LEARNING MATERIAL
On
Computer Application
Of
1st/2nd semester of all Engineering Branches

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Contents

CHAPTER-1: COMPUTER ORGANISATION

1.1 IntroductiontoComputer

- Computerisanelectronicdevicethatoperates(works)underthecontrolofprogramsstoredinitsown memoryunit.
- Acomputerisanelectronicmachinethatprocessesrawdatatogiveinformationasoutput.
- An electronic device that accepts data as input, and transforms it under the influence of aset of special instructions called Programs, to produce the desired output (referred to asInformation).

Explanations

- Acomputerisdescribedasanelectronicdevicebecause;itismadeupofelectroniccomponentsanduse selectricenergy(suchaselectricity)tooperate.
- Acomputerhasaninternalmemory,whichstoresdata&instructionstemporarilyawaitingproce ssing,andevenholdstheintermediateresult(information)beforeitiscommunicatedtotherecip ientsthroughtheOutputdevices.
- It works on the data using the instructions issued, means that, the computer cannot do anyusefuljobonitsown.Itcanonlyworkasperthesetofinstructionsissued.
- A computer will accept data in one form and produce it in another form. The data isnormallyheldwithinthecomputerasitisbeingprocessed.

Program:

- AcomputerProgramisasetofrelatedinstructionswritteninthelanguageofthecomputer&isusedto makethecomputerperformaspecifictask(or,todirectthecomputeronwhattodo).
- Asetofrelatedinstructionswhichspecifyhowthedataistobeprocessed.
- Asetofinstructionsusedtoguideacomputerthroughaprocess.

Data:

- Data is a collection of raw facts, figures or instructions that do not have much meaning totheuser.
- Data may be in form of numbers, alphabets/letters or symbols, and can be processed toproduceinformation.

TypesofData

Therearetwotypes/formsofdata:

a). Digital(discrete)data:

Digitaldataisdiscreteinnature.Itmustberepresentedinformofnumbers,alphabetsorsymbolsforittobeprocessedbyacomputer.Digitaldatais obtainedbycounting.E.g.1,2,3…

b). Analogue(continuous)data:

Analogue data is continuous in nature. It must be represented in physical nature in order to beprocessedbythecomputer.•Analoguedataisobtainedbymeasurement.E.g.Pressure,Temperature, Humidity, Lengths or currents, etc. The output is in form of smooth graphs fromwhichthedatacanberead.

DataProcessing:

- Itistheprocessofcollectingallitemsofdatatogether&convertingthemintoinformation.
- Processingreferstothewaythedataismanipulated(orhandled)toturnitintoinformation.
- The processing may involve calculation, comparison or any other logic to produce therequired result. The processing of the data usually results in some meaningful informationbeingproduced.

Information:

- Information is the data which has been refined, summarized & manipulated in the way youwantit,orintoamore meaningfulformfordecision-making.
- Theinformationmustbeaccurate,timely,completeandrelevant.

1.2 EvolutionofComputers

Computerevolution refersto thechangein computertechnology rightfromthe timecomputerswerefirstusedtothepresent.Ascomputingevolvestohighersystemlevels,soitsdesignalsochanges,fromtechnicaltosocio-technicaldesign.

Theseriesoftheevolutionofcomputersaregivenbelow.

- ✓ Abacus
- ✓ Pascaline
- ✓ Differenceengine
- ✓ Punchedcardequipment
- ✓ ABC
- ✓ UNIVAC-I

Abacus

- Thepresentdaycomputers arearesultofanevolutionaryprocesswhichstartedwaybackin500B.C.whenEgyptianusedamachinewhichisanearlyformofAbacus.
- HoweverthepresentformofAbacusisattributedtotheChineseandJapanese.
- Thisisamachine,whichwasusedforaddition,subtraction,multiplicationanddivisionoperation.

Pascaline

- In1645adeviceknownasPascalinewasinventedbyFrenchmathematicianBlaisePascal.
- Themachinewasalsousedperadditionandsubtractionpurpose.
- Thedevicewasoperatedbydialingasetofwheels.
- In1671LeibnizimprovedonPascal'saddingmachineandinventedtheLeibniz'sCalculator.

Differenceengine

- In1822CharlesBabbageinventedaDifferenceEngine.
- ThepurposeofthisdevicewastocalculatetherootsofpolynomialequationsandprepareastronomytablefortheBritishNavy.
- Heupgradedthisto,inventanAnalyticalengine,whichcouldstoreprograminstructionsinitially codedonpunchedcards andsubsequentlysharedinternally.
- ThereforeCharlesBabbageisknownasthefatherofcomputers.

Punchedcardequipment

- In1890Dr.H.Hollerithdevelopedpunchedcardequipment.
- Thisequipmentreadtheholespunchedinthecardandmechanicallyperformedthestatisticalanalysis.

ABC(Atanasoff-BerryComputer)

- ThefirstpureelectroniccomputerwasinventedbyJ.V.AtanasoffandC.BerrywhichisknownasAtanasoff-BerryComputerorABC.
- Itusedvacuumtubesforbothdatastorageanddatacomputation.
- SubsequentlyElectronicNumericalIntegratorandCalculator(ENIAC)wasdesignedandacceptedasthegeneralpurposecomputer.

UNIVAC

- In 1945 John Von Neumann first gave the idea of sharing the same internal memory forstoring both data and instruction, which was subsequently adopted in every computerorganization.
- OnthisprinciplesubsequentlyUniversalAutomaticComputer(UNIVAC-1)wasinvented

1.3 GenerationofComputers

Computers are devices that accomplish tasks or calculations in accordance to a set ofdirections,orprograms.Thefirstfullyelectroniccomputers,introducedinthe1940s,werevoluminousdevicesthatrequiredteamsofpeopletohandle.Incomparisontothosenew

machines,today'scomputersareastounding.Theyarenotonlythousandsoftimesmoreexpeditious, but also they can fit on your desk, on your lap, or even in your pocket. Computers aresuchanintegralpart ofoureverydaylifenow mostpeopletakethemforgranted.

Computers work through an interaction of hardware and software. The whole picture ofthe computer goes back to decades. However there are five apparent generations of computers.Each generation is defined by a paramount technological development that changes necessarilyhow computers operate – leading to more compressed, inexpensive, but more dynamic, efficientandboomingmachines.

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 costing resources to run.
Thesewereineffectivematerialswhichproduceahugeamountofheat,suckedenormouselectricityand subsequentlyengendered an abundance of heatwhich caused perpetualbreakdowns.

These first generation computers relied on 'machine language' (which is the most fundamentalprogramming language that can be understood by computers). These computers were limited tosolving one problem at a time. Input was predicated on punched cards and paper tape. Outputemergedonprint-outs.Thetwoeminentmachinesof this erawaretheUNIVACand ENIACmachines – the UNIVAC is the first ever commercial computer which was purchased in 1951 by abusinessnamedastheUSCensusBureau.

SecondGeneration–Transistors(1956–1963)

The supersession of vacuum tubes by transistors, visualized the onset of the second generation ofcomputing. Although first invented in 1947, transistors weren't used considerably in computersuntilthecessationofthe1950s.Theywereahugedevelopmentoverthevacuumtube,despite thefactstillsubjectingcomputerstodestroyingdifferentlevelsofheat.Howevertheywereextremelysu perior to the vacuum tubes, making computers smaller, more expeditious, inexpensive and lessburdensome onelectricity use.Theystillcountonpunched cardforinput/printouts.

Thelanguageemergedfromstrangebinarylanguagetosymbolic('assembly')languages.Thesemeant programmers could discover instructions in words. Meanwhile during the same time highcaliberprogramminglanguageswerebeingdeveloped(earlyversions ofCOBOLandFORTRAN).Transistor-driven machines were the first computers to store instructions into their recollections,peregrinatingfrommagneticdrumtomagneticcore'technology'.Theanticipatoryversionsoft hesemachineswerecreatedfortheatomicenergyindustry.

ThirdGeneration–IntegratedCircuits(1964–1971)

Bythisphase,transistorswerenowbeingminiaturizedandputonsiliconchips.Thisledtoahugeimprove mentinspeedandeffectivenessofthesemachines.Thesewerethefirstcomputerswhereusers interacted utilizing keyboards and monitors who interfaced with an operating system, aconsequential leap up from the punch cards and printouts. This facilitated these machines to runvariousapplicationsatonceutilizingacentralprogramwhichfunctionedtomonitormemory.

Asaresultoftheseadvanceswhichagainmademachinesmorereasonableandmoretiny,abrand newgroupofusersemergedduringthe'60s.
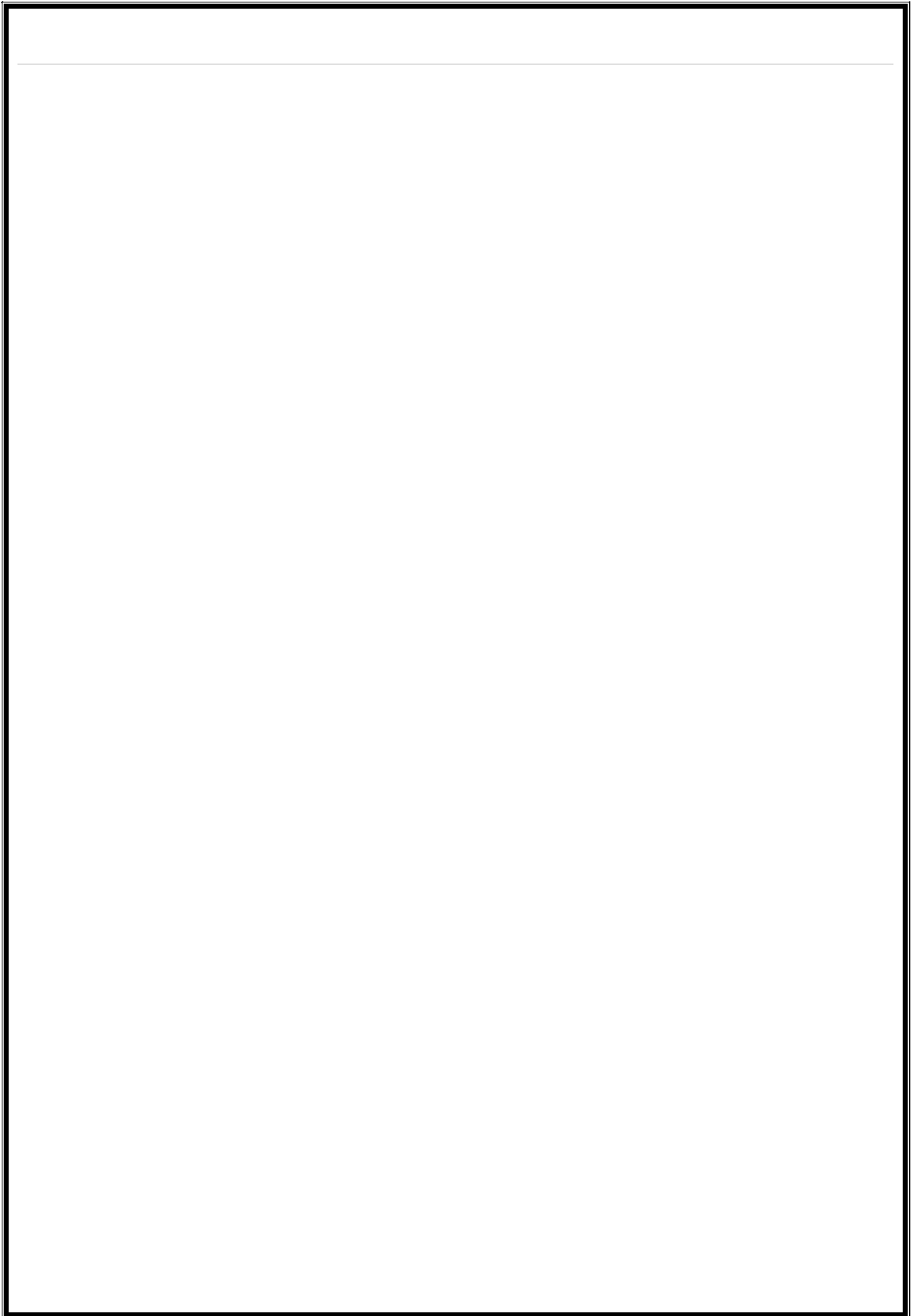
FourthGeneration–Microprocessors(1972–2010)

Thisinnovationcanbedefinedinoneword:Intel.Thechip-makeraccomplishedtheIntel4004chipin1971,whichlocatedallcomponentsofcomputersuchasCPU,recollection,input/outputcontrols onto a single chip. What overcrowded a room in the 1940s now gets fit in the palm of thehand.TheIntelchipcontainedthousandsofunifiedcircuits.Theyear1981sawthefirstevercomputer (IBM) categorically designed for home use and 1984 saw the Macintosh introduced byApple.Microprocessorseventransformedbeyondtherealmofcomputersandintoanincrementingnumberofeverydayproducts.

The incremented power of these small computers denoted they could be linked, establishingnetworks. Which eventually led to the expansion, birth and rapid evolution of the Internet? Otherprimary advances during this period have been the Graphical user interface (GUI), the mouse andmore oflatethestartlingadvancesin laptopcapabilityand hand-held contrivances.

FifthGeneration–ArtificialIntelligence(2010Onwards)

Computerdeviceswithartificialpotentialityarestillindevelopment,butsomeofthesetechnologiesare commencingtoemergeandbeusedsuchasvoicerecognition.AIisanauthenticity, made possible by adopting parallel processing and superconductors. Inclining to thefuture, computers will be thoroughly revolutionized again by quantum computation, molecularandnanotechnology.Theessenceoffifthgenerationwillbeutilizingthesetechnologiestoultimately engender machines which can proceed and acknowledge natural language, and haveefficiencytodetermineandorganizethemselves.

SummaryofGenerationofcomputers

Features	1stGeneration Computer	2ndGeneration Computer	3rdGeneration Computer	4thGenerationComputer
Main Switching Device	VacuumTube	Transistor	Integrated Circuit(IC)	Large ScaleIntegration(LSI)&VLSI
ComponentSize	6000 circuits/cubicfoot	10000 circuits/cubicfoot	10 millionscircuits/cubicfoot	Over 500 billioncircuits/cubicfoot
Number ofinstructions/sec.	250	30,000	2,00,000	80Millions
Meantimebetweenfailure	Hour	Days	Weeks	Months
Internal memorycapacity	4000characters	30000 characters	5,12,000 characters	Over 4 millioncharacters
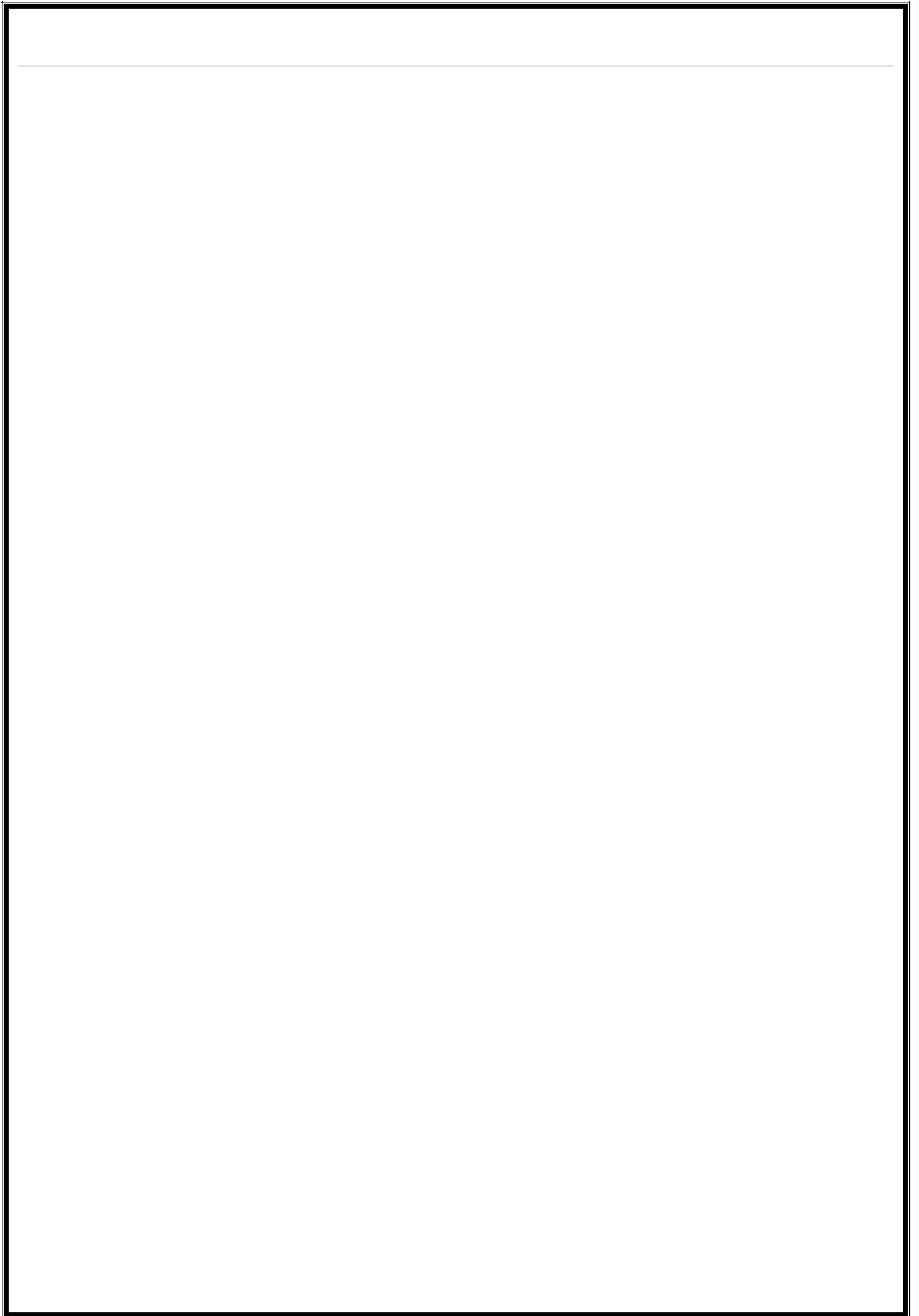
1.4 ClassificationofComputers

Allthemoderncomputersarebroadlyclassifiedintothefollowingthreecategories.

(i) AnalogComputer.

(ii) DigitalComputerand

(iii) HybridComputer.

Analogcomputers

- Aremostlyusedinindustriesinprocesscontrolactivities.
- These computers work on analog data such as variation in temperature, pressure, speed,voltageetc.
- They are not general purpose computers; rather they are specific to a particular applicationarea.Thereforethecostofsuchcomputervariesfromapplicationtoapplicationdependingonthecomplexity.
- Theusesofsuchcomputersareverylimited.

Digitalcomputers

- Thesecomputersaregeneralpurposecomputers,whichworkondigital/binarydata.
- Thespeedandaccuracywithwhichthesecomputersworkareveryhigh.
- Digitalcomputersarealsohavingseveralrangesfromsupercomputerstopersonalcomputers.

Hybridcomputers

- PracticallyHybridcomputerareusedtocontroltheentireprocess.
- The analog feature of such computer enables it to measure the physical quantities such atemperature,pressure,voltageleveletc.and convert them todigitaldata.
- Thesedataarethenprocessedbythecomputerbyusingitsdigitaldataprocessingcapability.
- The output from this computer may be taken in a paper as hardcopy, may be seen on adisplay device or may be converted intoanalog form to automatically control variousprocesses.

