Computer Application

Syllabus

Th.1b. COMPUTERAPPLICATION

1. COMPUTERORGANISATION
Introduction to Computer Evolution of Computers Generation of Computers Classification of Computers Basic Organization of Computer (Functional Block diagram) Input Devices, CPU & Output Devices. Computer Memory and Classification of Memory

2. COMPUTERSOFTWARE
Software concept, System software, Application software
Overview of Operating System Objectives and Functions of O.S ,
Types of Operating System: Batch Processing, Multiprogramming, Time Sharing OS Features of DOS, Windows and UNIX
Programming Languages Compiler, interpreter Computer Virus
Different Types of computer virus
Detection and prevention of Virus Application
of computers in different Domain

3. COMPUTERNETWORKANDINTERNET
Networking concept, Protocol, Connecting Media, Date Transmission mode
Network Topologies, Types of Network
NetworkingDeviceslikeHub,Repeater,Switch,Bridge,Router,Gateway&NIC
InternetServiceslikeE-Mail,WWW,FTP,Chatting,InternetConferencing,Electronic Newspaper & Online Shopping
DifferenttypesofInternetconnectivityandISP

4. FILEMANAGEMENTANDDATAPROCESSING
ConceptofFileandFolder
File Access and Storage methods. Sequential, Direct, ISAM
Data Capture, Data storage
DataProcessingandRetrieval

5. PROBLEMSOLVINGMETHODOLOGY
Algorithm, Pseudo code and Flowchart Generation of Programming Languages Structured Programming Language
ExamplesofProblemsolvingthroughFlowchart

6. OVERVIEWOFCPROGRAMMINGLANGUAGE
Constants, Variables and Data types in C Managing Input and Output operations.
Operators, Expressions, Type conversion & Typecasting
DecisionControlandLoopingStatements(If,If-else,If-else-if,Switch,While,Do-while,For, Break, Continue & Goto)
ProgrammingAssignmentsusingtheabovefeatures.

7. ADVANCEDFEATURESOFC
Functions and Passing Parameters to the Function (Call by Value and Call by Reference) Scope of Variables and Storage Classes
RecursionFunctionandTypesofRecursion
One Dimensional Array and Multidimensional Array
String Operations and Pointers
Pointer Expression and Pointer Arithmetic Programming Assignments using the above features. Structure and Union (Only concepts, No Programming)

Contents

CHAPTER-1:COMPUTERORGANISATION

IntroductiontoComputer

- Computer is an electronic device that operates (works) under the control of programs stored in its own memory unit.
- A computer is an electronic machine that processes raw data to give information as output.
- An electronic device that accepts data as input, and transforms it under the influenceof a set of specialinstructionscalled Programs,to produce the desired output (referred to as Information).

Explanations:

- A computer is described as an electronic device because; it is made up of electronic components and uses electric energy (such as electricity) to operate.
- A computer has an internal memory, which stores data & instructions temporarily awaiting processing, and even holds the intermediate result (information) before it is communicated to the recipients through the Output devices.
- It works on the data using the instructions issued, means that, the computer cannot do any useful job on its own. It can only work as per the set of instructionsissued.
- A computer will accept data in one form and produce it in another form. The data is normally held within the computer as it is beingprocessed.

Program:

- A computer Program is a set of related instructions written in the language of the computer & is used to make the computer perform a specific task (or, to direct the computer on what to do).
- A setofrelatedinstructionswhich specifyhowthedata istobeprocessed.
- A setofinstructionsused toguideacomputerthroughaprocess.

Data:

- Data is a collection of rawfacts, figures or instructions that do not have much meaning to the user.
- Data may be in form of numbers, alphabets/letters or symbols, and can be processed to produce information.

TypesofData

Therearetwotypes/forms ofdata:

a). Digital(discrete)data:

Digital data is discrete in nature. It must be represented in form of numbers, alphabets or symbols for it to be processed by a computer. Digital data is obtained by counting.
E.g.1, 2,3…

b). Analogue(continuous)data:

Analogue data is continuous in nature. It must be represented in physical nature in order tobe processed by the computer. • Analogue data is obtained by measurement. E.g. Pressure, Temperature, Humidity, Lengths or currents, etc. The output is in form of smooth graphs from which the data can be read.

DataProcessing:

- It is the process of collecting all items of data together & converting them into information.
- Processing refers to the way the data is manipulated (or handled) to turn it into information.
- The processing may involve calculation, comparison or any other logic to produce the required result. The processing of the data usually results in some meaningful information being produced.

Information:

- Information is the data which has been refined, summarized & manipulated in the way you want it, or into a more meaningful form for decision-making.
- Theinformationmustbeaccurate,timely,completeandrelevant.

EvolutionofComputers

Computer evolution refers to the change in computer technology right from the time computers were first used to the present. As computing evolves to higher system levels, so its design also changes, from technical to socio-technical design.
Theseriesoftheevolution ofcomputersare givenbelow.

- ✓ Abacus
- ✓ Pascaline
- ✓ Difference engine
- ✓ Punched cardequipment
- ✓ ABC
- ✓ UNIVAC-I

Abacus

- The present day computers are a result of an evolutionary process which started way back in 500 B.C. when Egyptian used a machine which is an early form ofAbacus.
- Howeverthe presentform of AbacusisattributedtotheChinese andJapanese.
- This is a machine, which was used for addition, subtraction, multiplication and division operation.

Pascaline

- In1645adeviceknownasPascalinewasinventedbyFrenchmathematicianBlaise   Pascal.
- Themachine wasalsousedperaddition andsubtractionpurpose.
- The device wasoperated bydialingaset ofwheels.
- In1671LeibnizimprovedonPascal'saddingmachineandinventedtheLeibniz's   Calculator.

Differenceengine

- In1822CharlesBabbageinventedaDifferenceEngine.
- Thepurposeofthisdevicewastocalculatetherootsofpolynomialequationsand prepare astronomy table for the British Navy.
- Heupgradedthisto,inventanAnalyticalengine,whichcouldstoreprograminstructions initially coded on punched cards and subsequently sharedinternally.
- ThereforeCharlesBabbage isknownasthefatherofcomputers.

Punchedcardequipment

- In1890Dr.H.Hollerithdevelopedpunchedcardequipment.
- This equipment read the holes punched in the card and mechanically performed thestatistical analysis.

ABC(Atanasoff-BerryComputer)

- The first pure electronic computer was invented by J. V. Atanasoff and C. Berry which is known as Atanasoff-Berry Computer or ABC.
- Itusedvacuumtubesfor bothdatastorageanddatacomputation.
- Subsequently ElectronicNumericalIntegratorandCalculator(ENIAC)wasdesigned and accepted as the general purpose computer.

UNIVAC

- In 1945 John Von Neumann first gave the idea of sharing the same internal memoryfor storing both data and instruction, which was subsequently adopted in every computer organization.
- On this principlesubsequently UniversalAutomaticComputer (UNIVAC-1) was invented

GenerationofComputers
Computersaredevicesthataccomplishtasksorcalculationsinaccordancetoasetof

directions,orprograms.Thefirstfullyelectroniccomputers,introducedinthe1940s,were voluminous devices that required teams of people to handle. In comparison to those new machines, today's computers are astounding. They are not only thousands of times more expeditious, but also they can fit on your desk, on your lap, or even in your pocket.Computers are such an integral part of our everyday life now most people take them for granted.

Computersworkthrough an interaction of hardware and software.The whole pictureof the computer goes back to decades. However there are five apparent generations of computers. Each generation is defined by a paramount technological development that changesnecessarily how computers operate -leading to more compressed, inexpensive, but more dynamic, efficient and booming machines.

FirstGeneration–VacuumTubes(1940–1956)

These ancient computers utilized vacuum tubes as circuitry and magnetic drums for recollection. As a result they were huge, actually taking up entire rooms and costingresources to run. These were ineffective materials which produce a huge amount of heat, sucked enormous electricity and subsequently engendered an abundance of heat which caused perpetual breakdowns.

These first generation computers relied on _machine language' (which is the most fundamental programming language that can be understood by computers). Thesecomputers were limited to solving one problem at a time. Input was predicated on punched cards and paper tape. Output emerged on print-outs. The two eminent machines of this era were the UNIVAC and ENIAC machines -the UNIVAC is the first ever commercial computer which was purchased in 1951 by a business named as the US Census Bureau.

SecondGeneration–Transistors(1956–1963)

The supersession of vacuum tubes by transistors, visualized the onset of the second generation of computing. Although first invented in 1947, transistors weren't used considerably in computers until the cessation of the 1950s. They were a huge development over the vacuum tube, despite the fact still subjecting computers to destroying different levels of heat. However they were extremely superior to the vacuum tubes, making computers smaller, more expeditious, inexpensive and less burdensome on electricity use. They still count on punched card for input/printouts.

The language emerged from strange binary language to symbolic (_assembly') languages. These meant programmers could discover instructions in words. Meanwhile during the same time high caliber programming languages were being developed (early versions of COBOL and FORTRAN). Transistor-driven machines were the first computers to store instructionsinto their recollections, peregrinating from magnetic drum to magnetic core _technology'. The anticipatory versions of these machines were created for the atomic energy industry.

ThirdGeneration–IntegratedCircuits(1964–1971)
By this phase, transistors were now being miniaturized and put on silicon chips. This led to a huge improvement in speed and effectiveness of these machines. These were the first computers where users interacted utilizing keyboards and monitors who interfaced with an operating system, a consequential leap up from the punch cards and printouts. This facilitated thesemachinesto runvarious applications atonceutilizinga central program which functioned to monitor memory.
As a result of these advances which again made machines more reasonable and more tiny, a brand new group of users emerged during the _60s.

FourthGeneration–Microprocessors(1972–2010)

This innovation can be defined in one word: Intel. The chip-maker accomplished the Intel4004 chip in 1971, which located all components of computer such as CPU, recollection, input/output controls onto a single chip. What overcrowded a room in the 1940s now getsfitin the palm of the hand. The Intel chip contained thousands of unified circuits. The year 1981 saw the first ever computer (IBM) categorically designed for home use and 1984 saw the Macintosh introduced by Apple. Microprocessors even transformed beyond the realm of computers and into an incrementing number of everyday products.

The incremented power of these small computers denoted they could be linked, establishing networks. Which eventually led to the expansion, birth and rapid evolution of the Internet? Other primary advances during this period have been the Graphical user interface (GUI), the mouse and more of late the startling advances in laptop capability and hand-held contrivances.

FifthGeneration–ArtificialIntelligence(2010Onwards)

Computer devices with artificial potentiality are still in development, but some of these technologies are commencing to emerge and be used such as voice recognition. AI is an authenticity, made possible by adopting parallel processing and superconductors. Inclining to the future, computers will be thoroughly revolutionized again by quantum computation, molecular and nano technology. The essence of fifth generation will be utilizing these technologies to ultimately engender machines which can proceed and acknowledge natural language, and have efficiency to determine and organize themselves.

SummaryofGenerationofcomputers

Features	1st Generation Computer	2nd Generation Computer	3rd Generation Computer	4th Generation Computer
Main Switching Device	Vacuum Tube	Transistor	Integrated Circuit(IC)	Large Scale Integration(LSI) & VLSI
Component Size	6000 circuits/cubic foot	10000 circuits/cubic foot	10millions circuits/cubic foot	Over 500 billion circuits/cubic foot
Number of instructions/sec.	250	30,000	2,00,000	80 Millions
Meantime between failure	Hour	Days	Weeks	Months

Internal memory capacity	4000 characters	30000 characters	5,12,000 characters	Over 4 million characters

ClassificationofComputers

Allthemoderncomputersarebroadlyclassifiedintothefollowingthree categories.

    a) AnalogComputer.

    b) DigitalComputerand

    c) HybridComputer.

Analogcomputers

- Aremostlyusedinindustriesinprocesscontrolactivities.
- These computers work on analog data such as variation in temperature, pressure, speed, voltage etc.
- They are not general purpose computers; rather they are specific to a particular application area. Therefore the cost of such computer varies from application to application depending on the complexity.
- Theuses ofsuchcomputersareverylimited.

Digital computers

- Thesecomputersaregeneralpurposecomputers,whichworkon digital/binarydata.
- The speedand accuracywithwhich thesecomputers workare veryhigh.
- Digitalcomputersarealso havingseveralrangesfromsupercomputerstopersonal computers.

Hybridcomputers

- PracticallyHybrid computerareusedto controltheentireprocess.
- The analog feature of such computer enables it to measure the physical quantities such a temperature, pressure, voltage level etc. and convert them to digitaldata.
- These data are then processed by the computer by using its digital data processing capability.
- The output from this computer may be taken in a paper ashardcopy, may be seen ona display device or may be converted into analog form to automatically control various processes.

Digital computers

Digitalcomputersareclassifiedintothefollowingfourcategories:

    o SuperComputers.
    o MainframeComputers.
    o MiniComputers.
    o Micro Computer

Super computers

- Thesecomputersarespecificallydesignedtomaximizetheprocessingoffloatingpoint instructions.
- This is possible because of parallel processing technique which implements multipleprocessors to work in parallel manner.
- Such computers are very expensive and used in very high-end numerical processing, geographical information system, etc.
- Some of the popularsupercomputersareCray, Param,Anupametc.
- ThespeedofprocessingofsupercomputersaremeasuredinGFLOPSi.e.,Giga Floating Point Operations Per Second.
- Thesecomputersusedtheirownoperating systemandprogramminglanguageand hence vary from computer to computer.

Mainframe computers

Thesecomputersareintendedforsubstantialhighvolumedataprocessing.

Thesecomputersarecharacterizedby–

- Largeprimarymemory.
- Substantialprocessingcapabilities.(MIPS)
- Substantialamountofperipheraldevicesthatcanbeattached.
- Ahighdatacommunicationcapabilityi.e.abilitytoconnectthousandsofterminals.
- Widevarietyofmemorysizeand terminalsupportoption.
- Abilitytohandlelargetypecomputerapplication.

ApplicationofMainframe Computer

- space research,
- universityconnectivity,
- Wideareanetwork(WAN)implementationetc.

Specificationofmainframecomputers.

- Processingspeed-30to100millioninstructionpersecond(MIPS)
- Wordlength-Morethan64bits.
- I/Odevice-Widerangeofperipheraldevices.
- InternalStorage-Morethan1GB.

Mini Computers

- Fairlylargeprimarymemory.
- Mediumscaleprocessingcapabilityi.e.,lesserthanmainframebuthigherthanpersonal computers.
- Canconnectupto500terminals onLAN.
- Supportswiderangeofapplicationareas.
- Affordable,unlikemainframecomputersbysmallbusinessorganization.

The application of mini computers

- The field of engineering and scientific organizations,
- Educational Institutes,
- Universities,
- Small/medium business organizations.

These computers are mainly used for medium or large volume data processing activity.

Specification of mini computer

- Processing speed-10to30MIPS.
- Word length-32bits.
- I/O device-Wide range of I/O devices can be connect.
- Internal storage-66MB to 512MB.

Micro computers

This is the smallest and least expensive computers are or personal computers popularly known as PC.

Typical features.

- These computers are portable.
- They require minimum power.
- Processing power is appropriate for handling most of the tasks.
- Memory capacity is sufficient to handle most of the tasks.
- Ease of use and support to various types of operating systems and applications oftwares.
- Affordable price tag.
- These micro computers are further classified into three categories i.e., PC, PC-XT and PC-AT.

Typical Specifications of PC

- Processor-I8086/I8088 microprocessor.
- Memory-640KB of RAM
- Two 360K Floppy Disk drive.
- Numerical Processor-I8087.
- System bus-8 bit data bus & 16 bit address bus.
- Clock speed-8MHz

Personal Computer

- A PC-XT or Personal Computer with extended technology is an Up gradation of the PC. It is having all the features discussed above. Apart from these the concept of secondary memory / mass storage in the form of hard disk drive, was introduced for the first time.
- The present days PC are PC-AT or personal computer with advanced technology.

- Processor–I80386/80486/Pentium.
- Memory–2MBto512MB.
- Floppydiskdrive1.44MB
- Hard disk drive 1.2MBto80GB.
- Systembus–32bitto64bit.
- Clockspeed–Upto3GHz
- OperatingSystem–MS-DOS,Windows,UNIX,Linuxetc.

Basic Organization of Computer (Functional Block diagram),

InputDevices, CPU & Output Devices.

A digital computer is considered to be a calculating device that can perform arithmetic operations at enormous speed. It is defined as a device that operates upon information/data. To be able to process data the computer is made of various functional units to perform its specified task.

BlockDiagramofComputer

Block diagram of computer
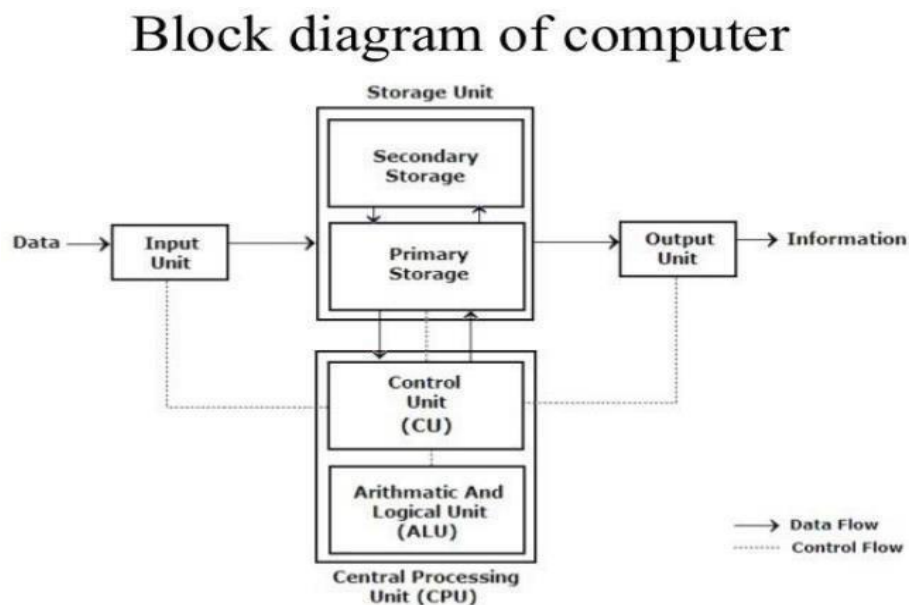
InputDevice:

Computers need to receive data and instruction in order to solve any problem. Therefore, we need to input the data and instructions into the computers. The input unit consists of one or more input devices. **Keyboard** is the one of themost commonly used input device. Other commonly used input devices are the **Mouse, Scanner, Microphone** etc. All the input devices perform the following functions.

- Acceptthedataandinstructionsfromtheoutsideworld.

- Convertittoaformthatthecomputercanunderstand.
- Supplytheconverteddatatothe computer systemforfurtherprocessing.

CentralProcessingUnit:

The Control Unit (CU) and Arithmetic Logic Unit (ALU) of the computer are togetherknown asthe Central Processing Unit (CPU). The CPU is like brain performs the following functions:

- It performsallcalculations.
- It takes alldecisions.
- It controls all unitsof thecomputer.

ArithmeticLogicalUnit:

- All calculations are performed in the Arithmetic Logic Unit (ALU) of the computer. It also does comparison and takes decision. The ALU can perform basic operations such as addition, subtraction, multiplication, division, etc and does logic operations viz, >, <, =, _etc. Whenever calculations are required, the control unit transfers the data from storage unit to ALU once the computations are done, the results are transferred to the storage unit by the control unit and then it is send to the output unit for displaying results.

ControlUnit:

- It controls all other units in the computer. The control unit instructs the input unit,where to store the data after receiving it from the user. It controls the flow of data and instructions from the storage unit to ALU. It also controls the flow of results from the ALU to the storage unit.

- The control unit is generally referred as the central nervous system of the computer that control and synchronizes it's working.

OutputDevice:

- The output unit of a computer provides the information and results of a computation to outside world. Printers, Visual Display Unit (VDU) are the commonly used output devices. Other commonly used output devices are Speaker, Headphone, andProjector etc.

StorageUnit:

The storage unit of the computer holds data and instructions that are entered through the input unit, before they are processed. It preserves the intermediate and final resultsbefore these are sent to the output devices. It also saves the data for the later use. The various storage devices of a computer system are divided into two categories.

a) **PrimaryStorage:** Stores and provides very fast. This memory is generally used to hold the program being currently executed in the computer, the data being received from the input unit, the intermediate and final results of the program. The primary memory is temporary in nature. The data is lost, when the computer is switched off. In order to store the data permanently, the data has to be transferred to the secondary memory. The cost of the primary storage is more compared to the secondary storage. Therefore, most computers shave limited primary storage capacity

Secondary Storage: Secondary storage is used like an archive. It stores several programs, documents,databases etc.The programs that you run on the computer arefirst transferred to the primary memory before it is actually run. Whenever the results aresaved, again they get stored in the secondary memory. The secondary memory is slower and cheaper than the primary memory. Some of the commonly used secondary memory devices are Hard disk, CD,etc.,

MemorySize:

- Alldigitalcomputersusethebinarysystem,i.e.0'sand1's.Eachcharacterora   number   is represented by an 8-bit code.
- The set of 8 bits is called a byte. A character occupies 1-byte space. A numeric occupies 2- byte space. Byte is the space occupied in the memory.
- The size of the primary storage is specified in KB (Kilobytes) or MB (Megabyte). One KB is equal to 1024 bytes and one MB is equal to 1000KB. The size of the primary storage in a typical PC usually starts at 16MB. PCs having 32 MB, 48MB, 128 MB, 256MB memory are quite common.

ComputerMemoryandClassificationofMemory

- Computer memory is a generic term for all of the different types of data storage technology that a computer may use, including RAM, ROM, and flashmemory.
- Some types of computer memory are designed to be very fast, meaning that thecentral processing unit (CPU) can access data stored there very quickly. Other types are designed to be very low cost, so that large amounts of data can be stored there economically.
- Another way that computer memory can vary is that some types are non-volatile,which means they can store data on a long term basis even when there is no power. And some types are volatile, which are often faster, but which lose all the data stored on them as soon as the power is switched off.
- A computer system is built using a combination of these types of computer memory, and the exact configuration can be optimized to produce the maximum dataprocessing speed or the minimum cost, or some compromise between thetwo.

TypesofComputerMemory: PrimaryandSecondary

- Although many types of memory in a computer exist, the most basic distinction is between primary memory, often called system memory, and secondary memory,which is more commonly called storage.
- The keydifferencebetweenprimaryandsecondarymemoryis speedofaccess.
- Primary memory includes ROM and RAM, and is located close to the CPU on the computer motherboard, enabling the CPU to read data from primary memory very quickly indeed. It is used to store data that the CPU needs imminently so that it does not have to wait for it to be delivered.
- Secondary memory by contrast, is usually physically located within a separate storage device, such as a hard disk drive or solid state drive (SSD), which is connected to the computer system either directly or over a network. The cost per gigabyte of secondary

memory is much lower, but the read and write speeds are significantlyslower.
- Over several periods of computer evolution, awide of arrayof computer memorytypes has been deployed, each with its own strengths andweaknesses.

PrimaryMemoryTypes:RAMand ROM

There aretwokeytypes ofprimarymemory:

- **RAM,or randomaccessmemory**
- **ROM**, or read-onlymemory

Let'slookin-depthatbothtypesofmemory.

1) RAMComputerMemory

The acronym RAM stems from the fact that data stored in random access memory can be accessed– as the name suggests -in any random order. Or, put another way, any random bitof data can be accessed just as quickly as any other bit.

The most important things to understand about RAM are that RAM memory is very fast, it can be written to as well as read, it is volatile (so all data stored in RAM memory is lostwhen it loses power) and, finally, it is very expensive compared to all types of secondary memory in terms ofcost per gigabyte. It is because of the relative high cost of RAM compared to secondary memory types that most computer systems use both primary and secondary memory.

Data that is required for imminent processing is moved to RAM where it can be accessed and modified very quickly, so that the CPU is not kept waiting. When the data is no longer required itis shunted out to slower but cheaper secondary memory, and the RAM space that has been freed up is filled with the next chunk of data that is about to beused.

TypesofRAM

DRAM: DRAM stands for Dynamic RAM, and it is the most common type of RAM used in computers. The oldest type is known as single data rate (SDR) DRAM, but newer computers use faster dual data rate (DDR) DRAM. DDR comes in several versions including DDR2 , DDR3, and DDR4, which offer better performance and are more energy efficient than DDR. However different versions are incompatible, so it is not possible to mix DDR2 with DDR3 DRAM in a computer system. DRAM consists of a transistor and a capacitor in each cell.
SRAM: SRAM stands for Static RAM, and it is a particular type of RAM which is faster than DRAM, butmoreexpensive and bulker,havingsixtransistorsin each cell. Forthose reasons SRAM is generallyonlyused asa data cache within a CPU itself or as RAM in veryhigh-end server systems. A small SRAM cache of the most imminently-needed data can result in significant speed improvements in a system

The key differences between DRAM and SRAM are that SRAM is faster than DRAM - perhaps two to threetimesfaster -butmoreexpensive andbulkier.SRAM is usuallyavailable in megabytes, while DRAM is purchased in gigabytes.

DRAM uses more energy than SRAM because it constantly needs to be refreshed to maintaindata integrity, while SRAM - thoughvolatile –does not need constant refreshing when it is powered up.

2) ROMComputerMemory

ROM stands for read-onlymemory, and the name stems from the fact that while data can be read from this type of computer memory, data cannot normally be written to it. It is a very fast type of computer memory which is usually installed close to the CPU on the motherboard.

ROM is a type of non-volatile memory, which means that the data stored in ROM persists in thememory even when it receives no power -for example when the computer is turned off. In that sense it is similar to secondary memory, which is used for long termstorage.

When a computer is turned on, the CPU can begin reading information stored in ROM without the need for drivers or other complex software to help it communicate. The ROM usually contains "bootstrap code" which is the basic set of instructions a computer needs to carry out to become aware of the operating system stored in secondary memory, and to load parts of the operating system into primary memory so that it can start up and become ready to use.

ROM is also used in simpler electronic devices to store firmware which runs as soon as the device is switched on.

TypesofROM

ROMisavailableinseveraldifferenttypes,includingPROM,EPROM,andEEPROM.

PROM: PROM standsfor Programmable Read-OnlyMemory, and it is differentfrom true ROM in that while a ROM is programmed (i.e. has data written to it) during the manufacturing process, a PROM is manufactured in an empty state and then programmed later using a PROM programmer or burner.

EPROM: EPROM stands for Erasable Programmable Read-Only Memory, and as the name suggests, data stored in an EPROM can be erased and the EPROM reprogrammed. Erasingan EPROM involves removingit from the computer andexposingit to ultraviolet light before re-burning it.

EEPROM: EEPROM stands for Electrically Erasable Programmable Read-Only Memory, and the distinction between EPROM and EEPROM is that the latter can be erased and written to by the computer system it is installed in. In that sense EEPROM is not strictly read-only. However in many cases the write process is slow, so it is normally only done to update program code such as firmware or BIOS code on an occasional basis.

SecondaryMemory

We know that processor memory, also known as primary memory, is expensive as well as limited.The fasterprimarymemory is also volatile. If we needto store large amount of dataor programs permanently, we need a cheaper and permanent memory. Such memory is called secondary memory. Here we will discuss secondary memory devices that can be used to store large amount of data, audio, video and multimedia files.

Characteristicsof SecondaryMemory
Thesearesomecharacteristicsof secondarymemory,whichdistinguishitfromprimary memory
- Itisnon-volatile,i.e. itretainsdata whenpowerisswitchedoff
- It islarge capacitiestothe tune ofterabytes

- It ischeaper as comparedtoprimarymemory

DependingonwhethersecondarymemorydeviceispartofCPUornot,therearetwotypes ofsecondarymemory-fixedandremovable.
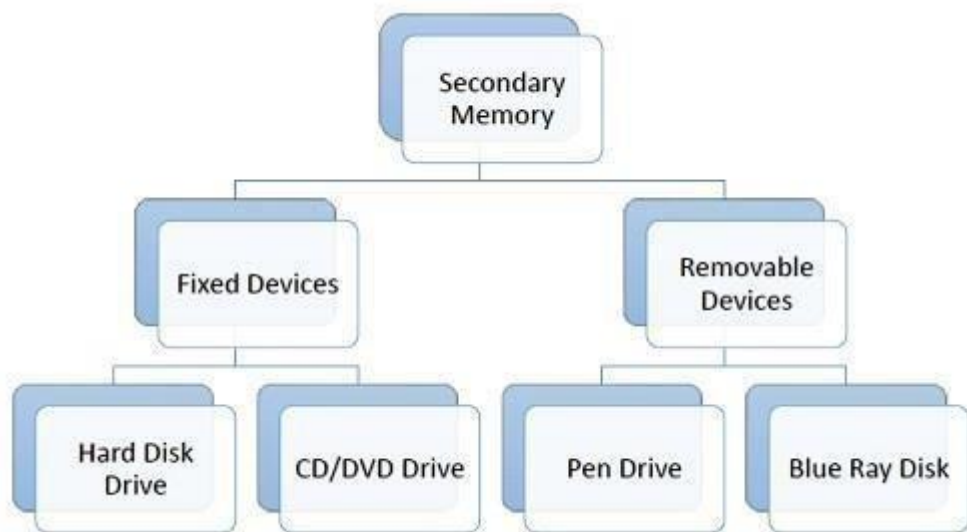
Letus lookatsomeofthesecondarymemorydevicesavailable.

Hard Disk Drive

Hard disk drive is made up of a series of circular disks called platters arranged one over the other almost ½ inches apart around a spindle. Disks are made of non-magnetic material like aluminum alloy and coated with 10-20 nm of magnetic material.

Standard diameter of these disks is 14 inches and they rotate with speeds varying from 4200 rpm (rotations per minute) for personal computers to 15000 rpm for servers. Data is stored by magnetizing or demagnetizing the magnetic coating. A magnetic reader arm is used to read data from and write data to the disks. A typical modern HDD has capacity in terabytes (TB).

CDDrive

CD stands for Compact Disk. CDs are circular disks that use optical rays, usually lasers, to read and write data. They are very cheap as you can get 700 MB of storage space for less than a dollar. CDs are inserted in CD drives built into CPU cabinet. They are portable as you can eject the drive, remove the CD and carry it with you. There are three types of CDs−

- CD-ROM(CompactDisk-ReadOnlyMemory)−ThedataontheseCDsare recorded by themanufacturer.ProprietarySoftware,audioorvideoarereleasedon CD-ROMs.
- CD-R (Compact Disk - Recordable) − Data can be written by the user once on the CD-R.Itcannotbedeletedormodified later.
- CD-RW (Compact Disk - Rewritable) − Data can be written and deleted on these opticaldisksagainand again.

DVD Drive

DVD stands for Digital Video Display. DVD are optical devices that can store 15 times the data held by CDs. They are usually used to store rich multimedia files that need high storage capacity. DVDs also come in three varieties -read only, recordable andrewritable.

Pen Drive

Pen drive is a portable memory device that uses solid state memory rather than magnetic fields or lasers to record data. It uses a technology similar to RAM, except that it isnonvolatile. It is also called USB drive, key drive or flash memory.

BluRayDisk

Blu Ray Disk (BD) is an optical storage media used to store high definition (HD) video and other multimedia filed. BD uses shorter wavelength laser as compared to CD/DVD.This enables writing arm to focus more tightly on the disk and hence pack in more data. BDs can store up to 128 GB data.

SolvedQuestions

ShortAnswerTypeQuestions.

Outlinethekeyfeaturesof1stGenerationComputerinbrief.*(2019-Winter)*

Ans. The period of first generation was from 1946-1959. The computers of first generation used vacuum tubes as the basic components for memory and circuitry for CPU (Central Processing Unit). These tubes, like electric bulbs, produced a lot of heat and the installations used to fuse frequently. Therefore, they were very expensive and only large organizations were able to afford it. In this generation, mainly batch processing operating system was used. Punch cards, paper tape, and magnetic tape was used as input and output devices. The computers in this generation used machine code as the programming language.

WhatisCPU?*(2018-Summer)*

Ans. A central processing unit (CPU), also called a central processor, main processoror just processor, is the electronic circuitry within a computer that executes instructions that make up a computer program. The CPU performs basic arithmetic, logic, controlling, and input/output (I/O) operations specified by the instructions in the program.

WhatisALU?*(2014-Winter)*

Ans. Stands for "Arithmetic Logic Unit." An ALU is an integrated circuit within a CPU or GPU that performs arithmetic and logic operations. Arithmetic instructions include addition, subtraction, and shifting operations, while logic instructions include boolean comparisons, such as AND, OR, XOR, and NOT operations.

NamethreeinputdevicesusedinPC.*(2016-Summer)*

Ans. Thethreeinput devices usedinPCareKeyboard, Mouseand Scanner.

Discussaboutthegenerationofcomputers?Explainthekeyfeaturesofcomputersof each generation?*(2013-Winter)*

Ans.A computer isanelectronicdevice thatmanipulates information or data.Ithasthe ability to store, retrieve, and process data.

Nowadays, a computer can be used to type documents, send email, play games, and browse the Web. It can also be used to edit or create spreadsheets, presentations, and even videos. But the evolution of this complex system started around 1940 with the first Generation of Computer and evolving eversince.

Therearefive generationsofcomputers.

FIRSTGENERATION

Features:

- 1946-1959istheperiodoffirstgenerationcomputer.
- J.P.EckertandJ.W.Mauchyinventedthefirstsuccessfulelectroniccomputer called ENIAC, ENIAC stands for ‾Electronic Numeric Integrated and Calculator‖.
- FewExamplesare:ENIAC,EDVAC,UNIVAC,etc.

Advantages:

- Itmadeuseofvacuumtubes whicharetheonly electroniccomponent available during those days.
- Thesecomputerscouldcalculateinmilliseconds.

Disadvantages:

- These wereverybiginsize, weight wasabout 30tones.

- Thesecomputerswerebased on vacuumtubes.

- Thesecomputerswereverycostly.

SECONDGENERATION

Features:

- 1959-1965istheperiodofsecond-generation computer.

- SecondgenerationcomputerswerebasedonTransistorinsteadofvacuumtubes.
- FewExamplesare:Honeywell400,IBM7094,etc.

