we can jump from top to bottom or bottom to top. To jump from one line to another line, the goto statement requires a label. Label is a name given to the instruction or line in the program. When we use a goto statement in the program, the execution control directly jumps to the line with the specified label.

7.1 Functions and Passing Parameters to the Function (Call by Value andCall by Reference)

Functions

- A function is a group of statements that together perform a task. Every C program has at least one function, which is main (), and all the most trivial programs can define additionalfunctions.
- You can divide up your code into separate functions. How you divide up your code among different functions is up to you, but logically the division is such that each function performs a specific task.
- A function declaration tells the compiler about a function's name, return type, and parameters. A function definition provides the actual body of the function.
- A function can also be referred as a method or a sub-routine or a procedure, etc.

Defining a Function

- The general form of a function definition in C programming language is as follows −
  - return type function name(parameter list) {
  - body of the function
  - }
- A function definition in C programming consists of a function header and a function body. Here are all the parts of a function −
  - **Return Type** − A function may return a value. The return type is the data type of the value the function returns. Some functions perform the desired operations without returning a value. In this case, the return type is the keyword void.
  - **Function Name** − This is the actual name of the function. The function name and the parameter list together constitute the function signature.
  - **Parameters** − A parameter is like a placeholder. When a function is invoked, you pass a value to the parameter. This value is referred to as actual parameter or argument. The parameter list refers to the type, order, and number of the parameters of a function. Parameters are optional; that is, a function may contain no parameters.
  - **Function Body** − The function body contains a collection of statements that definewhat the function does.

Parameters in C functions

- A Parameter is the symbolic name for "data" that goes into a function. There are two ways to pass parameters in C: Pass by Value, Pass by Reference.

Call by Value

Pass by Value, means that a copy of the data is made and stored by way of the name of the parameter. Any changes to the parameter have NO effect on data in the calling function.

- In call by value method, the value of the actual parameters is copied into the formal parameters. In other words, we can say that the value of the variable isused in the function call in the call by value method.

- In call by value method, we cannot modify the value of the actual parameter by theformal parameter.
- In call by value, different memory is allocated for actual and formal parameterssince the value of the actual parameter is copied into the formal parameter.
- The actual parameter is the argument which is used in the function call whereasformal parameter is the argument which is used in the function definition.

Call by Reference

- A reference parameter "refers" to the original data in the calling function. Thus, any changes made to the parameter are also made to the original variable.
- In call by reference, the address of the variable is passed into the function call as the actual parameter.
- The value of the actual parameters can be modified by changing the formal parameters since the address of the actual parameters is passed.
- In call by reference, the memory allocation is similar for both formal parameters and actual parameters. All the operations in the function are performed on thevalue stored at the address of the actual parameters, and the modified value gets stored at the same address.

- There are two ways to make a pass by reference parameter:

ARRAYS

- Arrays are always pass by reference in C. Any change made to the parametercontaining the array will change the value of the original array.

The ampersand (&) used in the function prototype. Function (& parameter name)

- To make a normal parameter into a pass by reference parameter, we use the "& param" notation. The ampersand (&) is the syntax to tell C that any changes made to the parameter also modify the original variable containing the data.

7.2 Scope of Variables and Storage Classes, Recursion, Function andTypes of Recursion

7.2.1 Scope of variables

- When we declare a variable in a program, it cannot be accessed against the scope rules. Variables can be accessed based on their scope. The scope of a variable decides the portion of a program in which the variable can be accessed. The scope of the variable is defined as follows...
- Scope of a variable is the portion of the program where a defined variable can be accessed.
- The variable scope defines the visibility of variable in the program. Scope of a variabledepends on the position of variable declaration.
- In C programming language, a variable can be declared in three different positions andthey are as follows...
  - Before the function definition (Global Declaration)
  - Inside the function or block (Local Declaration)

    - In the function definition parameters (Formal Parameters)

7.2.2 Storage Classes

- Storage classes in C are used to determine the lifetime, visibility, memory location, andinitial value of a variable. There are four types of storage classes in C
    - Automatic
    - External
    - Static
    - Register

Automatic

- Automatic variables are allocated memory automatically at runtime.
- The visibility of the automatic variables is limited to the block in which they are defined.
- The scope of the automatic variables is limited to the block in which they are defined.
- The automatic variables are initialized to garbage by default.
- ~~□ The memory assigned to automatic variables gets freed upon exiting from the block.~~
- The keyword used for defining automatic variables is auto.
- Every local variable is automatic in C by default.