Digitalcomputers

Digitalcomputersareclassifiedintothefollowingfourcategories:

- o SuperComputers.
- o MainframeComputers.
- o MiniComputers.
- o MicroComputer

Supercomputers

- Thesecomputersarespecificallydesignedtomaximizetheprocessingoffloatingpointinstructions.
- Thisispossiblebecauseofparallelprocessingtechniquewhichimplementsmultipleprocessorstoworkinparallelmanner.
- Suchcomputersareveryexpensiveandusedinveryhigh-endnumericalprocessing,geographicalinformationsystem,etc.
- Some of the popular supercomputersare Cray, Param, Anupametc.
- ThespeedofprocessingofsupercomputersaremeasuredinGFLOPSi.e.,GigaFloatingPointOperationsPerSecond.
- Thesecomputersusedtheirownoperatingsystemandprogramminglanguageandhencevaryfromcomputertocomputer.

Mainframecomputers

Thesecomputersareintendedforsubstantialhighvolumedataprocessing.

Thesecomputersarecharacterizedby–

- Largeprimarymemory.
- Substantialprocessingcapabilities.(MIPS)
- Substantialamountofperipheraldevicesthatcanbeattached.
- Ahighdatacommunicationcapabilityi.e.abilitytoconnectthousandsofterminals.
- Widevarietyofmemorysizeandterminalsupportoption.
- Abilitytohandle largetypecomputerapplication.

ApplicationofMainframeComputer

- spaceresearch,
- universityconnectivity,
- Wideareanetwork(WAN)implementationetc.

Specificationofmainframecomputers.

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

MiniComputers

- Fairlylargeprimarymemory.
- Mediumscaleprocessingcapabilityi.e.,lesserthanmainframebuthigherthanpersonalcomputers.
- Can connect up to500 terminalson LAN.
- Supportswiderangeofapplicationareas.
- Affordable,unlikemainframecomputersbysmallbusinessorganization.

The application of minicomputers

- Thefieldofengineeringandscientificorganizations,
- EducationalInstitutes,
- Universities,
- Small/mediumbusinessorganizations.

Thesecomputersaremainlyusedformediumorlargevolumedataprocessingactivity.

Specificationofminicomputer

- Processingspeed–10to30MIPS.
- Wordlength–32bits.
- I/Odevice–WiderangeofI/Odevicescanbeconnect.
- Internalstorage–66MBto512MB.

Microcomputers

ThisisthesmallestandleastexpensivecomputersareorpersonalcomputerspopularlyknownasPC.

Typicalfeatures.

- Thesecomputersareportable.
- Theyrequireminimumpower.
- Processingpowerisappropriateforhandlingmostofthetasks.
- Memorycapacityissufficienttohandlemostofthetasks.
- Easeofuseandsupporttovarioustypesofoperatingsystemsandapplicationsoftwares.
- Affordablepricetag.
- Thesemicrocomputersarefurtherclassifiedintothreecategoriesi.e.,PC,PC-XTandPC-AT.

TypicalSpecificationsofPC

- Processor–I8086/I8088microprocessor.
- Memory–640KBofRAM
- Two360KFloppyDiskdrive.
- NumericalProcessor–I8087.
- Systembus–8bitdatabus&16bitaddressbus.
- Clockspeed–8MHz

PersonalComputer

- A PC-XT or Personal Computer with extended technology is an Up gradation of thePC. It is having all the features discussed above. Apart from these the concept ofsecondarymemory/massstorageintheformofharddiskdrive,wasintroducedforthefirsttime.
- ThepresentdaysPC are PC-ATorpersonalcomputerwith advancedtechnology.

FeaturesofPC-AT

- Processor–I80386/80486/Pentium.
- Memory–2MBto512MB.
- Floppydiskdrive1.44MB
- Harddiskdrive1.2MBto80GB.
- Systembus–32bitto64bit.
- Clockspeed–Upto3GHz
- OperatingSystem–MS-DOS,Windows,UNIX,Linuxetc.

1.5 Basic OrganizationofComputer(FunctionalBlockdiagram),InputDevices,CPU&OutputDevices.

A digital computer is considered to be a calculating device that can perform arithmetic operationsat enormous speed. It is defined as a device that operates upon information/data. To be able toprocessdatathecomputerismadeofvariousfunctionalunitstoperformitsspecifiedtask.

BlockDiagramofComputer

Block diagram of computer
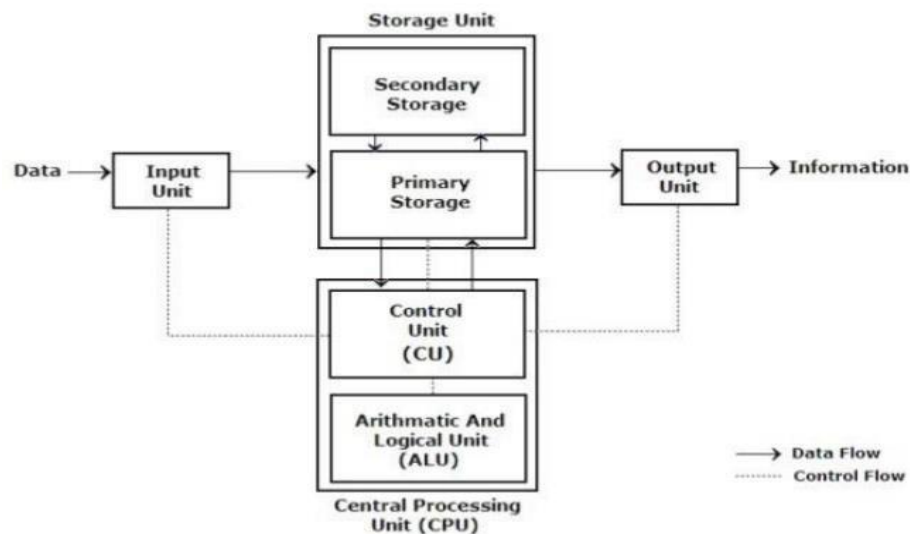
InputDevice:

Computersneedtoreceivedataandinstructioninordertosolveanyproblem.Therefore,weneedto input the data and instructions into the computers. The input unit consists of one or more inputdevices.**Keyboard**istheoneofthemostcommonlyusedinputdevice.Othercommonlyusedinputdevic esarethe**Mouse,Scanner,Microphone**etc.Alltheinputdevicesperformthefollowingfunctions.

- Acceptthedataandinstructionsfromtheoutsideworld.
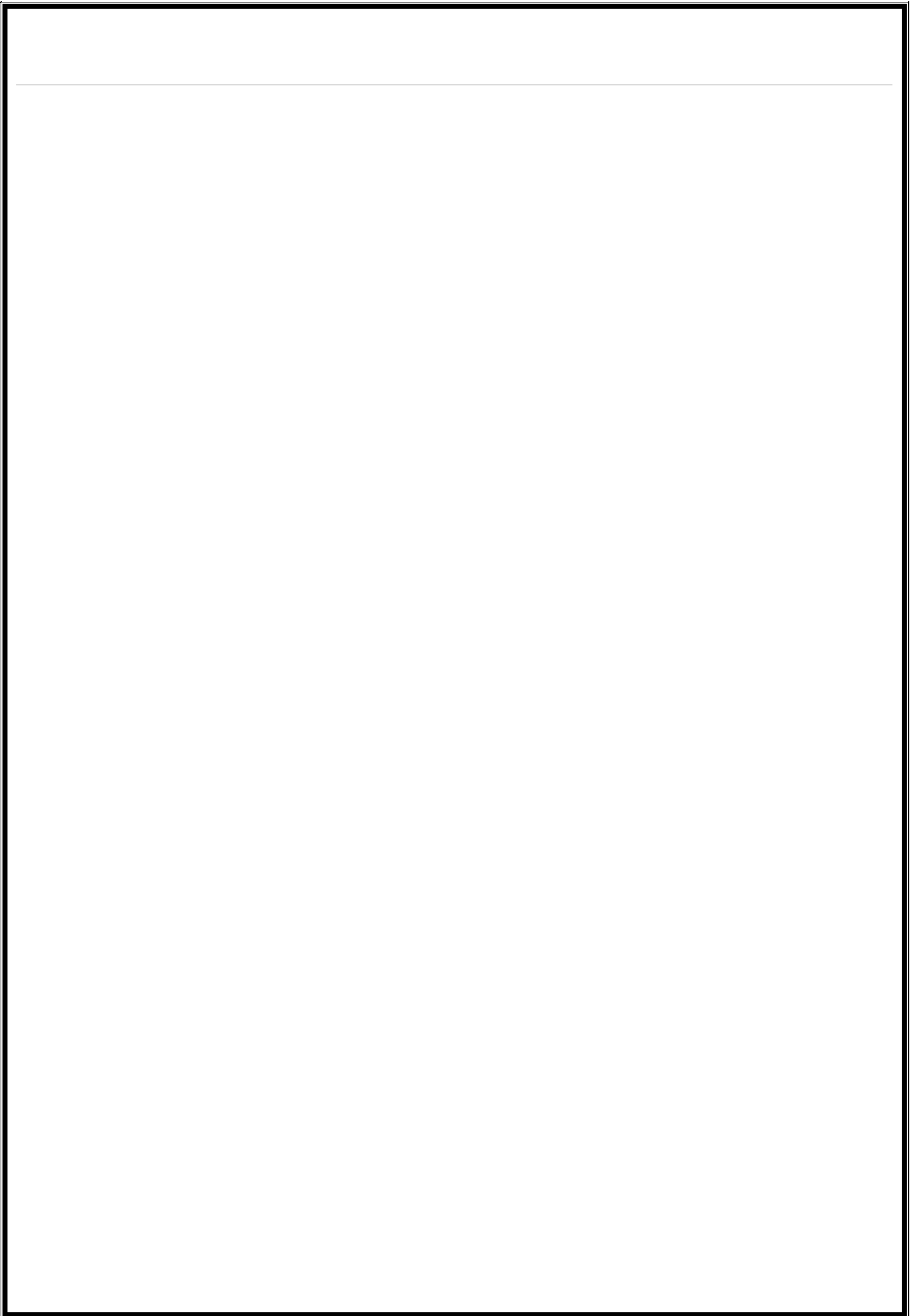
- Convertittoaformthatthecomputercanunderstand.
- Supplytheconverteddatatothecomputersystemforfurtherprocessing.

CentralProcessingUnit:

The Control Unit (CU) and Arithmetic Logic Unit (ALU) of the computer are together known astheCentralProcessingUnit(CPU).TheCPUislikebrainperformsthefollowingfunctions:

- Itperformsallcalculations.
- Ittakesalldecisions.
- Itcontrolsallunitsofthecomputer.

ArithmeticLogicalUnit:

- All calculations are performed in the Arithmetic Logic Unit (ALU) of the computer. It alsodoescomparisonandtakesdecision.TheALUcanperformbasicoperationssuchasaddition, subtraction,multiplication,division,etcanddoeslogic operations viz, >, <, =,'etc. Whenever calculations are required, the control unit transfers the data from storageunit to ALU once the computations are done, the results are transferred to the storage unitby thecontrolunitandthen itissendtotheoutputunitfordisplayingresults.

ControlUnit:

- It controls all other units in the computer. The control unit instructs the input unit, where tostore the data afterreceiving it from the user. Itcontrols theflow of data andinstructionsfromthestorageunittoALU.ItalsocontrolstheflowofresultsfromtheALUtothestora geunit.

- The control unit is generally referred as the central nervous system of the computer thatcontrolandsynchronizesit'sworking.

OutputDevice:

- The output unit of a computer provides the information and results of a computation tooutside world. Printers, Visual Display Unit (VDU) are the commonly used output devices.Other commonlyused outputdevicesareSpeaker, Headphone,andProjectoretc.

StorageUnit:

Thestorageunitofthecomputerholdsdataandinstructionsthatareenteredthroughtheinputunit,beforethe yareprocessed.Itpreservestheintermediateandfinalresultsbeforethesearesenttotheoutputdevices.Ital osavesthedataforthelateruse.Thevariousstoragedevicesofacomputersystemaredividedintotwocategori es.

a) PrimaryStorage: Storesandprovidesveryfast.Thismemoryisgenerallyusedtoholdtheprogram beingcurrentlyexecutedin the computer,the databeingreceivedfrom theinputunit,theintermediateandfinalresultsoftheprogram.Theprimarymemoryistemporaryin nature.Thedataislost,whenthecomputerisswitchedoff.Inordertostorethedatapermanently,thedatahast obetransferredtothesecondarymemory.Thecostoftheprimarystorageismorecomparedtothesecondarys torage.Therefore,mostcomputersshavelimitedprimarystoragecapacity.

b) Secondary Storage: Secondary storage is used like an archive. It stores several programs,documents,databasesetc.Theprogramsthatyourunonthecomputerarefirsttransferredtotheprimarymemorybeforeitisactuallyrun.Whenevertheresultsaresaved,againtheygetstoredinthe secondary memory. The secondary memory is slower and cheaper than the primary memory.SomeofthecommonlyusedsecondarymemorydevicesareHarddisk,CD,etc.,

MemorySize:

- Alldigitalcomputersusethebinarysystem,i.e.0'sand1's.Eachcharacteroranumberis representedbyan8-bitcode.
- The set of 8 bits is called a byte. A character occupies 1-byte space. A numeric occupies 2-bytespace.Byteisthespaceoccupiedinthememory.
- The size of the primary storage is specified in KB (Kilobytes) or MB (Megabyte). One KB isequal to 1024 bytes and one MB is equal to 1000KB. The size of the primary storage in atypical PC usually starts at 16MB. PCs having 32 MB, 48MB, 128 MB, 256MB memory arequitecommon.

1.6 ComputerMemoryandClassificationofMemory

- Computermemoryisa generictermforallofthedifferenttypesofdatastoragetechnologythatacomputermayuse,includingRAM,ROM,andflashmemory.
- Some types of computer memory are designed to be very fast, meaning that the centralprocessing unit (CPU) can access data stored there very quickly. Other types are designedtobeverylowcost,sothatlargeamountsofdatacanbestoredthereeconomically.
- Another way that computer memory can vary is that some types are non-volatile, whichmeans they can store data on a long term basis even when there is no power. And sometypesarevolatile,whichareoftenfaster,butwhichloseallthedatastoredonthemassoonasthepowerisswitchedoff.
- A computer system is built using a combination of these types of computer memory, andthe exact configuration can be optimized to produce the maximum data processing speedortheminimum cost,orsomecompromisebetweenthetwo.

TypesofComputerMemory:PrimaryandSecondary

- Although many types of memory in a computer exist, the most basic distinction is betweenprimary memory, often called system memory, and secondary memory, which is morecommonlycalledstorage.
- Thekeydifferencebetweenprimaryandsecondarymemoryisspeedofaccess.
- Primary memory includes ROM and RAM, and is located close to the CPU on the computermotherboard, enabling the CPU to read data from primary memory very quickly indeed. Itis used to store data that the CPU needs imminently so that it does not have to wait for it tobedelivered.
- Secondary memory by contrast, is usually physically located within a separate storagedevice, such as a hard disk drive or solid state drive (SSD), which is connected to thecomputer system either directly or over a network. The cost per gigabyte of secondarymemory ismuch lower,but theread and writespeeds are significantlyslower.
- Overseveralperiodsofcomputerevolution,awideofarrayofcomputermemorytypeshasbeendeployed,eachwithitsownstrengthsandweaknesses.
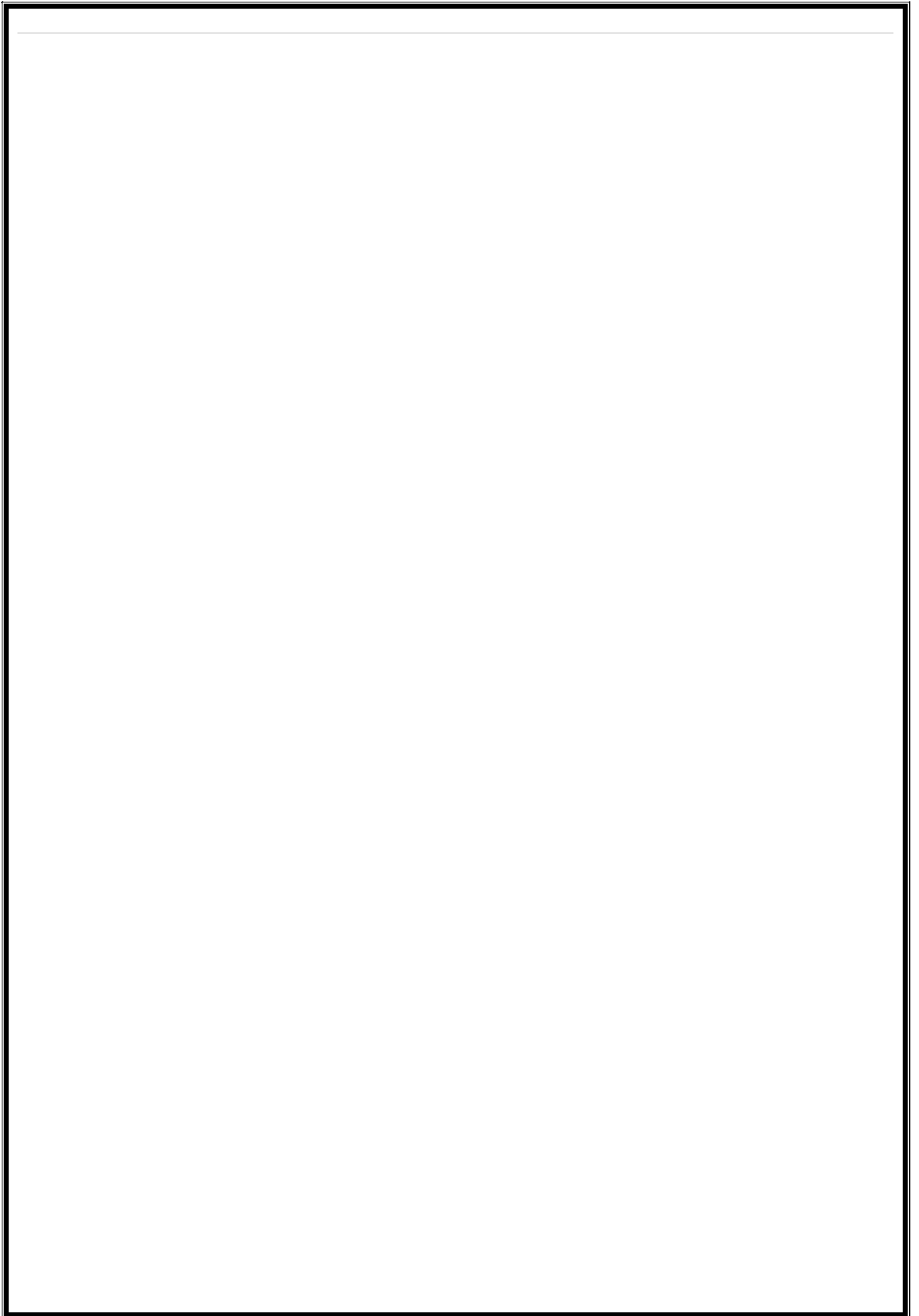
PrimaryMemoryTypes:RAMandROM

Therearetwokeytypesofprimarymemory:

- **RAM,orrandomaccess memory**
- **ROM,orread-onlymemory**

Let'slookin-depthatbothtypesofmemory.

1) RAMComputerMemory

TheacronymRAMstemsfromthefactthatdatastoredinrandomaccessmemorycanbeaccessed – as the name suggests – in any random order. Or, put another way, any random bit of data can beaccessedjustasquicklyasanyotherbit.

The most important things to understand about RAM are that RAM memory is very fast, it can bewritten to as well as read, it is volatile (so all data stored in RAM memory is lost when it losespower) 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 memorytypes thatmostcomputersystemsusebothprimaryand secondarymemory.

Data that is required for imminent processing is moved to RAM where it can be accessed andmodified 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 freedupisfilledwiththenextchunkofdatathatisabouttobeused.

TypesofRAM

DRAM:DRAMstandsforDynamicRAM,anditisthemostcommontypeofRAMusedincomputers. The oldest type is known as single data rate (SDR) DRAM, but newer computers usefaster dual data rate (DDR) DRAM. DDR comes in several versions including DDR2 , DDR3, andDDR4,whichofferbetterperformanceandaremoreenergyefficientthanDDR.Howeverdifferentve rsions are incompatible, so it is not possible to mix DDR2 with DDR3 DRAM in a computersystem.DRAMconsistsofatransistorandacapacitorineachcell.