Advantages:

- Due to the presence of transistors instead of vacuum tubes, the size of electron component decreased. This resulted in reducing the size of a computer as compared to first generation computers.
- Less energyandnotproduceasmuchheat as thefirstgeneration.
- Assemblylanguage and punch cards wereusedforinput.

Disadvantages:

- A coolingsystemwasrequired.
- Constantmaintenancewasrequired.
- Onlyusedfor specific purposes.

THIRDGENERATION

Features:

- 1965-1971istheperiodofthirdgenerationcomputer.
- ThesecomputerswerebasedonIntegrated circuits.
- ICwasinvented byRobert Noyce and JackKilbyIn 1958-1959.
- ICwasa singlecomponentcontainingnumberoftransistors.
- FewExamplesare:PDP-8,PDP-11,ICL2900,etc.

Advantages:

- Thesecomputerswerecheaperascomparedto second-generation computers.
- Theywerefastandreliable.
- UseofICin thecomputerprovidesthesmallsize ofthe computer.

Disadvantages:

- IC chipsaredifficulttomaintain.
- ThehighlysophisticatedtechnologyrequiredforthemanufacturingofICchips.
- Airconditioningisrequired.

FOURTHGENERATION

Features:

- 1971-1980istheperiodoffourthgenerationcomputer.
- Thistechnologyisbasedon Microprocessor.
- A microprocessor is used in a computer for any logical and arithmetic function tobe performed in any program.
- Graphics User Interface (GUI) technology was exploited to offer more comfort tousers.
- FewExamplesare:IBM4341,DEC10,STAR1000,etc.

Advantages:

- Fastestincomputationandsizegetreducedascomparedtotheprevious generation of computer.
- Heatgeneratedisnegligible.
- Smallinsizeascomparedtopreviousgenerationcomputers.

Disadvantages:

- TheMicroprocessordesignandfabricationareverycomplex.
- Airconditioningisrequired inmanycasesdue tothepresenceofICs.
- AdvancetechnologyisrequiredtomaketheICs.

FIFTH GENERATION

Features:

- Theperiodofthefifthgenerationin1980-onwards.
- Thisgenerationisbasedonartificialintelligence.

- The aim of the fifth generation is to make a device which could respond to natural language input and are capable of learning and self-organization.
- This generation is based on ULSI (Ultra Large Scale Integration) technology resulting in the production of microprocessor chips having ten million electronic components.
- FewExamplesare:Desktop,Laptop,etc.

Advantages:

- Itismore reliable andworksfaster.
- Itisavailableindifferentsizesanduniquefeatures.
- Itprovidescomputerswithmoreuser-friendlyinterfaceswithmultimediafeatures.

Disadvantages:

- Theyneedverylow-level languages.
- Theymaymakethehumanbrainsdullanddoomed.

Discuss about the various input devices used inPC platform? *(2013-Summer)*

Ans. Following are some of the important input devices which are used in a

computer −

Keyboard

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

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

Mouse

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

Generally, it has two buttons called the left and the right button and a wheel is present between the buttons. A mouse can be used to control the position of the cursor on the screen, but it cannot be used to enter text into the computer.

Joystick

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

Joystick

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

LightPen

Light pen is a pointingdevice similar to a pen. It is used to select adisplayed menu item or draw pictures on the monitor screen. It consists of a photocell and an optical systemplaced in a small tube.

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

TrackBall

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

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

Scanner

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

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

Digitizer

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

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

Microphone

Microphoneisaninputdevicetoinputsoundthatisthen storedinadigitalform.

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

Magnetic InkCardReader (MICR)

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

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

OpticalCharacterReader(OCR)

OCRisan inputdeviceusedto reada printed text.

OCR scans the text optically, character by character, converts them into a machine readable code, and stores the text on the system memory.

BarCode Readers

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

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

OpticalMarkReader(OMR)

OMR is a specialtype of optical scannerused to recognize the typeof markmade by pen or pencil. It is used where one out of a few alternatives is to be selected and marked.

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

EXERCISE

ShortAnswerTypeQuestions.

Outlinethekeyfeaturesof4th generationcomputerinbrief.

Differentiatebetweenanalogcomputeranddigitalcomputer.

Definehybridcomputer.

Differentiatebetweendataandinformation?

Differentiatebetweensoftcopyandhardcopyoutput?

DefineAuxiliarymemoryusedinPC.

Defineprimarymemoryused inPC.

Definememoryhierarchy.Statethedifferentmemorypresentin thedifferentlevels.

(2015-Winter,2013-Winter)

Definea cachememory.

What isanOMR?

WhatisaMICR?*(2014-Winter)*

Define Hardcopyoutput and SoftcopyoutputfromaPC.

Differentiatebetweenvolatileandnon-volatilecomputermemory.

Whatarethedifferenttypes ofplottersusedinPC?

LongAnswerTypeQuestions.

Discussabout thevariousoutputdevicesused in aPCplatform?

Whatisclassificationof computer?Compareandcontrastthefeaturesofdifferent classes of computers? *(2013-Winter)*

Discussabouttheevolutionof computers?Givesuitableexamplesof various computers?

Whatismemoryhierarchy? Explain themainfeatures of the varioustypesof memory present at different levels of this hierarchy? *(2016-Winter)*

Differentiate betweenprimarymemoryand secondarymemoryused in PC.Give proper example to substantiate your answer? *(2017-Winter)*

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CHAPTER–2:COMPUTERSOFTWARE

Softwareconcept

Softwareisaprogramwhichhelpsthehumanusertogiveinstructiontocomputer hardware.

TypesofSoftware
- Systemssoftware
- Applicationsoftware

Systemsoftware

- System Softwareis a set of programsthatmanage the resources ofa computer system.
- System Softwareis a collectionof systemprogramsthat perform a varietyof functions such as -
  - FileEditing
  - Resource Accounting
  - I/OManagement
  - Storage,MemoryManagementaccess
- SystemSoftwarecanbebroadlyclassifiedintothree typesas:
  - Systemcontrolprograms
  - Systemsupportprograms
  - Systemdevelopmentprograms
    - Systemcontrolprograms
      - controlstheexecutionofprograms
      - managethestorage &processingresourcesofthecomputer
      - performothermanagement&monitoringfunction
      - Themost important oftheseprogramsistheoperatingsystem, DBMS & communication monitors.
    - Systemsupportprograms
      - Provide routine service functions to the other computer programs& computerusers:
        E.g.Utilities,libraries,performancemonitors&jobaccounting.
    - Systemdevelopmentprograms
      - Assistsinthecreationofapplication
      - Programs. e.g., language translators such as BASIC interpreter & application generators.

Applicationsoftware
- Application software, or app for short, is software that performs specific tasks for anend-user.
- Effectively, if the user is interacting directly with a piece of software it is application software. For example, Microsoft Word or Excel is application software, as are common web browsers such as Firefox or Google Chrome.
- It also includes the category of mobile apps, including communication apps such as WhatsApp or games such as Candy Crush Saga. There are also app versions of common services such as those providing weather or transport information or apps for customers to interact with companies.

- Application software is distinct from system software, which refers to the software that actually keeps the systems running such as the operating system, computational science software, game engines, industrial automation, and software as service applications.
- Instead of interacting with the user, the system software interacts with other softwareor hardware.

OverviewofOperatingSystem

- An operating system (OS) is software that manages computer hardware resourcesand provides common services for computer programs. The operating system is an essential component of the system software in a computer system.
- Application programs usually require an operating system to function. Time-sharing operating systems schedule tasks for efficient use of the system and may also include accounting software for cost allocation of processor time, mass storage, printing, and other resources.
- For hardware functions such as input and output and memory allocation, the operating system acts as an intermediary between programs and the computer hardware, althoughthe application code is usually executed directly by the hardware and will frequently makea system call to an OS function or be interrupted by it. Operating systems can be found on almost any device that contains a computer–from cellular phones and video game consoles to supercomputers and web servers.
- Examples of popular modern operating systems include Android, BSD, iOS, Linux, OS X, QNX, Microsoft Windows, Windows Phone, and IBM z/OS. All these, except Windows, Windows Phone and z/OS, share roots in UNIX.

Types ofoperatingsystems

- Real-time
- Multi-user
- Multi-taskingvs.single-tasking
- Distributed

ObjectivesandFunctionsofO.S

OStypicallyprovidesservicesinthefollowing areas:
1. **Program development -** The OS provides a variety of facilities and services, such as editors and debuggers, to assist the programmer in creating programs.
2. **Program execution -** A number of steps need to be performed to execute a program. Instructions and data must be loaded into main memory, I/O devices and files must be initialized, and other resources must be prepared. The OS handles these scheduling duties for the user.
3. **Access to I/O devices -** Each I/O device requires its own peculiar set of instructionsor control signals for operation. The OS provides a uniform interface that hides these details so that programmers can access such devices using simple reads andwrites.
4. **Controlled access to files -** For file access, the OS must reflect a detailed understanding of not only the nature of the I/O device (disk drive, tape drive) but also the structure of the data contained in the files on the storage medium. In the case of a system with multiple users, the OS may provide protection mechanisms to control access to the files.

5. **System access -** For shared or public systems, the OS controls access to the system as a whole and to specific system resources. The access function must provide protection of resources and data from unauthorized users and must resolve conflictsfor resource contention.
6. **Errordetectionandresponse-**Avarietyoferrorscanoccurwhileacomputersystemis running. These include internal and external hardware errors, such as a memory error, or a device failure or malfunction; and various software errors, such as division byzero, attempt to access forbidden memory location etc. In each case, the OS must provide a response that clears the error condition with the least impact on running applications. The response may range from ending the program that caused the error, to retrying the operation, to simply reporting the error to the application.
7. **Accounting -**A good OS willcollect usage statisticsforvariousresources and monitor performance parameters such as response time.

ThemajorfunctionsofOperatingSystemareitactsas-

- TheResourceManagerforComputer.
- TheMemoryManager forcomputer.
- TheDeviceManagerforcomputer.
- TheUsermanager.

TypesofOperatingSystem:BatchProcessing,Multiprogramming&Time Sharing OS

FollowingaresomemajortypesofOperatingsystem.

Real-timeoperatingsystem

A real-time operating system is a multitasking operating system that aims at executing real-time applications. Real-time operating systems often use specialized scheduling algorithms so that they can achieve a deterministic nature of behavior. The main objective of real-time operating systems is their quick and predictable response to events. They have an event-driven or time sharing design and often aspects of both. An event-driven system switches between tasks based on their priorities or external events while time-sharing operating systems switch tasks based on clock interrupts.

Multi-useroperatingsystem

Amulti-useroperatingsystemallowsmultipleuserstoaccessacomputersystemat the sametime. Time-sharing systems and Internet servers can be classified as multi-user systems as they enable multiple-user access to a computer through the sharing of time. Single-user operating systems have only one user but may allow multiple programs to run at the sametime.

Multi-taskingvs.single-taskingOperatingSystem

A multi-tasking operating system allows more than one program to be running at the same time, fromthe point ofview of human time scales. A single-tasking systemhas only one running program.

DistributedOperating system

A distributed operating system manages a group of independent computers and makes them appear to be a single computer. The development of networked computers that couldbe linked and communicate with each other gave rise to distributed computing. Distributed computations are carried out on more than system.

BatchProcessing

Batch processing is the execution of a series of programs ("jobs") on a computerwithout manual intervention. Jobs are set up so they can be run to completion without human interaction. All input parameters are predefined through scripts, command-line arguments, control files, or job control language. This is in contrast to "online" or interactive programs which prompt the user for such input. A program takes a set of data files as input, processes the data, and produces a set of output data files. This operating environment is termed as "batch processing" because the input data are collected into batches or sets of records and each batch is processed as a unit.

Multiprogramming

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

TimeSharingOS

In computing, time-sharing is the sharing of a computing resource among many usersby means of multiprogramming and multi-tasking. Its introduction in the1960s, andemergence as the prominent model of computing in the 1970s, represented a major technological shift in the history of computing. By allowing a large number of users to interact concurrently with a single computer, time-sharing dramatically lowered the cost of providing computing capability, made it possible for individuals and organizations to use a computer without owning one, and promoted the interactive use of computers and the development of new interactiveapplications.

FeaturesofDOS,WindowsandUNIX

FeaturesofDOS

The operating system is a system software used for management of computer hardware and application software. It is an interactive interface of computer.MS-DOS is a very popular operating system for PC, and it is replaced by its extension Windows operating system. In the Windows environment, DOS is also Boss because many utilities programs of MS-DOS are used in trouble shooting of Windows Operating system.

MS-DOS

MS-DOS stands for Microsoft Disk Operating System. Tim Paterson developed this operating system in 1980. The IBM (International Business Machine) released first PC (Personal Computer) in 1981. MS-DOS version 1.0 was used as operating system in IBM-PC and become talk of town in overnight. The father of PC Operating System is Gary Kildall of Digital Research. He had his Ph.D in computer and designed more successful operating System called CP/ M. The selling ofCP / Mis more than 600,000 copies proves itspopularity.TheMicrosoftDiskOperatingSystemorMS-DOSwasbasedonQDOS,the

Quick and Dirty Operating System written by Tim Peterson of Seattle Computer Products, for their prototype Intel 8086 based computer. QDOS was based on Gray Kildall's CF/M. Paterson had bought a CP/ M manual and used it as the basis to writehis operating system six weeks, QBOS was different enough from CP / M. MS-DOS version 7.0 is lunched in 1997 which is a hidden with Window95/98OS.

It has three essential files and many command files. These essential files are: IO.SYS, MSDOS.SYS, and COMMAND.COM. These files are called system files of MS-DOS.The DOS is Boss in real sense, because in the age of Windows operating system, hardware utilities are dependent on the DOS.

The heartofMS-DOS:

- IO.SYS:This let DOScommunicate with thehardware throughtheBIOS (Basic Input/ Output System).
- MSDOS.SYS:Thisisa DOSkernel.
- COMMAND.COM: Thisis whereallthDOScommands are storedandinterpreted.
- COFIG.SYS:Hardwareconfigurationinformationisstoredhere.
- AUTOEXEC.BAT: Alltheprogramsthataresupposedtorunat startup arecalledhere.
- Booting:Thebootingisa processof loadingsystemfilesintomainmemory(RAM). There are two types of booting: cold booting and warmbooting.

WindowsandUNIX

It is an operating system, extension of MS-DOS with user friendly GUI and several facilities to control memory, hardware, text, graphics, audio, video, internet connection etc.

Version

Comments

Windows1.0

Thisoperating system with user interface isa notification of MSDOS. The nifty mouse is used to click on desired program to open. It was first called interface manager, but then changed in to the more appealing Windows. Windows 1.0lanched in November 1985.

Windows2.0

It wasreleased in 1987 to take advantage of the awesome processingpowerof the Intel 286processor. The first version of Microsoft Word and Excel are introduced in this version.

Windows3.0

It was released in May 1990. It came with a prettier 16-colorinterface, and new technological bells and whistles that let it make better use of the memory. In 1991, Microsoft brought multimedia support for Windows 3.0, called feature, though, is the active desktop, which integrates the web browser (internet Explorer), with operating system.

Windows2000

Its interface is similar to interface for windows 98. It has new security protocol with an encryption facility to authenticate users logging in to the network. It supports 32 FAT file systemalongwithNTFC(NewTechnologyFileSystem),makingiteasierforusersto upgradeforWindows98.Ithasquiterobustlybridkernelarchitecture,makeitmorestable

version.

Windows Me

Later in 2000, Windows Millennium (windows me) Edition was released for the home user. This was the last version of Windows to be based on Windows 98. Windows Me had always been regarded as Microsoft' sway of keeping users busy while they waited for Windows XP.

WindowsXP

Here, XP stands for experience. It bought together the robust Kernel of windows 2000 and all the friendless and multimedia support of Windows Me, and painted on anew face for it. Apart from the merger of Windows2000 and me, Windows Xp also added new features to enhance its performance. The first of These Throttling, Usually, Windows likes to do many things at once, but when memory falls short, it will throttle itsmemory access, doing fewer ata time. This shows the system down considerably, but prevents it fromcrashing.

Windows7

Windows 7 is an operating system released by Microsoft on October 22, 2009. Itfollows the previous (sixth) version of Windows, called Windows Vista.

Like previous versions ofWindows,Windows 7 has a graphical user interface (GUI) that allows you to interact with items on the screen using a keyboard and mouse. However, Windows 7 is also includes a feature called "Windows Touch" that supports touch screeninput and multi touch functionality

Windows8

Windows 8 is the latest version of Microsoft's Windows operating system. It was released on October 26, 2012, and is the first major update to Windows since Windows 7, which was released over three years earlier.

The goal of the new Windows 8 interface is to function on both traditional desktop PCs, such as desktop computers and laptops, as well as tablet PCs. Windows 8 supports both touch screen input as well as traditional input devices, such as a keyboard andmouse.

Windows10

Windows 10 is a major version of the Microsoft Windows operating system that was released on July 29, 2015. It is built on the Windows NT kernel and follows Windows 8.

While Windows 10 includes many new features, it also brings back the Start Menu, which was dropped in Windows 8. The new and improved Start Menu provides quick access to settings, folders, and programs and also includes tiles from the Windows 8 interface. The bottom of the Windows 10 Start Menu includes a search bar that allows you to search both your local PC and the web.

UNIXOperatingSystem

The UNIX (pronounced as YEW-nihks) is a powerful, flexible, multi-user Operating system with GUI and several utilities. Ken Thompson and Dennis Ritchie wrote Compiler under UNIX in 1969 at Bell Labs. In 1973, Thompson and Ritchie rewrote the UNIX kernel using C language. It is based on MULTICS operating system. Its first user was Bell patent department. XENIX, VENIX, MICRONIX, LINUX, UNIXWARE-7 etc are version of UNIX operating system.

TheUNIX operatingsystemismadeupfromthreeparts:

(a) Kernel: It is a hub of operating system dedicated for memory management, file management and communication within system.

(b) Shell: It is an interface between kernel and users.When a user logs in, the login program matches the username and password, and then starts shell. The shell is a command line interpreter (CLI) of UNIX.

(c) Program or command: It is used to accomplish specific tasks. When one command is terminated, the shell displays prompt % to accept next command forexecution.

ProgrammingLanguages

A programming language is a formal constructed language designed to communicate instructions to a machine, particularly a computer. Programming languages can be used to create programs to control the behavior of a machine or to express algorithms so that the computer hardware can run with a proper step by step instruction.

The earliest programming languages preceded the invention of the computer and were used to direct the behavior of machines such as Jacquard looms and player pianos.Thousands of different programming languages have been created, mainly in the computer field, and many more still are being created every year. Many programming languages require computation to be specified in an imperative form (i.e., as a sequence of operations to perform), while other languages utilize other forms of program specification such as the declarative form (i.e. the desired result is specified, not how to achieve it).

The description of a programming language is usually split into the two components of syntax (form) and semantics (meaning). Some languages are defined by a specification document (for example, the C programming languages specified by an ISO Standard), while other languages (such as Perl) have dominant implementation that is treated as a reference. There are two major types of programming languages I,e. Procedural programming language and Object Oriented programming language.

Proceduralprogramming

In procedural programming our code is organized into small "procedures" that use and change our data. In ColdFusion, we write our procedures as either custom tags or functions. These functions typically take some input, do something, then produce some output. Ideally yourfunctionswouldbehaveas"blackboxes ̄whereinputdatagoesinandoutputdatacomes out.

The key idea here is that our functions have no intrinsic relationship with the data they operate on. As long as you provide the correct number and type of arguments, the function will do its work and faithfully return its output.

Sometimes our functions need to access data that is not provided as a parameter, i.e., we need access data that is outside the function. Data accessed in this way is considered "global" or "shared" data.

So in a procedural system our functions use data they are "given" (as parameters) but also directly access any shared data they need.

Objectorientedprogramming

In object oriented programming, the data and related functions are bundled together into an "object". Ideally, the data inside an object can only be manipulated by calling the object's functions. This means that your data is locked away inside your objects and your functions provide the only means of doing something with that data. In a well-designed object oriented system objects never access shared or global data, they are only permitted to use the data they have, or data they are given.

Compiler,Interpreter

Compiler: It is a program which translates a high level language program into a machine language program. A compiler is more intelligent than an assembler. It checks all kinds of limits, ranges, errors etc. But its program run time is more and occupies a larger part of the memory. It has slow speed. Because a compiler goes through the entire program and then translates the entire program into machine codes. If a compiler runs on a computer and produces the machine codes for the same computer then it is known as a self-compiler or resident compiler. On the other hand, if a compiler runs on a computer and produces the machine codes for other computer then it is known as a cross compiler.

Interpreter: An interpreter is a program which translates statements of program into machine code. It translates only one statement of the program at a time. It reads only one statement of program, translates it and executes it. Then it reads the next statement of the program again translates it and executes it. In this way it proceeds further till all the statements are translated and executed. On the other hand, a compiler goes through the entire program and then translates the entire program into machine codes. A compiler is 5 to 25 times faster than an interpreter. By the compiler, the machine codes are saved permanently for future reference. On the other hand, the machine codes produced by interpreter are not saved. An interpreter is a small program as compared to compiler. It occupies less memory space, so it can be used in a smaller system which has limitedmemory space.

ComputerVirus,DifferentTypesofcomputervirus

A computer virus is a malware program that, when executed, replicates by inserting copies of itself (possibly modified) into other computer programs, data files, or the boot sector of the hard drive. When this replication succeeds, the affected areas are then said to be "infected". Viruses often perform some type of harmful activity on infected hosts, such as stealing hard disk space or CPU time, accessing private information, corrupting data, displaying political or humorous messages on the user's screen, spamming their contacts, or logging their keystrokes. However, not all viruses carry a destructive payload or attempt to hide themselves–the defining characteristic of viruses is that they are self-replicating computer programs which install themselves without the user's consent.

Virus writers use social engineering and exploit detailed knowledge of security vulnerabilities to gain access to their hosts' computing resources. The vast majority of viruses target systems running Microsoft Windows, employing a variety of mechanisms to infect new hosts, and often using complex anti detection/stealth strategies to evade antivirus software. Motives for creating viruses can include seeking profit, desire to send a political message, personal amusement, to demonstrate that a vulnerability exists in software, for sabotage and denial of service, or simply because they wish to explore artificial life and evolutionary algorithms.

Computer viruses currently cause billionsof dollars worth of economic damage each year, due to causing systems failure, wasting computer resources, corrupting data, increasing maintenance costs, etc. In response, free, open source antivirus tools have been developed, and a multi-billion dollar industry of antivirus software vendors has cropped up, selling virus protection tousers of various operatingsystems of which Android andWindows are amongthe most victimized. Unfortunately, no currently existing antivirus software is able to catchall computer viruses (especially new ones); computer security researchers are actively searching for new ways to enable antivirus solutions to more effectively detect emerging viruses, before they have already become widely distributed.

DifferentTypesofcomputervirus

There are different types of viruses which can be classified according to their origin, techniques, types of files they infect, where they hide, the kind of damage they cause, thetype of operating system, or platform they attack. Let us have a look at few of them.

Memory Resident Virus-These viruses fix themselves in the computer memory and get activated whenever the OS runs and infects all the files that are then opened. Hideout: This type of virus hides in the RAM and stays there even after the malicious code is executed. It gets control over the system memory and allocates memory blocks through which it runs its own code, and executes the code when any function is executed. Target: It can corrupt files and programs that are opened, closed, copied, renamed, etc. Examples: Randex, CMJ,Meve, and MrKlunky, Protection: Install an antivirus program.

Direct Action Viruses-The main purpose of this virus is to replicate and take action when itis executed. When a specific condition is met, the virus will go into action andinfect files inthe directory or folder that are specified in theAUTOEXEC.BAT file path. This batch file is always located in the root directory of the hard disk and carries out certain operations when the computer is booted. Find First/Find Next technique is used where the code selects a few files as its victims.It also infects the external devices like pen drives or hard disks bycopying itself on them. Hideout: The viruses keep changing their location into new files whenever the code is executed, but are generally found in the hard disk's root directory. Target: It can corrupt files. Basically, it is a file- infector virus. Examples: Vienna virus. Protection: Install an antivirus scanner. However, this type of virus has minimal effect on the computer's performance.

Overwrite Viruses-A virus of this kind is characterized by the fact that it deletes the information contained in the files that it infects, rendering them partially or totally uselessonce they have been infected. Hideout: The virus replaces the file content. However, it does not change the file size. Examples:Way, Trj.Reboot, Trivial.88.D. Protection: The only way to clean a file infected by an overwrite virus is to delete the file completely, thus losing the original content. However, it is very easy to detect this type of virus, as the original program becomes useless.

Boot Sector Virus-This type of virus affects the boot sector of a hard disk. This is a crucial part of the disk, in which information of the disk itself is stored along with a program that makes it possible to boot (start) the computer from the disk. This type of virus is also called Master Boot Sector Virus or Master Boot Record Virus. Hideout: It hides in the memory until DOS accesses the floppy disk, and whichever boot data is accessed, the virus infects it. Examples: Polyboot.B, AntiEXE. Protection: The best way of avoiding boot sector viruses isto ensure that floppy disks are write-protected. Also, never start your computer with an unknown floppy disk in the disk drive.

Macroviruses infectfiles thatare createdusingcertain applicationsor programs that contain macros, like .doc, .xls, .pps, .mdb, etc. These mini programs make it possible to automate series of operations so that they are performed as a single action, thereby saving the user from having to carry them out one by one. These viruses automatically infect the file that contains macros, and also infects the templates and documents that the file contains. It is referred to as a type of e-mail virus. Hideout: These hide in documents that are shared via e-mail or networks. Examples: Relax, Melissa.A, Bablas, O97M/Y2KProtection: The best protection technique is to avoid opening e- mails from unknown senders. Also, disabling macros can help to protect your usefuldata.

Directoryviruses (also called Cluster Virus/File System Virus)-It infects the directory of your computer by changing the path that indicates the location of a file. When you execute a program file with an extension .EXE or .COM that has been infected by a virus, you are unknowingly running the virus program, while the original file and program is previously moved by the virus. Once infected, it becomes impossible to locate the original files. Hideout: It is usually located in only one location of the disk, but infects the entire program in the directory. Examples: Dir- 2virusProtection: All you can do is, reinstall all the files from the backup that are infected after formatting the disk.

Polymorphic viruses encrypt or encode themselves in a different way (using different algorithms and encryption keys) every time they infect a system. This makes it impossible for antivirus software to find them using string or signature searches (because they are different in each encryption). The virus then goes onto creates a large number of copies. Examples: Elkern, Marburg, Satan Bug and Tuareg, Protection: Install a high-end antivirus as the normal ones are incapable of detecting this type of virus.

Companion viruses: It can be considered as a type of file infector virus, like resident ordirect action types. They are known as companion viruses because once they get into the system they 'accompany' the other files that already exist.

In other words, to carry out their infection routines, companion viruses can wait in memory until a program is run (resident virus), or act immediately by making copies of themselves (direct action virus).

Hideout: These generally use the same filename and create a different extension of it. For example: If there is a file "Me.exe", the virus creates another file named "Me.com" and hides in the new file.When the system calls the filename "Me", the ".com" file gets executed (as ".com" has higher priority than ".exe"), thus infecting the system. Examples: Stator, Asimov.1539 and Terrax.1069 Protection: Install an antivirus scanner and also download Firewall.

FATVirus:The file allocation table (FAT) is the part of a disk used to store all the information about the location of files, available space, unusable space, etc. Hideout: FAT virus attacks the FAT section and may damage crucial information. It can be especially dangerous as it preventsaccesstocertainsectionsofthediskwhereimportantfilesarestored.Damage

causedcanresultinlossofinformationfromindividualfilesorevenentiredirectories.

Examples: Link Virus, Protection: Before the virus attacks all the files on the computer, locate all the files that are actually needed on the hard drive, and then delete the ones that are not needed. They may be files created by viruses.

Multipartite Virus-These viruses spread in multiple ways possible. It may vary in its action depending upon the operating system installed and the presence of certain files.

Hideout: In the initial phase, these viruses tend to hide in the memory as the resident viruses do; then they infect the hard disk. Examples: Invader, Flip and Tequila.

Protection: You need to clean the boot sector and also the disk to get rid of the virus, andthen reload all the data in it. However, ensure that the data is clean.

WebScriptingVirus-Manywebpagesincludecomplexcodesinordertocreateaninteresting and interactive content. This code is often exploited to bring about certain undesirableactions. Hideout: The main sources of web scripting viruses are the web browsers or infected web pages. Examples: JS.Fortnight is a virus that spreads through malicious e-mails. Protection: Install the Microsoft tool application that is a default feature in Windows 2000, Windows 7 and Vista. Scan the computer with this application.

Worms: A worm is a program verysimilar to a virus; it has the ability to self-replicate and can lead to negative effects on your system. But they can be detected and eliminated by an antivirus software. Hideout: These generally spread through emails and networks. They donot infect files or damage them, but they replicate so fast that the entire network maycollapse. Examples: PSWBugbear.B, Lovgate.F, Trile.C, Sobig.D, Mapson. Protection: Install an updated version of antivirus.

Trojans are another unsavory breed of malicious code are Trojans or Trojan horses, which unlike viruses, do not reproduce by infecting other files, nor do they self-replicate like worms. In fact, it is a program which disguises itself as a useful program or application.

Beware of the fact that these viruses copy files in your computer (when their carrier program is executed) that can damage your data, and even delete it. The attacker can also program the Trojans in such a manner that the information in our computer is accessible to them.

Logic Bombs are not considered viruses because they do not replicate. They are not even programs in their own right, but rather camouflaged segments of other programs. They are only executed when certain predefined condition is met. Their objective is to destroy data on the computer once certain condition shave been met. Logic bombs go undetected until launched, the results can be destructive, and your entire data can be deleted.

DetectionandpreventionofVirus

FollowingstepsmaybetakenforVirusDetectionandPrevention.

1. Do not open any files attached to an email from an unknown, suspicious or untrustworthy source.
2. Do not open any files attached to an email unless you know what it is, even if itappears to comefrom a dearfriend or someone you know. Some viruses can replicate themselves and spread through email. Better be safe than sorry and confirm that they really sent it.
3. Delete chain emails and junk email. Do not forward or reply to any to them. These types of email are considered spam, which is unsolicited, intrusive mail that clogs up thenetwork.
4. Exercise caution when downloading files from the Internet. Ensure that the source is a legitimate and a reputable one. Verify that an anti-virus program checks the files onthe download site. If you're uncertain, don't download the file atall.
5. Update your anti-virus software regularly. Thousands of viruses are discovered each month, so you'll want to be protected.
6. Back up your files on a regular basis. If a virus destroys your files, at least you can replace them with your back-up copy. You should store your backup copy in aseparate location from your work files, one that is preferably not on yourcomputer.
7. When in doubt, always err on the side of caution and do not open, download, or executeanyfiles oremailattachments. Notexecutingthefiles is especiallyimportant. Check with your product vendors for updates which include those for your operating system web browser, and email. One example is the security site section of Microsoft located at http://www.microsoft.com/security.
8. Stay away from Bit torrent sites. Some of the more popular ones include Lime wire, Bit Torrent, Frost wire and Pirate Bay. These are heavily laden with viruses, malware and spyware. Downloading material from these websites is one of the easiest ways to become infected. It's in your best interest to just avoid these websites completely.
9. Be careful when searching on the internet, the links that come up from your search engine may contain a virus. Never go to sites that soundsuspicious.
10. Due to the popularity of the social networking websites such as MySpace, Face book, andTwitter, virus makers target them morethananyother website.Online gamingand gambling websites also are high risk websites. It's best to avoid these kinds ofwebsites altogether.
11. If you happen to see a popup message when on the internet about being infected and to buy their software to protect yourself, do not fall for it! Most of the time these messages are easy to see as they tend to have bad grammar and spelling errors. Common names are XP Antivirus, Security Tools, ThinkPoint, Security Shield, Win 7 Security 2011, and similar variations. If do see one of these popup, do not click on them, immediately shut down your computer. If you click on any part of those windows you will give the virus permission to install and bypass your antivirus program.
12. If you see any suspicious pop-ups appear on your screen, do not click on them. If you do, it is very likely you will infect your computer. Instead use the following keyboard command, which will allow you to close the pop-up, without having the click on it or infecting yourself. The keyboard command is ALT + F4. If that fails, then shut downthe computer.

ApplicationofcomputersindifferentDomain

Computer is a device through which you can perform a variety of jobs. You can use your computer system for different applications by changing the softwarepackages

Usesof Computer atHome

Computercanbeusedathomeinthefollowing ways.

Home Budget

Computer can be used to manage Home Budget. You can easily calculate your expensesand income. You can list all expenses in one column and income in another column. Thenyou can apply any calculation on these columns to plan your home budget. There are also specialize software that can manage your income and expenses and generate some cool reports.

Computer Games

An important use of computers at home is playing games. Different types of games are available. These games are a source of entertainment and recreation. Many games are available that are specially developed to improve your mental capability and thinking power.

Working fromHome

People can manage the office work at home. The owner of a company can check the work of the employees from home. He can control his office while sitting at home.

Entertainment

People can find entertainment on the internet. They can watch movies, listen to songs, and watch videos download different stuff. They can also watch live matches on the internet.

Information

People can find any type of information on the internet. Educational and informative websites are available to download books, tutorials etc. to improve their knowledge and learn new things.

Chatting&Social Media

People canchat with friendsandfamilyon the internet usingdifferent softwarelike Skype etc. One can interact with friends over social media websites like Face book, Twitter & Google Plus. They can also share photos and videos withfriends.

UsesofComputersin Education

CBT are different programs that are supplied on CD-ROM. These programs include text, graphics and sound. Audio and Video lectures are recorded on the CDs. CBT is a low cost solution for educating people. You can train a large number of people easily.

Benefitsof CBT

Some benefits ofCBTare asfollows:

1. The students can learn new skills at their own pace. They can easily acquire knowledge in any available time of their own choice.
2. Training time can be reduced.
3. Training materials are interactive and easy to learn. It encourages students to learn the topic.
4. Planning and timing problems are reduced or eliminated.
5. The skills can be taught at any time and at any place.
6. It is very cost effective way to train the large number of students.
7. Training videos and audios are available at affordable prices.

ComputerAidedLearning(CAL)

Computer aided learning is the process of using information technology to help teaching and enhance the learning process. The use of computer can reduce the time that is spent on preparing teaching material. It can also reduce the administrative load of teaching and research. The use of multimedia projector and PowerPoint presentations has improved the quality of teaching. It has also helped the learning process.