Static

- The variables defined as static specifier can hold their value between the multiple function calls.
- Static local variables are visible only to the function or the block in which they aredefined.
- A same static variable can be declared many times but can be assigned at only one time.
- Default initial value of the static integral variable is 0 otherwise null.
- The visibility of the static global variable is limited to the file in which it has declared.
- The keyword used to define static variable is static.

7.2.3 Recursion Function

- Recursion is the process of repeating items in a self-similar way. In programming languages, if a program allows you to call a function inside the same function, then it is called a recursive call of the function.
- The C programming language supports recursion, i.e., a function to call itself. But while using recursion, programmers need to be careful to define an exit condition from the function, otherwise it will go into an infinite loop.
- Recursive functions are very useful to solve many mathematical problems, such as calculating the factorial of a number, generating Fibonacci series, etc.

7.2.4 Types of Recursion

Recursion are mainly of two types depending on weather a function calls itselffrom within itself weather two function call one another mutually.

Thus, the two types of recursion are:

- Direct recursion
- Indirect recursion

Recursion may be further categorized as:

- Linear recursion

- Binary recursion
- Multiple recursion

7.3 One Dimensional Array and Multidimensional Array, String Operationsand Pointers

7.3.1 One-dimensional array

□ Conceptually you can think of a one-dimensional array as a row, where elements arestored one after another.

□ Syntax: data type array_name[size];

□ datatype: It denotes the type of the elements in the array.

□ array_name: Name of the array. It must be a valid identifier.

□ size: Number of elements an array can hold. here are some example of array declarations:

7.3.2 Multidimensional Arrays

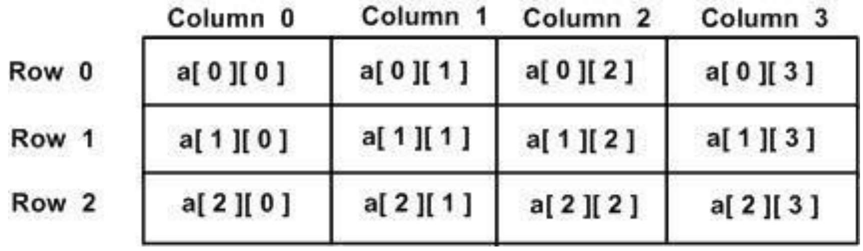
The simplest form of multidimensional array is the two-dimensional array. A two- dimensional array is, in essence, a list of one-dimensional arrays. To declare a two-dimensional integer array of size [x][y], you would write something as follows –

type array Name [x][y];

□ Where type can be any valid C data type and array Name will be a valid C identifier.

□ A two-dimensional array can be considered as a table which will have x number of rowsand y number of columns.

□ A two-dimensional array a, which contains three rows and four columns can be shown asfollows –



	Column 0	Column 1	Column 2	Column 3
Row 0	a[0][0]	a[0][1]	a[0][2]	a[0][3]
Row 1	a[1][0]	a[1][1]	a[1][2]	a[1][3]
Row 2	a[2][0]	a[2][1]	a[2][2]	a[2][3]

□ Thus, every element in the array a is identified by an element name of the form a[i][j],where 'a' is the name of the array, and 'i' and 'j' are the subscripts that uniquely identify each element in 'a'.

7.3.3 String operations

□ Strings are actually one-dimensional array of characters terminated by a null character '\0'. Thus a null-terminated string contains the characters that comprise the string followed by a null.

□ The following declaration and initialization create a string consisting of the word "Hello". To hold the null character at the end of the array, the size of the character array containing the string is one more than the number of characters in the word "Hello."

```
char greeting[6] = {'H', 'e', 'l', 'l', 'o', '\0'};
```

□ If you follow the rule of array initialization then you can write the above statement as follows –

```
char greeting[] = "Hello";
```

- Following is the memory presentation of the above defined string in C/C++ −
- Actually, you do not place the null character at the end of a string constant. The C compiler automatically places the '\0' at the end of the string when it initializes the array.

- A pointer is a variable whose value is the address of another variable, i.e., direct address of the memory location. Like any variable or constant, you must declare a pointer before using it to store any variable address. The general form of a pointer variable declarationis −

```
type *var-name;
```

- Here, type is the pointer's base type; it must be a valid C data type and var-name is the name of the pointer variable. The asterisk * used to declare a pointer is the same asterisk used for multiplication.

How to Use Pointers?