SRAM:SRAMstandsforStaticRAM,anditisaparticulartype ofRAMwhich is faster thanDRAM,butmore expensiveandbulker,havingsixtransistorsineachcell.For those reasonsSRAMis generally onlyusedas adatacache within aCPU itself or as RAM in very high-endserver systems. A small SRAM cache of the most imminently-needed data can result in significantspeedimprovementsinasystem

The key differences between DRAM and SRAM are that SRAM is faster than DRAM - perhaps twoto three times faster - but more expensive and bulkier. SRAM is usually available in megabytes,whileDRAMispurchasedingigabytes.

DRAM uses more energy than SRAM because it constantly needs to be refreshed to maintain dataintegrity,whileSRAM-though volatile–doesnotneedconstantrefreshingwhenitispoweredup.

2) ROMComputerMemory

ROM stands for read-only memory, and the name stems from the fact that while data can be readfrom this type of computer memory, data cannot normally be written to it. It is a very fast type ofcomputermemorywhichisusuallyinstalledclosetotheCPUonthemotherboard.

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 thatsenseitis similartosecondarymemory,whichisusedforlongterm storage.

When a computer is turned on, the CPU can begin reading information stored in ROM without theneed 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 becomeaware of the operating system stored in secondary memory, and to load parts of the operatingsystemintoprimarymemorysothatitcanstartup and becomereadytouse.

ROMisalsousedinsimplerelectronicdevicestostorefirmwarewhichrunsassoonasthedeviceisswitchedon.

TypesofROM

ROMisavailableinseveraldifferenttypes,includingPROM,EPROM,andEEPROM.

PROM: PROM stands for Programmable Read-Only Memory, and it is different from true ROM inthat while a ROM is programmed (i.e. has data written to it) during the manufacturing process, aPROM is manufactured in an empty state and then programmed later using a PROM programmerorburner.

EPROM:EPROMstandsforErasableProgrammableRead-OnlyMemory,andasthenamesuggests, data stored in an EPROM can be erased and the EPROM reprogrammed. Erasing anEPROM involves removing it from the computer and exposing it to ultraviolet light before re-burningit.

EEPROM: EEPROM stands for Electrically Erasable Programmable Read-Only Memory, and thedistinction between EPROM and EEPROM is that the latter can be erased and written to by thecomputer system it is installed in. In that sense EEPROM is not strictly read-only. However inmany cases the write process is slow, so it is normally only done to update program code such asfirmwareorBIOScodeonanoccasionalbasis.

SecondaryMemory

Weknowthatprocessormemory,alsoknownasprimarymemory,isexpensiveaswellaslimited.The faster primary memory is also volatile. If we need to store large amount of data or programspermanently,weneed acheaperand permanentmemory.Such memoryis called secondarymemory. Here we will discuss secondary memory devices that can be used to store large amountofdata,audio,videoandmultimediafiles.

CharacteristicsofSecondaryMemory
Thesearesomecharacteristicsofsecondarymemory,whichdistinguishitfromprimarymemory
- Itisnon-volatile,i.e.itretainsdatawhenpowerisswitchedoff
- Itislargecapacitiestothetuneofterabytes
- Itischeaperascomparedtoprimarymemory

Depending on whether secondary memory device is part of CPU or not, there are two types ofsecondarymemory–fixedandremovable.
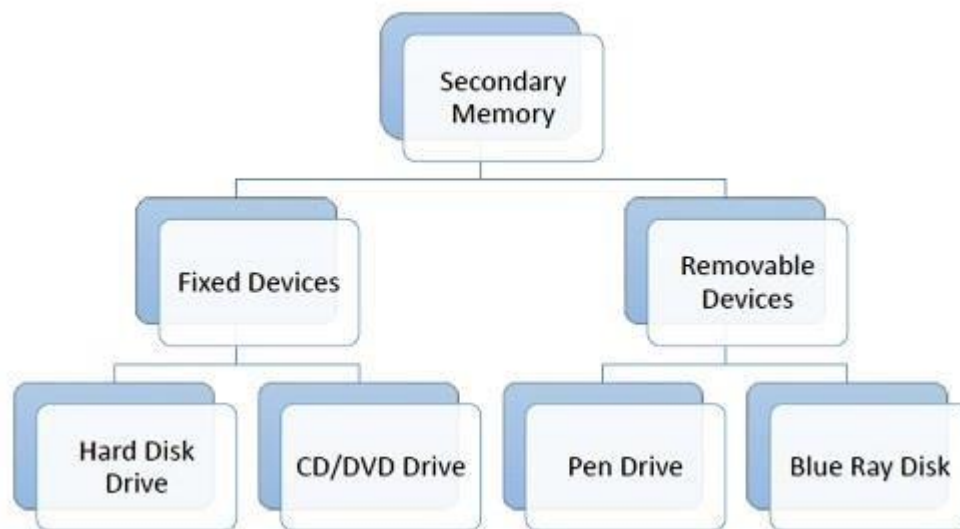
Letuslookatsomeofthesecondarymemorydevicesavailable.

HardDiskDrive

Hard disk drive is made up of a series of circular disks called platters arranged one over the otheralmost ½ inches apart around a spindle. Disks are made of non-magnetic material like aluminumalloyandcoatedwith10-20nmofmagneticmaterial.

Standard diameter of these disks is 14 inches and they rotate with speeds varying from 4200 rpm(rotationsperminute)forpersonalcomputersto15000rpmforservers.Dataisstoredbymagnetizing or demagnetizing the magnetic coating. A magnetic reader arm is used to read datafrom andwritedatato thedisks.AtypicalmodernHDDhascapacityinterabytes(TB).

CDDrive

CD stands for Compact Disk. CDs are circular disks that use optical rays, usually lasers, to readand 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 theCDandcarryitwithyou.TherearethreetypesofCDs–

- CD-ROM(CompactDisk–ReadOnlyMemory)–ThedataontheseCDsarerecordedby themanufacturer.ProprietarySoftware,audioorvideoarereleasedonCD-ROMs.
- CD-R(CompactDisk–Recordable)–DatacanbewrittenbytheuseronceontheCD-R.Itcannotbedeletedormodifiedlater.
- CD-RW(CompactDisk–Rewritable)–Datacanbewrittenanddeletedontheseopticaldisksagainandagain.

DVD Drive

DVDstandsforDigitalVideoDisplay.DVDareopticaldevicesthatcanstore15timesthedataheld by CDs. They are usually used to store rich multimedia files that need high storage capacity.DVDs alsocomeinthreevarieties–readonly,recordableandrewritable.

PenDrive

Pendrive 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 is nonvolatile. 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 128GB data.

SolvedQuestions

ShortAnswerTypeQuestions.

Q1 **Outline the key features of 1st Generation Computer in brief.** *(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.

Q2 **What is CPU?** *(2018-Summer)*

Ans. A central processing unit (CPU), also called a central processor, main processor or 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.

Q3 **What is ALU?** *(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.

Q4 **Name three input devices used in PC.** *(2016-Summer)*

Ans. The three input devices used in PC are Keyboard, Mouse and Scanner.
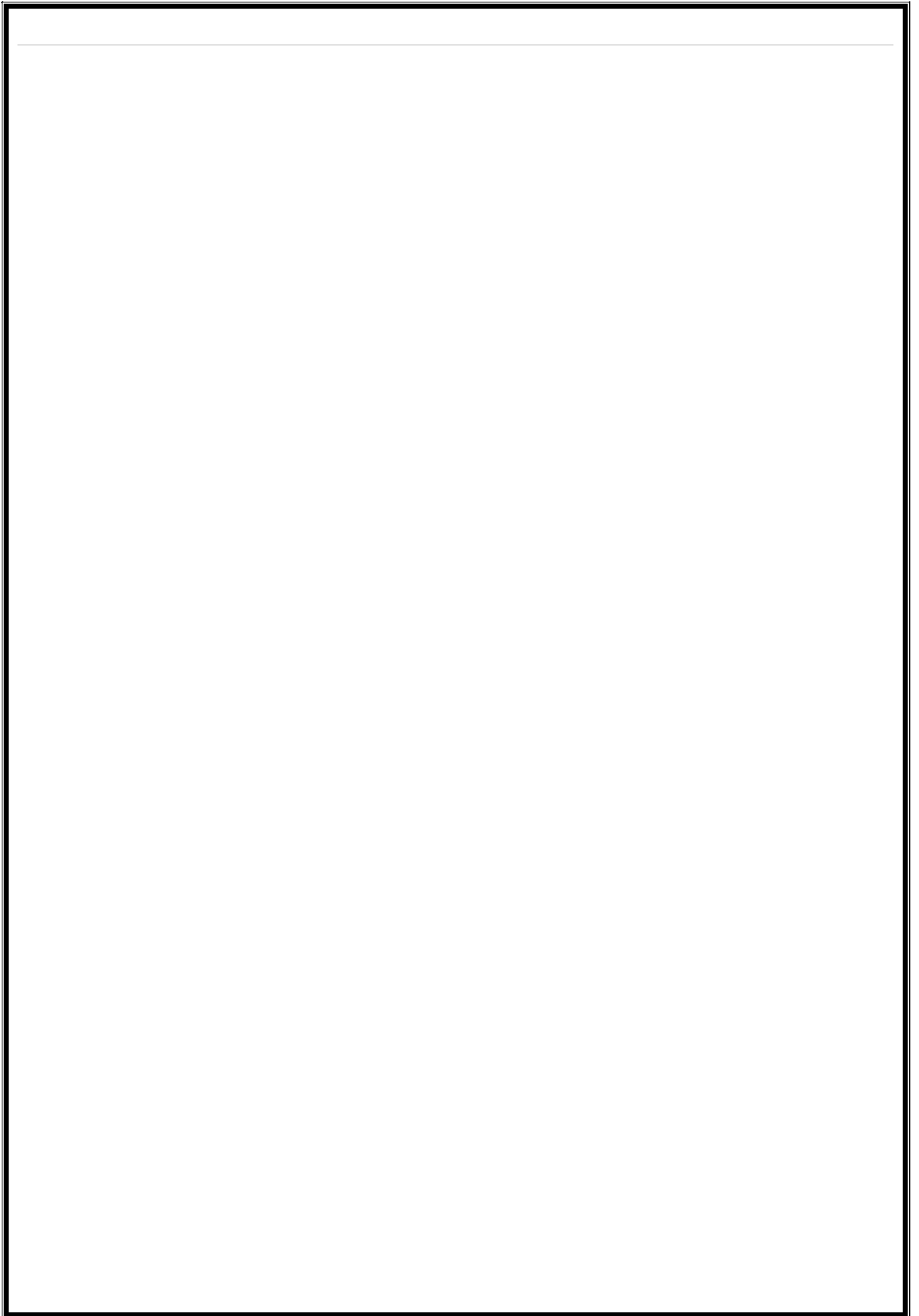
Q.1 **Discussaboutthegenerationofcomputers?Explainthekeyfeaturesof computersofeachgeneration?** *(2013-Winter)*

Ans. Acomputerisanelectronicdevicethatmanipulatesinformationordata.Ithastheabilitytostore,retrieve,andprocessdata.

Nowadays, a computer can be used to type documents, send email, play games, andbrowse the Web. It can also be used to edit or create spreadsheets, presentations, andeven videos. But the evolution of this complex system started around 1940 with thefirstGenerationofComputerandevolvingeversince.

Therearefivegenerationsofcomputers.

FIRSTGENERATION

Features:

- 1946-1959istheperiodoffirstgenerationcomputer.

- J.P.Eckert and J.W.Mauchy invented the first successful electronic computercalledENIAC,ENIACstandsfor"ElectronicNumericIntegratedandCalculator".

- FewExamplesare:ENIAC,EDVAC,UNIVAC,etc.

Advantages:

- Itmadeuseofvacuumtubeswhicharetheonlyelectroniccomponentavailableduringthosedays.

- Thesecomputerscouldcalculateinmilliseconds.

Disadvantages:

- Thesewereverybiginsize,weightwasabout30tones.

- Thesecomputerswerebasedonvacuumtubes.

- Thesecomputerswereverycostly.

SECONDGENERATION

Features:

- 1959-1965istheperiodofsecond-generationcomputer.

- SecondgenerationcomputerswerebasedonTransistorinsteadofvacuumtubes.

- FewExamplesare:Honeywell400,IBM7094,etc.

Advantages:

- Due to the presence of transistors instead of vacuum tubes, the size of electroncomponentdecreased.Thisresultedinreducingthesizeofacomputerascomparedtofirstgenerationcomputers.
- Lessenergyandnotproduceasmuchheatasthefirstgeneration.
- Assemblylanguageandpunchcards wereusedforinput.

Disadvantages:

- Acoolingsystemwas required.
- Constantmaintenancewasrequired.
- Only used forspecificpurposes.

THIRDGENERATION

Features:

- 1965-1971istheperiodofthirdgenerationcomputer.
- ThesecomputerswerebasedonIntegratedcircuits.
- ICwasinventedbyRobertNoyceandJackKilbyIn1958-1959.
- ICwasasinglecomponentcontainingnumberoftransistors.
- FewExamplesare:PDP-8,PDP-11,ICL2900,etc.

Advantages:

- Thesecomputerswerecheaperascomparedtosecond-generationcomputers.
- Theywerefastandreliable.
- UseofICinthe computerprovidesthesmallsizeofthecomputer.

Disadvantages:

- ICchips aredifficulttomaintain.
- ThehighlysophisticatedtechnologyrequiredforthemanufacturingofICchips.
- Airconditioning is required.

FOURTHGENERATION

Features:

- 1971-1980istheperiodoffourthgenerationcomputer.
- ThistechnologyisbasedonMicroprocessor.
- Amicroprocessorisusedinacomputerforanylogicalandarithmeticfunctiontobeperformedinanyprogram.
- GraphicsUserInterface(GUI)technologywasexploitedtooffermorecomforttousers.
- FewExamplesare:IBM4341,DEC10,STAR1000,etc.

Advantages:

- Fastestincomputationandsizegetreducedascomparedtothepreviousgenerationofcomputer.
- Heatgeneratedisnegligible.
- Smallinsizeascomparedtopreviousgenerationcomputers.

Disadvantages:

- TheMicroprocessordesignandfabricationareverycomplex.
- AirconditioningisrequiredinmanycasesduetothepresenceofICs.
- AdvancetechnologyisrequiredtomaketheICs.

FIFTHGENERATION

Features:

- Theperiodofthefifthgenerationin1980-onwards.
- Thisgenerationisbasedonartificialintelligence.

- The aim of the fifth generation is to make a device which could respond tonatural languageinputandarecapableoflearning andself-organization.
- ThisgenerationisbasedonULSI(UltraLargeScaleIntegration)technologyresulting in the production of microprocessor chips having ten million electroniccomponents.
- FewExamplesare: Desktop, Laptop,etc.

Advantages:
- Itismorereliableandworksfaster.
- Itisavailableindifferentsizesanduniquefeatures.
- Itprovidescomputerswithmoreuser-friendlyinterfaceswithmultimediafeatures.

Disadvantages:
- Theyneedverylow-levellanguages.
- Theymaymakethehumanbrainsdullanddoomed.

Q2 DiscussaboutthevariousinputdevicesusedinPCplatform?(2013-

Summer)**Ans.**Followingaresomeoftheimportantinputdeviceswhichareusedinacomputer–

Keyboard

Keyboardisthemostcommonandverypopularinputdevicewhichhelpstoinputdata to the computer. The layout of the keyboard is like that of traditional typewriter,althoughtherearesomeadditionalkeysprovidedforperformingadditionalfunctions.

Keyboardsareoftwosizes84keysor101/102keys,butnowkeyboardswith104keysor108 keysarealsoavailableforWindowsandInternet.

Mouse

Mouse is the most popular pointing device. It is a very famous cursor-control devicehaving a small palm size box with a round ball at its base, which senses the movementof the mouse and sends corresponding signals to the CPU when the mouse buttons arepressed.

Generally, it has two buttons called the left and the right button and a wheel is presentbetween the buttons. A mouse can be used to control the position of the cursor on thescreen,butitcannotbeusedtoentertextintothecomputer.

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 fourdirections.

Joystick

The function of the joystick is similar to that of a mouse. It is mainly used in ComputerAidedDesigning(CAD)andplayingcomputergames.

LightPen

Light pen is a pointing device similar to a pen. It is used to select a displayed menuitem or draw pictures on the monitor screen. It consists of a photocell and an opticalsystemplacedinasmalltube.

When the tip of a light pen is moved over the monitor screen and the pen button ispressed,itsphotocellsensingelementdetectsthescreenlocationandsendsthecorrespondingsignaltotheCPU.

Track Ball

Track ball is an input device that is mostly used in notebook or laptop computer,instead of a mouse. This is a ball which is half inserted and by moving fingers on theball,thepointercanbemoved.

Sincethewholedeviceisnotmoved,atrackballrequireslessspacethanamouse.Atrackballcomesinvariousshapeslikeaball,abutton,orasquare.

Scanner

Scanner is an input device, which works more like a photocopy machine. It is usedwhensomeinformationisavailableonpaperanditistobetransferredtotheharddiskofthecomputerforfurthermanipulation.

Scannercapturesimagesfromthesourcewhicharethenconvertedintoadigitalformthatcanbestoredonthedisk.Theseimagescanbeeditedbeforetheyareprinted.

Digitizer

Digitizerisaninputdevicewhichconvertsanaloginformationintodigitalform.Digitizer can convert a signal from the television or camera into a series of numbersthat could be stored in a computer. They can be used by the computer to create apictureofwhateverthecamerahadbeenpointedat.

DigitizerisalsoknownasTabletorGraphicsTabletasitconvertsgraphicsandpictorial data into binary inputs. A graphic tablet as digitizer is used for fine works ofdrawingandimagemanipulationapplications.

Microphone

Microphoneisaninputdevicetoinputsoundthatisthenstoredinadigitalform.

The microphone is used for various applications such as adding sound to a multimediapresentationorformixingmusic.

MagneticInkCardReader(MICR)

MICR input device is generally used in banks as there are large number of cheques tobe processed every day. The bank's code number and cheque number are printed onthe cheques with a special type of ink that contains particles of magnetic material thataremachinereadable.

This reading process is called Magnetic Ink Character Recognition (MICR). The mainadvantagesofMICRisthatitisfastandlesserrorprone.

OpticalCharacterReader(OCR)

OCRisaninputdeviceusedtoreadaprinted text.

OCRscansthetextoptically,characterbycharacter,convertsthemintoamachinereadablecode, andstoresthetextonthesystemmemory.

Bar Code Readers

Bar Code Reader is a device used for reading bar coded data (data in the form of lightand dark lines). Bar coded data is generally used in labelling goods, numbering thebooks,etc.Itmaybeahandheldscannerormaybeembeddedinastationaryscanner.

BarCodeReaderscansabarcodeimage,convertsitintoanalphanumericvalue,whichisthen fedto thecomputerthatthe barcode readerisconnected to.

OpticalMarkReader(OMR)

OMRisaspecialtypeofopticalscannerusedtorecognizethetypeofmarkmadebypenorpencil.Iti susedwhereoneoutofafewalternativesistobeselectedandmarked.

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

OpticalCharacterReader(OCR)

EXERCISE

ShortAnswerTypeQuestions.

Q.1   Outlinethekeyfeaturesof4thgenerationcomputerinbrief.

Q.2   Differentiatebetweenanalogcomputeranddigitalcomputer.

Q.3   Define hybrid computer.

Q.4   Differentiatebetweendataandinformation?

Q.5   Differentiatebetweensoftcopyandhardcopyoutput?

Q.6   DefineAuxiliarymemoryusedinPC.

Q.7   DefineprimarymemoryusedinPC.