Distance Learning

Distance learning is a new learning methodology. Computer plays the key role in this kind of learning. Many institutes are providing distance learning programs. The student does not need to come to the institute. The institute provides the reading material and the student attends virtual classroom. In virtual classroom, the teacher delivers lecture at his own workplace. The student can attend the lecture at home by connecting to a network. The student can also ask questions to the teacher.

OnlineExamination

The trend of online examination is becoming popular. Different examination like GRE, GMAT and SAT are conducted online all over the world. The questions are marked by computer. It minimizes the chance of mistakes. It also enables to announce the result in time.

UsesofComputersin Business

The use of computer technology in business provides many facilities. Businessmen are using computers to interact with their customers anywhere in the world. Many business tasks are performed more quickly and efficiently. Computers also help them to reduce the overall cost of their business. Computer can be used in business in the following ways.

Marketing

An organization can use computers for marketing their products. Marketing applications provide information about the products to customers. Computer is also used to manage distribution system, advertising and selling activities. It can also be used in deciding pricing strategies. Companies can know more about their customers and their needs and requirements etc.

StockExchange

Stock Exchange is the most important place for businessmen. Many stock exchanges use computers to conduct bids. The stockbrokers perform all trading activities electronically. They connect with the computer where brokers match the buyers with sellers. It reduces cost

asnopaperorspecialbuildingisrequired toconduct theseactivities.

UsesofcomputersinMedical

Field Hospital Management

System

Specialized hospital management softwares are used to automate the day today procedures and operations at hospitals. These tasks maybe online appointments, payroll admittance and discharge records etc.

Patient History

Hospital management systems can store data about patients. Computers are used to store data about patients, their diseases & symptoms, the medicines that are prescribed.

PatientsMonitoring

Monitoringsystems are installed inmedical wards and Intensive care units tomonitoring patients continuously. These systems can monitor pulse, blood pressure and body temperature and can alert medical staff about any serious situations.

LifeSupport Systems
Specializeddevicesareusedtohelpimpairedpatientslikehearingaids.

Diagnosis Purpose
A variety of software are used to investigate symptoms and prescribed medication accordingly. Sophisticated systems are used for tests like CT Scan, ECG, and other medical tests.

SolvedQuestions

ShortAnswerTypeQuestions.

Defineanoperatingsystem.Giveexamplesofthreeoperatingsystemusedon   PC.

Ans. An Operating System (OS) is an interface between computer user and computer hardware. An operating system is software which performs all the basic tasks like file management, memorymanagement, process management, handling input and output, and controlling peripheral devices such as disk drives and printers.

SomepopularOperatingSystemsincludeLinuxOperatingSystem,Windows Operating System, VMS, OS/400, AIX, z/OS, etc.

Defineabatchprocessingsystem.

Ans. Batch processing is the processing of transactions in a group or batch. No user interaction is required once batch processing is underway. This differentiates batch processing from transaction processing, which involves processing transactionsone at a time and requires user interaction.

Defineamultiprogrammingoperatingsystem.

Ans. Multiprogramming is a rudimentary form of parallel processing in which several programs are run at the same time on a uniprocessor. Instead, the operatingsystem

executes part of one program, then part of another, and so on. To the userit appears that all programs are executing at the same time.

Defineatimesharingoperatingsystem.

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

LongAnswerTypeQuestions

Defineanoperatingsystem.Discussaboutthemajorfunctionofanyoperating system. *(2013-Winter) (2017-Winter)*

Ans.

An operating system isa program on which application programs are executed and acts as a communication bridge (interface) between the user and the computer hardware.

The main task an operating system carries out is the allocation of resources and services, such as allocation of: memory, devices, processors and information. The operating system also includes programs to manage these resources, such as a traffic controller, a scheduler, memory management module, I/O programs, and a file system.

Functionsofanoperating System:

Security–

The operating system uses password protection to protect user data and similar other techniques. It also prevents unauthorized access to programs and user data.

Controloversystemperformance–

Monitors overall system health to help improve performance records the response time between service requests and system response to have a complete view of the systemhealth. This can help improve performance by providing important information needed to troubleshoot problems.

Jobaccounting–

Operating system Keeps track of time and resources used by various tasks and users, this information can be used to track resource usage for a particular user or group of user.

Errordetectingaids–

Operating system constantly monitors the system to detect errors and avoid the malfunctioning of computer system.

Coordinationbetweenothersoftwareandusers–

Operating systems also coordinate and assign interpreters, compilers, assemblers and other software to the various users of the computer systems.

MemoryManagement–

The operating system manages the Primary Memory or Main Memory. Main memory is made up of a large array of bytes or words where each byte or wordis assignedacertain address. Main memory is a fast storage and it can be accessed directly by the CPU. For a program to be executed, it should be first loaded in the main memory. An Operating System performs the following activities for memory management:

It keeps tracks of primary memory, i.e., which bytes of memory are used by which user program. The memory addresses that have already been allocated and the memory addresses of the memory that has not yet been used. In multi programming, the OS decides the order in which process are granted access to memory, and for how long. It allocates the memory to a process when the process requests it and deallocates the memory when the process has terminated or is performing an I/O operation.

ProcessorManagement–

In a multi programming environment, the OS decides the order in which processeshave access to the processor, and how much processing time each process has. This function of OS is called process scheduling. An Operating System performs the following activities for processor management.

Keeps tracks of the status of processes. The program which perform this task is known as traffic controller. Allocates the CPU that is processor to a process. De-allocates processor when a process is no more required.

DeviceManagement–

An OS manages device communication via their respective drivers. It performs the following activities for device management. Keeps tracks of all devices connected to system. Designates a program responsible for every device known as the Input/output controller. Decides which process gets access to a certain device and for how long. Allocates devices in an effective and efficient way. Deallocates devices when they are no longer required.

FileManagement–

A file system is organized into directories for efficient or easy navigation and usage. These directories may contain other directories and other files. An Operating System carries out the following file management activities. It keeps track of where information is stored,user access settings and status of every file and more. These facilities are collectively known as the file system.

What is the differencebetween Application Softwareand SystemSoftware? *(2015-Winter)*

Ans

Sr. No.	Key	SystemSoftware.	ApplicationSoftware.
1	Definition	System Software is the typeofsoftwarewhichis the interface between applicationsoftwareand system.	On other hand Application Software isthetypeofsoftwarewhichrunsas per user request. It runs on the platform which is provide by system software.
2	Development Language	In general System softwarearedevelopedin low level language which is more compatible with the system hardware in order to interact with.	While in case of Applicationsoftwarehighlevellangua geisused for their development as they are developed as some specificpurpose software.
3	Usage	Systemsoftwareisused for operating computer hardware.	OnotherhandApplicationsoftware is used by user to perform specific task.
4	Installation	System software are installedonthecomputer whenoperatingsystemis installed.	OnotherhandApplicationsoftware are installed according to user's requirements.
5	User interaction	As mentioned in above points system software are specific to system hardware so less or no userinteractionavailable in case of system software.	On other hand in application softwareusercaninteractswithitas user interface is available in this case.
6	Dependency	Systemsoftwarecan runindependently.It providesplatformfor running application Software.	On other hand in application software can't run independently. Theycan'trunwithoutthepresence of system software..
7	Examples	Some examples of systemsoftware'sare compiler, assembler, debugger, driver,etc.	Onotherhandsomeexamplesof application software's are word processor, web browser, media player, etc.

EXERCISE

ShortAnswerTypeQuestions.

Whatarethefour majorfunctions of anoperatingsystem?

Whatarethevarioustypes ofoperatingsystem usedonPC?

Defineamulti-taskingoperating system.

DefineGUI.

What iscomputersecurity?

Whatissoftware?*(2015-Summer)*

Write types ofsoftware?

Whatisapplicationsoftware?

Whatissystem software? Quote some examples ofsystemsoftware?

Whatisaninterpreter?Howisitdifferentfromcompiler?

LongAnswerTypeQuestions

Discuss the various objectives of an operating system. Illustrate your answer with proper examples.

WhatisDOS?Discussabout themainfeaturesofDOS withappropriateexamples.

Compareand contrastbetweenthefeaturesofUNIXoperatingsystem.

ComparethevariousfeaturesofwindowsandUNIXoperatingsystem.Give suitable example to substantiate your answer. *(2015-Summer)*

Writea shortnoteonSingle userVs. Multi-userO.S.

What is Virus? How does virus spread and what are the symptoms of virus attack? How can you prevent virus attack? *(2017-Winter) (2013-Winter) (2014-Winter)*

DistinguishbetweenCompilerandInterpreter?*(2016-Summer)*

DefineSoftware.Describevarioustypesof softwareandexplainthem?

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CHAPTER–3:COMPUTERNETWORKANDINTERNET

Networking concept, Protocol, Connecting Media,

DataTransmission mode

Networkingconcept

- A computer network is a collection of two or more computers, which are connected two or more computers, which are connected together to share information and resources.
- It is a combination of hardware and software that allows communication between computers over a network.

Protocol

- A protocol is a set of rules that the communication set of rules that thecommunication between computers on a network.
- Mostimportant setsof internetprotocolsareTCP/IP, HTTPS, SMTP,andFTP.

Connecting Media

- Connectingmedia ofanetworkrefertothetransmissionmediaused inthenetwork.
- Itreferstothephysicalmediathroughwhichcommunicationsignalscanbe transmitted from one point to another.
- It canbedividedinto twobroadcategories
  1) GuidedMedia
  2) UnguidedMedia

Guided Media:

- The data signal in guided medium is bound by the cabling system that guide the data signal along a specific path.
- Itconsistsofacable composedof materialslike copper,tinorsilver.
- Basically,theyaredividedintothreecategories:
  (a) EthernetcableorTwistedPair:
    - Inthispair,wiresaretwistedtogether,whicharesurroundedby aninsulating material and an outer layer called jacket.
    - Atwistedpairconsistsoftwoconductors(copper)
    - Ex-LANCable
  (b) CoaxialCable:
    - Itcarriesthesignalofhigherfrequencydatacommunicationthroughthe network.
    - Itiscommonlyusedintransferringmulti-channeltelevisionsignalsincities.
    - Ex-cableTVnetwork
  (c)Fiber–OpticsCable:
    - It is made up of glass or plastic and transmits signals in the form of light from a source at one end to another end.
    - ThespeedofOpticalfiberishundredsoftimesof fasterthancoaxialcables.

- Ex-WavelengthDivisionMultiplexing,SONETnetwork

UnguidedMedia:

- It is the transfer of information over a distance without the use of enhanced electrical conductors or wires.

- Whenthecomputersinanetworkinterconnectedanddataistransmittedthrough waves, then they are said to be connected through unguidedmedia.
- Somecommonlyusedunguidedmediaoftransmissionare-
  1. Radiowavetransmission
  2. Microwavetransmission
  3. Satellitecommunication
  4. Infraredwavetransmission
  5. Bluetooth.

DateTransmissionmode

- ThewayinwhichdataistransmittedfromoneplacetoanotheriscalledData transmission mode or data communication mode or directional modes.
- Therearemainly3 typesofdata transmissionmodesare-
  1. Simplexmode
  2. Half-duplexMode
  3. Full-duplexmode

Simplex mode-
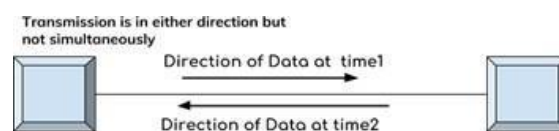
- Insimplexmode,datacanflowinonlyonedirection.
- Inthismode,asendercanonlysenddataandcannotreceiveit.
- Similarly,areceivercan onlyreceivedata butcannotsendit.
- Ex-Radio,Televisionetc.
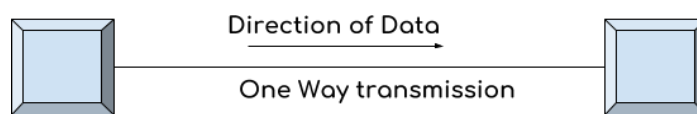
Simplex Mode
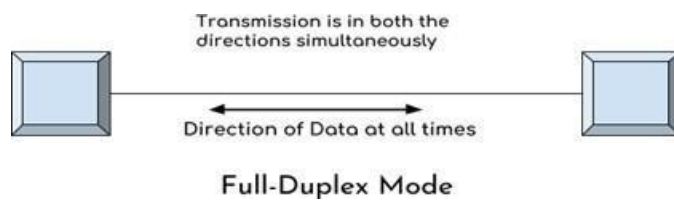
Half–duplexMode-

- Inhalf-duplexmode,datacanflowinbothdirectionsbutnotatasametime.
- Inthismode,datais sentandreceivedalternatively.
- Ex-walkie-Talkie

Half-Duplex Mode

Full-DuplexMode

Transmission is in both the directions simultaneously

Direction of Data at all times

Full-Duplex Mode

- InfullDuplex-mode,data canflowinbothdirectionsat thesametime.
- Ex-Mobilephone.

NetworkTopologies,TypesofNetwork

NetworkTopologies

- Networktopologyisdeterminedonlybytheconfigurationof connectionsbetween nodes.
- Inafullyconnectednetworkwithnnodes,therearen(n-1)/2directlinks.
- Themost commonlyused topologyaredescribedbelow:

1. BusTopology

- IncaseofBustopology,alldevicessharesinglecommunicationlineorcable.
- It isone of the simpleformsof networking whereafailureof adevice doesnot affect the other devices.
- Butfailureofthesharedcommunicationlinecanmakeallotherdevicesstop functioning.
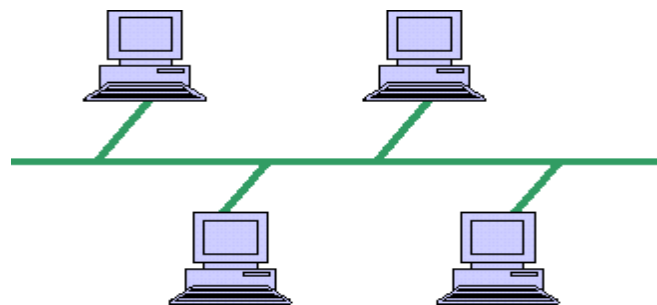
[BusTopologyDiagram]

2. RingTopology

- In ringtopology, eachhostmachine connectsto exactlytwo other machines, creating a circular network structure.
- Failureofanyhost resultsinfailureofthewholering.
- Thus,everyconnectionin theringispoint offailure.
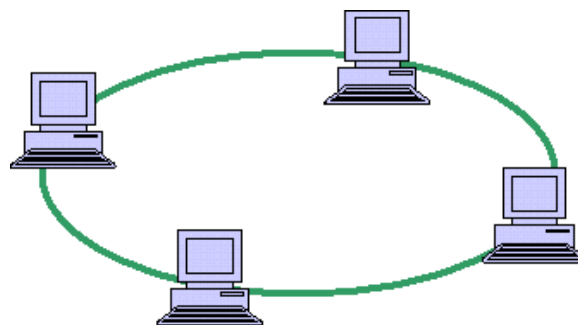
[RingTopologyDiagram]

3. Star Topology

- Allhosts instartopologyareconnected to acentraldevice, knownashub device, using a point-to-point connection.
- Ifthe centralhubfails,thenwhole networkfails.
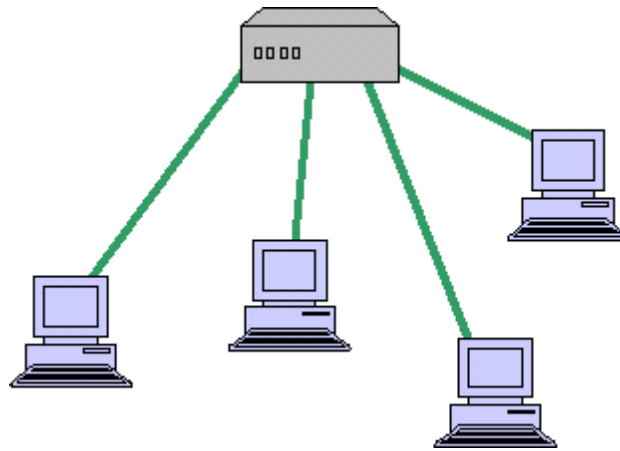
[Star TopologyDiagram]

4. TreeTopology

- Thisisalsoknownashierarchicaltopology.
- It is anetwork topologyinwhichnodesarearranged asatree.
- Thefunction of the central node inthistopologymaybedistributed.
- Itisanextensionand variationofstartopology.
- Atreetopologycombinescharacteristicsoflinearbusandstartopologies.
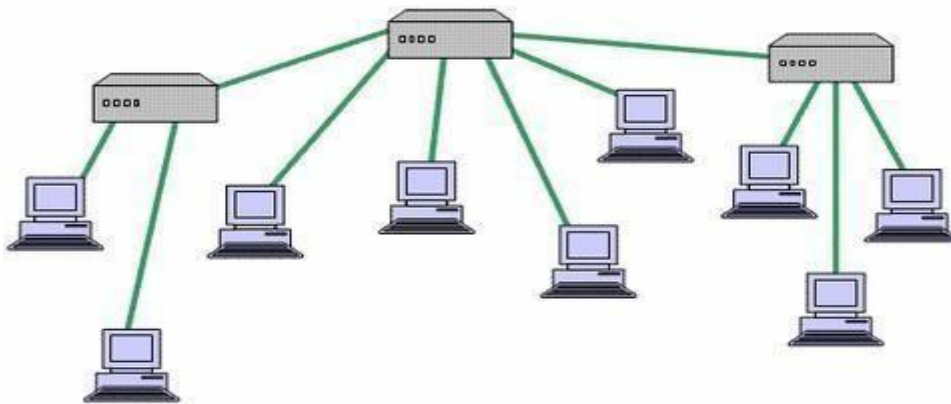
[Tree TopologyDiagram]

5. MeshTopology

- Itisalsoknownascompletelyinterconnectedtopology.
- Inmeshtopology, everynode has adedicated pointto pointlink toeveryothernode.
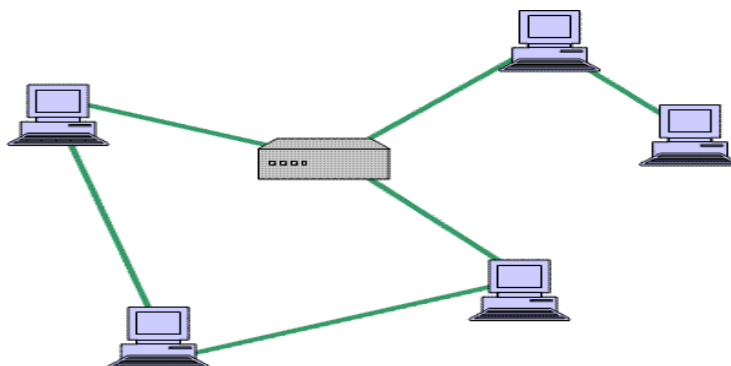
[MeshTopologyDiagram]

TypesofNetwork

- Therearebroadlyclassified intothreetypesofcomputernetwork.

  A. LAN
  B. WAN
  C. MAN
  D. PAN

LAN(LocalAreaNetwork)

- LANisasmallandsinglesitenetwork.
- ALANconnectsnetworkdevicesovera relativelyshortdistance.
- Itisa system inwhichcomputersareinterconnectedandthegeographical areasuch as home, office, building, school may be within abuilding.
- OnmostLANs cables are used toconnect thecomputers.
- Datatransferrate inLANisoftheorder10 to100Mbps.

WAN(WideArea Network)

- AWANisageographicallydispersedcollectionofLANs
- AWAN liketheinternetspansmostoftheworld.
- A networkdevice called arouterconnects LANtoaWAN.
- Thesekindofnetworksusetelephonelines,Satellitelinksandotherlong-range communication technologies to connect.
- WANuse technologylike ATMforconnectivity.

MAN(Metropolitan Area Network)

- Itisa datanetworkdesigned for a townorcity.
- It connects an area larger than a LAN, but smaller than aWAN, such as a city, with high performance hardware.
- Its main purpose is toshare hardware andsoftware resources bythe various users.
- Ex- CableTVnetwork.
- The computers inaWAN are connectedusingcoaxial cables orfiber optic cables.

PAN(Personal AreaNetwork)

- A personalareanetwork(PAN)isa computernetworkusedforcommunication among computer devices close to one person.
- Some examplesof devices that areused inaPAN areprinters,faxmachines, telephones, PDAs or scanners.
- The reach of aPANistypically within about 20-30feet (approximately6-9 meters).
- Personal areanetworks maybe wired with computer buses suchasUSB and FireWire.
- Awirelesspersonalareanetwork(WPAN) canalsobemadepossiblewith network technologies such as IrDA and Bluetooth..

NetworkingDeviceslikeHub,Repeater,Switch,Bridge,Router,Gateway & NIC

- Networkdevicesarerequiredtoprovideaninterface toconnectmultiplecomputersin a network.
- Therearemanytypesof networkdevices used in networking. Theseare Hub,Repeater,Switch,Bridge,Router,Gateway&NIC

HUB-

- o Networkingusinga startopologyrequiresacentralpointforthedevicestoconnect.
- o Itislikea repeaterwith multiple portstoconnectthe networkchannels.

www.WikiForU.com
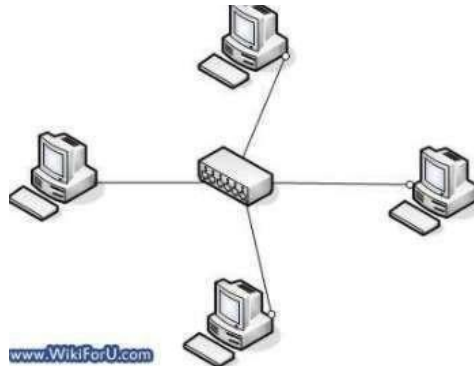
REPEATER

- o Repeatershavetwo ports andcan connecttwosegments ofaLAN.
- o Itisanelectronicdevice thatreceivesa signalandretransmitsit.
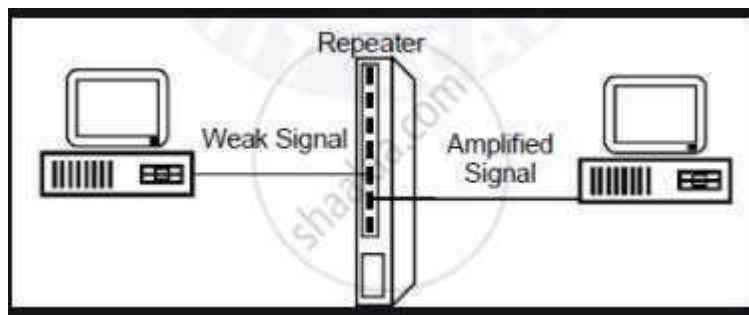
SWITCH

- o Itisa smallhardwaredevicethatjoinsmultiple computerstogetheroneLAN.
- o Ithelpstoreduce overallnetworktraffic.
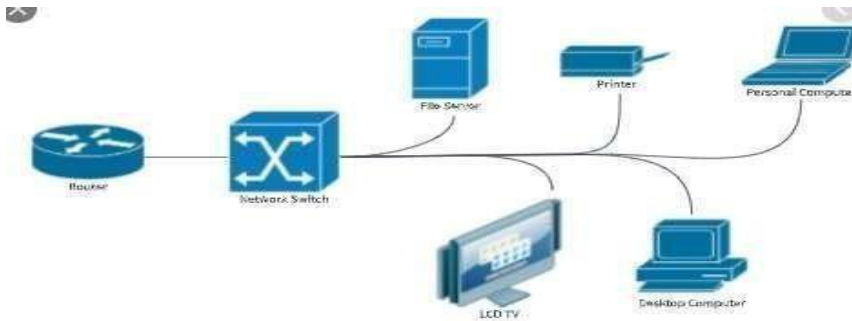
BRIDGE

- o A bridge isused to jointwo networksegmentstogether;it allowscomputersoneither segment to access resources on the other.
- o Theycanalsobeusedtodivided largenetworksintosmallersegment.

- o A bridge isused to jointwo networksegmentstogether;it allowscomputersoneither segment to access resources on the other.
- o Theycanalsobeusedto dividelarge networksinto smallersegment.

ROUTER

- o Routersarenetworking devices used to extend orsegment packetsfromone logical network to another.
- o Routers aremostoftenusedin large internetworks that useLANs to the internet using dedicated leased lines.
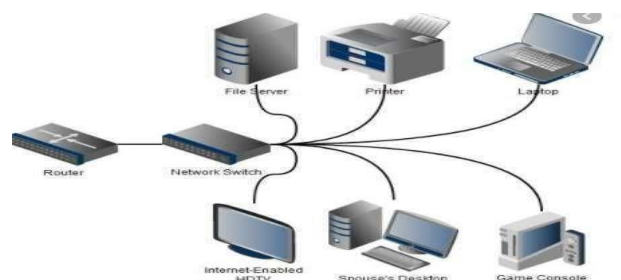
GATEWAY

- o Itisaninternetworkingdevice,whichjoinstwodifferentnetworkprotocolstogether.
- o Theyarealso known asprotocolconverters.

NIC(NetworkInterface Card)

- o It is a hardwareCard installedin acomputersoitcancommunicate onanetwork.
- o The network adapter provides one ormore portsfor the network cable to connect to and it transmits and receives data onto the network cable.
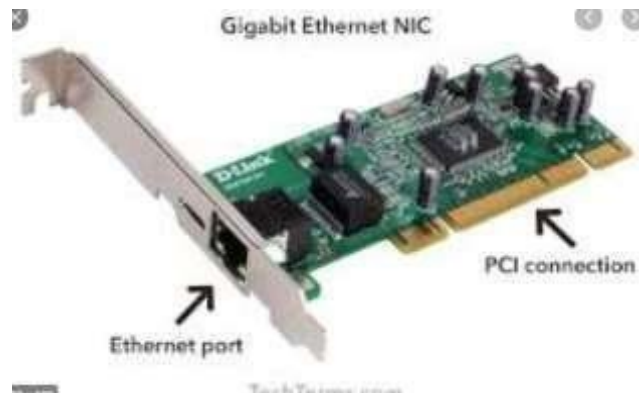
InternetServiceslikeE-Mail,WWW,FTP,Chatting,Internet

Conferencing,ElectronicNewspaper&OnlineShopping

- Internetisanetworkofnetworksthatconsistsmillionsofprivateandpublicnetworkof local to global scope.
- Aninternetusercanaccesstoawidevarietyofservicessuchas

E-MAIL(ElectronicMail)

- o E-mailisanelectronicversionofsendingandreceivingletter.
- o Touse E-mail,a usermust haveanEmailaddress.
- o TheEmailaddresscontainsallinformationrequiredtosendorreceivea message is called mail box.
- o Emailaddressconsistsoftwoparts separatedby@symbol
    - 1stpartis username
    - 2ndpartishostname(domain

    name) Example:

    principalbose@rediffmail.com

WWW(WorldWideWeb)

- o TheWorldWideWebis a system of internetservers that supportshypertext and multimedia to access several internet protocols on a single interface.
- o It isawayof exchanginginformationbetween computerson theinternet.

Example:

https://www.google.com/http://www.bosecuttack.in

/

FTP(FileTransferProtocol)

- o FTP is the internet file transfer between any computers that have an internet connection and also works between computers using totally different operating systems.

- o Itisaprotocolthroughwhichinternetuserscanuploadfilesfrom their computers to a website or download files from a website to theirPC.
- o It isthe easiest wayto transferfilesbetweencomputersvia the internetand utilities TCP/IP systems to perform uploading and downloadingtasks.

Chatting

- o Chattingistheonlinetextualormultimediaconversation.
- o Chatting i.e., a virtual means of communication that involves the sending and receivingof messages, shareaudioandvideo betweenuserslocatedin any part of the world.

Internet Conferencing

- o Internet conferencingallowsusersto carryon businessmeetingsandseminars makepresentation,provide online educationand offer direct customer support.
- o Internetconferencingsolutionsrequirehighspeedinternetconnectionatall user site.

ElectronicNewspaper

- o Anelectronicnewspaperisaself-contained,reusableandrefreshableversion of a traditional newspaper that acquires and holds information electronically.
- o Informationtobedisplayedwillbedownloadedthroughsomewireless internet connections.

OnlineShopping

- o It istheprocess of buyinggoods andservices from merchants whosell on the internet.
- o Themaincomponentsof onlineshoppingareproduct,sellingprice,accessibility to people, placement of orders, mode of payments, deliverymechanism.

DifferenttypesofInternetconnectivityandISP

DifferenttypesofInternetconnectivity

There aredifferenttypes of connections andspeeds toget onthe information super high way.

1) Dial-UpConnections

- Adialupisamethodofconnectingtotheinternetusinganexistingtelephone.
- Dialupconnectionusesthetelephonelinetoconnect totheinternet.
- Themodemmustdialthetelephoneeverytimeitwantstoconnecttothe internet hence the name Dial up.

a)   ModemDial-UpConnections-

- The modem connects the computer through the standard phone line which serves as the data transfer medium.
- A modem changes the digital data from your computer into analog data, a format that can be carried by telephone lines.

b)   ISDNDial-UpConnections-

- ThesecondtypeofdialupconnectionisthroughanISDN(Integrated services digital network).
- Itisadigitaltelephoneservicethatcantransmitvoice,dataandcontrol information over an existing single telephone line.

2) ADSLConnections

- ADSL (Asymmetric Digital Subscribers Line) connections are becoming more and more widely available and can provide an excellent internet connection.
- The connections work by splitting your phone line two separate channels, one for data (Internet) and one for voice (phone calls), which means you can talk on the phone and be connected to the internet at the same time.

3) CableConnections

- Cable connection are considered one of the best types of internet connections available to the home user, they offer very fast and reliable connections with a fixed monthly fee.
- A cable connection uses a totally separate medium to transfer that it doesn't affect your ability to make/receive phone calls.
- Cable connections are always on, eliminating long wait to make a connection.

ISP(InternetServiceProvider)

- WhenauserinitiatesaDialup connection, the modemdialsaphone number of an internet service provider (ISP) that is designated to receive Dial upcalls.
- TheISPthenestablishestheconnection,whichusuallytakesaboutten seconds and is accompanied by several beeping and buzzingsounds.
- ISP refers tothecompanythatprovides internetconnectionstotheusers.
- SomepopularISP's,areAirtel, MTNL, Vodafoneetc.

SolvedQuestions

ShortAnswerTypeQuestions.

DefineWWW. *(2017-Winter)*

Ans. TheWorldWide Web, commonly known as theWeb, is an information system where documents andotherweb resourcesareidentifiedbyUniformResource Locators, which may be interlinked by hypertext, and are accessible over the Internet.

Define HTTP.

Ans. TheHypertextTransferProtocolisanapplicationlayerprotocolfordistributed, collaborative, hypermedia information systems.

DefineaDNS.

Ans. The Domain Name System is a hierarchical and decentralized naming system for computers, services, or other resources connected to the Internet or a private network.It associatesvariousinformation with domain namesassignedtoeachof the participating entities.

Definea FTP. *(2016-Winter)*

Ans. The FileTransferProtocol is a standardnetwork protocolusedfor thetransfer of computer files from a server to a client on a computer network.

Explaine-mailmessageformat? *(2017-Winter)*

Ans. ElectronicMail(e-mail)isoneof themost widelyused services of the Internet. This service allows an Internet user to send a message in a formatted manner(mail) to other

Internet users in anypart of theworld. Message in themail notonlycontain text, but it also contains images, audio and videos data. The person who is sending mail is called senderand person who receives mail is called the recipient. It is just like postal mail service.

Format ofE-mail:

An e-mailconsistsofthreepartsthatare asfollows:

1. Envelope
2. Header
3. Body

Theseareexplainedasfollowingbelow.

1. Envelope:

The envelope part encapsulates the message. It contains all information that is required for sending any e-mail such as destination address, priority and security level. The envelope is used by MTAs for routing message.

2. Header:

The header consists of a series of lines. Each header field consists of a single line of ASCII text specifying field name, colon and value. The main header fields related to message transport are:

To: It specifiestheDNS address ofthe primaryrecipient(s).

CC: It refers to carbon copy. It specifies address of secondary recipient(s).

BCC: It refers to blind carbon copy. It is very similar to Cc. The only difference between Cc and Bcc is that it allow user to send copy to the third party without primary and secondary recipient knowing about this.

From:Itspecifiesname ofpersonwhowrotemessage.

Sender:Itspecifiese-mail addressofpersonwho has sent message.

Received: It refers to identity of sender's, data and also time message was received. It also contains the information which is used to find bugs in routing system. Return-Path: It is added by the message transferagent. This part isused to specify how to get back to the sender.

3. Body:

The body of a message contains text that is the actual content/message that needs to be sent, such as ¯Employees who are eligible for the new health care program should contact their supervisors by next Friday if they want to switch.‖ The message bodyalso may include signatures or automatically generated text that is inserted by the sender's email system.

Whatdoyoumeanbynetworktopologies?Whatarethemajortypesofnetwork topologies? *(2016-Winter) (2015-Winter) (2013-Winter)*

Ans.

Therearefivetypesoftopologyincomputer networks:

These are

1. MeshTopology
2. StarTopology
3. BusTopology
4. RingTopology
5. HybridTopology

MeshTopology

In mesh topology each device is connected to every other device on thenetwork through a dedicated point-to-point link. When we say dedicated it means that the link only carries data for the two connected devices only. Let's say we have n devices in the network then each device must be connected with (n-1) devices of the network. Number of links in a mesh topology of n devices would be n(n-1)/2.

AdvantagesofMeshtopology

1. Nodatatrafficissuesasthereisadedicatedlinkbetweentwodeviceswhich means the link is only available for those two devices.
2. Meshtopologyisreliableandrobustasfailureofonelinkdoesn'taffectotherlinks and thecommunicationbetween otherdevices onthe network.
3. Meshtopologyissecurebecausethereisapointtopointlinkthusunauthorized access is not possible.
4. Faultdetectioniseasy.

DisadvantagesofMesh topology

1. Amountofwiresrequiredto connectedeachsystem istediousandheadache.
2. Sinceeachdeviceneedstobeconnectedwithotherdevices,numberof I/O ports required must be huge.
3. Scalability issues because a device cannot be connected with large number of devices with a dedicated point to point link.