- There are a few important operations, which we will do with the help of pointers veryfrequently.
- We define a pointer variable,
- assign the address of a variable to a pointer and
- Finally access the value at the address available in the pointer variable.
- This is done by using unary operator * that returns the value of the variable located at theaddress specified by its operand. The following example makes use of these operations

7.4 Structure and Union (Only concepts, No Programming)

What is a structure?

A structure is a user defined data type in C. A structure creates a data type that can beused to group items of possibly different types into a single type.

How to create a structure?

–**struct**‖ keyword is used to create a structure.

How to declare structure variables?

- A structure variable can either be declared with structure declaration or as a separatedeclaration like basic types.
- A variable declaration with structure

```
declaration.struct Point
{
   int x, y;
} p1;
```

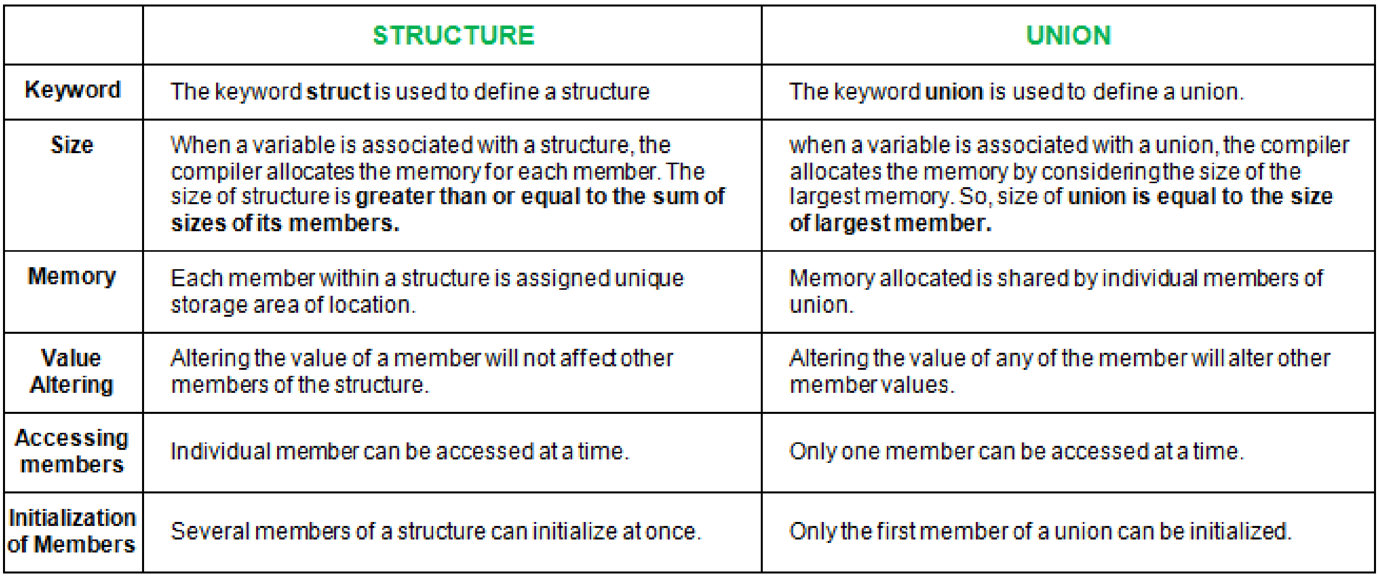
Union

- A union is a special data type available in C that allows storing different data types in thesame memory location.
- You can define a union with many members, but only one member can contain a value atany given time.

- Unions provide an efficient way of using the same memory location for multiple purposes.

Defining a Union:

- To define a union, you must use the union statement in the same way as you did whiledefining a structure.
- The union statement defines a new data type with more than one member for yourprogram.



	STRUCTURE	UNION
Keyword	The keyword **struct** is used to define a structure	The keyword **union** is used to define a union.
Size	When a variable is associated with a structure, the compiler allocates the memory for each member. The size of structure is **greater than or equal to the sum of sizes of its members.**	when a variable is associated with a union, the compiler allocates the memory by consideringthe size of the largest memory. So, size of **union is equal to the size of largest member.**
Memory	Each member within a structure is assigned unique storage area of location.	Memory allocated is shared by individual members of union.
Value Altering	Altering the value of a member will not affect other members of the structure.	Altering the value of any of the member will alter other member values.
Accessing members	Individual member can be accessed at a time.	Only one member can be accessed at a time.
Initialization of Members	Several members of a structure can initialize at once.	Only the first member of a union can be initialized.