Q.8   Definememoryhierarchy.Statethedifferentmemorypresentinthedifferentlevels.

(2015-Winter,2013-Winter)

Q.9   Defineacachememory.

Q.10   WhatisanOMR?

Q.11   WhatisaMICR?*(2014-Winter)*

Q.12   DefineHardcopyoutputandSoftcopyoutputfromaPC.

Q.13   Differentiatebetweenvolatileandnon-volatilecomputermemory.

Q.14   WhatarethedifferenttypesofplottersusedinPC?

LongAnswerTypeQuestions.

Q.1   Discussabout the variousoutput devicesusedina PC platform?

Q.2   Whatisclassificationofcomputer?Compareandcontrastthefeaturesofdifferentclassesofcomputers?*(2013-Winter)*

Q.3   Discussabouttheevolutionofcomputers?Givesuitableexamplesofvariouscomputers?

Q.4   Whatismemoryhierarchy?Explainthemainfeaturesofthevarioustypesofmemorypresentatdifferentlevels ofthishierarchy?*(2016-Winter)*

Q.5   DifferentiatebetweenprimarymemoryandsecondarymemoryusedinPC.Giveproperexampletosubstantiateyouranswer?*(2017-Winter)*

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CHAPTER–2:COMPUTERSOFTWARE

2.1 Softwareconcept

Softwareisaprogramwhichhelpsthehumanusertogiveinstructiontocomputerhardware.

TypesofSoftware

- Systemssoftware
- Applicationsoftware

2.1.1 Systemsoftware

- SystemSoftwareisasetofprogramsthatmanagetheresourcesofacomputersystem.
- SystemSoftwareisacollectionofsystemprogramsthatperformavarietyoffunctionssuchas-
    o FileEditing
    o ResourceAccounting
    o I/OManagement
    o Storage,MemoryManagementaccess
- SystemSoftwarecanbebroadlyclassifiedintotwotypesas:
    o Systemcontrolprograms
    o Systemsupportprograms
    o Systemdevelopmentprograms
- Systemcontrolprograms
    o controlstheexecutionofprograms
    o managethestorage&processingresourcesofthecomputer
    o performothermanagement&monitoringfunction
- Themostimportantoftheseprogramsistheoperatingsystem,DBMS&communicationmonitors.
- Systemsupportprograms
    o Provideroutineservicefunctionstotheothercomputerprograms&computerusers:
      E.g.Utilities,libraries,performancemonitors&jobaccounting.
- Systemdevelopmentprograms
    o Assistsinthecreationofapplication
    o Programs.e.g.,languagetranslatorssuchasBASICinterpreter&applicationgenerators.

2.1.2 Applicationsoftware

- Application software, or app for short, is software that performs specific tasks for an end-user.
- Effectively,if the useris interactingdirectlywith apieceofsoftwareitis applicationsoftware. For example, Microsoft Word or Excel is application software, as are commonwebbrowserssuchasFirefoxorGoogleChrome.
- Italsoincludesthecategoryofmobileapps,includingcommunicationappssuchasWhatsApp or games such as Candy Crush Saga. There are also app versions of commonservicessuchasthoseprovidingweatherortransportinformationorappsforcustomer stointeractwithcompanies.

- Application software is distinct from system software, which refers to the software thatactually keeps the systems running such as the operating system, computational sciencesoftware,gameengines,industrialautomation,andsoftwareasserviceapplications.
- Instead of interacting with the user, the system software interacts with other software orhardware.

2.2 OverviewofOperatingSystem

- An operating system (OS) is software that manages computer hardware resources andprovides common services for computer programs. The operating system is an essentialcomponentofthesystemsoftwareinacomputersystem.
- Applicationprogramsusuallyrequireanoperatingsystemtofunction.Time-sharingoperating systems schedule tasks for efficient use of the system and may also includeaccounting software for cost allocation of processor time, mass storage, printing, and otherresources.
- Forhardwarefunctionssuchasinputandoutputandmemoryallocation,theoperatingsystemactsasa nintermediarybetweenprogramsandthecomputerhardware,althoughthe application codeisusuallyexecuteddirectlybythe hardwareand willfrequentlymakea system call to an OS function or be interrupted by it. Operating systems can be found onalmostanydevicethatcontainsacomputer— fromcellularphonesandvideogameconsolestosupercomputersandwebservers.
- 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,WindowsPhone and z/OS, sharerootsinUNIX.

Typesofoperatingsystems

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

2.2.1 ObjectivesandFunctionsofO.S

OStypicallyprovidesservicesinthe followingareas:

1. **Program development -** The OS provides a variety of facilities and services, such aseditorsand debuggers,toassist theprogrammerin 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 mustbeinitialized,andotherresourcesmustbeprepared.TheOShandlestheseschedulingdutiesf ortheuser.
3. **Access to I/O devices -** Each I/O device requires its own peculiar set of instructions orcontrolsignalsforoperation.TheOSprovidesauniforminterfacethathidesthesedetailssothat programmerscanaccesssuchdevicesusingsimplereadsandwrites.
4. **Controlledaccesstofiles-**Forfileaccess,theOSmustreflectadetailedunderstandingof not only the nature of the I/O device (disk drive, tape drive) but also the structure ofthe data contained in the files on the storage medium. In the case of a system withmultipleusers,theOSmayprovideprotectionmechanismstocontrolaccesstothefiles.

5. **System access -** For shared or public systems, the OS controls access to the system as awhole and to specific system resources. The access function must provide protection ofresources and data from unauthorized users and must resolve conflicts for resourcecontention.
6. **Error detection and response -** A variety of errors can occur while a computer system isrunning. These include internal and external hardware errors, such as a memory error,oradevicefailureormalfunction;andvarioussoftwareerrors,suchasdivisionbyzero,attempt to access forbidden memory location etc. In each case, the OS must provide aresponse 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 theoperation,tosimplyreporting theerror to theapplication.
7. **Accounting -** A good OS will collect usage statistics for various resources and monitorperformanceparameterssuchasresponsetime.

ThemajorfunctionsofOperatingSystemareitactsas–

- TheResourceManagerfor Computer.
- TheMemoryManager forcomputer.
- The Device Managerforcomputer.
- TheUser manager.

2.2.2 TypesofOperatingSystem:BatchProcessing,Multiprogramming&TimeSharingOS

FollowingaresomemajortypesofOperatingsystem.

Real-timeoperatingsystem

A real-time operating system is a multitasking operating system that aims atexecuting real-timeapplications. Real-timeoperating systems oftenuse specializedscheduling algorithms so that theycanachieveadeterministicnatureofbehavior.Themainobjectiveofreal-timeoperatingsystemsistheirquickandpredictableresponsetoevents.Theyhaveanevent-drivenortimesharingdesign and often aspects of both. An event-driven system switches between tasks based on theirprioritiesorexternaleventswhiletime-sharingoperatingsystemsswitchtasksbasedonclockinterrupts.

Multi-useroperatingsystem

A multi-user operating system allows multiple users to access a computer system at the sametime. Time-sharing systems and Internet servers can be classified as multi-user systems as theyenable multiple-user access to a computer through the sharing of time. Single-user operatingsystemshave onlyoneuserbut mayallow multiple programs to runat thesame time.

Multi-taskingvs.single-taskingOperatingSystem

A multi-tasking operating system allows more than one program to be running at the same time,fromthe point ofviewofhumantimescales.Asingle-taskingsystemhas only one runningprogram.

DistributedOperatingsystem

A distributed operating system manages a group of independent computers and makes themappear to be a single computer. The development of networked computers that could be linkedand communicate with each other gave rise to distributed computing. Distributed computationsarecarriedoutonmorethansystem.

BatchProcessing

Batch processing is the execution of a series of programs ("jobs") on a computer without manualintervention. Jobs are set up so they can be run to completion without human interaction. Allinput parameters are predefined through scripts, command-line arguments, control files, or jobcontrollanguage.Thisisincontrastto"online"orinteractiveprogramswhichprompttheuserforsuch input. A program takes a set of data files as input, processes the data, and produces a set ofoutput data files. This operating environment is termed as "batch processing" because the inputdataarecollectedintobatchesorsetsofrecords andeachbatchisprocessedasaunit.

Multiprogramming

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

Time SharingOS

Incomputing,time-sharingisthesharingofacomputingresourceamongmany usersbymeansofmultiprogrammingandmulti-tasking.Itsintroductioninthe1960s,andemergenceastheprominentmodelofcomputinginthe1970s,representedamajortechnologicalshiftinthehistoryofcomputing.Byallowingalargenumberofuserstointeractconcurrentlywithasinglecomputer, time-sharing dramatically lowered the cost of providing computing capability, made itpossible for individuals and organizations to use a computer without owning one, and promotedtheinteractiveuseofcomputersandthedevelopmentofnewinteractiveapplications.

2.2.3 FeaturesofDOS,WindowsandUNIX

FeaturesofDOS

The operating system is a system software used for management of computer hardware andapplicationsoftware.Itisaninteractiveinterfaceofcomputer.MS-DOSisaverypopularoperatingsystem for PC, and it is replaced by its extension Windows operating system. In the Windowsenvironment, DOS is also Boss because many utilities programs of MS-DOS are used in troubleshootingofWindowsOperatingsystem.

MS-DOS

MS-DOSstands for MicrosoftDiskOperatingSystem.TimPatersondevelopedthis operatingsystem 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 inovernight. The father of PC Operating System is Gary Kildall of Digital Research. He had his

Ph.DincomputeranddesignedmoresuccessfuloperatingSystemcalledCP/M.ThesellingofCP/M

ismorethan600,000copiesprovesitspopularity.The MicrosoftDiskOperatingSystem orMS-DOSwasbasedonQDOS,theQuickandDirtyOperatingSystemwrittenbyTimPetersonofSeattleComputerProducts,fortheirprototypeIntel8086basedcomputer.QDOSwasbasedonGrayKildall's CF/M. Patersonhad boughtaCP/Mmanualanduseditas thebasis towritehisoperatingsystemsixweeks,QBOSwasdifferentenoughfromCP/M.MS-DOSversion7.0islunchedin1997whichisahiddenwithWindow95/98OS.

It has three essential files and many command files. These essential files are: IO.SYS, MSDOS.SYS,andCOMMAND.COM.ThesefilesarecalledsystemfilesofMS-DOS.TheDOSisBossinrealsense, because in the age of Windows operating system, hardware utilities are dependent on theDOS.

TheheartofMS-DOS:

- IO.SYS:ThisletDOScommunicatewiththehardwarethroughtheBIOS(BasicInput/OutputSystem).
- MSDOS.SYS:ThisisaDOSkernel.
- COMMAND.COM:ThisiswherealltheDOScommandsarestoredandinterpreted.
- COFIG.SYS:Hardwareconfigurationinformationisstoredhere.
- AUTOEXEC.BAT:Alltheprogramsthataresupposedtorunatstartuparecalledhere.
- Booting:Thebootingisaprocessofloadingsystemfilesintomainmemory(RAM).Therearetwotypesofbooting:coldbootingandwarmbooting.

Windows andUNIX

Itisanoperatingsystem,extensionofMS-DOSwithuserfriendlyGUIandseveralfacilitiestocontrolmemory,hardware,text,graphics,audio,video,internetconnectionetc.

VersionCommentsWin

dows1.0

This operating system with user interface is a notification of MSDOS. The nifty mouse is used toclick on desired program to open. It was first called interface manager, but then changed in to themoreappealingWindows.Windows1.0lanchedinNovember1985.

Windows2.0

Itwasreleasedin1987totakeadvantageoftheawesomeprocessingpoweroftheIntel286processor.ThefirstversionofMicrosoftWordandExcelareintroducedinthisversion.

Windows3.0

It was released in May 1990. Itcame with a prettier 16-colorinterface, and new technologicalbellsandwhistlesthatletitmakebetteruseofthememory.In1991,Microsoftbroughtmultimediasupport for Windows 3.0, called feature, through, is the active desktop, which integrates the webbrowser(internetExplorer),withoperatingsystem.

Windows2000

Its interface is similar to interface for windows 98. It has new security protocol with an

encryptionfacilitytoauthenticateusersloggingintothenetwork.Itsupports32FATfilesystemalongwith

NTFC (New Technology File System), making it easier for users to upgrade for Windows 98. It hasquiterobustlybridkernelarchitecture,makeitmorestableversion.

WindowsMe

Later in 2000, Windows Millennium (windows Me) Edition was released for the home user. Thiswas the last version of Windows to be based on Windows 98. Windows Me had always beenregardedasMicrosoft'swayofkeepingusersbusywhiletheywaitedforWindowsXP.

WindowsXP

Here, XP stands For experience. It bought together the robust Kernel of windows 2000 and all thefriendless and multimedia support of Windows Me, and painted on a new face for it. Apart fromthemergerofWindows2000andme,WindowsXpalsoaddednewfeaturestoenhanceitsperforma nce. The first of These Throttling, Usually, Windows likes to do many things at once, butwhen memory falls short, it will throttle its memory access, doing fewer at a time. This shows thesystemdownconsiderably,butpreventsitfromcrashing.

Windows7

Windows 7 is an operating system released by Microsoft on October 22, 2009. It follows theprevious(sixth)versionofWindows,calledWindowsVista.

Like previous versions of Windows, Windows 7 has a graphical user interface (GUI) that allowsyoutointeractwithitemsonthescreenusingakeyboardandmouse.However,Windows7isalsoin cludes a feature called "Windows Touch" that supports touch screen input and multi touchfunctionality

Windows8

Windows8isthelatestversionofMicrosoft'sWindowsoperatingsystem.ItwasreleasedonOctober26, 2012, and is the firstmajorupdatetoWindows sinceWindows 7, which was releasedoverthreeyearsearlier.

The goal of the new Windows 8 interface is to function on both traditional desktop PCs, such asdesktop computers and laptops, as well as tablet PCs. Windows 8 supports both touch screeninputaswellastraditionalinputdevices,suchasakeyboardandmouse.

Windows10

Windows 10 is a major version of the Microsoft Windows operating system that was released onJuly29,2015.Itis builtontheWindows NTkernelandfollows Windows8.

WhileWindows10includesmanynewfeatures,italsobringsbacktheStartMenu,whichwasdroppedinWind ows8.ThenewandimprovedStartMenuprovidesquickaccesstosettings,folders,andprogramsandalsoincl udestilesfromtheWindows8interface.ThebottomoftheWindows 10 Start Menu includes a search bar that allows you to search both your local PC and theweb.

UNIXOperatingSystem

The UNIX (pronounced as YEW-nihks) is a powerful, flexible, multi-user Operating system withGUI and several utilities. Ken Thompson and Dennis Ritchie wrote Compiler under UNIX in 1969at Bell Labs. In 1973, Thompson and Ritchie rewrote the UNIX kernel using C language. It is basedonMULTICSoperatingsystem.ItsfirstuserwasBellpatentdepartment.XENIX,VENIX,MICRONIX ,LINUX,UNIXWARE-7etcareversionofUNIXoperatingsystem.

TheUNIXoperatingsystemismadeupfromthreeparts:

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

(b) Shell: Itisaninterfacebetweenkernelandusers.Whenauserlogsin,theloginprogrammatches the username and password, and then starts shell. The shell is a command line interpreter(CLI)ofUNIX.

(c) Programorcommand: Itisusedtoaccomplishspecifictasks.Whenonecommandisterminated, theshelldisplaysprompt% toaccept nextcommandforexecution.

2.3 ProgrammingLanguages

A programming language is a formal constructed language designed to communicate instructionsto a machine, particularly a computer. Programming languages can be used to create programs tocontrolthebehaviorofamachineortoexpressalgorithmssothatthecomputerhardwarecanrunwith aproperstepbystepinstruction.

The earliest programming languages preceded the invention of the computer and were used todirect the behavior of machines such as Jacquard looms and player pianos. Thousands of differentprogramming languages have been created, mainly in the computer field, and many more still arebeingcreatedeveryyear.Manyprogramminglanguagesrequirecomputationtobespecifiedinanim perative form (i.e., as a sequence of operations to perform), while other languages utilize otherformsofprogramspecificationsuchasthedeclarativeform(i.e.thedesiredresultisspecified,noth owtoachieveit).

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 (forexample, the C programming languages specified by an ISO Standard), while other languages(such asPerl)havedominantimplementation thatistreated asareference.

There are two major types of programming languages I,e. Procedural programming language andObjectOrientedprogramminglanguage.

Proceduralprogramming

In procedural programming our code is organized into small "procedures" that use and changeourdata.InColdFusion,wewriteourproceduresaseithercustomtagsorfunctions.Thesefunctio nstypicallytakesomeinput,dosomething,thenproducesomeoutput.Ideallyyourfunctionswouldbeha ve as"blackboxes"whereinputdatagoesinandoutput datacomesout.

The key idea here is that our functions have no intrinsic relationship with the data they operateon.Aslongasyouprovidethecorrectnumberandtypeofarguments,thefunctionwilldoits
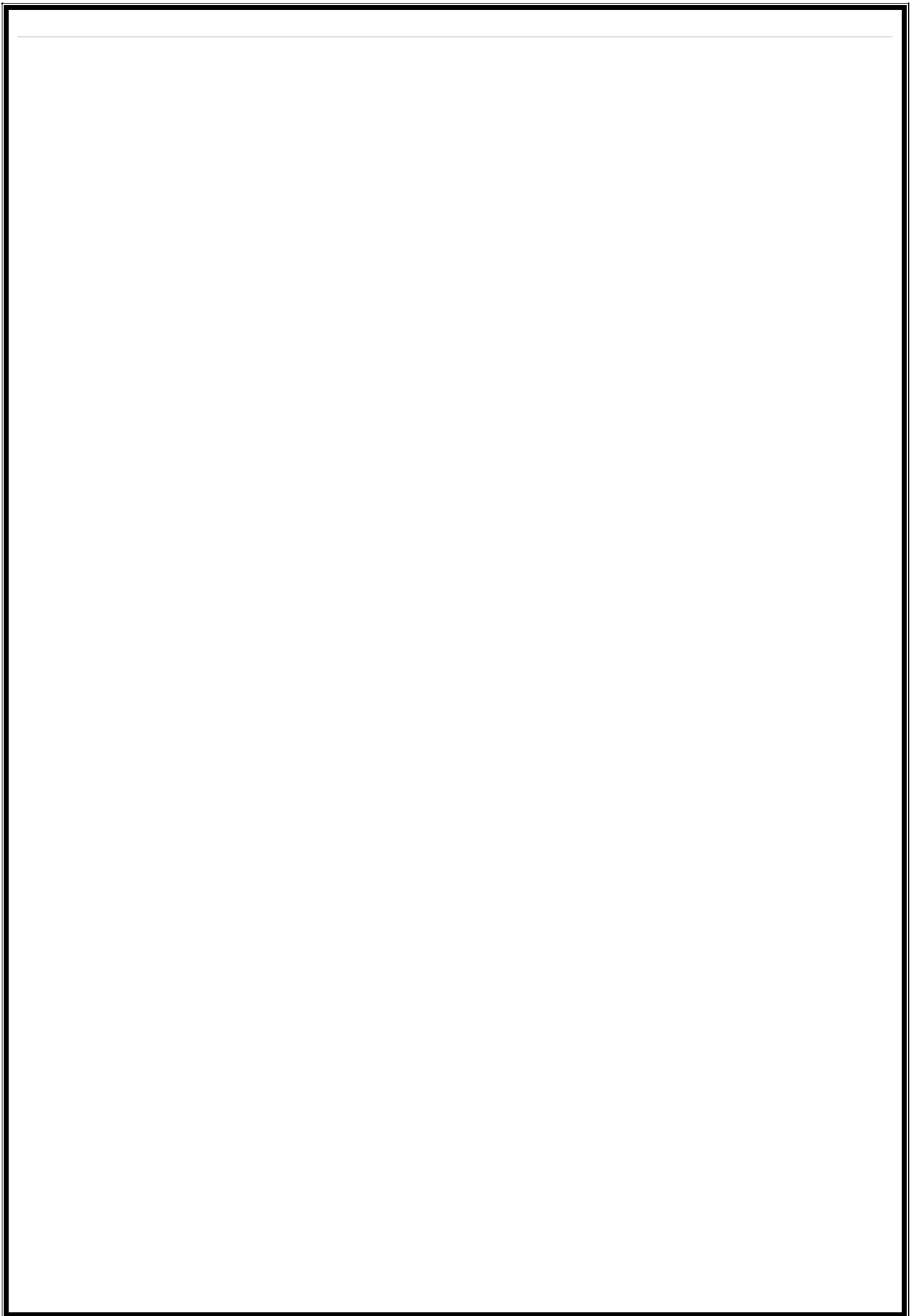
workandfaithfullyreturnitsoutput.