Star Topology

In star topology each device in the network is connected to a central device called hub. Unlike Mesh topology, star topology doesn't allow direct communication between devices; a device must have to communicate through hub. If one device wants to send data to other device, it has to first send the data to hub and then the hub transmit that data to the designated device.

AdvantagesofStartopology

1. Lessexpensivebecauseeachdeviceonlyneedonel/Oportandneedstobe connected with hub with one link.
2. Easier toinstall
3. Less amount of cables required because each device needs to be connected with the hub only.
4. Robust,ifonelinkfails,otherlinkswillworkjustfine.

5. Easyfault detectionbecausethelink canbeeasilyidentified.

DisadvantagesofStar topology

1. Ifhubgoesdowneverythinggoesdown,noneofthedevicescanworkwithouthub.
2. Hub requiresmoreresources and regularmaintenance because it isthe central system of star topology.

Bus Topology

In bus topology there is a main cable and all the devices are connected to this main cable through drop lines. There is a device called tap that connects the drop line to the main cable. Since all the data is transmitted over the main cable, there is a limit of drop lines andthe distance a main cable can have.

Advantagesofbustopology

1. Easyinstallation,eachcableneedstobeconnectedwithbackbonecable.
2. Lesscables requiredthan Mesh andstartopology

Disadvantagesofbus topology

1. Difficultlyinfaultdetection.
2. Notscalableasthereisalimit of howmanynodesyoucanconnectwithbackbonecable.

Ring Topology

Inringtopologyeachdeviceis connectedwiththetwodevices oneither sideofit.
There are two dedicated point to point links a device has with the devices on the either side of it. This structure forms a ring thus it is known as ring topology. If a device wants to send data to another device then it sends the data in one direction, each device in ring topology has a repeater, if the received data is intended for other device then repeater forwards this data until the intended device receives it.

AdvantagesofRingTopology

1. Easy toinstall.
2. Managingiseasierasto addorremove a device fromthe topologyonlytwo links are required to be changed.

DisadvantagesofRing Topology

1. A linkfailure canfailthe entire network as thesignal willnot travelforward due to failure.
2. Datatrafficissues,sinceallthedataiscirculatinginaring.

Hybridtopology

Acombinationof twoor moretopologyis knownas hybridtopology. For examplea combination of star and mesh topology is known as hybrid topology.

AdvantagesofHybrid topology

1. We can choose the topology based on the requirement for example, scalability is our concern then we can use star topology instead of bustechnology.
2. Scalableaswecanfurtherconnectothercomputernetworkswiththeexisting networks with different topologies.

DisadvantagesofHybrid topology

1. Faultdetectionisdifficult.
2. Installationisdifficult.
3. Designiscomplexsomaintenanceishighthusexpensive.

EXERCISE

ShortAnswerTypeQuestions.

Definecomputernetwork.*(2014-Summer)*

Whatarethevarious types ofnetworks?

WhatisaMAN?

Whatarethedifferenttopologiesusedincomputernetwork?*(2018-Summer)*

NamesomeInternetserviceprovidersinIndia?

What doyoumeanbyawebpage?

Whatisawebsite?

Whatise-mail?What are theusesofe-mail?

Whatare thebenefitsofe-mail?

Whatarethelimitationsofe-mail?

DefineaURL.*(2013-Summer)*

Whatdo you meanbyNetworktopology?*(2016-Winter)*

Whataretheadvantages and DisadvantagesofBusTopology?

Whatisamodem?

LongAnswerTypeQuestions

Discussabout the variouscategoriesof computernetwork.Give acomparisons between LAN and WAN.

Describevariouscategoriesofnetworkwithexample.*(2016-Summer)*

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CHAPTER–4:FILEMANAGEMENTANDDATAPROCESSING

ConceptofFileandFolder

Conceptoffileandfolder:-

- In earlierDOS basedsystem, we hadorganizeddataintofilesanddirectories.
- In GUIbased operatingsystem, suchaswindow, we have file andfolders,in which data are organized during storage in computer memory.
- However, the unit of rawdata in binaryformatis eitherbyte (B) or kilobyte(KB) or megabyte(MB) or gigabyte (GB).
- A byte issmallestunitof information.It isused tomeasurethe size of our documents.

$$1Byte=1B=8bits$$
$$1KB=2^{10}Bytes=1024Bytes$$
$$1MB=2^{10}KB=1024KB$$
$$1GB=2^{10}MB=1024MB$$
$$1TB=2^{10}GB=1024GB$$

Files:

- Files are themostbasic unitof datathat usercan store on a disk. Afile is the common storage unit in a computer.
- Allprogram anddataarecontained inafileand thecomputerneedsandwritesfiles.
- Ineveryprogram, image, video,songanddocumentarestoredinafile.
- It ispossibleto moveafilefromonefoldertoanother.
- One cancreate,save,open,move anddeletefiles.
- There aredifferenttypes of files dependingon the type of information theycontain.There are image files etc.
- Thefilesare assigneda type offile which canbe knownfrom theextensionof thefile name.
- The file name can have up to 255 character, it can contain letter,number,blank space and specialcharacterslike dashes,underlines, etc.butthereis a group that cannotbe used ($\bar{}$, /,
- >,<,|)
- Fileextensionfilesareidentifiedbya short"extension"attheendoftheirname.
- Ex: Soumya.jpgis aJPEGimage
- Chandan.docisaMicrosoft worddoc
- ABC.exeisanexecutableapplicationinwindows.

Folders:

- Afolderisacollectionofmultiple files.
- Afolder holdsoneormorefiles anditcanbeemptywithjustaname.
- Foldercanalsostoreotherfolderscalledsubfolders.
- Folderswerealsocalled"directories"inoperatingsystemsbeforewindows.
- Itwouldbecome almostpossible tomanagehundredsoffilesin yourcomputer.

Differentbetweenafileandafolder:

File:

- Filestoredata,whethertext,musicoritem.
- Filesaretakingspacesoncomputermemory.
- Eachfilehasitsownextension.
- Easilymoveor copydata fromonefiletoanother.
- Cannotcreate anyfolderorsubfolderwith inafile.

Folder:

- Afolderstoresfilesandother folders.
- Foldersarenottakingspaceoncomputermemory.
- Foldersdo not haveany extension.
- Copyor movefilesfromonefolderto anotherfolder.
- Cancreate different types offilesorsubfolders in afolder.

FileAccessandStoragemethods.Sequential,Direct,ISAM

FileAccessandstorage method:

- An accessmethoddefinesthe technique thatisusedtostoreand receivedata.
- An access method is a function of a main frame operating system that enableaccess to data on click or other external device.
- In computing an access method is a program or a hardware mechanism thatmoves the data between the computer and an outing device such as a hard diskor a displayterminal.
- It is also used to describe the way that data islocated within a large unit of datasuch asa data set or files.
- Therearevarious typesofaccessmethods

1) RandomAccessorDirect Access:

- Direct access method is based on a disk model if a file, since disks allowrandom access to any file block.
- This types of access method provides a speedy access to the file. It provides immediate access to large amount of information.
- Itallowstheprogramstoreadandwritetherecordsinarapidmannerinonparticular   orders.
- Fordirectaccess,we canviewthefileasanumbersequenceofblocksorrecords.
- Thismethod isusuallyused indatabase.

2) SequentialAccess:

- Thisis themostcommonmethod.
- Heretheinformationpresentinthefileisaccessedinasequentialfashion,onrecord after the other.
- It isverycommonapproach which is usedbyeditorsand compilerusually.
- TheRead and write operationfromthemajorpart of theoperationsdone onafile.
- Areadoperationreadsthenextportionofthefileandautomaticallyadvancesthefile pointer, which tracks the I/O Locations.
- A write operation appends to the endof filesandadvancesto theand, if thenewly written material.

3) IndexedSequentialAccessMethod(ISAM)-

- Thismethodisbuiltontopofdirect access method.
- Herean indexcontainsthepointerstovariousblocks of thefile.
- So,tofindarecordinsideafile,wefirstlysearchtheindexandlaterusethepointer obtained to access the file directly and find the record we have been searching for.
- Therecordsofthedatafilearestoredinsequentialorderaccordingtosomedataattributes.
- Since ISAM is static, it doesn't change its structure if records are added or deleted fromthe data file.
- ISAM is available in many variations on microcomputer, mini computers, and main frame computers.

DataCapture,Datastorage,DataProcessingandRetrieval

Data Capture:-

- Data capture is the process of identification and extraction of data from ascanned document, often to be sent to a workflow for routing and action aspart of business process.
- Multiple methods are available for capturing data from unstructured documents (letters, invoices, email, fax, forms etc.)
- Methodsof capturefrom documentsinelectronicformatareidentifiedbelow:

Singleclick:

- It is an optical character recognition (OCR) tool that can be used to capture machine produced charactersinlowvolumead-hoccaptureapplicationandpopulatinga lineof businessapplication.

OCR:

- OCRastechnologyprovidestheabilitytosuccessfullycapturemachineproduced characters in full page.
- OCRsystemscanrecognizemanydifferentOCRfontsaswellastypewriterand computer printed characters.

ICR(Intelligentcharacterrecognition):

- ICRisthe computertranslation handprintedand writtencharacters.
- Data is entered from hand printed forms through a scanner and the image of the capture data is then analyzed and then translated by sophisticated ICR software.

BarcodeRecognition:

- Dependent upon the type of barcodes that is used, the amount of meta data that can be included is high, as is the level of recognition.
- Theapplicationofsingleandmultiplebarcodestoparticulardocumenttypessuchas proof of delivery notes.

IDR(Intelligentdocument recognition):

- Thelevelofcapabilityisdependentupontheindividualproduct.
- Theseapplicationareusedto capturemetadatafromdocumentsthatisruledbased.
- Ex:Theproductwillidentifypostcodes,logos,keywords.

DataStorage:

- Data storage is the holding of data in an electromagnetic from for access by a computer processor.
- Therearetwokinds of storage:

a) Primary storage is data that is held in RAM and other memory devices that are built into computers.
b) Secondary storage is data that is stored on external storage devices such as hard disks, tapes, CD, Pen drive etc.

Followingaresomemaindevicesfordatastorage:
- ➢ Hard disks
- ➢ Floppydisks
- ➢ Opticaldisks
- ➢ CD
- ➢ Pendrives
- ➢ Flat memorycard/memorycard

DataProcessing:

- Dataprocessingmustbeprocessed inordertoconvert itintoinformation.
- Forthispurpose, differentoperationsmaybeperformedondata.
- Data processing is defined as a sequence of operations on data to convert it into useful information.
- Thedataprocessingcanbeaccomplishedthroughfollowingmethods:

1. ManualDataProcessing:
- In this method, data is processed manually without using any machine or tool to get required results.
- Inmanualdataprocessing,allthecalculationsandlogicaloperationsare performed manually on the data.
- Ex:Marksheets, feereceipts

2. MechanicalDataProcessing:
- Inthismethod,dataisprocessedbyusingdifferentdevicesliketypewriters, mechanical printers or other mechanical devices.
- Examination board and printing press use mechanical data processing devicesfrequently.

3. ElectronicData Processing:
- It isthemoderntechnique toprocessdata.
- The data is processed through computer; data and set of instructions are given to the computer as input and the data according to the given set of instructions.
- Thecomputerisalsoknown aselectronicdata processingmachine.
- Ex:resultsofstudentsarepreparedthroughcomputers.

DataRetrieval:

- Data isoneofthemost important assets of anybusiness.
- Datarecoveryreferstothewholeprocessofsalvagingthislostdatathatiscorrupted, failed, damaged or inaccessible.
- Lostfilescanoccurbecauseofanyofthebelowpossibilities.

  1) Filewasmistakenly deleted.

  2) Filewascorruptedordeleted byscandisk.

  3) Anotherprogram deletedthefile.

  4) Fileispasswordprotected.

- Followingaresomedifferentmethodsof datarecovery:-

1) Physicaldamagetostoragedevices:

- Differentfailurecancausephysicaldamagetoyourstoragemedia.

2) Mediaerrorsandcorruptpartitionsandfilesystems:

- In some cases, media errors or damage to the file system or partition tablecanmake the data on a hard drive to be unreadable.

3) Onlinedatarecovery:

- This is another popular method of data recovery Sydney business use to restore deleted or lost files.

- Itisamethodofdatarecoverythatisperformedovertheinternetwithout necessarily having the computer or the drive in possession.

SolvedQuestions

ShortAnswerTypeQuestions.

Q.1Whatisthedifference betweenfileandfolder.

Ans:-.

Sl.No.	Key	File	Folder
1	Extension	Filesmayormaynothave extensions.	Folders do not haveextensions.
2	Container	A File can notcontain another file/folder.	Afoldercancontainany number of file/folders.
3	Memorysize	Afilehas certain size and memory consumption.	A folder has no size of itsown. It derives the size from the files it contains.
4	Attributes	Name, Extension, Date, Time, Length and Protection(Read-Only,hidden etc.)	Name, Date, Time and Protection (Read-Only, hidden etc.)

Q.2 What do you mean by ISAM? *(2016-Winter)*

Ans:- i.

I. It stands for Indexed Sequential Access Method.

II. ISAM is a method for creating, maintaining, and manipulating computer files of data so that records can be retrieved sequentially or randomly by one or more keys.

III. In this method, each record has the address of its data block, searching a record in a huge database is quick and easy.

IV. This method supports range retrieval and partial retrieval of records.

Q.3 Define OCR.

Ans:-
I. Stands for "Optical Character Recognition.
II. OCR is a technology that recognizes text within a digital image.
III. It is commonly used to recognize text in scanned documents, but it serves many other purposes as well.

Q. 4 What is folder. *(2017-Winter)*

Ans:- A Folder is a collection of tables, charts, or other outputs in the Report tree.

- It is the same idea as having folders on your computer.

- They created by right-clicking on the Report tree and selecting Add Folder.

- Folders are also called directories because of the way they organize data within the file system of a storage device.

Long Answer Type Questions.

Q. 1 What is file access? Explain the various type of file access method. *(2014-Winter)* *(2015- Winter)*

Ans:- A file access definition can control access to data in specified tables and columns, or to tables and columns for which access is not granted explicitly. You define access permissions by creating an access list for a table, column, or the default.

When a file is used, information is read and accessed into computer memory and there are several ways to access this information of the file. Some systems provide only one access method for files.

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

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

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

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

Q. 2Discussaboutthe Data storagedevices.

Ans:- A storage device is a piece of computer hardware used for saving, carrying andpulling out data. It can keep and retain information short-term or long-term. It can be a device inside or outside a computer or server. Other terms for storage device is storage medium or storage media.

A storage device is one of the basic elements of any computer device. It almost saves all data and applications in a computer except for hardware firmware. It comes in different shapes and sizes depending on the needs and functionalities.

Therearetwo differenttypes ofstorage devices:

	PrimaryStorageDevice	**SecondaryStorageDevice**
Size	Smaller	Larger
DataRetention	Temporary	Permanent
Location	Internal	Internal/External
E.g	RAM,ROM	Magnetic Storage Device, Floppydiskette,Harddrive, Magnetic strip , Cassette tape, etc.

EXERCISE

ShortAnswerTypeQuestions.

Whatisthe differencebetween RandomAccessmethodandsequentialaccess method?
 (2017-Winter)

Whatis Data processinganddiscuss about someoperations that can beperformed on data?

LongAnswerTypeQuestions.

Whatdo you mean byfileaccess?Explain the varioustypesof file access techniques. *(2017- Summer)*

 DiscussabouttheDataRetrieval.

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CHAPTER–5:PROBLEMSOLVINGMETHODOLOGY

Problemsolving

Solving problems is the core of computer science. Programmers must first understand how a human solves a problem, then understand how to translate this "algorithm" into something a computer can do, and finally how to "write" the specific syntax (required by a computer)to get the job done.It is sometimes the casethat amachine will solve a problem in a completely different way than a human.

ComputerProgrammersare problem solvers.In orderto solve a problemona computer you must:

1. Knowhowto representtheinformation(data)describingtheproblem.

2. Determinethestepstotransformtheinformationfromonerepresentationintoanother

Algorithm,PseudocodeandFlowchart

Algorithm

An algorithm is a set of specific steps to solve a problem. Think of it this way: if youwere to tell your 3 year old niece to play your favorite song on the piano (assuming the niece has never played a piano), you would have to tell her where the piano was, and how to sit on the bench, and how to open the cover, and which keys topress, and which order topressthem in, etc, etc, etc.

Definition:
- Analgorithm isa well-definedprocedurethatallowsa computertosolveaproblem.
- Algorithmisdefinedasthestep-by-stepsolutionofprobleminuser'slanguage.
- Itisconsideredasaneffective procedureforsolvingaprobleminfinite numberofsteps.
- Anotherwayto describeanalgorithmisasequence ofunambiguousinstructions.
- Infact,itisdifficulttothinkofataskperformedbyyourcomputerthatdoesnotuse algorithms.

ThecharacteristicsofAlgorithmare
- Precise
- Unambiguous
- Finitetermination
- Uniquesolution

Example:

1. Algorithmtofindoutsumoftwo numbers tobetakenasinput.

> Step-1 Read the 1st number x
> Step-2Readthe2ndnumbery
> Step-3Sum=x+y
> Step-4PrintSum

Thisisanexample whereonlysequence is exhibited

2. Algorithmtofindout largerbetween two numberstobetakenasinput.

> Step-1Readthe1stnumberx
> Step-2 Read the 2nd number y
> Step-3 If x > y
> ThenPrintx
> Else if x<y
> ThenPrinty
> ElsePrint ‾BothareEqual‾

Thisisanexample whereBranchingis exhibited

3. Algorithm tofindout sum offirst 10 natural numbers.
   > Step-1 i=1, Sum=0
   > Step-2Repeatstep3and4whilei<>10
   > Step-3 Sum= Sum+i
   > Step-4i=i+1Step-5PrintSum

ThisisanexamplewhereRepetitionis exhibited

Pseudocode

It is a concise description algorithm in English language that uses programming language constructs. It contains outlines of the program that can be easily converted to program. It focuses on the logic of the algorithm without giving stress on the syntax of programming language. This is meant for understanding the logic of the program easily. Flowchart can be considered as an alternative to pseudo code. Several constructs/key wordsof programming language can be usedin the algorithm to write the pseudo code.

Someofthemare
> If...Endif
> Dowhile...enddo
> While ... end while
> Repeat ... until
> For ... end for
> Caseendcase
> Call
> Return

Flowchart

Flowchart is a graphical or symbolic representation of the process of solution to a problem or algorithm. It helps to visualize the complex logic of the solution of the problem in a simplified manner through diagrammatic representation. Each step of the algorithm is presented using a symbol and a short description. The different symbols used for the flowchart are

Symbol	Purpose	Description
	Flowline	Indicatestheflowoflogicbyconnecting symbols.
	Terminal(Stop/Start)	Representsthestartandtheendofa flowchart.
	Input/output	Usedforinputandoutputoperation.
	Processing	Usedforarithmeticoperationsanddata-manipulations.
	Decision	Usedfordecisionmakingbetweentwoor more alternatives.
	On-pageConnector	Usedtojoindifferentflowline
	Off-pageConnector	Usedtoconnecttheflowchartportionona different page.
	PredefinedProcess/Function	Representsagroupofstatements performing one processing task.

GenerationofProgrammingLanguages

ProgrammingLanguage

Programming language is a tool to express the logic or instructions for understanding of the computer. Any programming language has two components:

a) Syntax
b) Semantics

Syntax refers to the rules to be followed for writing valid program statements.Compiler can detect errors in syntax while compiling the program. Semantics is associated with logic of the program. Compiler cannot detect the semantic error. The user of programmer candiagnose semantic error.

There are good numbers of High level languages, each meant for specific area of data processing. Commonlyknown languages areBASIC, FORTRAN, COBOL, Pascal, C, C++ etc. While FORTRAN is good for Numerical and scientific calculation, COBOL is good for Business applications involving large amount of data handling.

GenerationsofProgrammingLanguage

TheProgramminglanguagescanbeclassifiedinto4generations:

1stGeneration: Machine Language

2ndGeneration: Assembly Language

3rdGeneration: High Level Language

4thGeneration:VeryHighLevelLanguage

Machine Level language contains instructions in binary form i.e. in 0s and 1s. Thus writing instruction was very difficult and needs heavy expertise. This was used in early days computers.

Assembly level language instructions were written using symbolic codes known as mnemonics. In comparison to Machine language, it is relatively easier to write program, but still it requires lot of expertise. A translator called assembler is used to translate assembly language program to machine level language.

High level language contains instructions in English like words so that user will feel easier to formulate and write the logical statements of the program. Here the logic may spread over multiple statements as against a single statement in assembly language. It uses a translator called compiler for translation of High level language program to machine level language program. There are many High level languages used for programming such as BASIC, FORTRAN, COBOL, PASCAL, C, C++ etc.

Very High Level language otherwise called as 4GL uses nonprocedural logical statements.

A typicalexampleof 4GListhe querylanguage such asSQL.

StructuredProgrammingLanguage

Structured Programming is also known as Modular Programming. In this type of programming technique, the program shall be broken into several modules. This helps in managing memory efficiently as the required module of the program will be loaded into the memory only and not the entire program. This will also enhance code reuse. Writing, understanding, debugging and modifying the individual module of the program is also easier.

ExamplesofProblemsolvingthroughFlowchart

Example

1. **Addtwonumbersenteredbytheuser.**

```
           ( Start )
              │
              ▼
   ┌──────────────────────────┐
   │ Declarevariablesn1, n2,andsum │
   └──────────────────────────┘
              │
              ▼
        ╱───────────────╲
       ╱  Readn1andn2     ╲
       ╲───────────────────╲
              │
              ▼
   ┌──────────────────────────┐
   │        sum=n1+n2          │
   └──────────────────────────┘
              │
              ▼
        ╱───────────────╲
       ╱   Display sum    ╲
       ╲───────────────────╲
              │
              ▼
           ( Stop )
```
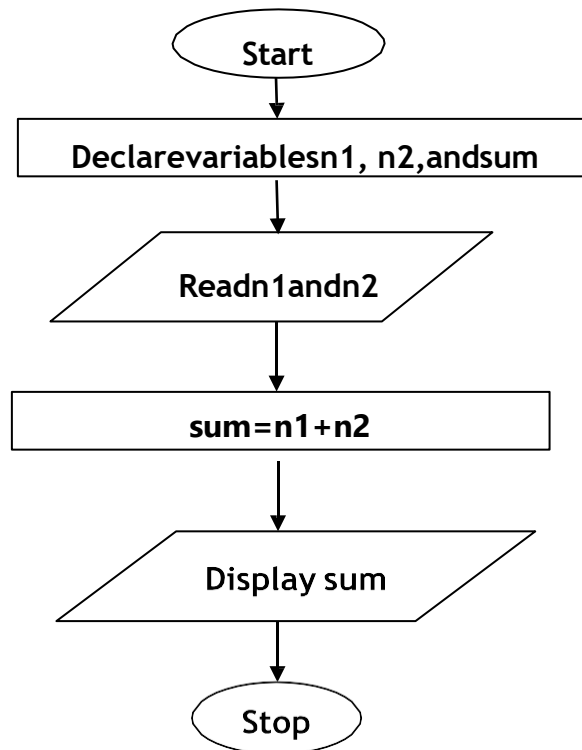
2. Flowchart to calculate the average of two numbers

```
        ┌─────────┐
        │  Start  │
        └─────────┘
             │
             ▼
       ╱──────────────╲
      ╱  Read num1,    ╲
      ╲    num2         ╱
       ╲──────────────╱
             │
             ▼
       ┌──────────────┐
       │   Average=   │
       │ (num1+num2)/2│
       └──────────────┘
             │
             ▼
       ╱──────────────╲
      ╱    Print        ╲
      ╲                  ╱
       ╲──────────────╱
             │
             ▼
        ┌─────────┐
        │  Stop   │
        └─────────┘
```
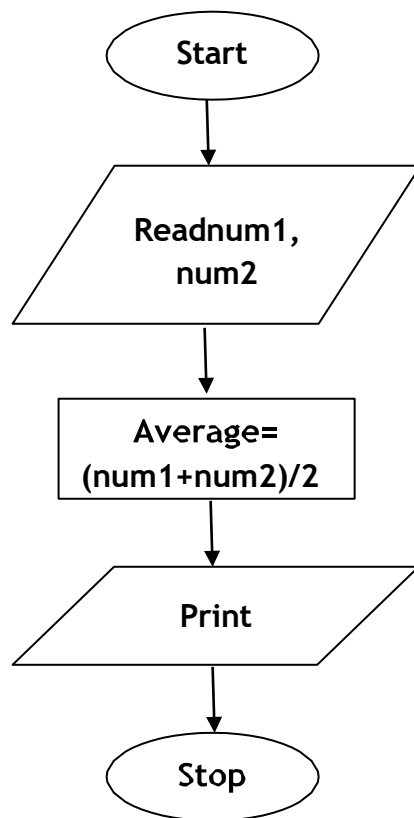
3. Flowchart to Calculate the Interest of a Bank Deposit

```
        ┌─────────┐
        │  Start  │
        └─────────┘
             │
             ▼
       ╱──────────────╲
      ╱    Input        ╱
       ╲──────────────╱
             │
             ▼
       ╱──────────────╲
      ╱  Input Years    ╱
       ╲──────────────╱
             │
             ▼
       ╱──────────────╲
      ╱  Input Rate     ╱
       ╲──────────────╱
             │
             ▼
       ┌──────────────┐
       │   Compound   │
       └──────────────┘
             │
             ▼
       ╱──────────────╲
      ╱ Print Interest  ╱
       ╲──────────────╱
             │
             ▼
        ┌─────────┐
        │  Stop   │
        └─────────┘
```
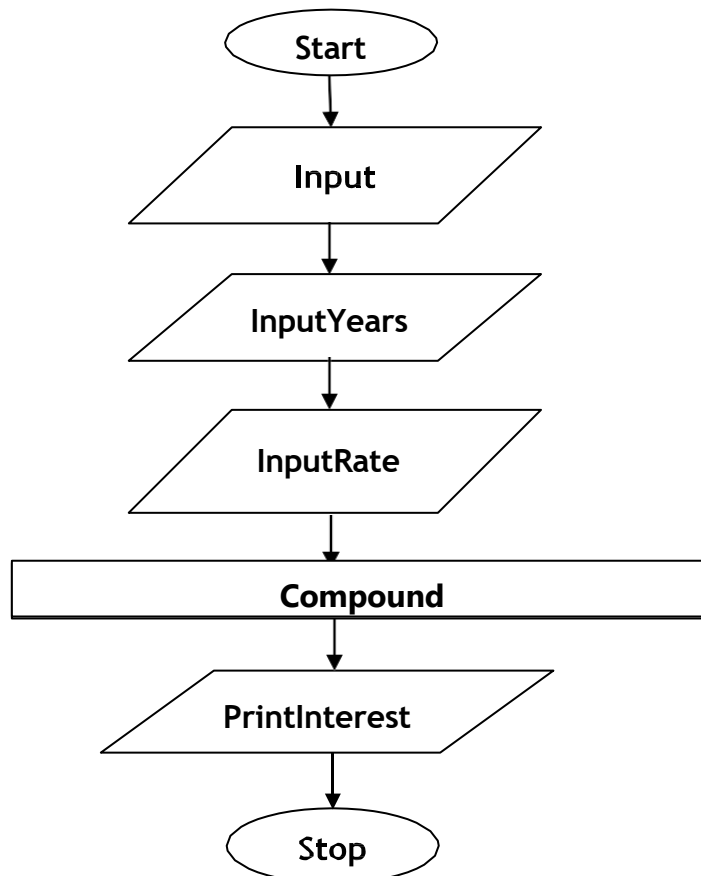
4. **Flowchartto calculatetheareaofacircle.**

```
          ┌───────────┐
         (    Start    )
          └─────┬─────┘
                │
          ╱───────────╲
         ╱    Inputr    ╲
        ╱───────────────╲
                │
          ┌───────────┐
          │   Area=    │
          │    πr2     │
          └─────┬─────┘
                │
          ╱───────────╲
         ╱   PrintArea  ╲
        ╱───────────────╲
                │
          ┌───────────┐
         (    Stop     )
          └───────────┘
```
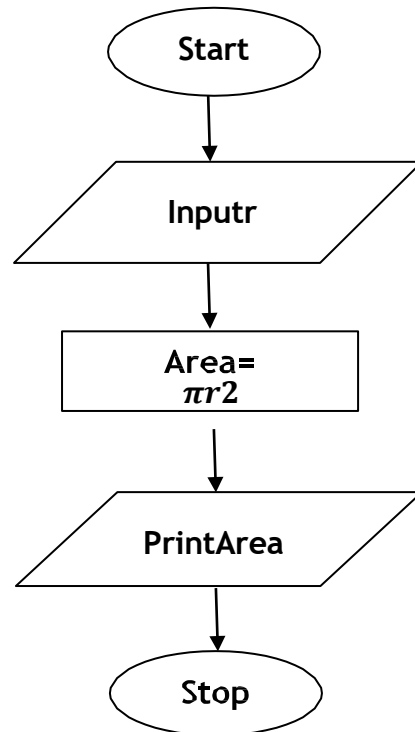
5. **Flowcharttocalculatetheareaofatriangle.**

```
          ┌───────────┐
         (    Start    )
          └─────┬─────┘
                │
          ╱───────────╲
         ╱   Reada,b,c  ╲
        ╱───────────────╲
                │
          ┌───────────┐
          │ S=a+b+c    │
          │      2     │
          └─────┬─────┘
                │
       ┌──────────────────┐
       │ Area=√s(s−a)(s−b)(s−c) │
       └────────┬─────────┘
                │
          ╱───────────╲
         ╱   PrintArea  ╲
        ╱───────────────╲
                │
          ┌───────────┐
         (    Stop     )
          └───────────┘
```

For flowchart 4:
$$Area = \pi r^2$$

For flowchart 5:
$$S = \frac{a+b+c}{2}$$
$$Area = \sqrt{s(s-a)(s-b)(s-c)}$$
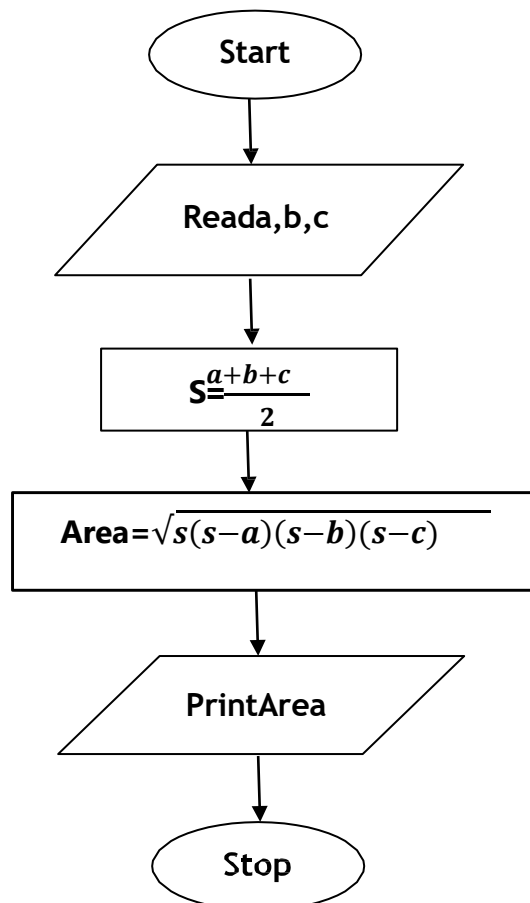
6. Findthelargestamongthreedifferentnumbersenteredbytheuser.

Start

Declarevariablesa,bandc

Read a,b andc

Is a>b?

False / True

Is b>c?

True / False

Is a>c?

False / True

print b

printc

printa

Stop
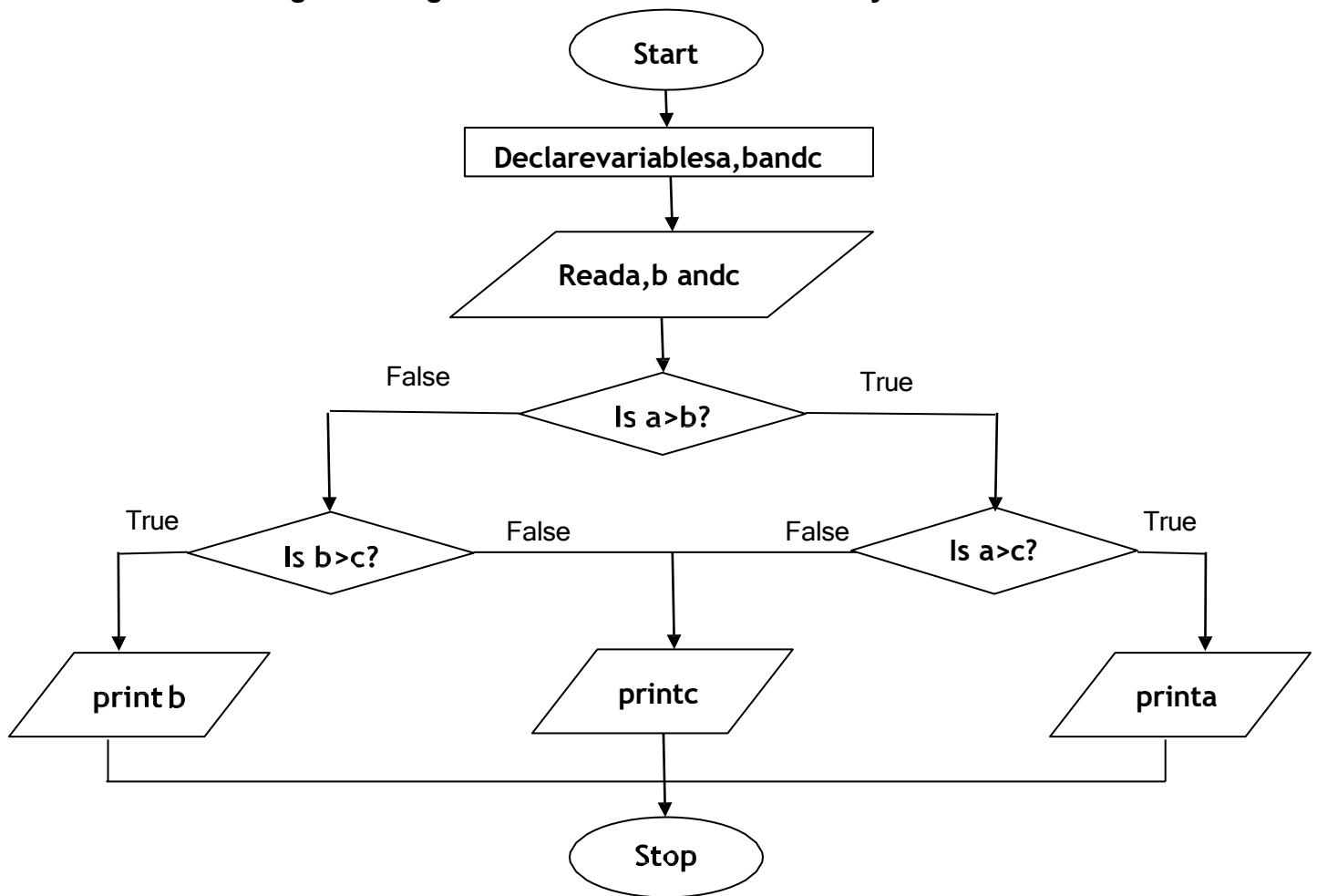
7. Findalltherootsofaquadraticequationax^2+bx+c=0

```
                    ┌─────────┐
                    │  Start  │
                    └─────────┘
                         │
                         ▼
              ┌────────────────────┐
              │  Declare variables a,│
              │ b,c,D,x1,x2,rpandip │
              └────────────────────┘
                         │
                         ▼
              ┌────────────────────┐
              │ Calculatediscriminant│
              │   D ← b²-4ac        │
              └────────────────────┘
                         │
                         ▼
```

True   Is   False

$$r1 \leftarrow (-b+\sqrt{D})/2a$$
$$r2 \leftarrow (-b-\sqrt{D})/2a$$

Write"rootsare Imaginary"

Displayr1 andr2

Stop
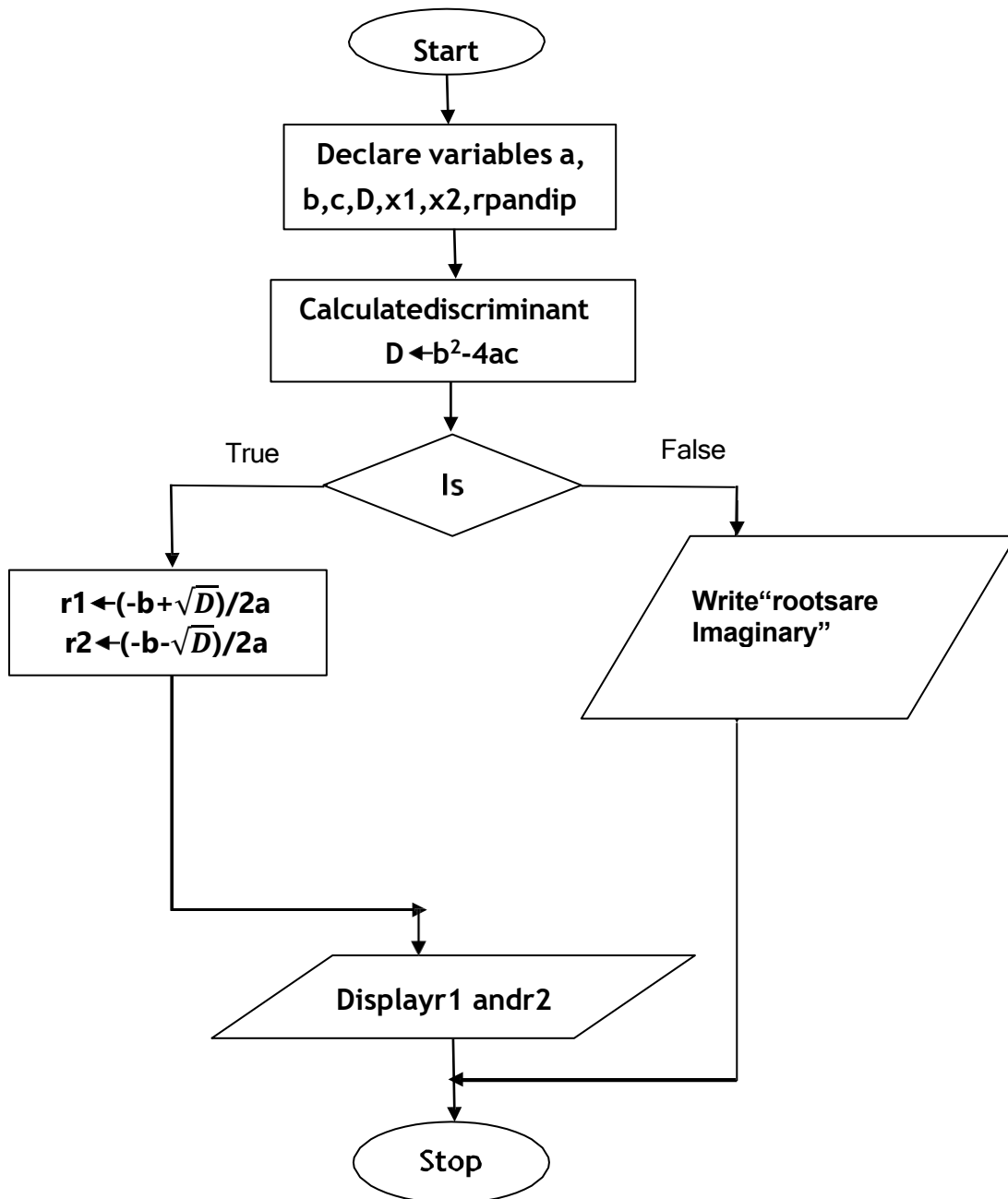
8. FlowcharttoDetermineandOutputWhetherNumberNisEvenorOdd

```
                    ( Start )
                        │
                        ▼
                   / Read N /
                        │
                        ▼
            [ Remainder=N modulo 2 ]
                        │
                        ▼
        YES        < IsRemainder        NO
    ┌───────────      =0? >───────────┐
    │                                  │
    ▼                                  ▼
[ Answer=EVE ]                   [ Answer=OD ]
    │                                  │
    └──────►  / OutputAnswer / ◄───────┘
                     │
                     ▼
                 ( Stop )
```
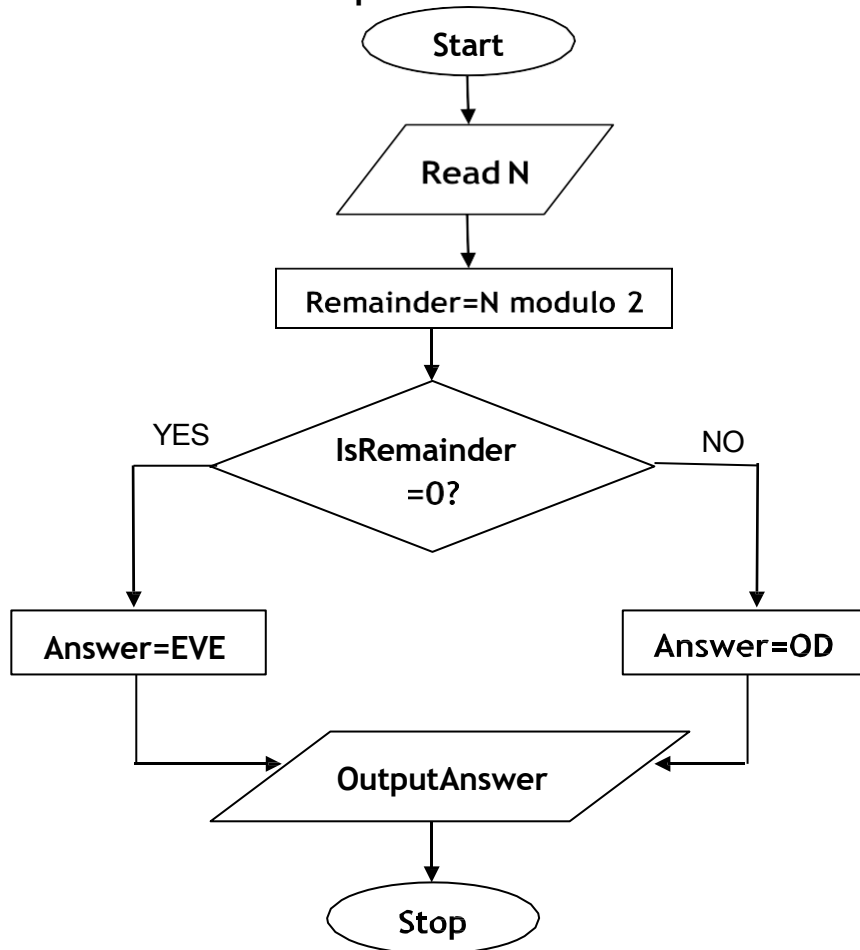
9. Flowcharttofindoutlargerbetweentwonumberstobetakenasinput

```
              ( Start )
                  │
                  ▼
              / Read /
                  │
                  ▼
            < Is x>y? >──Yes──► / Printx /──┐
                  │                          │
                  No                         │
                  ▼                          │
            < Is x<y? >──Yes──► / Printy /───┤
                  │                          │
                  ▼                          │
        / PrintBothEqual /                   │
                  │                          │
                  ◄──────────────────────────┘
                  ▼
              ( Stop )
```
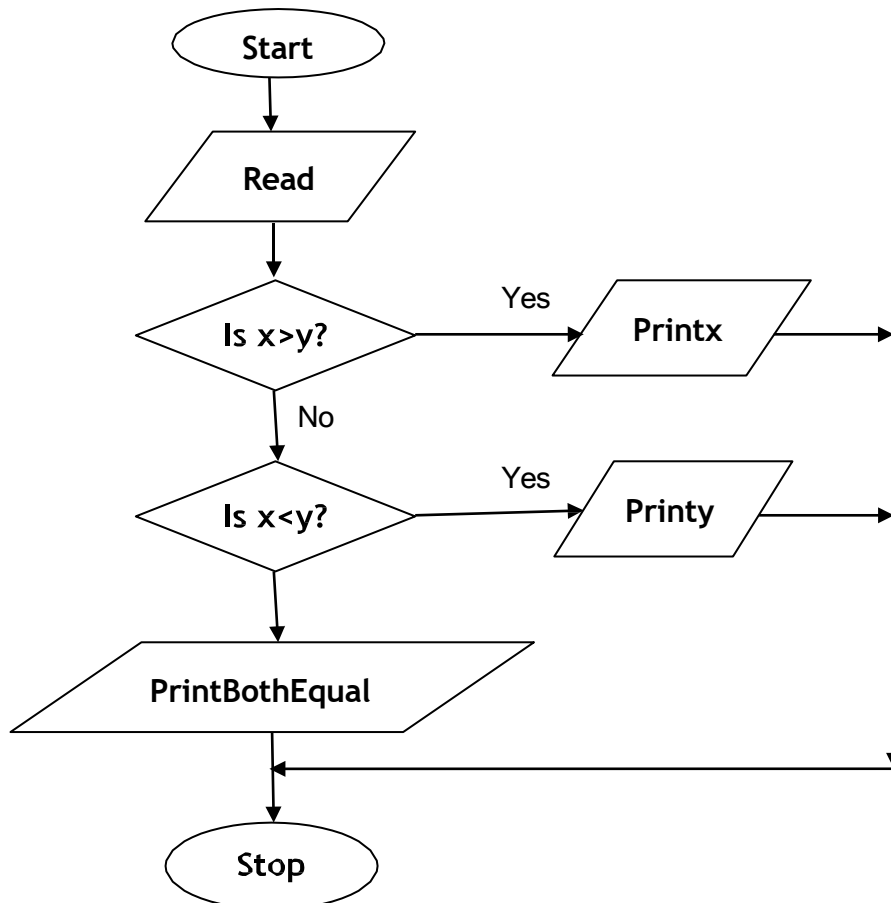
10. Flowchart to Determine Whether a Temperature is Below or Above the Freezing Point

```
                    ( Start )
                        |
                        v
                  / Read temp /
                        |
                        v
              | Reaminder=N modulo 2 |
                        |
                        v
       YES         < Is temp<32? >         NO
        |                                    |
        v                                    v
 / Print*BelowFreezing* /          / Print*AboveFreezing* /
        |                                    |
        +------> / OutputAnswer / <----------+
                        |
                        v
                    ( Stop )
```
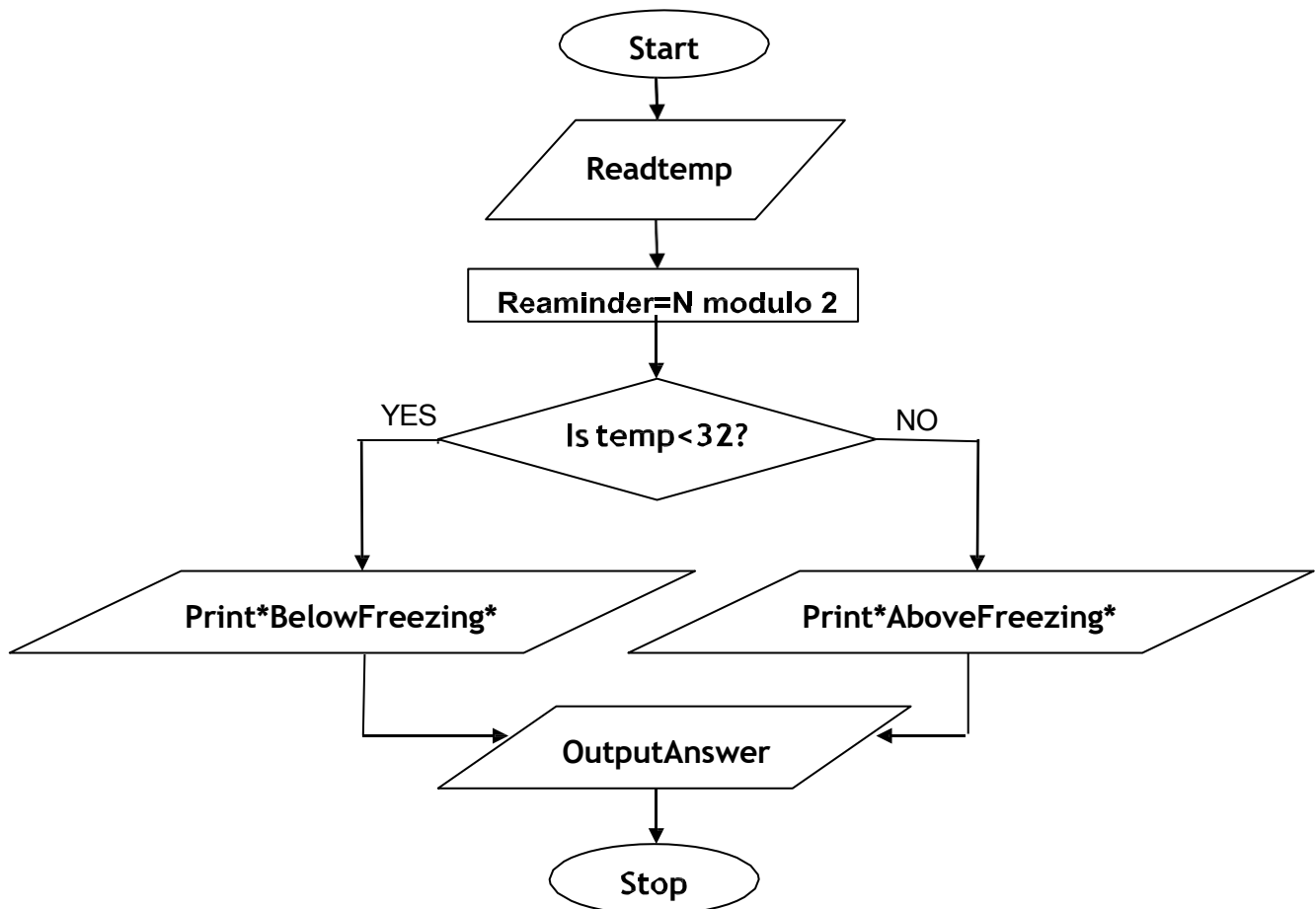
11. Flowchart to Determine Whether A Student Passed the Exam or Not

```
                    ( Start )
                        |
                        v
                / Input m1,m2,m3,m4 /
                        |
                        v
              | Grade=(m1+m2+m3+m4)/4 |
                        |
                        v
       YES         < If Grade<60? >         NO
        |                                    |
        v                                    v
     / Print*Fail* /                    / Print*Pass* /
        |                                    |
        +-----------> ( Stop ) <-------------+
```
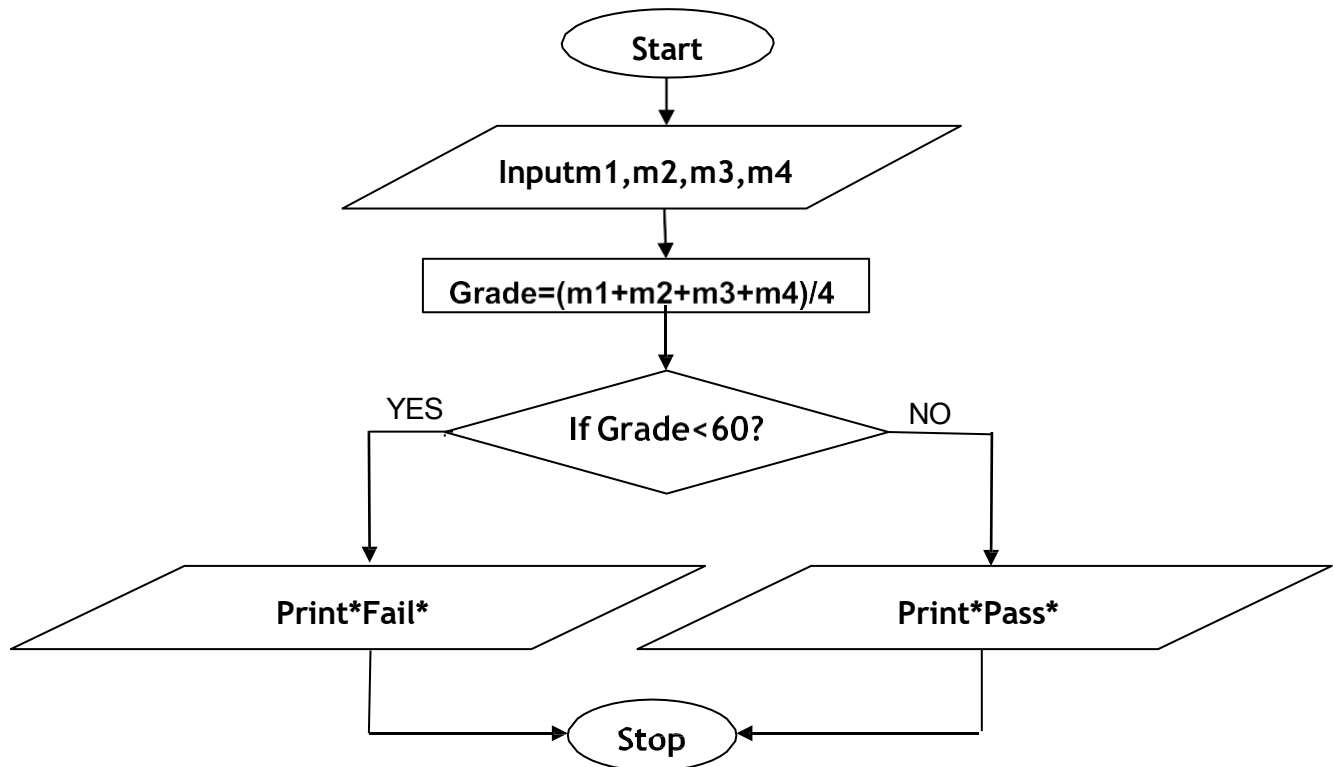
12. Flowchart to find out sum of first 10 natural numbers

```
                    ┌─────────────┐
                    │    Start    │
                    └──────┬──────┘
                           │
                    ┌──────▼──────┐
                    │  i=1, Sum=0 │
                    └──────┬──────┘
                           │◄──────────────────────┐
                    ┌──────▼──────┐                 │
                    │  Sum=Sum+i  │                 │
                    └──────┬──────┘                 │
                           │                        │
                    ┌──────▼──────┐                 │
                    │    i=i+1    │                 │
                    └──────┬──────┘                 │
                           │                        │
                        ┌──▼──┐                     │
                        │ Is  │───── NO ────────────┘
                        └──┬──┘
                           │ YES
                    ┌──────▼──────┐
                   / Print Sum   /
                  └──────┬──────┘
                           │
                    ┌──────▼──────┐
                    │    Stop     │
                    └─────────────┘
```
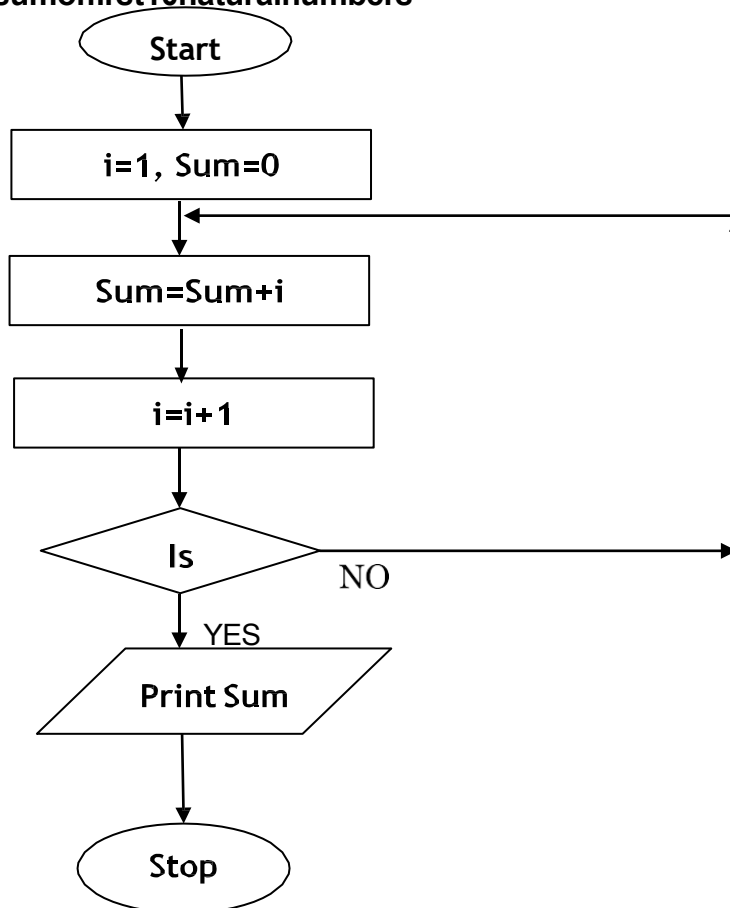
Solved Questions

Short Answer Type Questions.

Q.1 Define an algorithm. *(2013-Winter)*

Ans:- An algorithm is a set of instructions designed to perform a specific task. This can be a simple process, such as multiplying two numbers, or a complex operation, such as playing a compressed video file. Algorithm is defined as the step-by-step solution of problem in user's language. It is considered as an effective procedure for solving a problem in finite number of step.

Q.2 What are the characteristics of an Algorithm?

Ans:-
1. **Input specified:**
   The input is the data to be transformed during the computation to produce the output. An algorithm should have 0 or more well-defined inputs.

2. **Output specified:**
   The output is the data resulting from the computation (your intended result). An algorithm should have 1 or more well-defined outputs, and should match the desired output.

3. **Effectiveness:**
   For an algorithm to be effective, it means that all those steps that are required to get to output must be feasible with the available resources.

4. **Independent:**
    An algorithm should have step-by-step directions, which should be independent of any programming code. It should be such that it could be run on any of the programming languages.

Q.3 What is the function of a FlowChart? What information does it depict?

Ans:-

- A flowchart describes the steps software takes to process information, from the beginning data inputs, through processing and logical decisions, to the point where the program ends.
- Software developers use flowcharts to plan out how computer applications work before programmers write the code.
- It helps to visualize the complex logic of the solution of the problem in a simplified manner through diagrammatic representation
- Each step of the algorithm is presented using a symbol and a short description.

What information It depicts.:-

A flowchart is a picture of the separate steps of a process in sequential order. It is a generic tool that can be adapted for a wide variety of purposes, and can be used to describe various processes, such as a manufacturing process, an administrative or service process, or a project plan.

Q.4 Differentiate between algorithm and flowchart *(2015- Winter)*

Ans:-

S.NO	Algorithm	Flowchart
1.	Algorithm is step by step procedure to solve the problem.	Flowchart is a diagram created by different shapes to show the flow of data.
2.	Algorithm is complex to understand.	Flowchart is easy to understand.
3.	In algorithm plain text are used.	In flowchart, symbols/shapes are used.
4.	Algorithm is easy to debug.	Flowchart it is hard to debug.
5.	Algorithm is difficult to construct.	Flowchart is simple to construct.

LongAnswerTypeQuestions.

Q. 1Writean algorithms and flowchart ofthe followings:
   a. Tofindsum&averageof3numbers.

Ans:-Algorithm

- Step 1:Start.
- Step2:Readthe threenumber suppose"a","b","c" from theuser.
- Step 3:Sum=a+b+c;
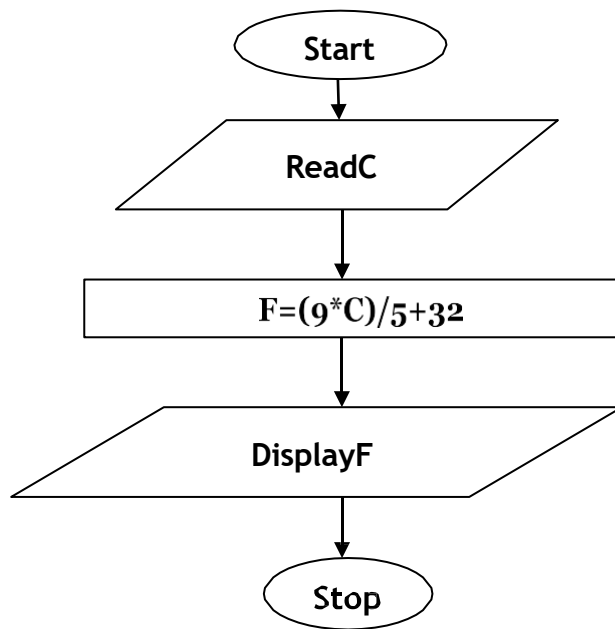- Step 4:Avg.=Sum/3.
- Step5:Display "Sum "and"Avg".
- Step6:End.

Flowchart:
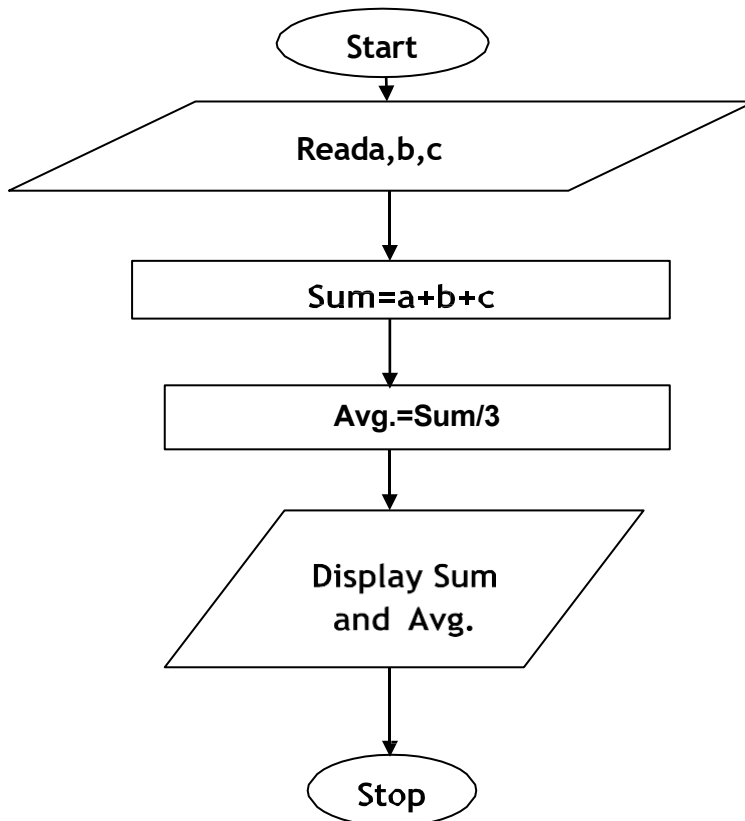
   b. ToconverttemperaturefromdegreeCelsiusto Fahrenheit.Algorithm

- Step1 :Start
- Step2:Readtheinputof temperatureinCelsius(sayC)
- Step3 :F=(9*C)/5+32
- Step4:PrinttemperatureinFahrenheitisF
- Step5 :Stop

Flowchart

```
        ( Start )
            |
            v
      _____
     / ReadC    /
    /_____/
            |
            v
  +------------------+
  | F=(9*C)/5+32     |
  +------------------+
            |
            v
      _____
     / DisplayF /
    /_____/
            |
            v
        ( Stop )
```

<u>EXERCISE</u>

ShortAnswerTypeQuestions.

What is a flowchart?*(2014-Summer)*

Give the flowchart symbols for keeping, I/O statement and decision statement.

LongAnswerTypeQuestions

Draw a flowchart to find sum of 10 random numbers.*(2017-Winter)*

Write an algorithms and flowchart of the followings:

a. To calculate square of number n.

b. To identify whether the entered number e dis positive(+) or negative(-).

c. To generate natural numbers which are divisible by 5 in between 1 and 200?

d. To find sum of digits of a three-digit number(say 364).

****

CHAPTER–6:OVERVIEWOFCPROGRAMMINGLANGUAGE

Constants,VariablesandDatatypesinC

TheC Language

C is a professional programmer's language. It was designed to get in one's way as littleas possible. Kernighan and Ritchie wrote the original language definition in their book, *The C Programming Language* (below), as part of their research at AT&T.Unix and C++ emerged from the same labs. For several years I used AT&T as my long distance carrier in appreciation of all that CS research, but hearing "thank you for using AT&T" for the millionth time has used up that goodwill.

ImportantPoints

➢ The CLanguage isdeveloped byDennisRitchieforcreatingsystemapplicationsthat

directly interact with the hardware devices such as drivers, kernels,etc.

➢ Cprogrammingisconsideredasthe baseforotherprogramminglanguages, that is why

it   is known as mother language.

➢ It canbedefinedbythefollowingways:

1. Motherlanguage

2. Systemprogramminglanguage

3. Procedure-orientedprogramming language

4. Structuredprogramminglanguage

5. Mid-levelprogramming language

1) Cas amotherlanguage

C language is considered as the mother language of all themodernprogramming languages because most of the compilers, JVMs, Kernels, etc. are written in C language, and most of the programming languages follow C syntax, for example, C++, Java, C#, etc. It provides the core concepts like the array, strings, functions, file handling, etc. that are being used in many languages like C++, Java, C#, etc.

2) Casasystem programminglanguage

A system programming language is used to create system software. C language is a system programming language because it can be used to do low-level programming (for example driver and kernel). It is generally used to create hardware devices, OS, drivers, kernels, etc. For example, Linux kernel is written in C.

Itcan'tbeusedforinternet programminglikeJava,.Net, PHP,etc.

3) Casaprocedurallanguage

Aprocedureisknownasafunction,method,routine,subroutine,etc.Aprocedurallanguage specifies a series of steps for the program to solve the problem.

Aprocedurallanguagebreakstheprogramintofunctions,datastructures,etc.

Cisaprocedurallanguage.InC,variablesandfunctionprototypesmustbedeclared before being used.

4) Casastructured programminglanguage

Astructuredprogramminglanguageisasubsetoftheprocedurallanguage.Structure means to break a program into parts or blocks so that it may be easy to understand.

Inthe Clanguage, we breaktheprogramintopartsusingfunctions.It makes the program

easiertounderstandand modify.

5) **Casamid-level programminglanguage**

C is considered as a middle-level language because it supports the feature of both low-level and high-level languages. C language program is converted into assembly code, it supports pointer arithmetic (low-level), but it is machine independent (a feature of high-level).

A Low-level language is specific to one machine, i.e., machine dependent. It is machine dependent, fast to run. But it is not easy to understand.

A High-Level language is not specific to one machine, i.e., machine independent. It is easy to understand.

QuickHistoryofC

- DevelopedatBellLaboratoriesintheearlyseventiesbyDennisRitchie.

- Bornoutof two otherlanguages-BCPL (Basic Control Programming Language) and B.

- C introduced such things as character types, floating point arithmetic, structures, unions and the preprocessor.

- The principal objective was to devise a language that was easy enough to understand to be "high-level"-i.e. understood by general programmers, but low-level enough tobe applicable to the writing of systems-level software.

- The language should abstract the details of how the computer achieves its tasks in such a way as to ensure that C could be portable across different types of computers, thus allowing the UNIX operating system to be compiled on other computers with a minimum of re-writing.

- C as a language was in use by 1973, although extra functionality, such as new types, was introduced up until 1980.

- In 1978, Brian Kernighan and Dennis M. Ritchie wrote the seminal work The C Programming Language, which is now the standard reference book forC.

- Aformal ANSIstandardfor C was producedin1989.

- In 1986, a descendant of C, called C++ was developed by Bjarne Stroustrup, which is in wide use today. Manymodern languages such as C#, Java and Perlare basedon C andC++.

- Using C language scientific, business and system-level applications can be developed easily.

Constants

In C programming language, a constant is similar to the variable but the constant hold only one value during the program execution. That means, once a value is assigned to the constant,thatvaluecan'tbechangedduringtheprogramexecution.Oncethevalueis

assigned to the constant,   it is fixed throughout the program. A constant can be defined asfollows...

A constant is a named memory location which holds only one value throughout the program

execution.

In C programming language, a constant can be of any data type like integer, floating-point, character, string and double, etc.,

Integerconstants

An integer constant can be a decimal integer or octal integer or hexadecimal integer. A decimal integer value is specified as direct integer value whereas octal integer value isprefixed with 'O' and hexadecimal value is prefixed with 'OX'.