Sometimes our functions need to access data that is not provided as a parameter, i.e., we needaccess datathatis outsidethefunction. Dataaccessedinthiswayis considered"global" or"shared"data.

So in a procedural system our functions use data they are "given" (as parameters) but also directlyaccessanyshareddatatheyneed.

Objectorientedprogramming

In object oriented programming, the data and related functions are bundled together into an"object".Ideally,thedatainsideanobjectcanonlybemanipulatedbycallingtheobject'sfunctions.This means that your data is locked away inside your objects and your functions provide the onlymeans of doing something with that data. In a well designed object oriented system objects neveraccess shared or global data, they are only permitted to use the data they have, or data they aregiven.

2.4 Compiler,Interpreter

Compiler: Itis aprogram which translates ahigh levellanguageprogram intoa machinelanguage 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. Ithasslowspeed.Becauseacompilergoesthroughtheentireprogramandthentranslatestheentireprog ram into machine codes. If a compiler runs on a computer and produces the machine codesforthesamecomputerthenitisknownasaselfcompilerorresidentcompiler.Ontheotherhand,if a compiler runs on a computer and produces the machine codes for other computer then it isknownasacrosscompiler.

Interpreter: An interpreter is a program which translates statements of program into machinecode. It translates only one statement of the program at a time. It reads only one statement ofprogram, translates it and executes it. Then it reads the next statement of the program againtranslatesitandexecutesit.Inthiswayitproceedsfurthertillallthestatementsaretranslatedande xecuted. On the other hand, a compiler goes through the entire program and then translates theentire program into machine codes. A compiler is 5 to 25 times faster than an interpreter. By thecompiler, the machine codes are saved permanently for future reference. On the other hand, themachinecodes produced by interpreter are notsaved. An interpreter is a small program ascompared to compiler. It occupies less memory space, so it can be used in a smaller system whichhaslimitedmemoryspace.

2.5 ComputerVirus,DifferentTypesofcomputervirus

Acomputervirusisamalwareprogramthat,whenexecuted,replicatesbyinsertingcopiesofitself (possibly modified) into other computer programs,data files, or the boot sector of the harddrive.Whenthisreplicationsucceeds,theaffectedareasarethensaidtobe"infected".Virusesoftenperfo rmsometypeofharmfulactivityoninfectedhosts,suchasstealingharddiskspaceorCPUtime,accessingpriva teinformation,corruptingdata,displayingpoliticalorhumorousmessagesontheuser'sscreen,spammingth eircontacts,orloggingtheirkeystrokes.However,notallvirusescarryadestructivepayloadorattempttohide themselves—thedefiningcharacteristicof viruses is that they are self replicating computer programs which install themselves without theuser'sconsent.

Virus writers use social engineering and exploit detailed knowledge of security vulnerabilities togain access totheir hosts' computing resources. The vastmajority of viruses target systemsrunning Microsoft Windows, employing a variety of mechanisms to infect new hosts, and oftenusing complex anti detection/stealth strategies to evade antivirus software. Motives for creatingviruses can include seeking profit, desire to send a political message, personal amusement, todemonstrate that a vulnerability exists in software, for sabotage and denial of service, or simplybecausetheywishtoexploreartificiallifeandevolutionaryalgorithms.

Computer viruses currently cause billions of dollars worth of economic damage each year, due tocausing systems failure, wasting computer resources, corrupting data, increasing maintenancecosts, etc. In response, free, open source antivirus tools have been developed, and a multi-billiondollar industry of antivirus software vendors has cropped up, selling virus protection to users ofvariousoperatingsystemsofwhichAndroidandWindowsareamongthemostvictimized.Unfortunately,nocurrentlyexistingantivirussoftwareisabletocatchallcomputerviruses(especially new ones); computer security researchers are actively searching for new ways to enableantivirus solutions to more effectively detect emerging viruses, before they have already becomewidelydistributed.

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, the type of operatingsystem,orplatform theyattack.Letushavealookatfewofthem.

Memory Resident Virus-These viruses fix themselves in the computer memory and get activatedwheneverthe OS runs and infects all thefiles thatare thenopened.Hideout:This typeof virushides in the RAM and stays there even after the malicious code is executed. It gets control over thesystemmemoryandallocatesmemoryblocksthroughwhichitrunsitsowncode,andexecutesthe code when any function is executed. Target: It can corrupt files and programs that are opened,closed,copied,renamed,etc.Examples:Randex,CMJ,Meve,andMrKlunky,Protection: Installanantivirusprogram.

Direct Action Viruses-The main purpose of this virus is to replicate and take action when it isexecuted. When a specific condition is met, the virus will go into action and infect files in thedirectory or folder that are specified in theAUTOEXEC.BAT file path. This batch file is alwayslocatedintherootdirectoryoftheharddiskandcarriesoutcertainoperationswhenthecomputer is booted. Find First/Find Next technique is used where the code selects a few files as its victims.Italsoinfectstheexternaldeviceslikependrivesorharddisksbycopyingitselfonthem.Hideout: The viruses keep changing their location into new files whenever the code is executed, but aregenerally 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 typeofvirushasminimaleffectonthecomputer'sperformance.

Overwrite Viruses-A virus of this kind is characterized by the fact that it deletes the informationcontained in the files that it infects, rendering them partially or totally useless once they have beeninfected.Hideout:Thevirusreplacesthefilecontent.However,itdoesnotchangethefilesize.Examples: Way,Trj.Reboot,Trivial.88.D.Protection:Theonlywaytocleanafileinfectedbyanoverwrite virus is todelete the file completely, thus losingthe original content. However, it is veryeasytodetectthistypeofvirus,astheoriginalprogrambecomesuseless.
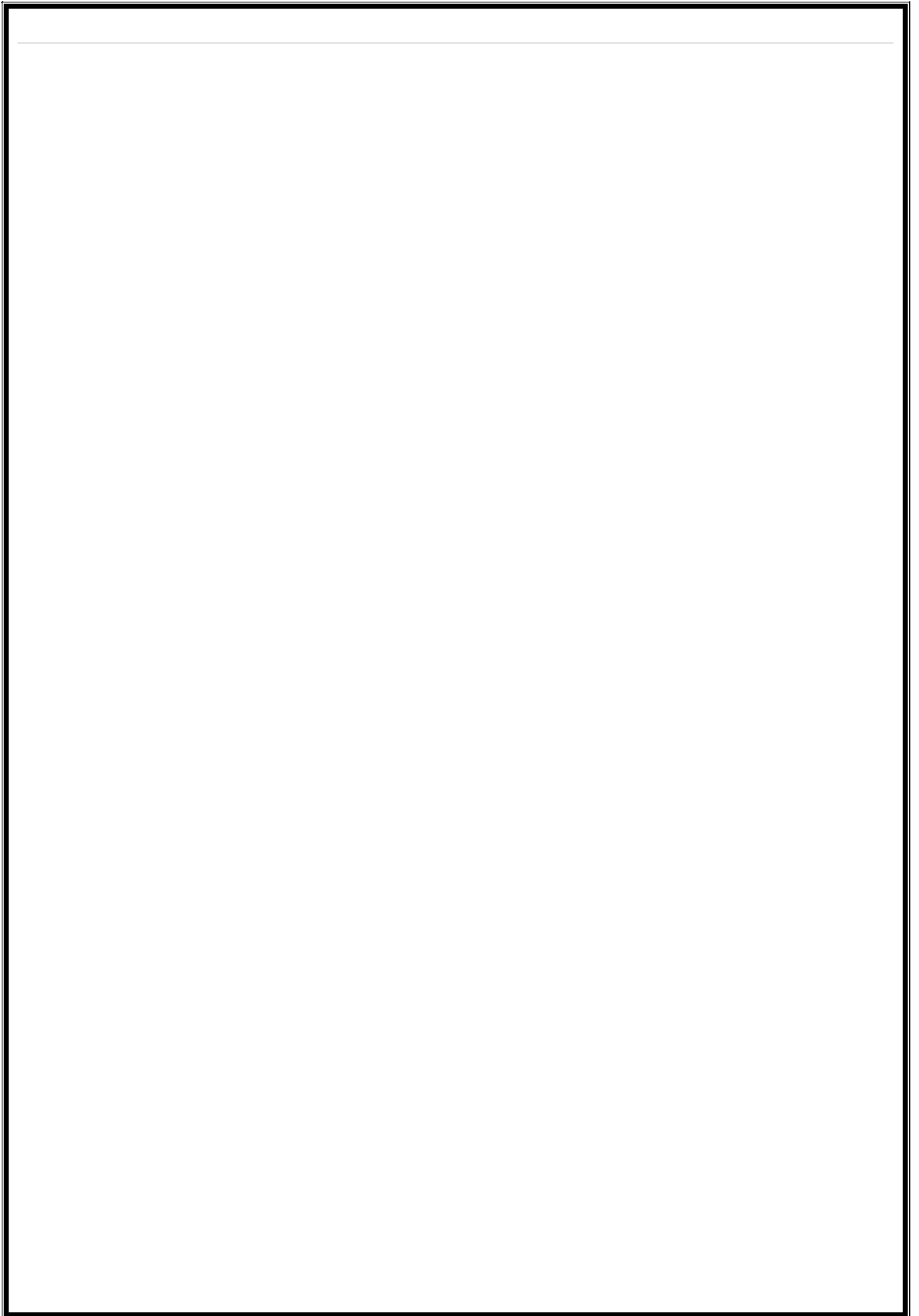
BootSectorVirus-
Thistypeofvirusaffectsthebootsectorofaharddisk.Thisisacrucialpartofthedisk,inwhichinformationofthe diskitselfisstoredalongwithaprogramthatmakesitpossible to boot (start) the computerfrom the disk.Thistypeof virus is also called MasterBootSector Virus or Master Boot Record Virus. Hideout: It hides in the memory until DOS accesses thefloppydisk,andwhicheverbootdataisaccessed,thevirusinfectsit.Examples:Polyboot.B,AntiEXE.Protec tion: Thebestwayof avoidingbootsectorviruses is toensurethatfloppydisksarewrite-protected.Also,neverstartyourcomputerwithanunknownfloppydiskinthediskdrive.

Macro viruses infect files that are created using certain applications or programs that containmacros, like .doc, .xls, .pps, .mdb, etc. These mini programs make it possible to automate series ofoperations so that they are performed as a single action, thereby saving the user from having tocarry them out one by one. These viruses automatically infect the file that contains macros, andalso infects the templates and documents that the file contains. It is referred to as a type of e-mailvirus. 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-mailsfromunknownsenders.Also,disablingmacros canhelptoprotectyourusefuldata.

Directoryviruses(alsocalledClusterVirus/FileSystemVirus)-
Itinfectsthedirectoryofyourcomputerbychangingthepaththatindicatesthelocationofafile.Whenyouexec uteaprogramfilewithanextension.EXEor.COMthathasbeeninfectedbyavirus,youareunknowinglyrunnin gthevirusprogram,whiletheoriginalfileandprogramispreviouslymovedbythevirus.Onceinfected,itbeco mes impossibletolocatethe original files.Hideout:Itis usuallylocatedinonlyonelocationofthedisk,butinfectstheentireprograminthedirectory.Examples:Dir-2virusProtection: All you can dois, reinstall all thefilesfrom thebackup thatareinfected afterformattingthedisk.

Polymorphicvirusesencryptorencodethemselvesinadifferentway(usingdifferentalgorithmsand encryption keys) every time they infect a system. This makes it impossible for antivirussoftware to find them using string or signaturesearches (because they are different in eachencryption).Thevirusthengoesontocreatesalargenumberofcopies.Examples:Elkern,Marburg, Satan Bug and Tuareg, Protection: Install a high-end antivirus as the normal ones areincapableofdetectingthistypeofvirus.

CompanionvirusesItcanbeconsideredasatypeoffileinfectorvirus,likeresidentordirectaction types. Theyare known as companion viruses becauseoncetheygetinto the system they'accompany'theotherfilesthatalreadyexist.

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

Hideout:Thesegenerallyusethesamefilenameandcreateadifferentextensionofit.Forexample:If there is a file "Me.exe", the virus creates another file named "Me.com" and hides in the new file.Whenthesystemcallsthefilename"Me",the".com"filegetsexecuted(as".com"hashigherprioritythan".e xe"),thusinfectingthesystem.Examples:Stator,Asimov.1539andTerrax.1069Protection:Installanantivir usscannerandalsodownloadFirewall.

FAT Virus: The file allocation table (FAT) is the part of a disk used to store all the informationabout the location of files, available space, unusable space, etc. Hideout: FAT virus

attacks the FATsectionandmaydamagecrucialinformation.Itcanbeespeciallydangerousasitpreventsaccess

tocertainsectionsofthediskwhereimportantfilesarestored.Damagecausedcanresult inlossofinformationfromindividualfilesorevenentiredirectories.

Examples: Link Virus, Protection: Before the virus attacks all the files on the computer, locate allthe files that are actually needed on the hard drive, and then delete the ones that are not needed.Theymaybefilescreatedbyviruses.

Multipartite Virus-These viruses spread in multiple ways possible. It may vary inits actiondepending upontheoperatingsystem installedandthepresence ofcertain files.

Hideout: In the initial phase, these viruses tend to hide in the memory as the resident viruses do;thentheyinfecttheharddisk.Examples:Invader,FlipandTequila.

Protection: You need toclean the bootsectorand alsothe diskto getrid of thevirus, and thenreloadallthedatainit.However,ensurethatthedataisclean.

WebScriptingVirus-
Manywebpagesincludecomplexcodesinordertocreateaninterestingandinteractivecontent.Thiscod eisoftenexploitedtobringaboutcertainundesirableactions.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 theMicrosoft tool application that is a default feature in Windows 2000, Windows 7 and Vista. Scanthecomputerwiththisapplication.

Worms: A worm is a program very similar to a virus; it has the ability to self-replicate and canlead to negative effects on your system. But they can be detected and eliminated by an antivirussoftware. Hideout: These generally spread through emails and networks. They do not infect filesordamage them, but theyreplicatesofastthat the entire networkmaycollapse.Examples:PSWBugbear.B,Lovgate.F,Trile.C,Sobig.D,Mapson.Protection:Insta llanupdatedversionofantivirus.

Trojans are another unsavory breed of malicious code are Trojans or Trojan horses, which unlikeviruses,donotreproducebyinfectingotherfiles,nordotheyself-replicatelikeworms.Infact,itisaprogramwhichdisguisesitselfasausefulprogramorapplication.

Beware of the fact that these viruses copy files in your computer (when their carrier program isexecuted) that can damage your data, and even delete it. The attacker can also program theTrojansinsuchamannerthattheinformationin ourcomputer isaccessibletothem.

LogicBombsarenotconsideredvirusesbecausetheydonotreplicate.Theyarenotevenprograms in their own right, but rather camouflaged segments of other programs. They are onlyexecuted when certain predefined condition is met. Their objective is to destroy data on thecomputer once certain condition shave been met. Logic bombs go undetected until launched, theresultscanbedestructive,andyourentiredatacanbedeleted.

2.5.1 DetectionandpreventionofVirus

FollowingstepsmaybetakenforVirusDetectionandPrevention.

1. Do not open any files attached to an email from an unknown, suspicious or untrustworthysource.
2. Do not open any files attached to an email unless you know what it is, even if it appears tocome from a dear friend or someone you know. Some viruses can replicate themselves andspreadthroughemail.Betterbesafethansorryandconfirmthattheyreallysentit.
3. Delete chain emails and junk email. Do not forward or reply to any to them. These types ofemailareconsideredspam,whichisunsolicited,intrusivemailthatclogsupthenetwork.
4. Exercise caution when downloading files from the Internet. Ensure that the source is alegitimate and a reputable one. Verify that an anti-virus program checks the files on thedownloadsite.Ifyou'reuncertain,don'tdownloadthefileatall.
5. Updateyouranti-virussoftwareregularly.Thousandsofvirusesarediscoveredeachmonth,soyou'llwanttobeprotected.
6. Back up your files on a regular basis. If a virus destroys your files, at least you can replacethem with your back-up copy. You should store your backup copy in a separate locationfromyourworkfiles,onethatispreferablynotonyourcomputer.
7. When in doubt, always err on the side of caution and do not open, download, or executeany files or email attachments. Not executing the files is especially important. Check withyour product vendors for updates which include those for your operating system webbrowser,andemail.OneexampleisthesecuritysitesectionofMicrosoftlocatedathttp://www.microsoft.com/security.
8. Stay away from Bit torrent sites. Some of the more popular ones include Lime wire, BitTorrent, Frost wire and Pirate Bay. These are heavily laden with viruses, malware andspyware. Downloading material from these websites is one of the easiest ways to becomeinfected.It's in your best interest to just avoidthese websitescompletely.
9. Be careful when searching on the internet, the links that come up from your search enginemaycontainavirus.Nevergotositesthatsoundsuspicious.
10. Due to the popularity of the social networking websites such as MySpace, Face book, andTwitter,virusmakerstargetthemmorethananyotherwebsite.Onlinegamingandgambling websites also are high risk websites. It's best to avoid these kinds of websitesaltogether.
11. If you happen to see a popup message when on the internet about being infected and tobuytheirsoftwaretoprotectyourself,donotfallforit!Mostofthetimethesemessagesareeasy to see as they tend to have bad grammar and spelling errors. Common names are XPAntivirus, Security Tools, ThinkPoint, Security Shield, Win 7 Security 2011, and similarvariations. If do see one of these popup, do not click on them, immediately shut down yourcomputer. If you click on any part of those windows you will give the virus permission toinstallandbypassyourantivirusprogram.
12. If you see any suspicious pop-ups appear on your screen, do not click on them. If you do, itis very likely you will infect your computer. Instead use the following keyboard command,whichwillallowyoutoclosethepop-up,withouthavingtheclickonitorinfectingyourself. Thekeyboardcommand isALT+F4. Ifthatfails,then shutdownthe computer.
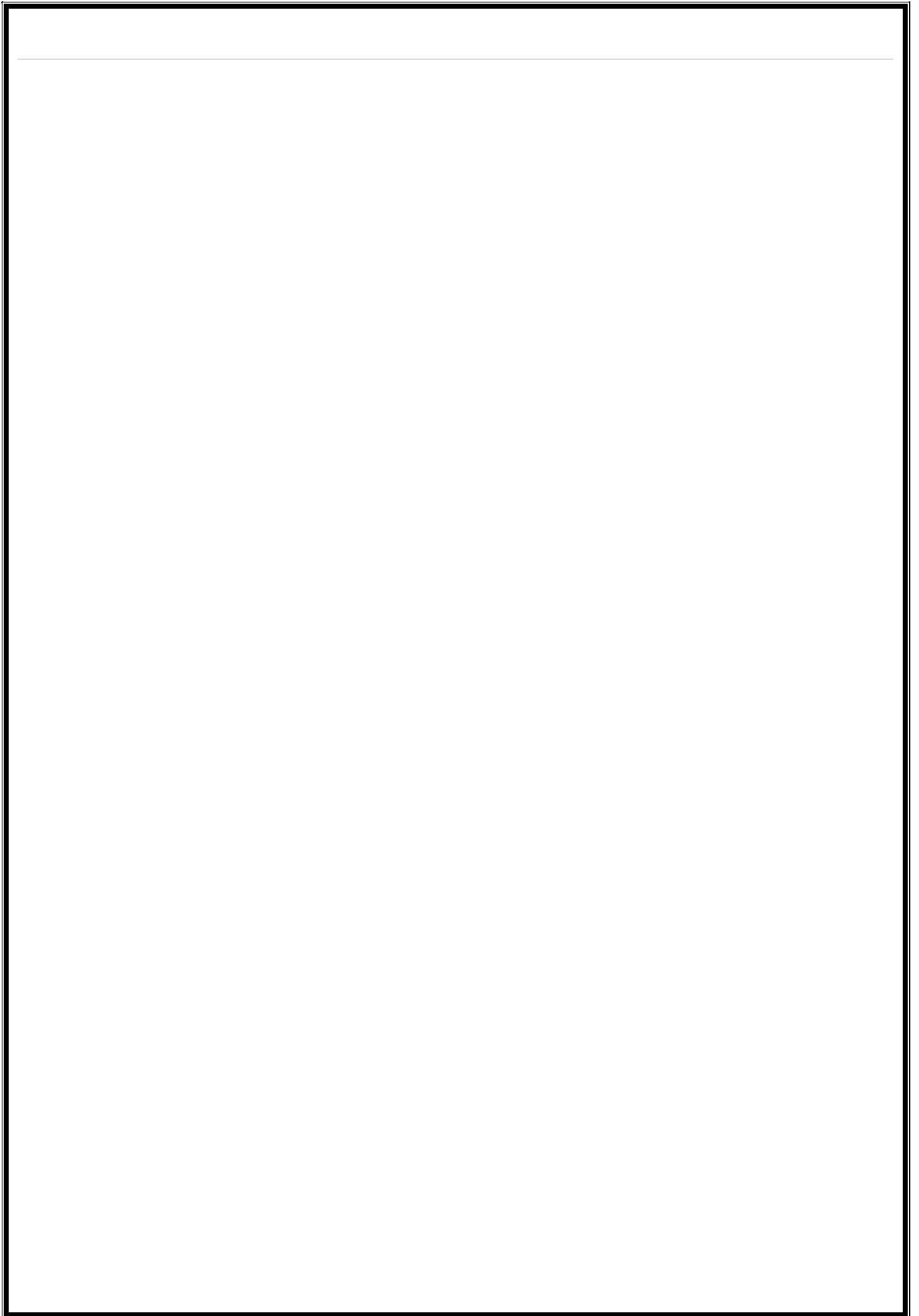
2.6 ApplicationofcomputersindifferentDomain

Computerisadevicethroughwhichyoucanperformavarietyofjobs.Youcanuse yourcomputersystemfordifferentapplicationsbychangingthesoftwarepackages

UsesofComputeratHome

Computercanbeusedathomein thefollowingways.

HomeBudget

Computer can be used to manage Home Budget. You can easily calculate yourexpenses andincome. You can list all expenses in one column and income in another column. Then you canapply any calculation on these columns to plan your home budget. There are also specializesoftwarethatcanmanageyourincomeandexpensesandgeneratesomecoolreports.

ComputerGames

An importantuseof computers athome is playinggames. Differenttypes ofgames areavailable.Thesegamesareasourceofentertainmentandrecreation.Manygamesareavailablethatarespe ciallydevelopedtoimproveyourmentalcapabilityandthinkingpower.

WorkingfromHome

People can manage the office work at home. The owner of a company can check the work of theemployeesfromhome.Hecancontrolhisofficewhilesittingathome.

Entertainment

People can find entertainment on the internet. They can watch movies, listen to songs, and watchvideos downloaddifferentstuff.Theycanalsowatchlivematches ontheinternet.

Information

People can find any type of information on the internet. Educational and informative websites areavailabletodownloadbooks,tutorialsetc.toimprovetheirknowledgeandlearnnewthings.

Chatting&SocialMedia

People can chat with friends and family on the internet using different software like Skype etc.One can interact with friends over social media websites like Face book, Twitter & Google Plus.Theycanalsosharephotosandvideoswithfriends.

UsesofComputersinEducation

CBT are different programs that are supplied on CD-ROM. These programs include text, graphicsand sound. Audio and Video lectures are recorded on the CDs. CBT is a low cost solution foreducatingpeople.Youcantrainalargenumberofpeopleeasily.

BenefitsofCBT

SomebenefitsofCBTareasfollows:
1. Thestudentscanlearnnewskillsattheirownpace.Theycaneasilyacquireknowledgeinany

availabletimeoftheirownchoice.
2. Trainingtimecanbereduced.
3. Trainingmaterialsareinteractiveandeasytolearn.Itencouragesstudentstolearnthetopic.
4. Planningandtimingproblemsarereducedoreliminated.
5. Theskillscanbetaughtatanytimeandatanyplace.
6. Itisverycosteffectivewaytotrainthelargenumberofstudents.
7. Trainingvideosandaudiosareavailableataffordableprices.

ComputerAidedLearning(CAL)

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

DistanceLearning

Distance learning is a new learning methodology. Computer plays the key role in this kind oflearning. Many institutes are providing distance learning programs. The student does not need tocome to the institute. The institute provides the reading material and the student attends virtualclassroom.Invirtualclassroom,theteacherdeliverslectureathisownworkplace.Thestudentca nattend the lecture at home by connecting to a network. The student can also ask questions to theteacher.

OnlineExamination

The trend of online examination is becoming popular. Different examination like GRE, GMAT andSATareconductedonlineallovertheworld.Thequestionsaremarkedbycomputer.Itminimizesthe chanceofmistakes.Italsoenablestoannouncetheresultintime.

UsesofComputersinBusiness

The use of computer technology in business provides many facilities.Businessmen are usingcomputers to interact with their customers anywhere in the world. Many business tasks areperformed more quickly and efficiently. Computers also help them to reduce the overall cost oftheirbusiness.Computercanbeusedinbusinessinthefollowingways.

Marketing

An organization can use computers for marketing their products. Marketing applications provideinformation aboutthe products tocustomers.Computerisalso usedtomanagedistributionsystem,advertisingandsellingactivities.Itcanalsobeusedindecidingprici ngstrategies.Companiescanknowmoreabout theircustomersandtheirneedsandrequirementsetc.

StockExchange

StockExchangeisthemostimportantplaceforbusinessmen.Manystockexchangesusecomputers to conduct bids. The stockbrokers perform all trading activities electronically. Theyconnect with the computer where brokers match the buyers with sellers. It reduces cost as nopaperorspecialbuildingisrequiredtoconducttheseactivities.

Uses of computers in Medical

Field HospitalManagementSystem

Specialized hospital management softwares are used to automate the day today procedures andoperationsathospitals.Thesetasksmaybeonlineappointments,payrolladmittanceanddischarger ecordsetc.

PatientHistory

Hospital management systems can store data about patients. Computers are used to store dataabout patients, theirdiseases & symptoms, themedicinesthat are prescribed.

Patients Monitoring

MonitoringsystemsareinstalledinmedicalwardsandIntensivecareunitstomonitoringpatientscontin uously. These systems can monitor pulse, blood pressure and body temperature and canalertmedicalstaffaboutanyserioussituations.

LifeSupportSystems

Specializeddevicesareusedtohelpimpairedpatientslikehearingaids.

DiagnosisPurpose

A variety of software are used to investigate symptoms and prescribed medication accordingly.Sophisticatedsystems areusedfortests like CTScan,ECG,and othermedicaltests.

SolvedQuestions

ShortAnswerTypeQuestions.

Q.1 Defineanoperatingsystem.GiveexamplesofthreeoperatingsystemusedonPC.

Ans. AnOperatingSystem(OS)isaninterfacebetweencomputeruserandcomputerhardware. An operating system is software which performs all the basic tasks like filemanagement, memory management, process management, handling input and output,and controllingperipheraldevicessuchasdiskdrivesandprinters.

SomepopularOperatingSystemsincludeLinuxOperatingSystem,WindowsOperatingSyste m,VMS,OS/400,AIX,z/OS,etc.

Q.2 Defineabatchprocessingsystem.

Ans. Batchprocessingistheprocessingoftransactionsinagrouporbatch.Nouserinteractionisrequire doncebatchprocessingisunderway.Thisdifferentiatesbatchprocessing from transaction processing, which involves processing transactions one at atimeandrequiresuserinteraction.

Q.3 Define amultiprogrammingoperatingsystem.

Ans. Multiprogrammingisarudimentaryformofparallelprocessinginwhichseveralprogramsar erunatthesametimeonauniprocessor.Instead,theoperatingsystem

executespartofoneprogram,thenpartofanother,andsoon.Totheuseritappearsthatallprog ramsareexecutingatthesametime.

Q.4 **Defineatimesharingoperatingsystem.**

Ans. Time-sharing enables many people, located at various terminals, to use a particularcomputer system at the same time. Multitasking or Time-Sharing Systems is a logicalextensionofmultiprogramming.Processor'stimeissharedamongmultipleusers sim ultaneouslyistermedastime-sharing.

LongAnswerTypeQuestions

Q.1 **Defineanoperatingsystem.Discussaboutthemajorfunctionofanyoperatingsystem.*(201 3-Winter)(2017-Winter)***

Ans. An operating system is a program on which application programs are executed andactsasacommunicationbridge(interface)betweentheuserandthecomputerhardware.

Themaintaskanoperatingsystemcarriesoutistheallocationofresourcesandservices,sucha sallocationof:memory,devices,processorsandinformation.Theoperatingsystem also includes programs to manage these resources, such as a traffic controller, ascheduler,memorymanagementmodule,I/Oprograms,andafilesystem.

FunctionsofanoperatingSystem:

Security–

The operating system uses password protection to protect user data and similar othertechniques.Italsopreventsunauthorizedaccesstoprogramsanduserdata.

Controloversystemperformance–

Monitors overall system health to help improve performance records the response timebetween service requests and system response to have a complete view of the systemhealth.Thiscanhelpimproveperformancebyprovidingimportantinformationneededto troubleshootproblems.

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 ofuser.

Errordetectingaids–

Operatingsystemconstantlymonitorsthesystemtodetecterrorsandavoidthemalfunctioni ngofcomputersystem.

Coordinationbetweenothersoftwareandusers–

Operatingsystemsalsocoordinateandassigninterpreters,compilers,assemblersandothersoft waretothevarioususersofthecomputersystems.

MemoryManagement–

The operating system manages the Primary Memory or Main Memory. Main memory ismade up of a large array of bytes or words where each byte or word is assigned acertain address. Main memory is a fast storage and it can be accessed directly by theCPU. For a program to be executed, it should be first loaded in the main memory. AnOperatingSystem performsthe followingactivitiesformemory management:

It keeps tracks of primary memory, i.e., which bytes of memory are used by which userprogram. The memory addresses that have already been allocated and the memoryaddresses of the memory that has not yet been used. In multi programming, the OSdecides the order in which process are granted access to memory, and for how long. ItAllocates the memory to a process when the process requests it and deallocates thememory whenthe processhas terminated orisperforming an I/Ooperation.

ProcessorManagement–

Inamultiprogrammingenvironment,theOSdecidestheorderinwhichprocesseshaveaccess to the processor, and how much processing time each process has. This functionofOSiscalledprocessscheduling.AnOperatingSystemperformsthefollowingactivi tiesforprocessormanagement.

Keepstracksofthestatusofprocesses.Theprogramwhichperformthistaskisknownastrafficcont roller.AllocatestheCPUthatisprocessortoaprocess.De-
allocatesprocessorwhenaprocessisnomorerequired.

DeviceManagement–

An OS manages device communication via their respective drivers. It performs thefollowing activities for device management. Keeps tracks of all devices connected tosystem. designates a program responsible for every device known as the Input/outputcontroller. 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 nolongerrequired.

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 Systemcarriesoutthefollowingfilemanagementactivities.Itkeepstrackofwhereinformatio nis stored, user access settings and status of every file and more. These facilities arecollectivelyknownasthefilesystem.

Q2 **What is the difference between Application Software and System Software?** *(2015-Winter)*

Ans

Sr. No.	Key	System Software.	Application Software.
1	Definition	System Software is the type of software which is the interface between application software and system.	On other hand Application Software is the type of software which runs as per user request. It runs on the platform which is provide by system software.
2	Development Language	In general System software are developed in low levell anguage which is more compatible with the system hardware in order to interact with.	While in case of Application software high level language is used for their development as they are developed as some specific purpose software.
3	Usage	System software is used for operating computer hardware.	On other hand Application software is used by user to perform specific task.
4	Installation	System software are installed on the computer when operating system is installed.	On other hand Application software are installed according to user's requirements.
5	User interaction	As mentioned in above points system software are specific to system hardware sole ssor no user interaction available in case of system software.	On other hand in application software user can interacts with it as a user interface is available in this case.
6	Dependency	System software can run independently. It provides platform for running application software.	On other hand in application software can't run independently. They can't run without the presence of system software..
7	Examples	Some examples of system software's are compiler, assembler, debugger, driver, etc.	On other hand some examples of application software's are word processor, web browser, media player, etc.
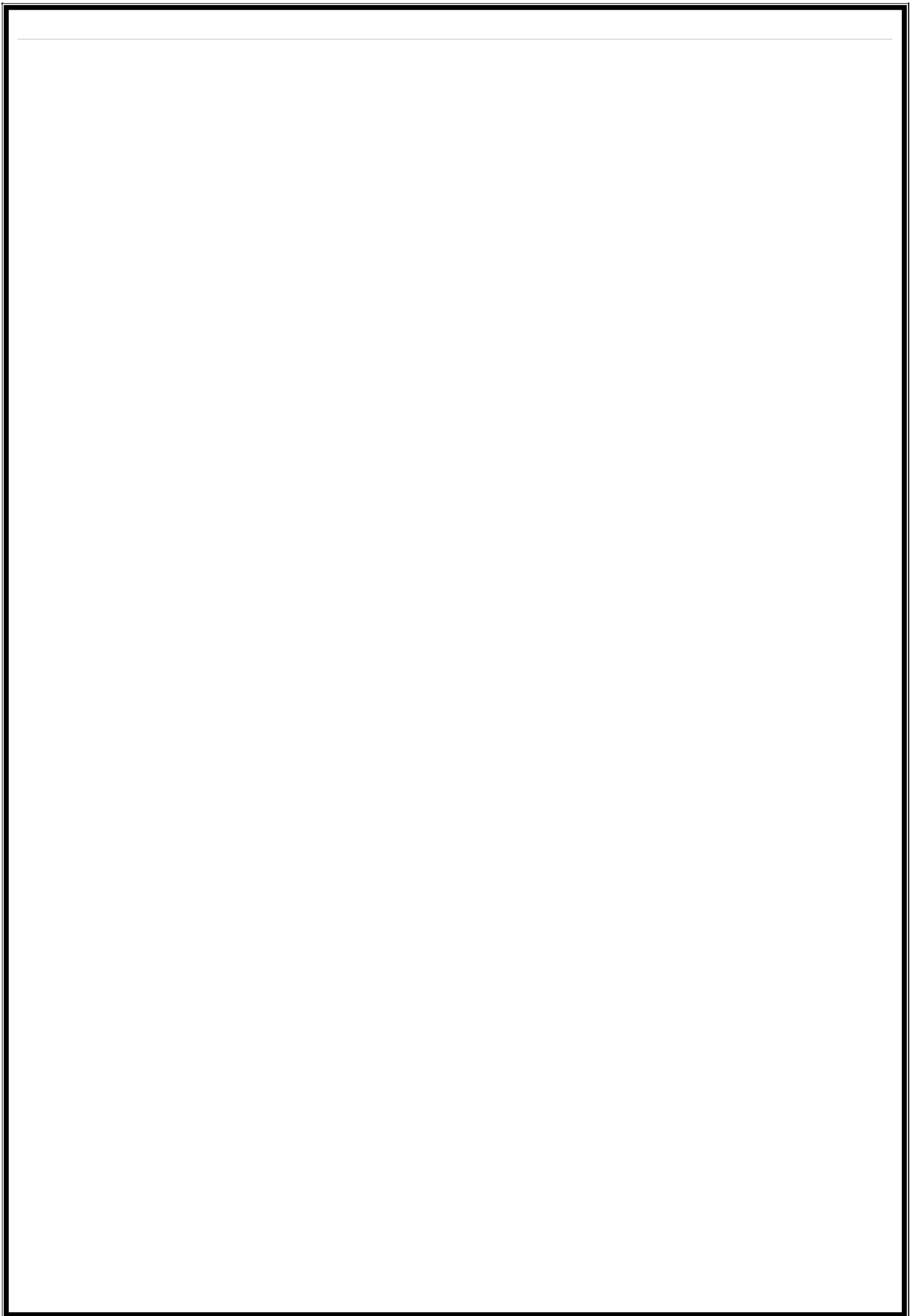
EXERCISE

ShortAnswerTypeQuestions.

Q.1 Whatarethefourmajorfunctionsofanoperatingsystem?

Q.2 WhatarethevarioustypesofoperatingsystemusedonPC?

Q.3 Defineamulti-taskingoperatingsystem.

Q.4 DefineGUI.

Q.5 Whatiscomputersecurity?

Q.6 Whatissoftware?*(2015-Summer)*

Q.7 Writetypesofsoftware?

Q.8 Whatisapplicationsoftware?

Q.9 Whatissystemsoftware?Quotesomeexamplesofsystemsoftware?

Q.10 Whatisaninterpreter?Howisitdifferentfromcompiler?

LongAnswerTypeQuestions

Q.1 Discussthevariousobjectivesofanoperatingsystem.Illustrateyouranswerwithproperexamples.

Q.2 Whatis DOS?DiscussaboutthemainfeaturesofDOSwithappropriateexamples.

Q.3 CompareandcontrastbetweenthefeaturesofUnixoperatingsystem.

Q.4 ComparethevariousfeaturesofwindowsandUnixoperatingsystem.Givesuitableexampletosubstantiateyouranswer.*(2015-Summer)*

Q.5 WriteashortnoteonSingleuserVs.Multi-userO.S.

Q.6 WhatisVirus?Howdoesvirusspreadandwhatarethesymptomsofvirusattack?Howcanyoupreventvirusattack?*(2017-Winter)(2013-Winter)(2014-Winter)*

Q.7 DistinguishbetweenCompilerandInterpreter?*(2016-Summer)*

Q.8 DefineSoftware.Describevarioustypesofsoftwareandexplainthem?

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CHAPTER–3:COMPUTERNETWORKANDINTERNET

3.1 Networkingconcept,Protocol,ConnectingMedia,DataTransmissionmode

Networkingconcept

➢ Acomputernetworkisacollectionoftwoormorecomputers,whichareconnectedtwoormorecomputers,whichareconnectedtogethertoshareinformationandresources.

➢ Itisacombinationofhardwareandsoftwarethatallowscommunicationbetweencomputersoveranetwork.

3.1.1 Protocol

➢ Aprotocolisasetofrulesthatthecommunicationsetofrulesthatthecommunicationbetweencomputersonanetwork.

➢ Mostimportantsetsofinternetprotocols are TCP/IP,HTTPS,SMTP,andFTP.

3.1.2 ConnectingMedia

➢ Connectingmediaofanetworkrefertothetransmissionmediausedinthenetwork.

➢ Itreferstothephysicalmediathroughwhichcommunicationsignalscanbetransmittedfromonepointtoanother.

➢ Itcanbedividedintotwobroadcategories

    i. GuidedMedia

    ii. UnguidedMedia

GuidedMedia:

➢ Thedatasignalinguidedmediumisboundbythecablingsystemthatguidethedatasignalalongaspecificpath.

➢ Itconsistsofacablecomposedofmaterialslikecopper,tinorsilver.