An integer constant can also be unsigned type of integer constant or long type of integer constant. Unsigned integer constant value issuffixed with 'u' and long integer constantvalue is suffixed with 'l' whereas unsigned long integer constant value is suffixed with 'ul'.

Example

125 ---- >DecimalIntegerConstant

O76 ---- >Octal IntegerConstant

OX3A ----- >HexaDecimalIntegerConstant

50u ----->UnsignedIntegerConstant

30l -----> Long IntegerConstant

100ul----- >UnsignedLongIntegerConstant

Floating Pointconstants

A floating-point constant must contain both integer and decimal parts. Sometimes it may also contain the exponent part. When a floating-point constant is represented in exponentform, the value must be suffixed with 'e' or 'E'.

Example

Thefloating-pointvalue3.14isrepresentedas3E-14inexponentform.

CharacterConstants

A characterconstant isa symbolenclosed insingle quotation. A characterconstant hasa maximum length of one character.

Example

'A'

'2'

'+'

In the C programming language, there are some predefined character constants called escape sequences. Every escape sequence has its own special functionality and everyescape sequence is prefixed with '\' symbol. These escape sequences are used in output function called 'printf()'.

String Constants

➤ Astringconstantisacollectionofcharacters,digits,specialsymbolsandescape sequences that are enclosed in double quotations.
➤ Wedefine stringconstant inasingle lineas follows. .... "ThisisDiplomasmartclass"

- ➢ Wecandefinestringconstantusingmultiplelinesas follows... "

        This\

        is\

    Diplomasmartclass"
- ➢ Wecanalso definestringconstantbyseparatingit with white spaceasfollows...

    "This""is""Diploma smart class"

    Alltheabove threedefinesthe samestring constant.

Creating constantsinC

- In acprogramminglanguage, constants canbe createdusingtwoconcepts...
    - o Usingthe ⁻**const**‖keyword
    - o Using ⁻**#define**‖preprocessor

Usingthe "const" keyword

- Wecreate a constantof anydata type using'const' keyword. Tocreate a constant, we

    prefix the variable declaration with 'const' keyword.

- The generalsyntaxforcreatingconstantusing'const' keywordis asfollows...
    constdatatypeconstantName;
                OR
    constdata type constant Name=value ;

Example

    constintx=10;
    Here,'x'isaintegerconstantwithfixedvalue10.

ExampleProgram

    #include<stdio.h>
    #include<conio.h>v
    oid main()
    {
    inti=9;
    constintx=10; i
    = 15 ;
    x = 100 ; // creates an error
    printf("i=%d\nx=%d",i,x);
    }

Theaboveprogramgivesanerrorbecausewearetryingtochangetheconstantvariable value (x =

100).

Using'#define'preprocessor

    We can also create constants using '#define' preprocessor directive. When we create constant using this preprocessor directive it must be defined at the beginning of the program (because all the preprocessor directives must be written before the global declaration).

We use the following syntax to create constant using '#define' preprocessor directive...
#define CONSTANTNAME value

Example

> #definePI3.14

> Here,PIisaconstantwithvalue 3.14

ExampleProgram
```
#include<stdio.h>#i
nclude<conio.h>#def
ine PI 3.14 void
main()
{
intr,area;
printf("Pleaseentertheradiusofcircle:"); scanf("%d",
&r) ;
area=PI*(r*r);
printf("Areaofthecircle=%d",area);
}
```

Variables:

Variables in a c programming language are the named memory locations where the user can store different values of the same datatype during the program execution. That means a variable is a name given to a memory location in which we can store different values of the same data type. In other words, a variable can be defined as a storage container to holdvalues ofthe same data type during the program execution. The formal definition of a datatype is as follows.

Variable is a name given to a memorylocation where we can store different values of the same datatype during the program execution.

Every variable in c programming language must be declared in the declaration section before it is used. Every variable must have a data type that determines the range and type of values be stored and the size of the memory to be allocated.

A variable name maycontain letters, digits and underscore symbol. The following are the rules to specify a variable name...

- Variablename shouldnot startwithadigit.

- Keywordsshouldnot be used asvariablenames.

- Avariablenameshouldnotcontainanyspecialsymbolsexceptunderscore(_).

- Avariablenamecanbeofanylengthbutcompilerconsidersonlythefirst31 characters of the

  variable name.

Declarationof Variable

Declaration of a variable tells the compiler to allocate the required amount of memorywith the specified variable name and allows only specified datatype values into that memory location.In C programming language, the declaration can be performed either before the function as global variables or inside any block or function. But it must be at the beginning of block or function.
DeclarationSyntax:

datatypevariableName;

Example

int number;

The above declaration tells to the compiler that allocates 2 bytes of memory with the name ‾number‖andallowsonlyintegervaluesintothatmemorylocation.
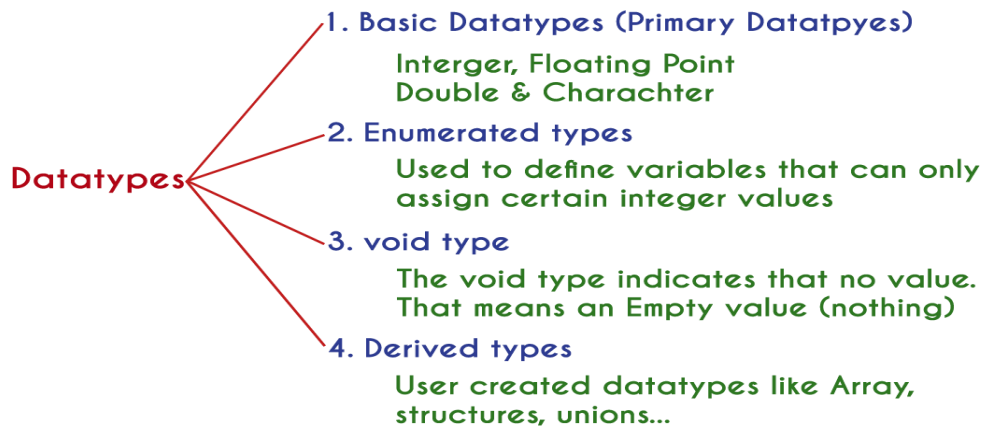
Datatypes

Data used in c program is classified into different types based on its properties. In the C programming language, a data type can be defined as a set of values with similar characteristics. All the values in a data type have the same properties.

Data types in the c programming language are used to specify what kind of value can be stored in a variable. Thememory size and type ofthe value ofa variable are determined bythe variable data type. In a c program, each variable or constant or array must have a datatype and this data type specifies how much memory is to be allocated and what type of values are to be stored in that variable or constant or array. The formal definition of a data type is as follows...

TheDatatypeisasetofvaluewithpredefinedcharacteristics.Datatypesareusedto declare variable, constants, arrays, pointers, and functions.
Inthecprogramminglanguage,datatypesareclassifiedasfollows...
➢ Primarydatatypes(BasicdatatypesORPredefined datatypes)
➢ Deriveddata types(Secondarydata typesORUser-defined datatypes)
➢ Enumerationdatatypes
➢ Voiddatatype

Primarydata types

The primary data types in the C programming language are the basic data types. All the primary data types are already defined in the system. Primary data types are also called as Built-In data types. The following are the primary data types in c programming language.

- Integerdatatype

- FloatingPointdatatype

- Doubledatatype

- Characterdatatype

Basic Datatypes (Primary Datatpyes)

- Interger
  - Signed
    - int
    - short int
    - long int
  - Unsigned
    - int
    - short int
    - long int
- Floating Point
  - float
  - double
  - long double
- Character
  - char
  - signed char
  - Unsigned Char
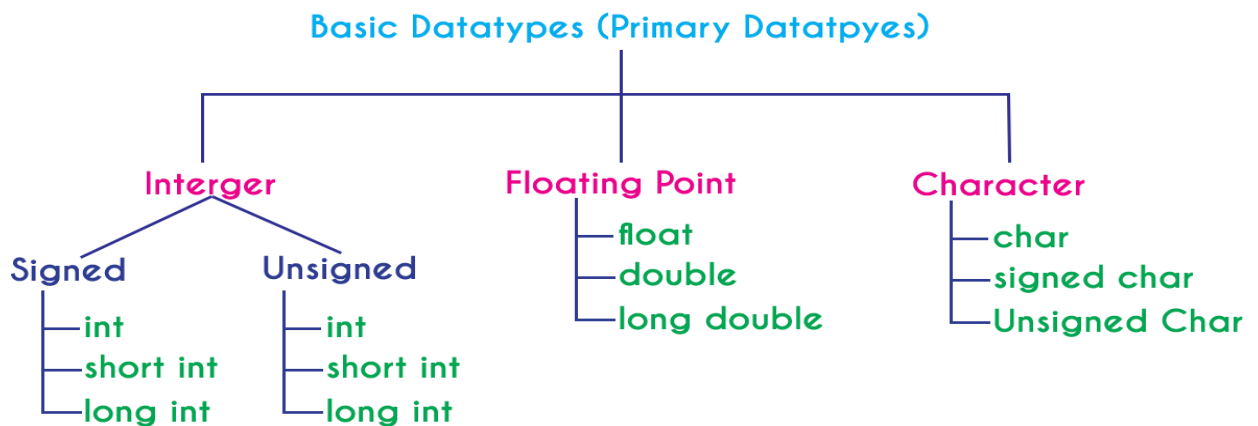
IntegerDatatype(int)

The integer data type is a set of whole numbers. Every integer value does not have the decimal value. We use the keyword "int" to represent integer data type in c. We use the keyword int to declare the variables and to specify the return type of a function. The integer data type is usedwith different type modifiers like short, long, signed and unsigned. The following table provides complete details about the integer data type.

Type	Size (Bytes)	Range	Specifier
int (signed short int)	2	-32768 to +32767	%d
short int (signed short int)	2	-32768 to +32767	%d
long int (signed long int)	4	-2,147,483,648 to +2,147,483,647	%d
unsigned int (unsigned short int)	2	0 to 65535	%u
unsigned long int	4	0 to 4,294,967,295	%u

FloatingPointdata types

Floating-pointdatatypesareasetofnumberswiththedecimalvalue.Everyfloating- point value must contain the decimal value. The floating-point data type has two variants...
- float
- double

Weuse the keyword "float" to representfloating-point data type and"double" to represent double data type in c. Both float and double are similar but they differ in the number of decimal places. The float value contains 6 decimal places whereas double value contains 15 or 19 decimal places. The following table provides complete details about floating-point data type.

Characterdatatype

The character data type is a set of characters enclosed in single quotations. Thefollowing table provides complete details about the character data type.

Type	Size (Bytes)	Range	Specifier
char (signed char)	1	-128 to +127	%c
unsigned char	1	0 to 255	%c

The following table provides complete information about all the data types in c programming language...

	Integer	Floating Point	Double	Character
What is it?	Numbers without decimal value	Numbers with decimal value	Numbers with decimal value	Any symbol enclosed in single quotation
Keyword	int	float	double	char
Memory Size	2 or 4 Bytes	4 Bytes	8 or 10 Bytes	1 Byte
Range	-32768 to +32767 (or) 0 to 65535 (Incase of 2 bytes only)	1.2E – 38 to 3.4E + 38	2.3E-308 to 1.7E+308	-128 to + 127 (or) 0 to 255
Type Specifier	%d or %i or %u	%f	%ld	%c or %s
Type Modifier	short, long signed, unsigned	No modifiers	long	signed, unsigned
Type Qualifier	const, volatile	const, volatile	const, volatil	const, volatile

Voiddatatype

The void data type means nothing or no value. Generally, the void is used to specify a function which does not return any value. We also use the void data type to specify empty parameters of a function.

Type	Size (Bytes)	Range	Specifier
float	4	1.2E – 38 to 3.4E + 38	%f
double	8	2.3E-308 to 1.7E+308	%ld
long double	10	3.4E-4932 to 1.1E+4932	%ld

<u>**Enumerateddatatype**</u>

An enumerated data type is a user-defined data type that consists of integer constants and each integer constant is given a name. The keyword "enum" is used to define the enumerated data type.

Deriveddatatypes

Derived data types are user-defined data types. The derived data types are alsocalledas user- defined data types or secondary data types. In the c programming language, the derived datatypes are created using the following concepts...

- Arrays
- Structures
- Unions

ManagingInputandOutputoperations.

OutputFunctions

C programming language provides built-in functions to perform output operation. The output operations are used to display data on user screen (output screen) or printer or any file. The c programming language provides the following built-in output functions...

- printf()

- putchar()

- puts()

- fprintf()

printf()function

The printf() function is used to print string or data values or a combination of string and data values on the output screen (User screen). The printf() function is built-in function defined in a header file called "stdio.h". When we want to use printf() function in our program we need to include the respective header file (stdio.h) usingthe #include statement.The printf()function has the following syntax...

Syntax:

```
printf("messagetobedisplay!!!");
```

ExampleProgram
```
#include<stdio.h>
#include<conio.h>
void main()
{
printf("Hello!WelcometoDiplomasmart class!!!");
}
```
In the above exampleprogram, we used theprintf()function to printa stringonto the output screen.

Outputof the programis   **Hello!Welcome toDiploma smart class!!!**

The printf() function is also used to display data values. When we want to display data values we use format string of the data value to be displayed.

Syntax:

```
printf("formatstring",variableName);
```

ExampleProgram:

```
#include<stdio.h>
#include<conio.h>
void main()
{
inti=10;floatx=5.5; printf("%d
%f",i, x);
}
```

In the above example program, we used the printf() function to print data values of variables i and x on to the output screen. Here i is an integer variable so we have used format string %d and x is a float variable so we have used format string %f.

Theprintf()function canalsobeusedtodisplaystringalongwithdatavalues.

To display the output in different lines or as we wish, we use some special characters called escape sequences. Escape sequences are special characters with special functionality used in printf() function to format the output according to the user requirement. In the C programming language, we have the following escape sequences...

Escapesequence	Meaning
\n	MovesthecursortoNewLine
\t	InsertsHorizontalTab(5characters space)
\v	InsertsVerticalTab(5lines space)
\a	Beepsound
\b	Backspace(removesthepreviouscharacter from itscurrentposition)
\\	InsertsBackwardslashsymbol
\?	InsertsQuestionmarksymbol
\'	InsertsSinglequotationmarksymbol
\"	InsertsDoublequotationmarksymbol

Consider the following example program...

Example Program:

```
#include<stdio.h>
#include<conio.h>
void main()
{
printf("Welcome to\n");
printf("Diplomasmartclass\n");
printf("theperfectwebsiteforlearning");
}
```

Output:-
```
Welcome
toDiplomasmartclas
s
theperfectwebsitefor learning
```

putchar()function

The putchar() function is used to display a single character on the output screen. The putchar() functions prints the character which is passed as a parameter to it and returns the same character as a return value. Thisfunction is used to print onlya single character. To print multiple characters we need to write multiple times or use a looping statement. Consider the following example program...

```
#include<stdio.h>
#include<conio.h>
void main()
{
charch='A';
putchar(ch);
}
```

puts()function

The puts() function is used to display a string on the output screen. The puts() functions prints a string or sequence of characters till the newline. Consider the following example program...

ExampleProgram

```
#include<stdio.h>
#include<conio.h>
void main()
{
charname[30];
printf("\nEnteryourfavouritewebsite:");
gets(name);
puts(name);
}
```

fprintf()function

The fprintf()function is used with the concept of files. The fprintf()function is used to print a line into the file. When you want to use fprintf() function the file must be opened in writing mode.

InputFunctions

C programming language provides built-in functions to perform input operations.The input operations are used to read user values (input) from the keyboard. The c programming language provides the following built-in input functions.

- scanf()
- getchar()
- getch()
- gets()
- fscanf()

scanf()function

The scanf() function is used to read multiple data values of different data types from the keyboard.The scanf()function is built-infunction defined in a header file called "stdio.h".When we want to use scanf() function in our program, we need to include the respective header file (stdio.h) using #include statement. The scanf() function has the following syntax...

Syntax:

scanf("formatstrings",&variableNames);

ExampleProgram

```
#include<stdio.h>
#include<conio.h>
void main()
{
int i;
printf("\nEnteranyintegervalue:");
scanf("%d",&i);
printf("\nYouhaveentered%dnumber",i);
}
```

In the above example program, we used the scanf() function to read an integer valuefrom the keyboard and store it into variable 'i'.

Output:-

Enteranyintegervalue:53
Youhaveentered53number

The scanf() function is also used to read multiple data values of different or the samedata types. Consider the following example program...

ExampleProgram

```
#include<stdio.h>
#include<conio.h>
void main()
{
int i;floatx;
printf("\nEnter oneintegerfollowedbyonefloatvalue:"); scanf("%d%f",&i,
&x);
printf("\nintegervalue=%d,floatvalue=%f",i,x);
}
```

Output:-

Enteroneintegerfollowedbyonefloatvalue:5932.8
integervalue=59,floatvalue=32.8

In the above example program, we used the scanf() function to read one integer value and one float value from the keyboard. Here 'i' is an integer variable so we have used format string %d, and 'x'isafloat variable so wehave usedformat string%f.

The scanf() function returns an integer value equal to the total number of input values read using scanf function.

ExampleProgram
```
#include<stdio.h>
#include<conio.h>
void main()
{
inti,a,b;
float x;
printf("\nEntertwointegersandone float:"); i =
scanf("%d%d%f",&a, &b, &x); printf("\nTotal
inputs read : %d",i);
}
```

getchar()function:

The getchar() function is used to read a character from the keyboard and return it to the program. This function is used to read a single character. To read multiple characters we need to write multiple times or use a looping statement. Consider the following example program...

ExampleProgram
```
#include<stdio.h>
#include<conio.h>
void main()
{
charch;
printf("\nEnteranycharacter:");
ch = getchar();
printf("\nYouhaveentered:%c\n",ch);
}
```

Output:-
    Enteranycharacter:H
    Youhaveentered:H

getch()function

The getch() function is similar to getchar function. The getch() function is used to read a character from the keyboard and return it to the program. This function is used to read a single character. To read multiple characters we need to write multiple times or use a looping statement. Consider the following example program...

ExampleProgram
```
#include<stdio.h>
#include<conio.h>
void main()
{
charch;
printf("\nEnteranycharacter:");
```

```
ch =getch();
printf("\nYouhaveentered:%c",ch);
}
```

gets()function

The gets() function is used to read a line of string and stores it into a character array. The gets() function reads a line of string or sequence of characters till a newline symbol enters. Consider the following example program...

ExampleProgram

```
#include<stdio.h>
#include<conio.h>
void main()
{
charname[30];
printf("\nEnteryourfavouritewebsite:");
gets(name);
printf("%s",name);
}
```

fscanf()function

The fscanf() function is used with the concept of files. The fscanf() function is used toread data values from a file. When you want to use fscanf() function the file must be opened in reading mode.

Operators,Expressions,Typeconversion&Typecasting

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.

- ArithmeticOperators
- RelationalOperators
- LogicalOperators
- Increment& DecrementOperators
- AssignmentOperators
- BitwiseOperators
- ConditionalOperator
- SpecialOperators

ArithmeticOperators(+,-,*,/,%)

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
%	Remainderofthe 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).
- Theremainderofthedivision operatorisusedwithintegerdatatypeonly.

RelationalOperators(<,>,<=,>=, ==,!=)

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<5isFALSE
>	ReturnsTRUEif thefirstvalueislargerthan second value otherwisereturnsFALSE	10>5is TRUE
<=	ReturnsTRUEif thefirstvalue is smallerthanorequaltosecondvalueotherwise returns FALSE	10<=5isFALSE
>=	ReturnsTRUEif thefirstvalueislargerthanor equal to second valueotherwisereturnsFALSE	10>= 5is TRUE
==	ReturnsTRUEifbothvaluesare equal otherwise returns FALSE	10== 5isFALSE
!=	Returns TRUE if both values are not equal otherwise returns FALSE	10!=5 is TRUE

LogicalOperators(&&,||,!)

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
&&	LogicalAND-ReturnsTRUEif all conditions are TRUEotherwisereturns FALSE	10<5&&12>10is FALSE
||	LogicalOR-ReturnsFALSEif all conditions are FALSE otherwise returnsTRUE	10<5||12>10is TRUE
!	LogicalNOT-ReturnsTRUEif condition is FLASE andreturns FALSEifitisTRUE	!(10<5&&12>10)is TRUE

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

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

Increment&DecrementOperators(++&--)

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	Addsonetoexisting value	inta= 5;a++;⇒ a =6
--	Decrement	Subtracts one from existingvalue	inta= 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-IncrementorPre-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.

ExampleProgram

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

Post-IncrementorPost-Decrement

In the case of post-increment, the value of the variable is increased by one after the expression evaluation.In the caseof 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.

ExampleProgram

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

AssignmentOperators(=,+=,-=,*=,/=,%=)

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 C programming language.

Operator	Meaning	Example
=	Assigntheright-handsidevaluetoleft- hand side variable	A=15
+=	Addbothleftandright-handsidevalues and store the result into left-hand side variable	A+=10⇒A=A+10
-=	Subtractright-handsidevaluefromleft- hand side variable value and storethe result into left-hand side variable	A-=B⇒A= A-B
*=	Multiplyright-handsidevaluewithleft- handsidevariablevalueandstorethe result into left-hand side variable	A*=B⇒A=A*B
/=	Divideleft-handsidevariablevaluewith right-hand side variable value and store theresultinto theleft-handside variable	A /=B⇒A=A/B
%=	Divideleft-handsidevariablevaluewith right-handsidevariablevalueand store the remainder into the left-hand side variable	A %=B⇒A= A%B

BitwiseOperators(&,|,^,~,>>,<<)

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.

Letusconsidertwo variables AandB asA=25 (11001)and B=20 (10100).

Operator	Meaning	Example
&	theresult of Bitwise ANDis1 if allthe bitsare1 otherwise it is0	A&B⇒16(10000)
|	theresult of BitwiseORis0ifallthe bitsare0 otherwise it is1	A|B⇒29(11101)
^	theresult of BitwiseXORis0ifallthe bitsaresameotherwise itis1	A^B⇒13(01101)
~	theresultofBitwiseoncecomplement is negationofthebit(Flipping)	~A⇒6(00110)
<<	theBitwiseleftshiftoperatorshiftsall thebitstotheleftbythespecified number of positions	A<<2⇒ 100 (1100100)
>>	theBitwiserightshiftoperatorshiftsall the bits to the right by the specified numberofpositions	A>>2⇒6(00110)

ConditionalOperator(?:)

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 acondition, 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?TRUEPart:FALSE Part;

Example

A=(10<15)?100:200;⇒Avalue is100

SpecialOperators(sizeof,pointer,comma,dot,etc.)

Thefollowingarethespecialoperatorsincprogramming language.

sizeof operator

Thisoperatorisusedtofindthesizeofthememory(inbytes)allocatedforavariable. Thisoperatorisusedwiththefollowingsyntax. sizeof(variable

Name);

Example

sizeof(A);⇒theresultis2ifAisaninteger

Pointeroperator(*)

Thisoperatorisusedtodefinepointervariables incprogramming language.

Commaoperator(,)

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

Dotoperator(.)

Thisoperator is usedtoaccessmembersofstructureor union.

OperatorPrecedenceandAssociativity

WhatisOperatorPrecedence?

Operator precedence is used to determine the order of operators evaluated in an expression. In c programming language every operator has precedence (priority). When there is 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.

WhatisOperatorAssociativity?

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 in the following table.

Precedence	Operator	OperatorMeaning	Associativity
1	() [] -> .	functioncallarrayreference structure memberaccess structure memberaccess	LefttoRight
2	! ~ + - ++ -- & *sizeof (type)	negation 1'scomplementUnaryplusUnary minus increment operator decrement operatoraddressofoperatorpointer returns size of a variable typeconversion	Rightto Left
3	* / %	multiplication divisionremainder	LefttoRight
4	+ -	addition subtraction	LefttoRight
5	<< >>	left shift rightshift	LefttoRight
6	< <= > >=	lessthan lessthanorequaltogreaterthan greater than or equal to	LefttoRight
7	== !=	equal tonotequalt o	LefttoRight
8	&	bitwiseAND	LefttoRight
9	^	bitwiseEXCLUSIVEOR	LefttoRight
10			bitwiseOR	LefttoRight
11	&&	logicalAND	LefttoRight
12	||	logicalOR	LefttoRight
13	?:	conditionaloperator	LefttoRight
14	= *= /= %= += -= &= ^= |= <<= >>=	assignment assignmultiplicationassigndivision assign remainder assign addition assign subtraction assign bitwise AND assign bitwise XOR assign bitwise OR assign left shift assignrightshift	Rightto Left
15	,	separator	LefttoRight

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

Expressions

Whatisanexpression?

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.

IntheCprogramminglanguage,anexpressionisdefinedasfollows.

Anexpressionisacollectionofoperatorsandoperandsthatrepresentsaspecificvalue.

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.

ExpressionTypesinC

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

- Infix Expression
- PostfixExpression
- PrefixExpression

Theaboveclassificationisbasedontheoperatorpositioninthe expression.

InfixExpression

- Theexpressioninwhichtheoperatorisusedbetweenoperandsiscalledinfixexpression.

- Theinfixexpressionhasthefollramminggeneralstructure.

Operand1Operator Operand2

PostfixExpression

- Theexpressioninwhichtheoperatorisusedafteroperandsiscalledpostfixexpression.
- Thepostfixexpressionhasthefollowinggeneralstructure.

Operand1Operand2Operator

PrefixExpression

- Theexpressioninwhichtheoperatorisusedbeforeoperandsiscalledaprefix   expression.
- Theprefixexpressionhasthefollowinggeneralstructure.

OperatorOperand1Operand2

TypeConversionandTypeCasting

In a programminglanguage, theexpression contains data values of the same datatype or different 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 is the 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   as follows...

- TypeConversion
- TypeCasting

TypeConversion

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...

```
int i = 10
;floatx=15.5;
char ch = 'A' ;
i= x;=======>xvalue 15.5 isconverted as 15andassignedtovariable i
x=i;=======>Hereivalue10isconvertedas10.000000andassignedtovariablex i = ch ;
=======> Here the ASCII value of A (65) is assigned to i
```

ExampleProgram

```
#include<stdio.h>
#include<conio.h>
void main()
{
inti = 95 ;
floatx=90.99;
char ch = 'A' ;
i=x;
printf("ivalueis%d\n",i); x
      = i ;
printf("xvalueis%f\n",x); i
      = ch ;
printf("ivalueis%d\n",i);
}
```

In the above program, we assign i = x, i.e., float variable value is assigned to the integer variable.Here,thecompilerautomaticallyconvertsthefloatvalue(90.99)intointegervalue (90) byremoving the decimal part of the float value (90.99) and thenit 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 adata loss. In such a case, we convert the data from one data type to another data type using explicittypeconversion. To performthis weuse the unary castoperator. Toconvert 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.

Thegeneralsyntaxof typecastingisasfollows.

(TargetDatatype)DataValue

Example

    inttotalMarks=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.

ExampleProgram

```
#include<stdio.h>
#include<conio.h>
int main()
{
inta,b,c; float
avg ;
printf("Enteranythreeintegervalues:");
scanf(¯%d%d%d‖,a,b, c);
avg =(a+b+c)/3;
printf("avgbeforecasting=&f",avg \n); avg
= (float)(a + b + c) / 3 ;
printf("avgaftercasting=%f",avg\n); return
0;
}
```

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:

                        //commentuntilthelineend

The // comment formis so handy that many C compilers now also support it, although iti s 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.

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

ControlStructures

C uses curlybraces ({}) to group multiple statements together.The statements execute in order. Some languages let you declare variables on anyline (C++). Other languages insist that variables 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 '{'. Moremodern languages like Java and C++ allow you to declare variables on any line, which is handy.

WhatisDecisionMakingStatement?

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 executionflowmay not be suitablefor all the program solutions.Sometimes, we makesome 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-makingstatementsarethestatementsthatareusedtoverifyagivencondition and decide whether a block of statements gets executed or not based on the condition result.

Inthe cprogramminglanguage, therearetwo decision-makingstatements theyareasfollows.
1. ifstatement
2. switchstatement

ifstatementinc

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

1. Simpleifstatement
2. if-elsestatement
3. Nestedifstatement
4. if-else-ifstatement(if-elseladder)

Simpleif statement

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;
    ....
}
```

Execution flow diagram
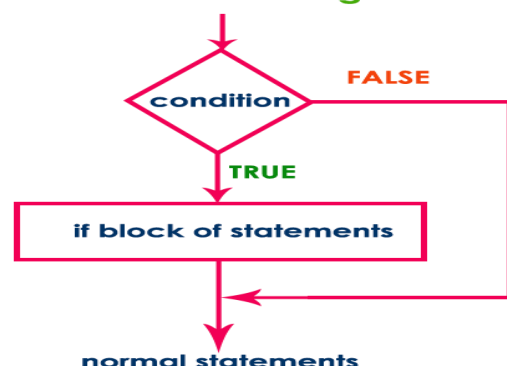
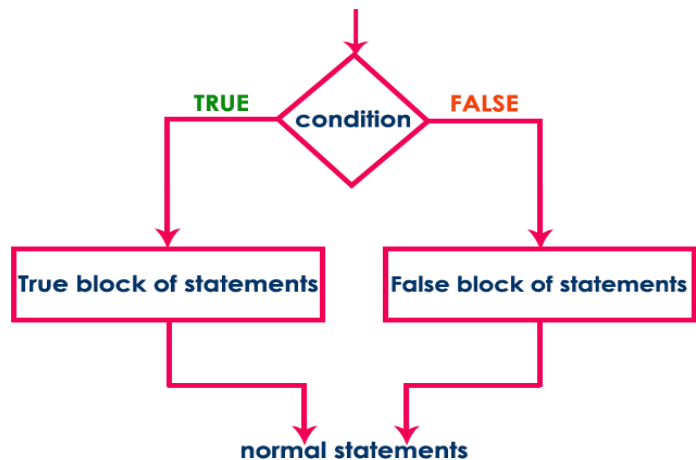Simple if statement isused when we have onlyone option that is executed or skipped based on a condition.

if-elsestatement

Theif-else statement isusedto verifythe givenconditionandexecutesonlyoneoutof the

Syntax

Execution flow diagram

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


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 and execution flow of the if-else statement is as follows.

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

Nested ifstatement

Writingaifstatementinsideanotherifstatementiscallednestedifstatement.The general syntax of the nested if statement is as follows.

Syntax

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

Thenestedifstatementcanbedefinedusinganycombinationofsimpleif&if-else   statements.

---

if-else-ifstatement(if-elseladder)

Writing aifstatement insideelse ofanifstatementis calledif-else-ifstatement. The general syntax of the if-else-if statement is as follows...

Syntax

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

Theif-else-ifstatementcanbedefinedusinganycombinationofsimpleif   &if-elsestatements.

Examples:

Program1:(Simpleifstatement)
```
#include<stdio.h>
int main()
{
intx =20;
inty =22;        if (x<y)
{
printf("Variablexislessthany");
}
return0;
}
```

Output:
Variablexislessthany

```
Program2:(Simpleifstatement)
#include <stdio.h>
int main()
{
inti=10; if
(i> 15)
{
printf("10islessthan 15");
}
printf("IamNot inif");
```

}

Output: IamNot inif

Program3:(if-else statement)

```
#include<stdio.h>
int main()
{
inti=20; if
(i< 15)
printf("iissmallerthan15");
else
printf("iisgreaterthan15"); return
0;
}
```

Output:iisgreaterthan 15

```
Program4:(if-elsestatement)
#include <stdio.h>
int main()
{
int age;
printf("Enteryourage:");
scanf("%d",&age);if(age
>=18)
{
/*Thisstatementwillonlyexecute ifthe
 *abovecondition(age>=18)returns true
 */
printf("Youareeligibleforvoting");
}
else
{
/*Thisstatementwillonlyexecute ifthe
*conditionspecifiedinthe"if"returnsfalse.*/ printf("You
are not eligible for voting");
}
return0;
}
```

Output:Enteryourage:14 Youarenoteligible forvoting

```
Program 5:(Nested-if statement)
#include<stdio.h>
int main()
{
 int var1,var2;
printf("Inputthevalueofvar1:");
scanf("%d",
&var1);printf("Inputthevalueofv
ar2:");
```

```c
scanf("%d",&var2);
if (var1 != var2)
{
printf("var1isnotequalto var2\n");
```

```c
//Nested if else
  if (var1>var2)
{
printf("var1isgreaterthan var2\n");
}
else
{
printf("var2isgreaterthan var1\n");
}
}
```

Output:
```
Inputthevalueofvar1:12
Inputthevalueofvar2:21
var1 is not equal to var2
var2 is greater than var1
```

Program6:(Nested-ifstatement)
```c
#include<stdio.h>
int main()
{
int i = 10;
if(i==10)
{
//Firstifstatement if
(i< 15)
printf("iissmallerthan15\n");
// Nested - if statementwillonlybe executedif statementaboveistrue if (i<
12)
printf("iissmallerthan12too\n"); else
printf("iisgreaterthan15");
}
return0;
}
```

Output:
iissmallerthan15
iissmallerthan12too

Program7:(if-else-ifstatement)
```c
#include<stdio.h>
void main()
{
int i = 20;
if(i==10)
```

```
        printf("i is 10");
        elseif(i==15)
        printf("i is 15");
        elseif(i==20)
        printf("i is 20");
        else

        printf("iisnotpres
        ent");
        }
```

Output:
        i is 20

Program8:(if-else-ifstatement)
```
        #include<stdio.h>
        int main()
        {    int var1,var2;
        printf("Inputthevalueofvar1:");
        scanf("%d",
        &var1);printf("Inputthevalueofv
        ar2:"); scanf("%d",&var2);
        if(var1 !=var2)
        {
        printf("var1is notequalto var2\n");
        }
        else
        if(var1>var2)
        {
        printf("var1isgreaterthan var2\n");
        }
        else
        if(var2>var1)
        {
        printf("var2isgreaterthan var1\n");
        }
        else
        {
        printf("var1isequaltovar2\n");
        }
        return0;
        }
```

Output:
        Inputthevalueofvar1:12
        Inputthevalueofvar2:21
        var1 is not equal to var2

'switch'statement inC

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. Intheswitchstatement,weprovideavaluethatistobecomparedwithavalueassociatedwith

eachoption.Wheneverthegivenvaluematchesthevalueassociatedwithanoption,theexecution starts from that option. In the switch statement, every option is defined as a case.

Theswitchstatementhasthefollowingsyntaxandexecutionflowdiagram.

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;
}
```


Flow Diagram
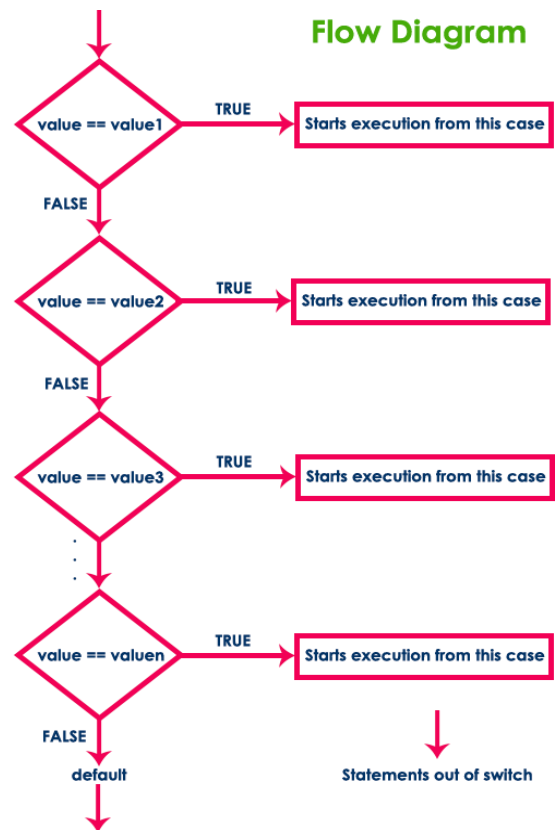
The switch statement contains one or more cases and each case has a value associated with it. At first switch statement compares the first case value with the switchValue, if it gets matched the execution starts from the first case. If it doesn't match the switch statement compares the second case value 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.