➢ Basically,theyaredividedintothreecategories:

(a) EthernetcableorTwistedPair:

- Inthispair,wiresaretwistedtogether,whicharesurroundedbyaninsulatingmaterialandanouterlayercalledjacket.
- Atwistedpairconsistsoftwoconductors(copper)
- Ex-LANCable

(b)CoaxialCable:

- Itcarriesthesignalofhigherfrequencydatacommunicationthroughthenetwork.
- Itiscommonlyusedintransferringmulti-channeltelevisionsignalsincities.
- Ex-cableTVnetwork

(c)Fiber–OpticsCable:

- Itismadeupofglassorplasticandtransmitssignalsintheformoflightfromasourceatoneendtoanotherend.
- ThespeedofOpticalfiberishundredsoftimesoffasterthancoaxialcables.
- Ex-WavelengthDivisionMultiplexing,SONETnetwork

UnguidedMedia:

➢ Itisthetransferofinformationoveradistancewithouttheuseofenhancedelectricalconductorsorwires.

- When the computers in a network interconnected and data is transmitted through waves, then they are said to be connected through unguided media.
- Some commonly used unguided media of transmission are –
  1. Radio wave transmission
  2. Microwave transmission
  3. Satellite communication
  4. Infrared wave transmission
  5. Bluetooth.

3.1.3 Date Transmission mode

- The way in which data is transmitted from one place to another is called Data transmission mode or data communication mode or directional modes.
- There are mainly 3 types of data transmission modes are-
  1. Simplex mode
  2. Half–duplex Mode
  3. Full–duplex mode

Simplex mode-

- In simplex mode, data can flow in only one direction.
- In this mode, a sender can only send data and cannot receive it.
- Similarly, a receiver can only receive data but cannot send it.
- Ex-Radio, Television etc.
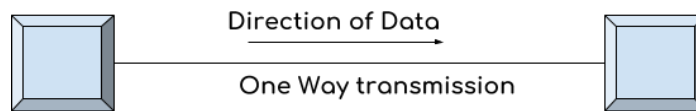
Simplex Mode

Half–duplex Mode-

- In half-duplex mode, data can flow in both directions but not at a same time.
- In this mode, data is sent and received alternatively.
- Ex-walkie-Talkie
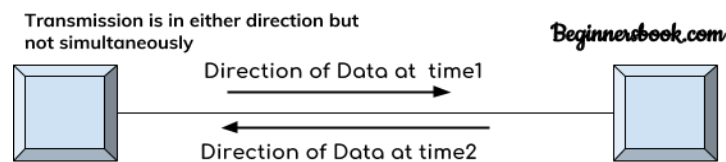
Half-Duplex Mode

Full-Duplex Mode

- In full Duplex-mode, data can flow in both directions at the same time.
- Ex-Mobile phone.
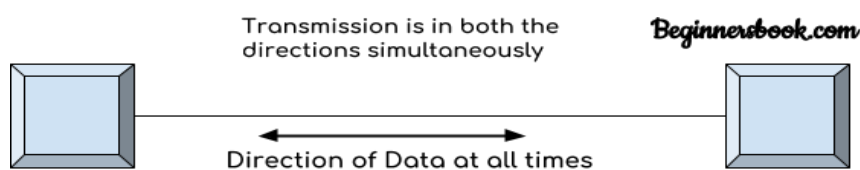
Full-Duplex Mode

3.2 Network Topologies, Types of Network

3.2.1 Network Topologies

- ➢ Network topology is determined only by the configuration of connections between nodes.
- ➢ In a fully connected network with n nodes, there are n(n-1)/2 direct links.
- ➢ The most commonly used topology are described below:

1. **Bus Topology**

   - In case of Bus topology, all devices share single communication line or cable.
   - It is one of the simple forms of networking where a failure of a device does not affect the other devices.
   - But failure of the shared communication line can make all other devices stop functioning.

[Bus Topology Diagram]
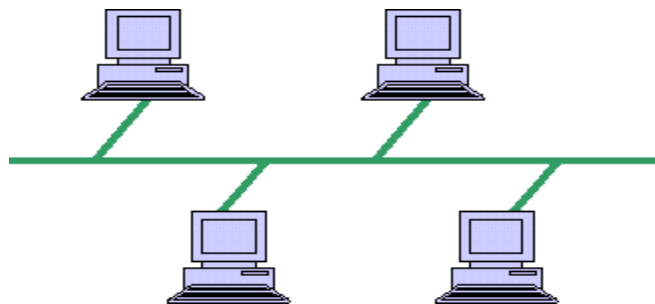
2. **Ring Topology**

   - In ring topology, each host machine connects to exactly two other machines, creating a circular network structure.
   - Failure of any host results in failure of the whole ring.
   - Thus, every connection in the ring is point of failure.
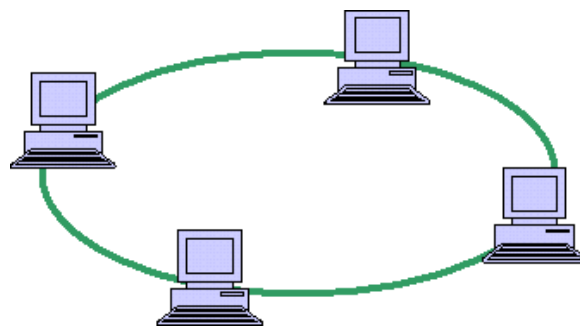
[Ring Topology Diagram]

3. **Star Topology**

   - All hosts in star topology are connected to a central device, known as hub device, using a point-to-point connection.
   - If the central hub fails, then whole network fails.
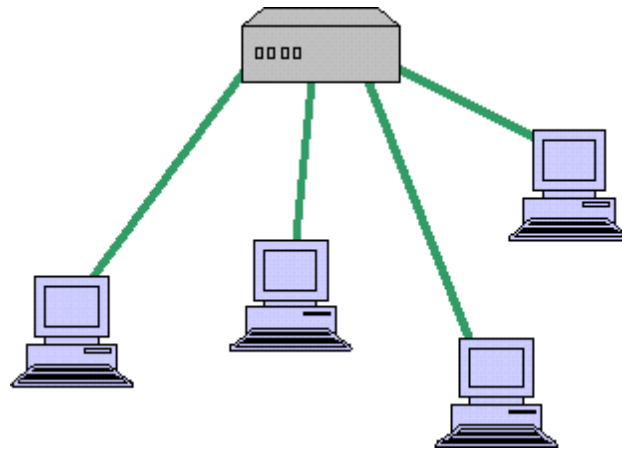
[StarTopologyDiagram]

4. TreeTopology

- Thisisalsoknownashierarchicaltopology.
- Itisanetworktopologyinwhichnodesarearrangedasatree.
- Thefunctionofthecentralnodeinthistopologymaybedistributed.
- Itisanextensionandvariationofstartopology.
- Atreetopologycombinescharacteristicsoflinearbusandstartopologies.
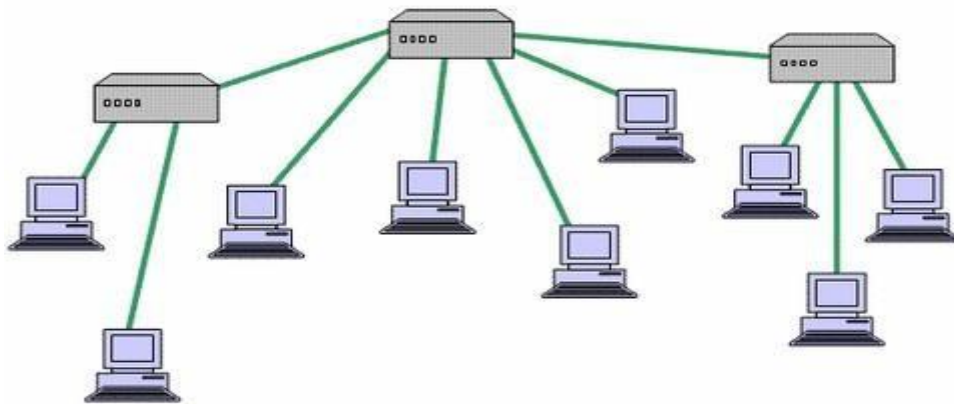
[TreeTopologyDiagram]

5. MeshTopology

- Itisalsoknownascompletelyinterconnectedtopology.
- Inmeshtopology,everynodehasadedicatedpointtopointlinktoeveryothernode.
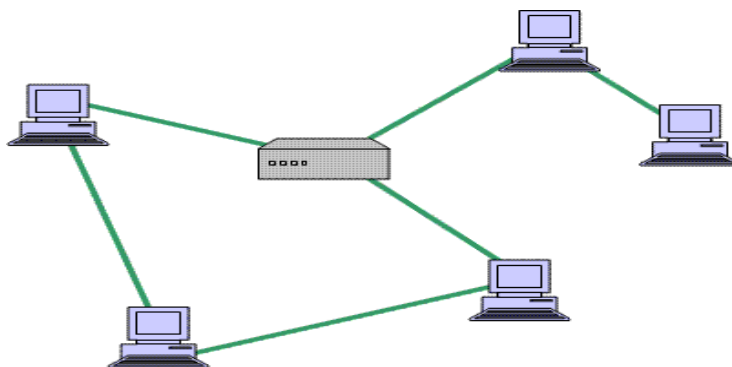
[MeshTopologyDiagram]

3.2.2 TypesofNetwork

- Therearebroadlyclassifiedintothreetypesofcomputernetwork.

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

LAN(LocalAreaNetwork)

- LANisasmallandsinglesitenetwork.
- ALANconnectsnetworkdevicesover arelativelyshortdistance.
- Itisasysteminwhichcomputersareinterconnectedandthegeographicalareasuchashome,office,building,schoolmaybewithinabuilding.
- OnmostLANscablesareusedtoconnectthecomputers.
- DatatransferrateinLANisoftheorder10to100Mbps.

WAN(WideAreaNetwork)

- AWANisageographicallydispersedcollectionofLANs
- AWANliketheinternetspansmostoftheworld.
- AnetworkdevicecalledarouterconnectsLANtoaWAN.
- Thesekindofnetworksusetelephonelines,Satellitelinksandotherlong-rangecommunicationtechnologiestoconnect.
- WANusetechnologylikeATMforconnectivity.

MAN(MetropolitanAreaNetwork)

- Itisadatanetworkdesignedforatownorcity.
- ItconnectsanarealargerthanaLAN,butsmallerthanaWAN,suchasacity,withhighperformancehardware.
- Itsmainpurposeistosharehardwareandsoftwareresourcesbythevarioususers.
- Ex-CableTVnetwork.
- ThecomputersinaWANareconnectedusingcoaxialcablesorfiberopticcables.

PAN(PersonalAreaNetwork)

- Apersonalareanetwork(PAN)isacomputernetworkusedforcommunicationamongcomputerdevicesclosetooneperson.
- SomeexamplesofdevicesthatareusedinaPANareprinters,faxmachines,telephones,PDAsorscanners.
- ThereachofaPANistypicallywithinabout20-30feet(approximately6-9meters).
- PersonalareanetworksmaybewiredwithcomputerbusessuchasUSBandFireWire.
- Awirelesspersonalareanetwork(WPAN)canalsobemadepossiblewithnetworktechnologiessuchasIrDAandBluetooth..

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

➤ Networkdevicesarerequiredtoprovideaninterfacetoconnectmultiplecomputersinanetwork.
➤ Therearemanytypesofnetworkdevicesusedinnetworking.Theseare

HubRepeat
erSwitchBr
idgeRouter
Gateway&NIC

HUB-

• Networkingusingastartopologyrequiresacentralpointforthedevicestoconnect.
• Itislikearepeaterwithmultipleportstoconnectthenetworkchannels.
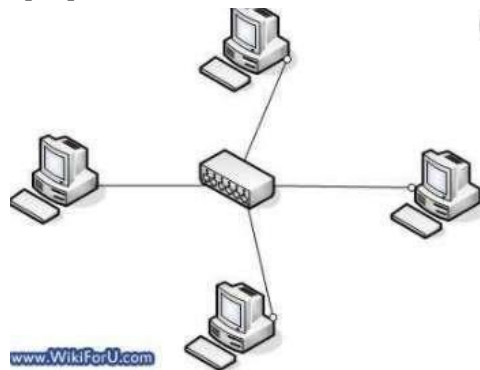
REPEATER

• RepeatershavetwoportsandcanconnecttwosegmentsofaLAN.
• Itisanelectronicdevicethatreceivesasignalandretransmitsit.
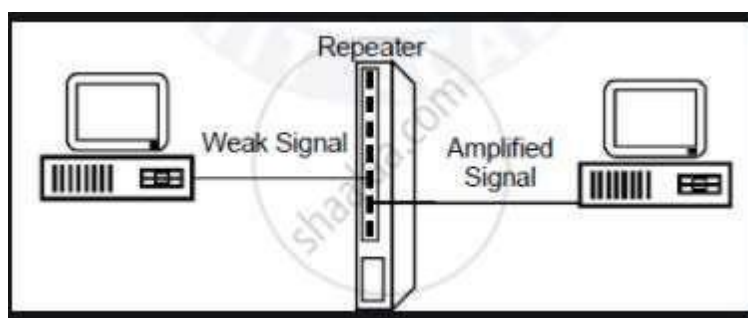
SWITCH

- ItisasmallhardwaredevicethatjoinsmultiplecomputerstogetheroneLAN.
- Ithelpstoreduceoverallnetworktraffic.
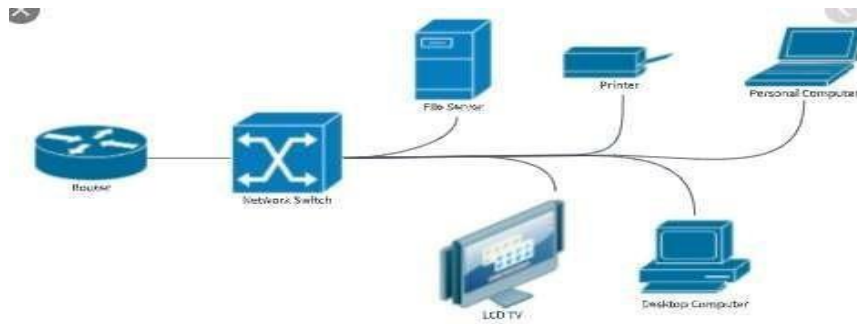
BRIDGE

- Abridgeisusedtojointwonetworksegmentstogether;itallowscomputersoneithersegmenttoaccessresourcesontheother.
- Theycanalsobeusedtodividedlargenetworksintosmallersegment.

- Abridgeisusedtojointwonetworksegmentstogether;itallowscomputersoneithersegmenttoaccessresourcesontheother.
- Theycanalsobeusedtodividelargenetworksintosmallersegment.

ROUTER

- Routersarenetworkingdevicesusedtoextendorsegmentpacketsfromonelogicalnetworktoanother.
- Routersaremostoften usedinlargeinternetworks thatuseLANstotheinternetusingdedicatedleasedlines.
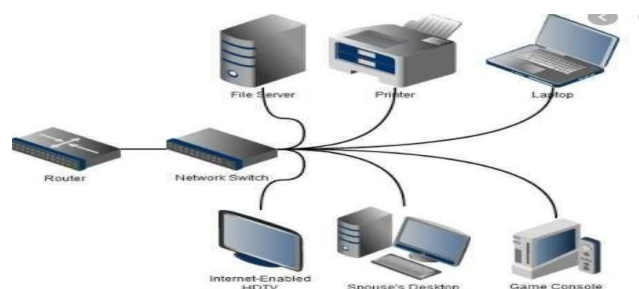
GATEWAY

- Itisaninternetworkingdevice,whichjoinstwodifferentnetworkprotocolstogether.
- Theyarealsoknownasprotocolconverters.

NIC(NetworkInterfaceCard)

- ItisahardwareCardinstalledinacomputersoitcancommunicateonanetwork.
- The networkadapterprovides one ormore ports for the networkcable toconnect toand ittransmitsandreceivesdataontothenetworkcable.
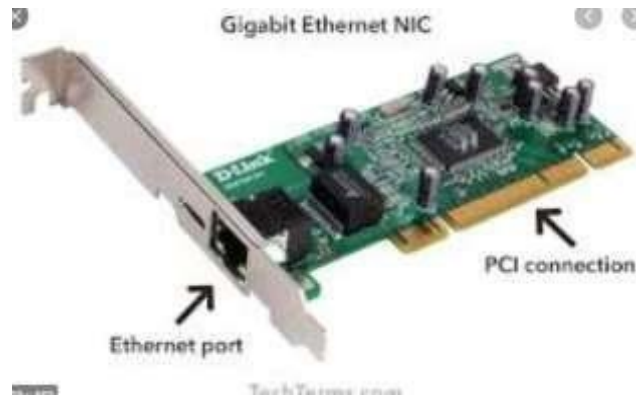
3.4 InternetServiceslikeE-Mail,WWW,FTP,Chatting,InternetConferencing,ElectronicNewspaper&OnlineShopping

- Internetisanetworkofnetworksthatconsistsmillionsofprivateandpublicnetworkoflocaltoglobalscope.
- Aninternetusercanaccesstoawidevarietyofservicessuchas

  E-MAIL(ElectronicMail)
  - E-mailisanelectronicversionofsendingandreceivingletter.
  - TouseE-mail,a usermusthaveanEmailaddress.
  - TheEmailaddresscontainsallinformationrequiredtosendorreceiveamessageiscalledmailbox.
  - Emailaddressconsistsoftwopartsseparatedby@symbol
    - 1stpartisusername
    - 2ndpartishostname(domainname)Exa

    mple:principalbose@rediffmail.com

  WWW(WorldWideWeb)
  - TheWorldWideWebisasystemofinternetserversthatsupportshypertextandmultimediatoaccessseveralinternetprotocolsonasingleinterface.
  - Itisawayofexchanginginformationbetweencomputersontheinternet.

  Example:

    https://www.google.com/http://www.bosecutt
    ack.in/

  FTP(FileTransferProtocol)
  - FTP is the internet file transfer between any computers that have an internetconnectionandalsoworksbetweencomputersusingtotallydifferentoper

atingsystems.

- o ItisaprotocolthroughwhichinternetuserscanuploadfilesfromtheircomputerstoawebsiteordownloadfilesfromawebsitetotheirPC.
- o ItistheeasiestwaytotransferfilesbetweencomputersviatheinternetandutilitiesTCP/IPsystemstoperformuploadinganddownloadingtasks.

Chatting

- o Chattingistheonlinetextualormultimediaconversation.
- o Chattingi.e.,avirtual means ofcommunicationthatinvolves thesendingandreceivingofmessages,shareaudioandvideobetweenuserslocatedin anypartoftheworld.

InternetConferencing

- o Internetconferencingallowsuserstocarryonbusinessmeetingsandseminarsmakepresentation,provideonlineeducationandofferdirectcustomer support.
- o Internetconferencingsolutionsrequirehighspeedinternetconnectionatallusersite.

ElectronicNewspaper

- o Anelectronicnewspaperisaself-contained,reusableandrefreshableversionofatraditionalnewspaperthatacquiresandholdsinformationelectronically.
- o Informationtobedisplayedwillbedownloadedthroughsomewirelessinternetconnections.

OnlineShopping

- o Itistheprocessofbuyinggoodsandservicesfrommerchantswhosellontheinternet.
- o Themaincomponentsofonlineshoppingareproduct,sellingprice,accessibilitytopeople,placementoforders,modeofpayments,deliverymechanism.

3.5 DifferenttypesofInternetconnectivityandISP

DifferenttypesofInternetconnectivity

Therearedifferenttypesofconnectionsandspeedstogetontheinformationsuperhighway.