Examples:
Program 1:

```
#include<stdio.h>
#include<conio.h>
void main()
{
int n ;
clrscr();
printf("Enteranydigit:");
scanf("%d", &n) ;
switch(n)
{
case0:printf("ZERO");
```

```
        break ;
        case1:printf("ONE");
        break ;
        case2:printf("TWO");

        break ;
        case3:printf("THREE");
        break ;
        case4:printf("FOUR");
        break ;
        case5:printf("FIVE");
        break ;
        case6:printf("SIX");
        break ;
        case7:printf("SEVEN");
        break ;
        case8:printf("EIGHT"); break
        ;
        case9:printf("NINE");
        break;default:printf("NotaDigit");
        }
        getch();
        }
```

Output:

```
    Enteranydigit:5
    FIVE
```

Program 2:
```
#include<stdio.h>
int main()
{
int num=2;
switch(num+2)
{
case 1:printf("Case1: Value is: %d", num);
case 2:printf("Case2: Value is: %d", num);
case 3:printf("Case3: Value is: %d", num);
default:printf("Default:Valueis:%d",num);
}
return0;
}
```

    Output:Default:valueis:2

Loopingstatements

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.

Theloopingstatementsareusedtoexecuteasinglestatementorblockof

statementsrepeatedlyuntilthegivenconditionisFALSE.

Clanguageprovidesthreeloopingstatements...
- whilestatement
- do-whilestatement
- forstatement

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

Syntax:

```
while( condition )
{
    ...
    block of statements;
    ...
}
```
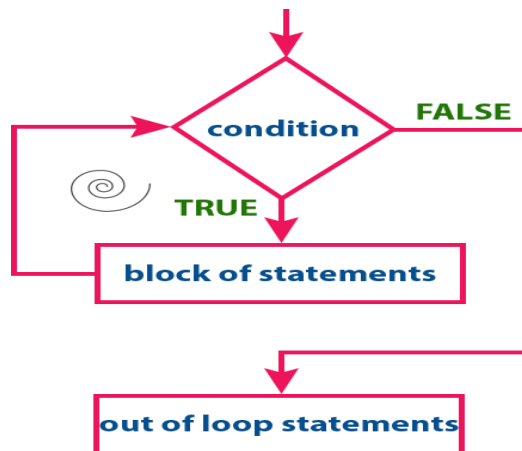
again. If it is TRUE, again the same statements get executed. The same process is repeated until the condition is evaluated to FALSE. Whenever the condition is evaluated to FALSE, the execution control moves out of the while block.

Examples:
Program 1:

```
#include<stdio.h>
#include<conio.h>
void main()
{
intn=0;
clrscr() ;
printf("Evennumbersupto10are");
while( n<= 10 )
{
if( n%2 == 0)
printf("%d\t",n);
n++ ;
}
```

```
    getch();
}
```

Output:
Even numbersupto10are0   2   4   6   8   10

Program 2:

```
#include<stdio.h>
int main()
{
int count=1;
while(count<=4)
{
printf("%d",count);
count++;
}
return0;
}
```
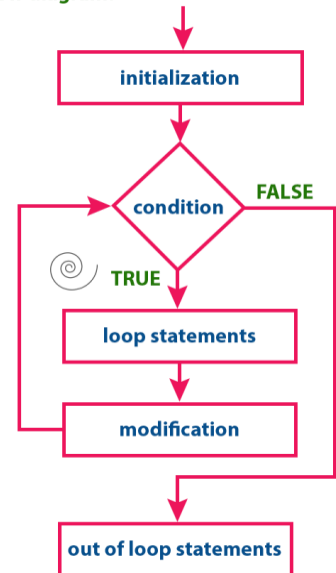
Output:
    1234

'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 ) ;
```

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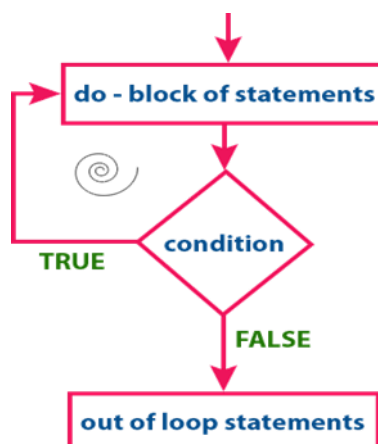
At first, the single statement or block of statements which are defined in do block are executed. After the execution of the doblock, the given condition gets evaluated. If the condition is evaluated to TRUE, the single statement or block of statements of do block are executed

again.
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.

Examples:
Program 1:

```
#include<stdio.h>
int main()
{
intj=0;
do
{
printf("Valueofvariablejis:%d\n",j);  j++;
}
while(j<=3);
return 0;
}
```

Output:
Valueofvariablejis:0
Valueofvariablejis:1
Valueofvariablejis:2
Valueofvariablejis:3

Program 2:

```
#include<stdio.h>
int main()
{
inti=0;
do
{
printf("whilevsdo-while\n");
}
while(i==1);
printf("Outofloop");
}
```

Output:
whilevsdo-while
Out of loop

For statement

The for statement is used to execute a single statement or a block of statements repeatedly as longasthe 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 isevaluated 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 sameprocess 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;
    ...
}
```

Execution flow diagram:

Examples:
Program 1:

```
//Printthenaturalnumbersfrom 1to10
    #include <stdio.h>
    int main()
    {
    int i;
    for (i=1;i< 11; ++i)
    {
    printf("%d",i);
    }
    return0;
    }
```

Output:
123456 789 10

Program 2:

```
    #include<stdio.h>
    int main()
    {
    for(int i=0; i<2;i++)
    {
    for(int j=0; j<4;j++)
    {
    printf("%d,%d\n",i,j);
    }
    }
    return0;
    }
```

Output:
0,0 0, 10, 20,31 0 1,1 1, 21,3

break,continue andgoto 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

Theabovethreestatementsdonotneedanyconditiontocontroltheprogramexecutionflow.

"break"statement

InC, thebreakstatement isusedtoperformthefollowingtwo things...

- breakstatement isused toterminatethe switch casestatement
- break statement is also used to terminate looping statements like while, do-while and 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 thefollowing program.

Examples:
Program 1:

```c
#include<stdio.h>
#include<stdlib.h>
void main ()
{
int i;
for(i=0;i<10; i++)
{
printf("%d",i);
if(i == 5)
break;
}
printf("\ncameoutsideofloopi= %d",i);
}
```

Output:
```
0123 45
cameoutsideofloopi=5
```

Program 2:
```c
#include<stdio.h>
int main ()
{
        /*localvariabledefinition*/ int
a = 10;
        /*whileloopexecution*/ while(
a< 20 )
{
```

```
printf("valueofa:%d\n",a);
a++;
if{a<15}
{
break;
        /*terminatetheloopusingbreakstatement*/
        }
        }
        return0;
        }
```

Output:

```
valueofa:10
valueofa:11
valueofa:12
valueofa:13
valueofa:14
value ofa:15
```

continue statement

The continue statement is used to move the program execution control to the beginningof 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.

Examples:
Program1:

```
#include<stdio.h>
void main ()
{
int i = 0;
while(i!=10)
{
printf("%d",i);
continue;
i++;
}
}
```

Output:
Infiniteloop

Program 2:

```
#include<stdio.h>i
nt main()
{
```

```c
    inti=1;//initializingalocalvariable
            //startingaloopfrom1to10
for(i=1;i<=10;i++)
{
if(i==5)
{        //ifvalue ofiisequalto5,itwillcontinuetheloop
continue;
}
printf("%d\n",i);
}        //endofforloop
return 0;
}
```

Output:
```
1
2
3
4
6
7
8
9
10
```

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.

Examples:
Program 1:
```c
#include<stdio.h>
void main()
{
int num,i=1;
printf("Enterthenumber whosetableyouwanttoprint:");
scanf("%d",&num);
table:printf("%dx%d=%d\n",num,i,num*i); i++;
if(i<=10)
gototable;
}
```
Output:
```
Enterthenumberwhosetableyouwanttoprint:10 10 x 1
= 10
10 x 2=20
10 x 3=30
10 x 4=40
10 x 5=50
10 x 6=60
10 x 7=70
10 x 8=80
```

```
         10 x 9=90
         10x 10=100
```

Program 2:

```c
#include<stdio.h>
void main()
{
int i, j, k;
for(i=0;i<10;i++)
{
 for(j=0;j<5;j++)
{
for(k=0;k<3;k++)
{
printf("%d%d%d\n",i,j,k);
if(j == 3)
{
gotoout;
}
}

}
}
out:
printf("cameout ofthe loop");
}
```

Output:
```
        000
        001
        002
        010
        011
        012
        020
        021
        022
        030
        cameoutoftheloop
```

ProgrammingAssignmentusingtheabovefeatures.

Somemore Examples:

ProgramtoCheckEvenor Odd

```
#include<stdio.h>
int main()
{
int num;
printf("Enteraninteger:");
scanf("%d", &num);
if(num %2 ==0)//True if num isperfectlydivisible by2
printf("%d is even.", num);
else
printf("%disodd.",num);
return 0;
}
```

Output

```
Enteraninteger:7 7
is odd.
```

ProgramtoCheckVowelor consonant

```
#include<stdio.h>
int main()
{
charc;
intlowercase_vowel,uppercase_vowel;
printf("Enter an alphabet: ");
scanf("%c",&c);
// evaluates to 1 if variable c is a lowercase vowellowercase_vowel
= (c == 'a' || c == 'e' || c == 'i' || c == 'o' || c == 'u');
//evaluatesto1ifvariable cisauppercase vowel
uppercase_vowel=(c=='A'||c=='E'||c=='I'||c== 'O'||c== 'U');
// evaluates to1(true) ifcis avowel
if(lowercase_vowel||uppercase_vowel) printf("%c
is a vowel.", c);
 else
printf("%cisaconsonant.",c); return
0;
}
```

Output

```
Enteranalphabet:G
G is a consonant.
```

ProgramtoCheckLeapYear

```
#include<stdio.h>
int main()
{
int year;
```

```c
printf("Enterayear:");
scanf("%d",&year);
//leapyearifperfectlyvisibleby400 if
(year % 400 == 0)
{
printf("%disaleapyear.", year);
}
// not a leapyearifvisible by100
//butnotdivisibleby400
elseif(year%100 ==0)
{
printf("%disnota leapyear.", year);
}
 //leapyearifnotdivisibleby100
// but divisible by 4
elseif(year%4==0)
{
printf("%disaleapyear.", year);
}
// allotheryears arenot leapyear else
{
printf("%disnota leapyear.", year);
}
return0;
}
```

Output

Enter a year: 1900
1900isnotaleapyear

Program toCheckAlphabet

```c
#include<stdio.h>
int main()
{
charc;
printf("Enteracharacter:");
scanf("%c", &c);
if ((c >='a'&& c<='z') || (c >= 'A'&& c <= 'Z')) printf("%c
is an alphabet.", c);
 else
printf("%cisnotanalphabet.",c);
return 0;
}
```

Output

Enteracharacter:*
*isnot analphabet

Tofind the FactorialofaNumber

```c
#include<stdio.h>
int main()
{
intn,i;
unsignedlonglongfact =1;
```

```c
    printf("Enteraninteger:");
```

```c
    scanf("%d",&n);
        //showserroriftheuserentersanegativeinteger if (n
< 0)
printf("Error!Factorialof anegativenumberdoesn'texist."); else
{
for(i=1;i<=n;++i)
{
fact*=i;
}
printf("Factorialof %d=%llu",n,fact);
}
return0;
}
```

Output

Enter an integer: 5
Factorialof10=120

MultiplicationTableUpto 10

```c
#include<stdio.h>
int main()
{
    intn,i;
    printf("Enteraninteger:");
    scanf("%d", &n);
    for(i=1; i<=10;++i)
      {
        printf("%d *%d =%d\n",n,i,n *i);
      }
    return0;
}
```

Output

```
Enteraninteger: 9
            9*1=9
            9*2=18
            9*3=27
            9*4=36
            9*5=45
            9*6=54
            9*7=63
            9*8=72
            9*9=81
            9*10=90
```

ToReverseanIntegernumber

```c
#include<stdio.h>
int main() {
    int n, rev = 0, remainder;
    printf("Enteraninteger:");
    scanf("%d", &n);
```

```c
    while (n !=0){
```

```c
        remainder = n%10;
        rev=rev*10+remainder; n
        /= 10;
    }
     printf("Reversednumber=%d", rev);
     return0;
}
```

Output

Enteraninteger:2345
Reversednumber=5432

ProgramtoCheck Palindrome

```c
#include<stdio.h>
int main()
{
    intn,reversedN=0,remainder,originalN; printf("Enter
    an integer: ");
    scanf("%d",&n);
    originalN = n;
    //reversedintegerisstoredinreversedN
    while (n != 0) {
        remainder=n %10;
        reversedN=reversedN*10+remainder; n
        /= 10;
    }
    //palindromeiforignalNandreversedNareequal if
    (originalN == reversedN)
        printf("%disapalindrome.",originalN); else
        printf("%disnotapalindrome.",originalN); return
    0;

}
```

Output

Enter an integer: 1001
1001isapalindrome.

SimpleCalculatorusingswitchStatement

```c
#include<stdio.h>
int main()
{
    char operator;
    doublefirst,second;
    printf("Enteranoperator(+, -,*,):");
    scanf("%c", &operator);printf("Enter
    two operands: "); scanf("%lf %lf",
    &first, &second); switch (operator)
    {
    case '+':printf("%.1lf +%.1lf =%.1lf",first, second,first +second);
        break;
```

```
case'-':printf("%.1lf -%.1lf =%.1lf",first,second,first -second); break;
case'*':printf("%.1lf*%.1lf =%.1lf",first,second,first*second); break;
case'/':printf("%.1lf /%.1lf =%.1lf",first,second,first/second); break;
default:printf("Error!operatorisnotcorrect");

    }
    return0;
}
```

Output
Enteranoperator(+,-,*,):* Enter
two operands: 1.54.5
1.5*4.5= 6.75

SolvedQuestions

ShortAnswerTypeQuestions.

NameofthefirstdeveloperofCprogramminglanguages.

Ans:- Dennis Ritchie

WhatarethevarioustypesofstatementavailableinCprogram?

Ans:- C has three types of statement.

(i) Assignment=

(ii) Selection(branching)if(expression)elseswitch.

(iii) Iteration(looping)while(expression)for(expression;expression;expression)do{block}

Whatisthepurposeofi/ostatementin„C"? Ans:-
- It is used to display a string inputted by gets() function. It isalso used to display an text (message) on the screen for program simplicity.
- Input Output Statement.

ExplaintheimportanceofC-language?

Ans:-
C is highly portable and is used for scripting system applications which form a major part of Windows, UNIX, and Linux operating system. C is a general-purpose programming language and can efficiently work on enterprise applications, games, graphics, and applications requiring calculations, etc.

LongAnswerTypeQuestions.
Givethegeneralstructureofa„C"program,anddiscussabouteachofthelines.
(2017-Winter)
Ans:-
Programming in C is a difficult task for someone who is completely oblivious to the basic structureofaCprogram.Aftercompletingthistutorial,youwouldlearnhowtheStructureofC

Program lookslikeandsoonyouwould becomfortablewritingyour ownprogramswithease!

PartofCprogram

---

1. # include <stdio.h> – This command is a preprocessor directive in C that includes all standard input-output files before compiling any C program so as to make use of all those functions in our C program.

2. int main() – This is the line from where the execution of the program starts. The main() function starts the execution of any Program.

3. { (Opening bracket) – This indicates the beginning of any function in the program (Here it indicates the beginning of the main function).

4. /* some comments */ – Whatever is inside /*—-*/ are not compiled and executed; theyareonlywritten foruserunderstandingorformakingthe program interactive by inserting a comment line. These are known as multiline comments. Single line comments are representedwiththehelpof2forwardslashes ‖//—‖.

5. printf("HelloWorld")–Theprintf()commandisincludedintheCstdio.hlibrary,which helps todisplaythemessageontheoutputscreen.

6. getch()– Thiscommand helpstoholdthescreen.

7. return 0 – ThiscommandterminatestheCprogramandreturnsanull value, that is, 0.

8. } (Closing brackets)- This indicates the end of the function. (Here it indicates the end of the main function)

WAPinCtofindtherealrootsofaquadraticequation.*(2017-Summer)*

Ans:-

```
#include<stdio.h>
#include<math.h>
int main()
{
 int a, b, c,
 d;doubleroot1,root2
 ;
 printf("Enter a, b andc where a*x*x + b*x+ c = 0\n");
 scanf("%d%d%d", &a, &b, &c);
 d=b*b-4*a*c; if
 (d < 0)
{
//complexroots,i isfor iota(√-1,squarerootof-1)
printf("First root = %.2lf + i%.2lf\n", -b/(double)(2*a), sqrt(-d)/(2*a));
printf("Secondroot=%.2lf -i%.2lf\n",-b/(double)(2*a),sqrt(-d)/(2*a));
 }
 else
{
//realroots
root1 = (-b+sqrt(d))/(2*a);
root2 = (-b - sqrt(d))/(2*a);
printf("First root = %.2lf\n", root1);
printf("Secondroot=%.2lf\n",root2);
 }
 return0;
```

}

EXERCISE

ShortAnswerTypeQuestions.

DifferentiatebetweenNumericandCharacterConstant?

Howcanyouuseasymbolic statement?

What doyoumeanbyoperatorandoperand?

WhatarethevarioustypesofOperatorusedintheCprogramming? **(2016-Summer)**

Differentiatebetweenlogicalandbitwiseoperator?

Differentiatebetweenincrementanddecrementoperator?

Differentiate between pre andpost increment/decrement operator? **(2013-Summer)**

Differentiatebetweenunaryplus andunaryminusoperator?

Whyconditionaloperatoriscalledternaryoperator?

DefineOperator?

Whatistherelationofarithmeticoperatorwithrelationaloperator? Explain with an appropriate expression?

Howcanexpressionwithincrementanddecrementoperatorswillbesolved?

Differentiatebetweenif-elseandelse-ifstatement?

Differentiatebetweenladderifandswitchstatement?(2017-Summer)

Whatdo you mean byconditionalcontrol statement?

Defineaniterativestatement ina C program.

Givethegeneralsyntaxofswitch……casestatementinC.

Differentiatebetweendo-whileandwhile…..dostatementinC.

LongAnswerType Questions

WAPin C toprintall2-DigitOdd Numbers.

WAPin CtoCalculateandprint thefactorialofa givennumber.

WAPinCtoComputeandprintthesumofthefollowingseries.*(2017- Winter)*

$$S=1+1/x +1/x^2+1/x^3+1/x^4 \cdots\cdots\cdots\cdots\cdots 1/x^n$$

WAPinCtocalculatethe sumofthedigitsof a given number.

WAPinCtoComputeandprintthesimpleinterestandcompound interest.

WAPinCtocompute$(a+b)^2$.

WAPinCtointerchangevalueoftwovariableswithoutusingthird variable.

WAPintofindthesum ofthegivenseries.**(2015-Winter)**

$1^n+2^n+3^n+4^n+\ldots\ldots\ldots\ldots\ldots\ldots m^n$.

WAP inCto print.

*

**

***

WAPin Ctofindthe prime number.(2017-Summer)

WAP in C to find greatest number among three integer numbers. ***(2015-Winter)***

WAPinCtocomputeandprintthesumofthefollowingseries.***(2017-   Winter)***

$$S=1+ \frac{1}{2}+-+ \frac{1}{4} \quad \frac{1}{6}+\cdots \quad \frac{1}{20}$$

WAPinC tofind whether a numberisArmstrong numberor not.

****

CHAPTER–7:ADVANCEDFEATURESOFC

FunctionsandPassingParameterstotheFunction(CallbyValueand Call by Reference)

Functions

- A function is a group of statements that together perform a task. Every C program has at least onefunction, which ismain (), and allthe most trivialprogramscandefine additional functions.
- You can divide up your code into separate functions. How you divide up your codeamong 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.
- Afunctioncanalsobereferredasamethodor asub-routineor aprocedure,etc.

DefiningaFunction

- ThegeneralformofafunctiondefinitioninCprogramminglanguageisasfollows−
  - returntypefunctionname(parameterlist){
  - bodyofthefunction
  - }
- 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.
  - **FunctionBody−**The function bodycontainsa collection of statements that define what the function does.

ParametersinCfunctions

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

  #### CallbyValue
  - Pass by Value, means that a copy of the data is made and stored by way of the nameoftheparameter.Any changestotheparameterhaveNOeffectondatain

thecallingfunction.

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

- o In call by value method, we cannot modify the value of the actual parameter by the formal parameter.
- o Incallbyvalue,differentmemoryisallocatedforactualandformalparameters since the value of the actual parameter is copied into the formal parameter.
- o 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 byReference
- o 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.
- o In call by reference, the address of the variable is passed into the function call as the actual parameter.
- o The value of the actual parameters can be modified by changing the formal parameters since the address of the actual parameters is passed.
- o 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 the value stored at the address of the actual parameters, and the modified value gets stored at the same address.

- Therearetwowaystomake apass byreferenceparameter:

ARRAYS
- o ArraysarealwayspassbyreferenceinC.Anychangemadetotheparameter containing the array will change the value of the original array.

Theampersand(&)usedinthefunctionprototype.Function(&parameter name)
- o 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.

CallbyValueExample:Swappingthevaluesofthetwovariables(SwappingnotPossible)

```
#include<stdio.h>
voidswap(int,int);//prototypeofthefunction int
main()
{
    inta=10; int
    b=20;
    printf("Beforeswappingthe valuesinmaina =%d,b =%d\n",a,b);
    swap(a,b);
    printf("After swappingvaluesinmaina =%d,b=%d\n",a,b);
//Thevalueofactualparametersdonotchangebychangingthe formalparametersin call by
value, a = 10, b = 20
}

voidswap (int a1, intb1)
{
    int temp;
    temp=a;
```

```
    a=b;
    b=temp;
    printf("Afterswappingvaluesinfunctiona=%d,b=%d\n",a,b);//Formalparameters,a
=20,b =10
    }
```

Output

Beforeswappingthevaluesinmaina=10,b=20 After
swapping values in function a = 20, b = 10 After
swapping values in main a = 10, b = 20

CallbyreferenceExample:
Swappingthevaluesofthetwo variables

```
#include<stdio.h>
voidswap(int*,int*);//prototypeof thefunction int
main()
{
    inta=10; int
    b=20;
    printf("Before swapping the values in main a = %d, b = %d\n",a,b); // printing the value
of a and b in main
    swap(&a,&b);
    printf("Afterswappingvaluesinmaina=%d,b=%d\n",a,b);//Thevaluesofactual parameters do
change in call by reference, a = 10, b = 20
}
    voidswap(int*a,int*b)
{
    int temp;
    temp=*a;
    *a=*b;
    *b=temp;
printf("After swapping values in function a = %d, b = %d\n",*a,*b); // Formal
parameters,a = 20, b = 10
}
```

Output:

Beforeswappingthevaluesinmaina=10, b=20 After
swapping values in function a = 20, b = 10 After
swapping values in main a = 20, b = 10

ScopeofVariablesandStorageClasses,Recursion,Functionand Types of Recursion

Scopeofvariables

- 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 ofvariable in the program. Scope ofa variabledepends on the position of variable declaration.
- In C programming language, a variable can be declared in three different positions andthey are as follows...
  - Beforethefunctiondefinition(GlobalDeclaration)
  - Insidethefunctionorblock(LocalDeclaration)
  - Inthefunctiondefinitionparameters(FormalParameters)

Before the function definition (Global Declaration)

Example Program

```
#include<stdio.h>
#include<conio.h>i
nt num1, num2 ;
void main()
{
void addition() ;
voidsubtraction();
voidmultiplication();
clrscr() ;
num1=10;
num2= 20;
printf("num1=%d,num2=%d",num1,num2); addition() ;
subtraction() ;
multiplication();
getch() ;
}
voidaddition()
{
intresult ;
result = num1 + num2 ;
printf("\naddition=%d",result);
}

voidsubtraction()
{
intresult ;
result = num1 - num2 ;
printf("\nsubtraction=%d",result);
}
voidmultiplication()
{
intresult ;
result = num1 * num2 ;
printf("\nmultiplication=%d",result);
}
```

Output:

Insidethefunctionorblock(LocalDeclaration)

Example Program

```
#include<stdio.h>
```

\

```c
#include<conio.h>v
oid main()
{
void addition() ;
intnum1,num2;
clrscr() ;
num1=10;
num2 = 20;
printf("num1=%d,num2=%d",num1,num2); addition() ;
getch();
}
voidaddition()
{
intsumResult;
sumResult = num1 + num2 ;
printf("\naddition=%d",sumResult);
}
```

Output:
Inthefunctiondefinitionparameters(FormalParameters)

Example Program

```c
#include<stdio.h>
#include<conio.h>
void main()
{
voidaddition(int,int);
int num1, num2 ;
clrscr() ;
num1=10;
num2= 20;
addition(num1,num2);
getch() ;
}
voidaddition(inta,int b)
{
int sumResult ;
sumResult=a+b;
printf("\naddition=%d",sumResult);
}
```

StorageClasses

- 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

\

o Register

Automatic

- Automaticvariablesareallocatedmemoryautomaticallyatruntime.
- Thevisibilityoftheautomaticvariablesislimitedtotheblockinwhichtheyare   defined.
- Thescopeoftheautomaticvariablesislimitedtotheblockinwhichtheyare   defined.
- Theautomaticvariablesareinitializedtogarbagebydefault.
- ~~Thememoryassignedtoautomaticvariablesgetsfreeduponexiting   fromtheblock.~~
- Thekeywordusedfordefiningautomaticvariablesisauto.
- Everylocalvariable isautomaticin Cbydefault.

Example

```
#include<stdio.h>
int main()
{
inta;//auto
char b;
float c;
printf("%d%c%f",a,b,c); // printinginitialdefault value of automaticvariables a, b, and c.
return 0;
}
```

Output:

```
garbagegarbagegarbage
```

Static

- Thevariablesdefinedasstaticspecifiercanholdtheirvaluebetweenthemultiple function calls.
- Staticlocalvariablesarevisibleonlytothefunctionortheblockinwhichtheyaredefined.
- A same staticvariablecan bedeclaredmanytimesbutcanbeassignedatonlyone time.
- Defaultinitialvalueofthestaticintegralvariableis0otherwisenull.
- Thevisibilityofthestaticglobalvariableislimitedtothefileinwhichithasdeclared.
- Thekeywordusedtodefine staticvariableisstatic.

Example

```
#include<stdio.h>
static char c;
static int i;
static float
f;staticchars[100];
void main ()
{
printf("%d%d%f%s",c,i,f);//theinitialdefaultvalue ofc,i,andf willbe printed.
}
```

Output:

```
000.000000(null)
```

Register

- Thevariablesdefinedastheregisterisallocatedthememoryintothe CPUregisters depending upon the size of the memory remaining in the CPU.
- Wecannotdereferencetheregistervariables,i.e.,wecannotuse&operatorforthe register variable.
- Theaccesstimeof theregistervariablesisfasterthantheautomaticvariables.
- Theinitialdefaultvalueoftheregisterlocalvariablesis 0.
- Theregisterkeywordisusedforthevariablewhichshouldbestoredinthe CPUregister. However,itiscompiler'schoicewhetherornot;thevariablescanbestoredinthe

  register.
- Wecan storepointersintotheregister,i.e.,aregistercanstorethe address of a variable.
- Staticvariablescannotbestoredintotheregistersincewecannotusemorethanone storage specifier for the same variable.

Example

```
#include<stdio.h>
int main()
{
 registerinta;//variableaisallocatedmemoryintheCPUregister.Theinitialdefault value of a is 0.
printf("%d",a);
}
```

Output:

```
0
```

External

- The external storage class is used to tell the compiler that the variable defined as extern is declared with an external linkage elsewhere in the program.
- The variables declared as extern are not allocated any memory. It is only declaration and intended to specify that the variable is declared elsewhere in the program.
- Thedefaultinitialvalueofexternalintegraltypeis0otherwise null.
- We can only initialize the extern variable globally, i.e., we can not initialize the externalvariable within any block or method.
- Anexternalvariablecanbedeclaredmanytimesbutcanbeinitialized atonlyonce.
- If a variable is declared as external then the compiler searches for that variable to be initialized somewhere in the program which may be extern or static. If it is not, then the compiler will show an error.

Example

```
#include<stdio.h>
int main()
{
  extern int a;
  printf("%d",a);
}
```

Output

```
main.c:(.text+0x6):undefinedreferenceto`a'
collect2: error: ld returned 1 exit status
```

RecursionFunction

- 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.

```
voidrecursion()
{
recursion();/*functioncallsitself*/
}
int main() {
recursion();
}
```

- 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.

Typesof Recursion

Recursionaremainlyoftwotypesdependingonweatherafunctioncallsitself from within itself weather two function call one another mutually.
Thus,thetwo typesof recursion are:

- Direct recursion
- Indirect recursion

Recursionmaybefurthercategorizedas:

- Linearrecursion
- Binaryrecursion
- Multiplerecursion

OneDimensionalArrayandMultidimensionalArray,StringOperations and Pointers

One-dimensionalarray

- Conceptuallyyoucanthinkofaone-dimensionalarrayasarow,whereelementsare stored one after another.
- Syntax:datatype array_name[size];
- datatype: Itdenotesthetypeof theelementsinthearray.
- array_name: Nameofthearray. Itmustbeavalid identifier.
- size:Numberofelementsanarraycanhold.herearesomeexampleofarraydeclarations:
    ```
    int num[100];
    floattemp[20];
    char ch[50];
    ```

Multidimensional Arrays

- Thesimplestformofmultidimensionalarrayisthetwo-dimensionalarray.Atwo-

dimensionalarrayis,inessence,alistofone-dimensionalarrays.Todeclareatwo- dimensional integer array of size [x][y], you would write something as follows −

typearrayName[x][y];

- Wheretype canbe anyvalid Cdata type andarrayNamewillbe avalid Cidentifier.
- A two-dimensional array can be considered as a table which will have x number of rows and y number of columns.
- A two-dimensional array a, which contains three rows and four columns can be shown as follows −

	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, everyelement inthearraya is identified byanelementnameof theforma[i][j], where 'a' is the name of the array, and 'i' and 'j' are the subscripts that uniquelyidentify each element in 'a'.

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 stringfollowed 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."

chargreeting[6]={'H','e', 'l','l', 'o','\0'};

- If you follow the rule of array initialization then you can write the above statement as follows −

chargreeting[]="Hello";

- FollowingisthememorypresentationoftheabovedefinedstringinC/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. Letus tryto printtheabove mentionedstring− Live Demo

```
#include <stdio.h>
intmain()
{
    char greeting[6] = {'H', 'e', 'l', 'l', 'o', '\0'};
    printf("Greetingmessage:%s\n",greeting);
    return 0;
}
```

Pointers

- 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 sameasterisk used for multiplication.

- Thereareafewimportantoperations,whichwewilldowiththehelpofpointersvery frequently.
- Wedefinea pointervariable,
- assigntheaddressofavariable toa pointerand
- Finallyaccessthevalueattheaddressavailableinthepointer variable.
- This is done by using unary operator * that returns the value of the variable located at the addressspecifiedby itsoperand. The following examplemakesuseoftheseoperations –

```
#include<stdio.h>
int main () {
intvar=20;/*actualvariabledeclaration*/  int
*ip; /* pointer variable declaration */
ip=&var;/*storeaddressof varinpointervariable*/
printf("Address of var variable: %x\n", &var );
/* address stored in pointer variable */
printf("Addressstoredinipvariable:%x\n",ip);
/* access the value using the pointer */
printf("Valueof*ipvariable:%d\n",*ip); return
0;
}
```

PointerExpressionandPointerArithmeticProgramming, Assignments using the above features.

- Pointers are used to point to address the location of a variable. A pointer is declared bypreceding the name of the pointer by an asterisk (*).
- Syntax:

```
datatype*pointer_name;
```

- When we need to initialize a pointer with variable's location, we use ampersand sign(&) before the variable name.

```
//Declarationofintegervariable int
var=10;
//Initializationofpointervariable  int
*pointer=&var;
```

➢ The ampersand (&) isused to get the address of a variable.We can directlyfind the

location of any identifier by just preceding it with an ampersand (&) sign.

Example:

```
//Thiscodeprintstheaddressof x
#include <stdio.h>
```

```
int main()
{
  intx =10;
//Printsaddressofx
  printf("Addressofvariablex=%p",&x);
  return 0;
}
```

PointerArithmetic Programming

Pointer in c is an address, which is a numeric value. Therefore, you can perform arithmetic operations on a pointer just as you can on a numeric value. There are four arithmetic operators that can be used on pointers: ++, --, +, and -

To understand pointer arithmetic, let us consider that ptr is an integer pointer whichpoints to the address 1000. Assuming 32-bit integers, let us perform the following arithmetic operation on the pointer −ptr++

After the above operation, the ptr will point to the location 1004 because each time ptr is incremented, it will point to the next integer location which is 4 bytes next to the current location. This operation will move the pointer to the next memory location without impacting the actual value at the memory location. If ptr points to a character whose address is 1000, then the above operation will point to the location 1001 because the next character will be available at 1001.

Incrementinga Pointer

Weprefer using a pointer in our program instead of an array because the variable pointer can be incremented, unlike the array name which cannot be incremented because it is a constant pointer. The following program increments the variable pointer to access each succeeding element of the array −

```
#include<stdio.h>
constintMAX=3;
void main ()
{
    intvar[]={10,100, 200};
    inti, *ptr;
    ptr = var;   /*letushavearrayaddressinpointer*/ for (
    i = 0; i< MAX; i++)
    {
      printf("Addressofvar[%d]=%x\n",i,ptr);
      printf("Value of var[%d] = %d\n", i, *ptr );
      ptr++;     /* move to the next location */
    }
}
```

Output
```
Addressofvar[0]=bf882b30 Value
of var[0] = 10
Addressofvar[1]=bf882b34
Value of var[1] = 100
Addressofvar[2]=bf882b38
Value of var[2] = 200
```

Decrementinga Pointer

The same considerations apply to decrementing a pointer, which decreases its value by the number of bytes of its data type as shown below −

```
#include<stdio.h>
constintMAX=3;
int main ()
{

  intvar[]={10, 100, 200};
 inti, *ptr;
 ptr=&var[MAX-1];/* let ushave arrayaddressin pointer*/ for ( i
 = MAX; i> 0; i--)
 {
   printf("Addressof var[%d]=%x\n",i-1,ptr);
   printf("Value of var[%d] = %d\n", i-1, *ptr );
   ptr--;/* move to the previous location */
 }
 return0;
}
```

Output

```
Addressofvar[2]=bfedbcd8
Value of var[2] = 200
Addressofvar[1]=bfedbcd4
Value of var[1] = 100
Addressofvar[0]=bfedbcd0
Value of var[0] = 10
```

Pointer Comparisons

Pointers may be compared by using relational operators, such as ==, <, and >. If p1 and p2 point to variables that are related to each other, such as elements of the same array, then p1 and p2 can be meaningfully compared.

The following program modifies the previous example − one by incrementing the variable pointer so long as the address to which it points is either less than or equal to the address of the last element of the array, which is &var[MAX - 1] −

Example

```
#include<stdio.h>
constintMAX=3;
int main ()
{
  intvar[]= {10,100, 200};
  inti, *ptr;
  /* let ushave addressof thefirstelement inpointer*/ ptr
  = var;
  i=0;
  while ( ptr<= &var[MAX- 1])
  {
    printf("Addressofvar[%d]=%x\n",i,ptr);
```

```
          printf("Valueofvar[%d]=%d\n",i,*ptr);
          /*pointtothenextlocation*/ ptr++;
         i++;
       }
        return0;
      }
```

Output

```
Addressofvar[0]=bfdbcb20 Value
of var[0] = 10
Address ofvar[1]=bfdbcb24

Value of var[1] = 100
Addressofvar[2]=bfdbcb28
Value of var[2] = 200
```

Structure andUnion(Onlyconcepts,No Programming)

Whatis astructure?

Astructureis auser defineddata typein C. Astructurecreates a data typethat can be used to group items of possibly different types into a single type.

Howtocreateastructure?

ˉ**struct**‖keywordisusedtocreateastructure.

Followingisan example

```
          structaddress
          {
            charname[50];

            charstreet[100];
            char city[50];
            char state[20];
            int pin;
          };
```

How todeclarestructure variables?

- Astructurevariablecaneitherbedeclaredwithstructuredeclarationorasaseparate declaration like basic types.
- Avariabledeclarationwithstructuredeclaration.
```
          struct Point
          {
            int x,y;
          }p1;
           Thevariablep1isdeclaredwith'Point'.
```
- Avariabledeclarationlikebasicdatatypes

```
                    structPoint
                    {
                        int x,y;
                    };
                    int main()
                    {
                        structPointp1; //The variable p1isdeclared likea normalvariable
                    }
```

Union

- A union is a special data type available in C that allows storing different data types in the same memory location.
- You can define a union with manymembers,but onlyone member can contain a value at any given time.
- Unionsprovideanefficientwayofusingthesamememorylocationformultiple purposes.

Defining aUnion:

- To define a union,you mustusethe unionstatementin the same way asyoudidwhile defining a structure.
- Theunionstatementdefinesanewdatatypewithmorethanonememberforyour program.
- Theformatoftheunionstatementis asfollows:

```
                    union [union name]
                    {
                    memberdefinition;
                    member definition;
                    ...
                    member definition;
                        };
```

	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 considering the 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.

Standard LibraryFunctions

Many basic housekeeping functions are available to a C program in form of standard library functions. To call these, a program must #include the appropriate .h file. Most compilers link in the standard library code by default. The functions listed in the next section are

themostcommonlyused ones,but there aremanymore which arenot listed here.

stdio.h	file input and output
ctype.h	charactertests
string.h	stringoperations
math.h	mathematicalfunctionssuchassin()andcos()
stdlib.h	utility functions such as malloc() andrand()
assert.h	the assert() debugging macro
stdarg.h	supportforfunctionswithvariablenumbersofarguments
setjmp.h	support for non-local flow controljumps
signal.h	supportforexceptionalconditionsignals
time.h	date andtime
limits.h,	float.hconstantswhichdefinetyperangevaluessuchasINT_MAX

ExamplesofadvanceprogramminginC
ExampleofArrayInC programmingtofindouttheaverageof4integers

```
#include<stdio.h>
int main()
{
    intavg=0;
    intsum=0;
    int x=0;
    intnum[4];/*Array-declaration-length4*/
    for(x=0;x<4;x++)/*Weare usingforloopto traverse throughthe*/
    {
        printf("Enternumber%d\n",(x+1));
        scanf("%d", &num[x]);
    }
    for(x=0;x<4;x++)
    {
      sum =sum+num[x];
    }
    avg=sum/4;
    printf("Averageofenterednumberis:%d",avg);
    return 0;
}
```

Output:
Enternumber1
10
Enternumber 2
10
Enternumber 3
20
Enternumber 4
40
Average of enterednumber is:20

Exampleto print theaddressof arrayelements

```c
#include<stdio.h>
int main( )
{
  intval[7] = {11, 22,33, 44, 55,66,77 };
  /*forlooptoprint value andaddressof each element of array*/ for (
  inti = 0 ; i< 7 ; i++ )
  {
    printf("val[%d]:valueis%dandaddressis%d\n",i,val[i],&val[i]);
  }
  return0;
}
```

Output:

```
val[0]:valueis11andaddressis1423453232
val[1]:valueis22andaddress      is1423453236
val[2]:valueis33andaddressis1423453240
val[3]:valueis44andaddressis1423453244
val[4]:valueis55andaddressis1423453248
val[5]:valueis66andaddressis1423453252
val[6]: valueis77andaddress is 1423453256
```

Example:PassingPointer toaFunction inC

```c
#include<stdio.h>
voidsalaryhike(int*var,intb)
{
    *var= *var+b;
}
int main()
{
  intsalary=0,bonus=0;
  printf("Entertheemployeecurrentsalary:");
  scanf("%d", &salary);
  printf("Enter bonus:");
  scanf("%d", &bonus);
  salaryhike(&salary, bonus);
  printf("Finalsalary:%d",salary);
  return 0;
}
```

Output:

```
Entertheemployeecurrentsalary:10000
Enter bonus:2000
Finalsalary:12000
```

ExampleforSwappingtwonumbersusingPointers

```c
#include<stdio.h>
voidswapnum(int*num1,int*num2)
```

```c
{
    int tempnum;
    tempnum=*num1;
    *num1= *num2;
    *num2= tempnum;
}
intmain()
{

    int v1 = 11, v2 = 77 ;
    printf("Before swapping:");
    printf("\nValueofv1is:%d",v1);
    printf("\nValueofv2is:%d",v2);
    /*calling swap function*/
    swapnum( &v1, &v2 );
    printf("\nAfter swapping:");
    printf("\nValueofv1is:%d",v1);
    printf("\nValueofv2is:%d",v2);
}
```

Output:

Beforeswapping:
Valueofv1is:11
Valueofv2is:77
After swapping:
Valueofv1is:77
Valueofv2 is: 11

Example:Programto find the sizeof an array

```c
#include<stdio.h>
int main()
{
    doublearr[]={11,22, 33,44,55,66};
    intn;
    /*Calculatingthesizeofthearraywiththis  formula.
     * n = sizeof(array_name) /sizeof(array_name[0])
     * Thisisauniversalformulatofindnumberofelementsin
     * anarray, which meansitwillworkforarrays of alldata
     * types suchas int,char,floatetc.
     */
    n = sizeof(arr) / sizeof(arr[0]);
    printf("Sizeof thearrayis:%d\n",n);
    return 0;
}
```

Output:

Sizeofthearrayis:6

Example:ProgramtoCalculateStandardDeviation

```c
#include<math.h>
#include<stdio.h>
floatcalculateSD(floatdata[]);
int main()
{
    int i;
    float data[10];
    printf("Enter10elements:");

  for (i = 0; i< 10; ++i)
    scanf("%f",&data[i]);
    printf("\nStandardDeviation=%.6f",calculateSD(data));
    return 0;
}
floatcalculateSD(floatdata[])
{
    floatsum =0.0,mean,SD=0.0; int i;
    for(i=0; i<10;++i)
    {
        sum += data[i];
    }
    mean = sum / 10;
    for(i=0;i<10;++i)
        SD+=pow(data[i]-mean,2);
    return sqrt(SD / 10);
}
```

OutputEnter 10 elements:1
2
3
4
5
6
7
8
9
10
StandardDeviation=2.872281

Example:ProgramtoAddTwo Matrices

```c
#include<stdio.h>
int main()
{
    intr,c,a[100][100],b[100][100],sum[100][100],i,  j;
    printf("Enterthenumberof rows(between1 and100):");
    scanf("%d", &r);
    printf("Enterthenumberof columns(between1and100):");
```

```c
        scanf("%d",&c);
        printf("\nEnterelementsof1stmatrix:\n"); for
        (i = 0; i< r; ++i)
            for(j=0;j<c;++j)
            {
                printf("Enterelement a%d%d:",i+1, j+1);
                scanf("%d", &a[i][j]);
            }

        printf("Enter elements of 2nd matrix:\n");
            for (i = 0; i< r; ++i)
                for(j=0;j<c; ++j)
                {
                    printf("Enterelementa%d%d:",i+1,j+1); scanf("%d",
                    &b[i][j]);
                }
                for(i=0;i<r;++i)//addingtwomatrices for (j
    = 0; j < c; ++j)
        sum[i][j]=a[i][j]+b[i][j];
    printf("\nSum of two matrices: \n");    //printingtheresult
    for (i = 0; i< r; ++i)
        for(j=0;j<c;++j)
        {
                printf("%d",sum[i][j]); if
                (j == c - 1)
                {
                    printf("\n\n");
                }
            }
        return0;
    }
```

Output

```
Enter the number of rows (between 1 and 100): 2
Enterthenumberof columns(between1 and100):3
Enter elements of 1st matrix:
Enterelementa11:2
Enterelementa12:3
Enterelementa13:4
Enterelementa21:5
Enterelementa22:2
Enterelementa23:3
Enterelementsof2ndmatrix:
Enter element a11: -4
Enterelementa12:5
Enterelementa13:3
Enterelementa21:5
Enterelementa22:6
Enterelementa23:3
Sum oftwomatrices:
```

```
-2  8  7
1086
```

Example: MultiplyMatrices byPassing it to aFunction

```c
#include<stdio.h>
//functiontogetmatrix elementsenteredbytheuser
voidgetMatrixElements(intmatrix[][10],introw,intcolumn)
{
  printf("\nEnterelements:\n");
  for (inti=0;i< row;++i)
  {
    for (intj = 0;j <column;++j)
    {
      printf("Entera%d%d: ",i+1,j+1);
      scanf("%d", &matrix[i][j]);
    }
  }
}


//functiontomultiplytwomatrices
voidmultiplyMatrices(intfirst[][10],intsecond[][10],intresult[][10],intr1,intc1,int r2, int c2)
{
  //Initializingelementsofmatrixmultto0. for
  (int i = 0; i< r1; ++i)
  {
    for (intj =0; j <c2; ++j)
    {
      result[i][j]= 0;
    }
  }

  //Multiplyingfirstandsecondmatricesandstoringitinresult for (int
  i = 0; i< r1; ++i) {
    for (intj= 0; j< c2; ++j){
      for(intk=0; k<c1;++k){
        result[i][j]+=first[i][k]*second[k][j];
      }
    }
  }
}
//functiontodisplaythe matrix
voiddisplay(intresult[][10],introw,intcolumn){ printf("\nOutput
  Matrix:\n");
  for(inti =0;i<row;++i){
    for(intj=0;j<column;++j){
      printf("%d", result[i][j]);
```

```c
                if(j==column-1)
                  printf("\n");
              }
          }
      }

      int main()
      {

       intfirst[10][10],second[10][10],result[10][10], r1,c1,r2,c2;
         printf("Enter rows and column for the first matrix: ");
         scanf("%d %d", &r1, &c1);
         printf("Enterrowsandcolumnforthesecondmatrix:");
         scanf("%d %d", &r2, &c2);
         //Takinginputuntil
         //1stmatrixcolumnsisnotequal to 2ndmatrixrow while
         (c1 != r2)
          {
            printf("Error! Enter rows and columns again.\n");
            printf("Enterrowsandcolumnsforthefirstmatrix:");
            scanf("%d%d", &r1, &c1);
            printf("Enterrowsandcolumnsforthesecondmatrix:");
            scanf("%d%d", &r2, &c2);
          }
          getMatrixElements(first, r1, c1);// get elements of the first matrix
          getMatrixElements(second, r2, c2);// get elements of the second matrix
          multiplyMatrices(first,second,result,r1,c1,r2,c2);// multiplytwomatrices.
          display(result, r1, c2);// display the result
          return0;
      }
```

Output

```
Enterrowsandcolumnforthefirstmatrix:2 3
Enterrowsandcolumnforthesecondmatrix:3  2

Enterelements:
Enter a11: 2
Entera12:-3
Entera13:4
Entera21:53
Entera22:3
Entera23:5

Enterelements:
Enter a11: 3
Entera12:3
Entera21:5
Entera22:0
```

Entera31:-3
Entera32:4

OutputMatrix:
-2122

159179

Example:ProgramtoFind the TransposeofaMatrix

```c
#include<stdio.h>
int main()
{
    inta[10][10],transpose[10][10],r,c,i,j;
    printf("Enter rows and columns: ");
    scanf("%d %d", &r, &c);
    // Assigning elements to the matrix
    printf("\nEntermatrixelements:\n");
    for (i = 0; i< r; ++i)
      for(j=0;j<c;++j)
      {
        printf("Enterelement a%d%d:",i+1, j+1);
        scanf("%d", &a[i][j]);
      }

    //Displayingthematrixa[][]

      printf("\nEnteredmatrix:\n");
      for (i = 0; i< r; ++i)
      for(j=0;j<c;++j)
      {
        printf("%d",a[i][j]); if
        (j == c - 1)
        printf("\n");
      }
    //FindingthetransposeofmatrixA for
      (i = 0; i< r; ++i)
        for(j=0;j<c;++j)
        {
          transpose[j][i]=a[i][j];
        }
    //Displayingthetransposeofmatrixa
    printf("\nTranspose of the matrix:\n");
    for (i = 0; i< c; ++i)
        for(j=0; j<r;++j)
```

```c
        {
          printf("%d",transpose[i][j]); if
          (j == r - 1)
             printf("\n");
        }
      return0;
    }
```

Output

```
Enterrowsandcolumns:2 3
Entermatrix elements:
Enter element a11: 1
Enter element a12: 4
Enter element a13: 0
Enterelementa21:-5
Enter element a22: 2
Enter element a23: 7

Enteredmatrix:
140
-527

Transposeofthe matrix:
1-5
42
0   7
```

Using Call byReference

```c
        #include<stdio.h>
        voidcyclicSwap(int*a,int*b,int*c); int
        main()
        {
           int a, b,c;
           printf("Entera,bandcrespectively:");
           scanf("%d %d %d", &a, &b, &c);
           printf("Value before swapping:\n");
           printf("a =%d \nb =%d \nc=%d\n",a, b, c);
           cyclicSwap(&a, &b, &c);
           printf("Valueafterswapping:\n");
           printf("a =%d \nb =%d \nc=%d",a,b, c);
           return 0;
        }
        voidcyclicSwap(int*n1,int*n2,int  *n3)
        {
           int temp;
           //swappingincyclic order
```

```
            temp=*n2;
            *n2=*n1;
            *n1=*n3;
            *n3=temp;
        }
```

Output

```
Entera,bandcrespectively:1 2
3
Valuebefore swapping:
a=1
b=2
c=3
Valueafter swapping:
a=3
b=1
c=2
```

SolvedQuestions

ShortAnswerTypeQuestions.

Whatisanarray?What isitsimportance inC? *(2015-Summer)*

Ans:-

Arrays a kind of data structure that can store a fixed-size sequential collection ofelements of the same type. An array is used to store a collection of data, but it is often more useful to think of an array as a collection of variables of the same type.

Whatisasingledimensionalarray?Howcanitbeinitialized? Ans:-

1D Arrays in C language -A list of items can be given one variable name using only one subscript and such a variable is called single sub-scripted variable or one dimensional array.

Whatarethevariousstringoperations? Ans:-

strcat - concatenate two strings. strchr -string scanning operation. strcmp - compare two strings. strcpy -copy a string.

Howcanyoureverseastring?
Ans:-Cprogramtoreverseastring int

```
main()
{
chars[100];
printf("Enterastringtoreverse\n");gets(s);
strrev(s);
printf("Reverseofthestring:%s\n",s); return
0;
}
```

LongAnswerTypeQuestions.

Write a program to find the sum of even numbers of an array? *(2017-Summer)*
Ans:

```c
#include<stdio.h>
main()
{
 int a[10],i,sum=0;
```

```c
printf("Enter upto 5 Values:"); for(i=0; i<5; i++)
scanf("%d",&a[i]); for(i=0;i<5;i++)
{
if(a[i]%2==0)
sum=sum+a[i];
 }
printf("TotalSumofEvenvaluesis:%d",sum);
getch();
}
```

Output :
```
Enter upto 5 Values: 2 3 5 4 7
TotalSumofEvenvaluesis:6
```

Write a program which prints the smallest element? **Ans:**

```c
#include<stdio.h>

int main()
{
  int a[30], i, num, smallest;
  printf("\nEnternoofelements:");
  scanf("%d", &num);
  //Readnelementsinanarray for
  (i = 0; i< num; i++)
    scanf("%d",&a[i]);
  //Considerfirstelementassmallest
  smallest = a[0];
  for(i=0;i< num;i++)
 {
    if(a[i] <smallest)
    {
      smallest=a[i];
    }
 }
 //Printout theResult
 printf("\nSmallestElement:%d",smallest);
 return (0);
}
```

Output:
```
Enternoofelements:5 11
44 22 55 99
SmallestElement:11
```

EXERCISE

ShortAnswerTypeQuestions.

Whatisamulti-dimensionalarray?Howisitinitialized? *(2017-Summer)*

Howcana two-dimensionalarraybedeclaredinC program?

Whatisbuilt-infunction? Givesomeexampleofthesefunctions?

Givesomeexamplesof Function Prototypes?

Differentiatebetween strcat()andstrcpy()?

Howcanyou applyarithmeticoperationsonstrings?

Howisastructuredifferent orsimilarfrom/toan array?

Howcanyoucreate structurevariables?*(2015-Summer)*

Howcan youdefinearray withinstructures?

Defineaunion?*(2014-Winter)*

Howcanyou declarea union?

Defineapointer? *(2015-Winter)(2016-Winter)*

Whatistherelationbetweenpointersandarrays?*(2015-Summer)*

Whatisthefunctionofmalloc()libraryfunction?

Whatis themeaningofreference?

What isaddressoperator?

Givean exampleof pointerinitialization?

Brieflyexplaintheassociationbetweenonedimensionalarraysandpointers?

Explaintherelationbetweenpointersandfunctions?

LongAnswerTypeQuestions

Writeaprogram whichreplaceseveryblankspaceina stringwith underscore?

Howcan you calculatethe size of anarray? Illustrate with the help of example. *(2014-Summer)*

How we can calla function by

    i. Reference

    ii. Value

Write a Cprogram which illustratespassingof argumentsbyreference? *(2016-*

Summer)

Write aprogramwhichreadsa stringand prints thenumberof wordsinit?

Whatisthedifferent between putc()andputs()and putchar()functions?**(2016-Winter)**

****

Chapter-wiseMultipleChoiceQuestions

CHAPTER-1:MCQ

The"0"and"1"inthebinarynumberingsystemarecalledBinarydigitsorknownas:

a) Bytes
b) Kilobytes
c) Bits
d) Kilobits

Ans:c) Bits

ThegenerationbasedonVLSI microprocessor:

a) 1st
b) 2nd
c) 3rd
d) 4th

Ans:d) 4th

ULSI stands for?

a) UltraLargeScaleIntegration
b) UnderLowerScaleIntegration
c) UltraLowerScaleIntegration
d) UnderLargeScaleIntegration

Ans:a)UltraLargeScaleIntegration

The period of _____generationwas1952-1964.

a) 1st
b) 2nd
c) 3rd
d) 4th

Ans:b) 2nd

Thebrainof anycomputersystem is:

a) ALU
b) Memory

c) CPU
d) ControlUnit

Ans:c) CPU

CD-ROMisa:

a) Semiconductormemory
b) Memoryregister
c) Magneticmemory
d) Noneofabove

Ans:d)Noneofabove

Ahybrid computer:

a) Resemblesdigitalcomputer
b) Resemblesanaloguecomputer
c) Resemblesbothadigitalandanaloguecomputer
d) Noneofthe above

Ans:c)Resemblesbothadigitalandanaloguecomputer

Whatwasthecomputerinventedby AttanasoffandClifford?

a) Mark I
b) ABC
c) Z3
d) Noneofabove

Ans:b)ABC

Whichofthe followingis notaninputdevice?

a) OCR
b) Opticalscanners
c) Voicerecognitiondevice
d) COM(ComputerOutputtoMicrofilm)

Ans:d)COM(ComputerOutputtoMicrofilm)

Whenwas vacuumtube invented?

a) 1900
b) 1906
c) 1910
d) 1880
Ans:b) 1906

Whatdoespartnumber, partdescriptionandnumberofpartsorderedbelongto?

a) Output
b) Input
c) Feedback
d) Control

Ans:b)Input

CPU is mainlyresponsiblefor:

a) Calculations
b) Processingthe data
c) Both1and2
d) Neither 1nor2

Ans:c)Both1and2

Whatisthe useof control unitofamicroprocessor?

a) Toacceptinputdatafromkeyboard
b) Toperformarithmeticandlogicfunctions
c) Tostore data in memory
d) Alloftheabove

Ans:b)Toperformarithmeticandlogicfunctions

IntheCPUofa computer, the logicalunitis mainlyresponsiblefor :

a) Controlflowof information
b) Comparingnumbers
c) Producingresult
d) Mathematicaloperation

Ans:b)Comparingnumbers

CPUis made upof two main components,and theyare:

a) Registersandmainmemory
b) Controlunitandregisters
c) ALU andbus

d) ControlunitandALU

Ans:d)ControlunitandALU

Abitisthemeasuringunitofthewidthofaprocessor'sdatapath.Commonlyused data path is of:

a) 24bits
b) 32bits
c) bits
d) 16bits

Ans:c) 8bits

Whatisthecombinationwithwhichcentralprocessing unitismade?

a) Arithmeticlogicandcontrolunit
b) Controlandstorage
c) Controlandoutputunit
d) Alloftheabove

Ans:a)Arithmeticlogicandcontrol unit

Whichlanguageisthesetofrulesthattellsthecomputerwhatoperationto perform?

a) Programminglanguage
b) Commandlanguage
c) Procedurallanguage
d) Structures

Ans:a)Programminglanguage

Whichoneofthefollowingstatementistrue forthe machine language?

a) Programswerefirstwritteninthislanguage
b) Computerunderstandsonlythislanguage
c) Itdiffersfromcomputerto computer
d) Alloftheabove

Ans:d) All oftheabove

Thelanguagewhichis understood bythe computer is:

a) Machinelanguage
b) Lowlevellanguage
c) Highlevellanguage
d) Alloftheabove

Ans:a)Machinelanguage

Junke-mailisalsocalled:

a) spam
b) spoof
c) snifferscript
d) spool
   Ans:a) spam

Office LANS, which are scattered geographically on large scale, can be connected by the use of corporate:

a) CAN
b) DAN
c) LAN
d) WAN

   Ans:d)WAN

Thedeviceusedtocarrydigital dataonanaloguelinesiscalledas:

a) Modem
b) Multiplexer
c) Modulator
d) Demodulator
   Ans:a) Modem

Malicioussoftwareisknown as:

a) Badware
b) Malware
c) Maliciousware
d) Illegalware
   Ans:b) Malware

A program that performs a useful task while simultaneously allowing destructiveacts is:

a) Worm
b) Trojanhorse

c) Virus
d) Macrovirus
   Ans:b)Trojanhorse

Whatisthenameofanapplicationprogramthatgathersuserinformationand sends it to someone through the Internet ?

a) A virus
b) Spybot
c) Logic bomb
d) Securitypatch
   Ans:b) Spybot

ISDNstandsfor:

a) IntegratedServicesDigitalNetwork
b) IntegratedSubscriberDigitalNetwork
c) InternetServicesDigitalNetwork
d) IntegratedSeveralDigitalNetwork
   Ans:a)IntegratedServicesDigitalNetwork

Whichofthe followingis anetworktopology?

a) LAN
b) WAN
c) MAN
d) BUS
   Ans:d)BUS

Thefirstwebbrowser is:

a) Mosaic
b) Netscape
c) Internetexplorer
d) Collabra
   Ans:a)Mosaic

Whichoneoffollowingaresetofrulesandprocedurestocontrolthedata transmission over the internet:

a) IPaddress
b) Domains
c) Protocol
d) Gateway
   Ans:c)Protocol

CHAPTER-4: MCQ

Q.1 **Which one of following iscollection of related fields that can be treated as a unitby**

some application program:

a) field
b) record
c) file
d) database

Ans:b) record

Whichofthe followingisnotapartoftheusage information ?

a) datacreated
b) identityofcreator
c) owner
d) last datemodified

Ans:c) owner

Severalinstructionsexecutionsimultaneouslyin:

a) processing
b) parallelprocessing
c) serialprocessing
d) multitasking

Ans:b)parallelprocessing

Aterm that refersto thewayinwhich thenodesof a network arelinked together:

a) network
b) topology
c) connection
d) interconnectivity

Ans:b) topology

TheDetailsviewshowallof thefollowingabouta file EXCEPT:

a) name
b) size
c) type
d) password

Ans:d) password

Aneasywayto sortfilesisto:

a) rightclickonafileinDetailsview
b) clickonthecolumnheaderinDetailsview
c) clickthesorticoninDetailsview
d) alphabetizethem

Ans:b)clickonthecolumnheaderinDetailsview

Aftercreatingafilemanagementsystemonyourcomputer, youshoulddoallof the following EXCEPT:

a) deletefilesthatarenolongerneeded
b) movefilestoappropriatefolders
c) renamefolderstobemoremeaningful
d) runtheTask Management

Ans:a)deletefilesthat are nolonger needed

Whenyouright-clickonafolderontheharddriveandchooseDelete, thefiles:

a) areerased
b) gointotheRecycleBin
c) aremovedintotheheadersectionoftheharddrive
d) gointotheOldDocumentsfolder

Ans:b)gointotheRecycle Bin

One ofthe firststepswhencreating afilemanagementsystem is to :

a) createnewfolders
b) deletefilesthatwillbemoved
c) changetoDetailsview
d) selectmultiplefiles

Ans:a)createnew folders

Folder names should:

a) usenumbersonly
b) beasshortas possible
c) notcontainspaces
d) bemeaningfulandrecognizable

Ans:d)bemeaningfulandrecognizable

CHAPTER-5: MCQ

AnAlgorithm represented in the form of programming languages is_____

a) Flowchart
b) Pseudo code
c) Program
d) None

Ans:c)Program

Keep the statement language _____whilewritingapseudocode.

a) Dependent
b) Independent
c) Casesensitive
d) Capitalized

Ans:b)Independent

FlowchartsandAlgorithmsareusedfor

a) Better Programming
b) EasytestingandDebugging
c) EfficientCoding
d) All

Ans:d)All

Whichofthefollowingis nota keyword?

a) Read
b) Write
c) Start
d) Endif

Ans:c)Start

_____isusedtoshow hierarchyinapseudocode.

a) Indentation
b) CurlyBraces
c) Round Brackets
d) Semicolon

Ans:a) Indentation

_____areidentifiedbytheiraddresses,wegivethemnames(fieldnames/variablen ames)usingwords.

a) Memoryvariables
b) MemoryLocations
c) MemoryAddresses
d) Datavariables

Ans:b) Memory Locations

_____beginswith lowercase letters.

a) Keywords
b) Variables
c) Tokens
d) Functions

Ans:b)Variables

Asymbol used for grouping.

a) ()
b) {}
c) []
d) ‖

Ans:a)()

Astatementused to close theIF block.

a) ELSE
b) ELSEIF
c) END
d) ENDIF

Ans:d)ENDIF

Instructurallanguage,wecan't addanewsort of

a) Loop
b) Function
c) Variable
d) Constant

Ans:a)Loop

CHAPTER-6: MCQ

WhoinventedCLanguage?

a) CharlesBabbage
b) Grahambel
c) DennisRitchie
d) SteveJobs

Ans:c)Dennis Ritchie

C is _____typeofprogramminglanguage?

a) ObjectOriented
b) Procedural
c) Bitlevel language
d) Functional

Ans:b)Procedural

AC program is acombination of?

a) Statements

b) Functions
c) Variables
d) Allofthe above

Ans:d)All of theabove

TypesofIntegersare?

a) short
b) int
c) long
d) Alltheabove

Ans:d)Allthe above

Choose acorrectstatementaboutC break; statement?

a) break;statement canbeusedinsideswitch block
b) break;statement canbe usedwith loopslikefor,while anddo while.
c) break; statement causesonlythesameorinnerloop wherebreak; ispresent to quit suddenly.
d) Alltheabove.

Ans:d)Allthe above.What isthe outputof theC Program?

```
int main()
{
   if( 4<5)
       printf("Hurray..\n");
       printf("Yes");
   else
       printf("England")

   return0;
}
```

a) Hurray..Yes
b) Hurray..
   Yes
c) Compilererror
d) Noneofthe above

Ans:c)Compilererror

Operator%in CLanguageiscalled?

a) PercentageOperator
b) QuotientOperator
c) Modulus
d) Division

Ans:c)Modulus

Canyou useC Modulo Divisionoperator%withfloat and int?

a) Onlyintvariables=Okay
b) Onlyfloatvariables= Okay
c) intorfloatcombination=Okay
d) Numeratorintvariable,Denominatoranyvariable=Okay

Ans:a)Onlyintvariables =Okay

Whichloopis faster in CLanguage, for,while or DoWhile?

a) for
b) while
c) dowhile
d) Allwork atsamespeed

Ans:d)All work at samespeed

Whatistheoutputof Cprogramwithswitchstatementor block?

```
int main()
{
int a;

switch(a);
{

printf("DEER");
}

printf("LION");
}
```

a) LION
b) DEER LION
c) Compilererror
d) Noneofthe above

Ans:b) DEERLION

CHAPTER-7: MCQ

Q.1ChoosecorrectstatementaboutFunctionsinCLanguage.

a) A Function isagroupofcstatements whichcanbe reusedanynumberoftimes.
b) EveryFunctionhasa returntype.
c) EveryFunction mayno maynotreturnavalue.
d) Allthe above.

Ans:d)Allthe above.

Q.2Afunctionwhichcallsitselfiscalleda_____function.

a) SelfFunction
b) AutoFunction
c) RecursiveFunction
d) StaticFunction

Ans:c)Recursive Function

Q.3HowmanyvaluescanaCFunctionreturnatatime?

a) OnlyOneValue
b) Maximumoftwovalues
c) Maximumofthreevalues
d) Maximumof8 values

Ans:a)OnlyOne Value

Q.4WhataretypesofFunctionsinCLanguage?

a) LibraryFunctions
b) UserDefinedFunctions
c) BothLibraryandUser Defined
d) Noneofthe above

Ans:c) BothLibraryandUser Defined

Q.5EveryCProgramshouldcontainwhichfunction?

a) printf()
b) show()

c) scanf()
d) main()

Ans:d)main()

Q.6 WhatisthemaximumnumberofstatementsthatcanpresentinaCfunction?

a) 64
b) 128
c) 256
d) Noneofthe above

Ans:d) None ofthe above

Q.7 ArgumentspassedtoafunctioninClanguagearecalled_____arguments.

a) Formalarguments
b) ActualArguments
c) DefiniteArguments
d) Ideal Arguments

Ans:b) ActualArguments

Q.8 AnarrayIndexstartswith?

a) -1
b) 0
c) 1
d) 2

Ans:b)0

Q.9 WhatistheoutputofCprogramwitharraysandpointers?

```
int main()
{
inta[3]={20,30,40};
int*p[3];
p=&a;
printf("%d",*p[0]);
}
```

a) 20
b) addressofelement20
c) Garbagevalue
d) Compilererror

Ans:d)Compilererror

Q.10 WhatisactuallypassedtoPRINTForSCANFfunctions?

a) Valueof String
b) AddressofString
c) EndaddressofString
d) Integerequivalentvalueof String

Ans:b) AddressofString

REFERENCES

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