1) Dial-UpConnections

- Adialupisamethod ofconnectingtotheinternetusinganexistingtelephone.
- Dialupconnectionusesthetelephonelinetoconnecttotheinternet.
- Themodemmustdialthetelephoneeverytimeitwantstoconnecttotheinternethencethe nameDialup.

    i. ModemDial-UpConnections-

- Themodemconnectsthecomputerthroughthestandardphonelinewhichservesasthedatatransfermedium.
- Amodemchangesthedigitaldatafromyourcomputerintoanalogdata,aformatthatcanbecarriedbytelephonelines.

    ii. ISDNDial-UpConnections-

- ➤ ThesecondtypeofdialupconnectionisthroughanISDN(Integratedservices digitalnetwork).
- ➤ Itisadigitaltelephoneservicethatcantransmitvoice,dataandcontrol

informationoveranexistingsingletelephoneline.

2) **ADSLConnections**
- ADSL(AsymmetricDigitalSubscribersLine)connectionsarebecomingmoreandmore widelyavailableandcan provideanexcellentinternet connection.
- Theconnectionsworkbysplittingyourphonelinetwoseparatechannels,onefordata(Internet)andoneforvoice(phonecalls),whichmeansyoucantalkonthephoneandbeconnected tointernetatthesametime.

3) **CableConnections**
- Cableconnectionareconsideredoneofthebesttypesofinternetconnectionsavailabletothe homeuser,theyofferveryfastandreliableconnectionswithafixedmonthlyfee.
- Acableconnectionusesatotallyseparatemediumtotransferthatitdoesn'taffectyour abilitytomake/receivephonecalls.
- Cableconnectionsarealwayson,eliminatinglongwaittomakeaconnection.

ISP(InternetServiceProvider)

- WhenauserinitiatesaDialupconnection,themodemdialsaphonenumberofaninternet serviceprovider(ISP)thatisdesignatedtoreceiveDialupcalls.
- TheISPthenestablishestheconnection,whichusuallytakesabouttensecondsandisaccompaniedbyseveralbeepingandbuzzingsounds.
- ISPreferstothecompanythatprovidesinternetconnectionstotheusers.
- SomepopularISP's,areAirtel,MTNL,Vodafoneetc.

SolvedQuestions

ShortAnswerTypeQuestions.

Q1 **DefineWWW.***(2017-Winter)*

Ans. The World Wide Web, commonly known as the Web, is an information system wheredocumentsandotherwebresourcesareidentifiedbyUniformResourceLocators,which may be interlinked byhypertext, and are accessible overthe Internet.

Q2 **DefineHTTP.**

Ans. TheHypertextTransferProtocolisanapplicationlayerprotocolfordistributed,collaborative, hypermediainformationsystems.

Q3 **DefineaDNS.**

Ans. The DomainNameSystem is a hierarchicaland decentralizednamingsystem forcomputers,services,orotherresourcesconnectedtotheInternetoraprivatenetwork.Itassociatesvariousinformationwithdomainnamesassignedtoeachoftheparticipatingentities.

Q4 **DefineaFTP.***(2016-Winter)*

Ans. TheFileTransferProtocolisastandardnetworkprotocolusedforthetransferofcomputerfilesfro maservertoaclientonacomputernetwork.

LongAnswerTypeQuestions

Q.1Explaine-mailmessageformat?*(2017-Winter)*

Ans. ElectronicMail(e-mail)isoneofthemostwidelyusedservicesoftheInternet.Thisserviceallowsan Internetusertosend amessageinaformattedmanner(mail)toother

Internetusersinanypartoftheworld.Messageinthemailnotonlycontaintext,butitalsocontains images, audio and videos data. The person who is sending mail is called senderandpersonwhoreceivesmailiscalledtherecipient.Itisjustlikepostalmailservice.

FormatofE-mail:

Ane-mailconsistsofthreepartsthatareasfollows:

1. Envelope
2. Header
3. Body

Theseareexplainedasfollowingbelow.

1. Envelope:

Theenvelopepartencapsulatesthemessage.Itcontainsallinformationthatisrequiredforsendi nganye-mailsuchasdestinationaddress,priorityandsecuritylevel.TheenvelopeisusedbyMTAsforrou tingmessage.

2. Header:

Theheaderconsistsofaseriesoflines.EachheaderfieldconsistsofasinglelineofASCIItext specifying field name, colon and value. The main header fields related to messagetransportare:

> To:ItspecifiestheDNSaddressoftheprimaryrecipient(s).
> CC:Itreferstocarboncopy.Itspecifiesaddressofsecondaryrecipient(s).
> BCC: It refers to blind carbon copy. It is very similar to Cc. The only differencebetweenCcandBccisthatitallowusertosendcopytothethirdpartywithoutpri maryandsecondaryrecipientknowingaboutthis.
> From:Itspecifiesnameofpersonwhowrotemessage.
> Sender:Itspecifiese-mailaddressofpersonwhohassentmessage.
> Received:Itreferstoidentityofsender's,dataandalsotimemessagewasreceived.It also contains the information which is used to find bugs in routing system.Return-Path:Itisaddedbythemessagetransferagent.Thispartisusedtospecifyhowtogetbac ktothesender.

3. Body:-Thebodyofamessagecontainstextthatistheactualcontent/messagethatneedsto be sent, such as "Employees who are eligible for the new health care program shouldcontact their supervisors by next Friday if they want to switch." The message body alsomay include signatures or automatically generated text that is inserted by the sender'semailsystem.

Q.2Whatdoyoumeanbynetworktopologies?Whatarethemajortypesofnetworktopologies?*(2016-Winter)(2015-Winter)(2013-Winter)*

Ans.

Therearefivetypesoftopologyincomputernetworks:Thesea re

1. MeshTopology
2. StarTopology
3. BusTopology

4. RingTopology

5. HybridTopology

MeshTopology

In mesh topology each device is connected to every other device on the network 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. Lets say we have n devices in the networktheneachdevicemustbeconnectedwith(n-1)devicesofthenetwork.Numberoflinksinameshtopologyofndeviceswouldben(n-1)/2.

AdvantagesofMeshtopology

1. Nodatatrafficissuesasthereisadedicatedlinkbetweentwodeviceswhichmeansthelinkisonlyavailableforthosetwodevices.

2. Meshtopologyisreliableandrobustasfailureofonelinkdoesn'taffectotherlinksand thecommunicationbetweenotherdevicesonthenetwork.

3. Meshtopologyissecurebecausethereisapointtopointlinkthusunauthorizedaccessisnotpossible.

4. Faultdetectioniseasy.

DisadvantagesofMeshtopology

1. Amountofwiresrequiredtoconnectedeachsystemistediousandheadache.

2. Sinceeachdeviceneedstobeconnectedwithotherdevices,numberofI/Oportsrequired mustbehuge.

3. Scalabilityissuesbecauseadevicecannotbeconnectedwithlargenumberofdeviceswith adedicatedpointtopointlink.

StarTopology

In star topology each device in the network is connected to a central device calledhub.Unlike Mesh topology,startopology doesn't allowdirect communication betweendevices; a device must have to communicate through hub. If one device wants to send datatootherdevice,ithastofirstsendthedatatohubandthenthehubtransmitthatdatatothedesignateddevice.

AdvantagesofStartopology

1. LessexpensivebecauseeachdeviceonlyneedoneI/Oportandneedstobeconnectedwithhubwithonelink.

2. Easiertoinstall

3. Lessamountofcablesrequiredbecauseeachdeviceneedstobeconnectedwiththehubonly.

4. Robust,ifonelinkfails,otherlinkswillworkjustfine.

5. Easyfaultdetectionbecausethelinkcanbeeasilyidentified.

DisadvantagesofStartopology

1. If hubgoesdown everythinggoes down, none of the devicescan workwithout hub.

2. Hubrequiresmoreresourcesandregularmaintenancebecauseitisthecentralsystemofstartopology.

BusTopology

Inbus topology thereis amain cableandall thedevices areconnectedtothis maincablethroughdroplines.Thereisadevicecalledtapthatconnectsthedroplinetothemaincable.Sinceallthedataistransmittedoverthemaincable,thereisalimitofdroplinesandthedistanceamaincablecanhave.

Advantagesofbustopology

1. Easyinstallation,eachcableneedstobeconnectedwithbackbonecable.

2. LesscablesrequiredthanMeshandstartopology

Disadvantagesofbustopology

1. Difficultlyinfaultdetection.

2. Notscalableasthereisalimitofhowmanynodesyoucanconnectwithbackbonecable.

RingTopology

Inringtopologyeachdeviceisconnectedwiththetwodevicesoneithersideofit. Therearetwodedicatedpointtopointlinksadevicehaswiththedevicesontheeithersideofit.Thi sstructureformsaringthusitisknownasringtopology.Ifadevicewantstosenddata to another device then it sends the data in one direction, each device in ring topologyhasarepeater,ifthereceiveddataisintendedforotherdevicethenrepeaterforwardsthi sdatauntiltheintendeddevicereceivesit.

AdvantagesofRingTopology

1. Easytoinstall.

2. Managingiseasierastoaddorremoveadevicefromthetopologyonlytwolinksarerequiredtob echanged.

DisadvantagesofRingTopology

1. Alinkfailurecanfailtheentirenetworkasthesignalwillnottravel forwardduetofailure.

2. Datatrafficissues,sinceallthedataiscirculatinginaring.

Hybridtopology

A combination of two or more topology is known as hybrid topology. For example acombinationofstarandmeshtopologyisknownashybridtopology.

AdvantagesofHybridtopology

1. Wecanchoosethetopologybasedontherequirementforexample,scalabilityisourconcernt henwecanusestartopologyinsteadofbustechnology.

2. Scalableaswecanfurtherconnectothercomputernetworkswiththeexistingnetworkswithdiff erenttopologies.

DisadvantagesofHybridtopology

1. Faultdetectionisdifficult.

2. Installationisdifficult.

3. Designiscomplexsomaintenanceishighthusexpensive.

EXERCISE

ShortAnswerTypeQuestions.

Q.1 Definecomputernetwork.*(2014-Summer)*

Q.2 Whatarethevarioustypesofnetworks?

Q.3 What is a MAN?

Q.4 Whatarethedifferenttopologiesusedincomputernetwork?*(2018-Summer)*

Q.5 NamesomeInternetserviceprovidersinIndia?

Q.6 Whatdoyoumeanbyawebpage?

Q.7 Whatisawebsite?

Q.8 Whatise-mail?Whataretheusesofe-mail?

Q.9 Whatarethebenefitsofe-mail?

Q.10 Whatarethelimitationsofe-mail?

Q.11 DefineaURL.*(2013-Summer)*

Q.12 WhatdoyoumeanbyNetworktopology?*(2016-Winter)*

Q.13 What arethe advantages andDisadvantages of BusTopology?

Q.14 Whatis amodem?

LongAnswerTypeQuestions

Q.1 Discussaboutthevariouscategoriesofcomputernetwork.GiveacomparisonsbetweenLAN andWAN.

Q.2 Describevariouscategoriesofnetworkwithexample.*(2016-Summer)*

****

CHAPTER–4: FILEMANAGEMENTANDDATAPROCESSING

4.1 ConceptofFileandFolder

Conceptoffileandfolder:-

- InearlierDOSbasedsystem,wehadorganizeddataintofilesanddirectories.
- InGUIbasedoperatingsystem,suchaswindow,wehavefileandfolders,inwhichdataareorganizedduringstorageincomputermemory.
- However,theunitofrawdatainbinaryformatiseitherbyte(B)orkilobyte(KB)ormegabyte(MB)orgigabyte(GB).
- Abyteissmallestunitofinformation.Itisusedtomeasurethesizeof ourdocuments.

$$1Byte=1B=8bits1KB=2^{10}Bytes$$
$$=1024Bytes1MB=2^{10}KB=1024$$
$$KB$$
$$1GB=2^{10}MB=1024MB$$
$$1TB=2^{10}GB=1024GB$$

Files:

- Filesarethemostbasicunitofdatathatusercanstoreonadisk.Afileisthecommonstorageunitinacomputer.
- Allprogramanddataarecontainedinafileandthecomputerneedsandwritesfiles.
- In every program, image, video, song and document are stored ina file.
- Itispossibletomoveafilefromonefoldertoanother.
- Onecancreate,save,open,moveanddeletefiles.
- Therearedifferenttypesoffilesdependingonthetypeofinformationtheycontain.Thereareimagefilesetc.
- Thefilesareassignedatypeoffilewhichcanbeknownfromtheextensionofthefilename.
- The file name can have up to 255 character, it can contain letter, number, blank space andspecialcharacterslikedashes,underlines,etc.butthereisagroupthatcannotbeused(",/,>,<,|)
- Fileextensionfilesareidentifiedbyashort"extension"attheendoftheirname.
- Ex:Soumya.jpgisaJPEGimage
- Chandan.docisaMicrosoftworddoc
- ABC.exeisanexecutableapplicationinwindows.

Folders:

- A folder is a collection of multiple files.
- A folder holds one or more files and it can be empty with just a name.
- Folder can also store other folders called subfolders.
- Folders were also called "directories" in operating systems before windows.
- It would become almost possible to manage hundreds of files in your computer.

Different between a file and a folder:

File:

- File store data, whether text, music or item.
- Files are taking spaces on computer memory.
- Each file has its own extension.
- Easily move or copy data from one file to another.
- Cannot create any folder or subfolder within a file.

Folder:

- A folder stores files and other folders.
- Folders are not taking space on computer memory.
- Folders do not have any extension.
- Copy or move files from one folder to another folder.
- Can create different types of files or subfolders in a folder.

4.2 File Access and Storage methods. Sequential, Direct, ISAM

File Access and storage method:

- An access method defines the technique that is used to store and receive data.
- An access method is a function of a mainframe operating system that enable access to data on click or o ther external device.
- In computing an access method is a program or a hardware mechanism that moves the data betwe en the computer and an outing device such as a hard disk or a display terminal.
- It is also used to describe the way that data is located within a large unit of data such as a data set o r files.
- There are various types of access methods

  1) Random Access or Direct Access:

  - Direct access method is based on a disk model if a file, since disks allow random access to any file block.

- ➤ Thistypesofaccessmethodprovidesaspeedyaccesstothefile.Itprovidesimme diateaccesstolargeamountofinformation.
- ➤ Itallowstheprogramstoreadandwritetherecordsinarapidmannerinonparticular orders.
- ➤ Fordirectaccess,wecanviewthefileasanumbersequenceofblocksorrecords.
- ➤ Thismethodisusuallyusedindatabase.

2) SequentialAccess:

- ➤ Thisisthemostcommonmethod.
- ➤ Heretheinformationpresentinthefileisaccessedinasequentialfashion,onrecordaftertheot her.
- ➤ Itisverycommonapproachwhichisusedbyeditorsandcompilerusually.
- ➤ TheReadandwriteoperationfromthemajorpartoftheoperationsdoneonafile.
- ➤ Areadoperationreadsthenextportionofthefileandautomaticallyadvancesthefilepo inter,whichtrackstheI/OLocations.
- ➤ Awriteoperationappendstotheendoffilesandadvancestotheand,ifthenewlywrittenmat erial.

3) IndexedSequentialAccessMethod(ISAM)-

- ➤ Thismethodisbuiltontopofdirectaccessmethod.
- ➤ Hereanindexcontainsthepointerstovariousblocksofthefile.
- ➤ So,tofindarecordinsideafile,wefirstlysearchtheindexandlaterusethepointerobtaine dtoaccessthefiledirectlyandfindtherecordwehavebeensearchingfor.
- ➤ Therecordsofthedatafilearestoredinsequentialorderaccordingtosomedataattributes .
- ➤ SinceISAMisstatic,itdoesn'tchangeitsstructureifrecordsareaddedordeletedfromtheda tafile.
- ➤ ISAM is available in many variations on microcomputer, mini computers, and mainframecomputers.

4.3 DataCapture,Datastorage, DataProcessingandRetrieval

4.3.1 DataCapture:-

- ➤ Datacaptureistheprocessofidentificationandextractionofdatafromascanneddocu ment,oftentobesenttoaworkflowforroutingandactionaspartofbusinessprocess.

> ➢ Multiplemethodsareavailableforcapturingdatafromunstructureddocuments(letters,invoices,email,fax,formsetc.)
> ➢ Methodsofcapturefromdocumentsinelectronicformatareidentifiedbelow:

Singleclick:

> ➢ It is an optical character recognition (OCR) tool that can be used to capture machineproducedcharactersinlowvolumead-hoccaptureapplicationandpopulatingalineofbusinessapplication.

OCR:

> ➢ OCR as technology provides the ability to successfully capture machine producedcharactersinfullpage.
> ➢ OCRsystemscanrecognizemanydifferentOCRfontsaswellastypewriterandcomputer printedcharacters.

ICR(Intelligentcharacterrecognition):

> ➢ ICRisthecomputertranslationhandprintedandwrittencharacters.
> ➢ Dataisenteredfromhandprintedformsthroughascannerandtheimageofthecaptur edataisthenanalyzedandthentranslatedbysophisticatedICRsoftware.

BarcodeRecognition:

> ➢ Dependentuponthetypeofbarcodesthatisused,theamountofmetadatathatcanbeincludedishigh,asisthelevelofrecognition.
> ➢ Theapplicationofsingleandmultiplebarcodestoparticulardocumenttypessuchaspro ofofdeliverynotes.

IDR(Intelligentdocumentrecognition):

> ➢ The level of capability isdependent upon theindividual product.
> ➢ Theseapplicationareusedtocapturemetadatafromdocumentsthatisruledbased.
> ➢ Ex: Theproduct willidentify postcodes,logos, keywords.

4.3.2 DataStorage:

> ➢ Datastorageistheholdingofdatainanelectromagneticfromforaccessbyacomputerproces sor.
> ➢ Therearetwokindsofstorage:
>
>   a) PrimarystorageisdatathatisheldinRAMandothermemorydevices thatarebuiltintocomputers.

b) Secondarystorageisdatathatisstoredonexternalstoragedevicessuchasharddisks,tapes, CD,Pendriveetc.

- Followingaresomemaindevicesfordatastorage:
  - Harddisks
  - Floppydisks
  - Opticaldisks
  - CD
  - Pendrives
  - Flatmemorycard/memorycard

4.3.3 DataProcessing:

- Dataprocessingmustbeprocessedinordertoconvertitintoinformation.
- Forthispurpose,differentoperationsmaybeperformedondata.
- Dataprocessingisdefinedasasequenceofoperationsondatatoconvertitintousefulinformation.
- Thedataprocessingcanbeaccomplishedthroughfollowingmethods:

1. ManualDataProcessing:

- Inthismethod,dataisprocessedmanuallywithoutusinganymachineor tooltogetrequiredresults.
- Inmanualdataprocessing,allthecalculationsandlogicaloperationsareperformedmanuallyonthedata.
- Ex:Marksheets,feereceipts

2. MechanicalDataProcessing:

- Inthismethod,dataisprocessedbyusingdifferentdevicesliketypewriters,mechanicalprintersorothermechanicaldevices.
- Examinationboardandprintingpressusemechanicaldataprocessingdevicesfrequently.

3. ElectronicDataProcessing:

- Itisthemoderntechniquetoprocessdata.
- Thedataisprocessedthroughcomputer;dataandsetofinstructionsaregiventothecomputer asinput andthe data according tothe given set ofinstructions.
- Thecomputerisalsoknownaselectronicdataprocessingmachine.
- Ex:resultsofstudentsarepreparedthroughcomputers.

4.3.4 DataRetrieval:

- Dataisoneofthemostimportantassetsofanybusiness.
- Datarecoveryreferstothewholeprocessofsalvagingthislostdatathatiscorrupted,failed,damagedorinaccessible.
- Lostfilescanoccurbecauseofanyofthebelowpossibilities.

    1) Filewasmistakenlydeleted.

    2) Filewascorruptedordeletedbyscandisk.

    3) Anotherprogramdeletedthefile.

    4) Fileispasswordprotected.

- Followingaresomedifferentmethodsofdatarecovery:-

    1) Physicaldamagetostoragedevices:

    o Differentfailurecancausephysicaldamagetoyourstoragemedia.

    2) Mediaerrorsandcorruptpartitionsandfilesystems:

    o Insomecases,mediaerrorsordamagetothefilesystemorpartitiontablecanmakethe dataonaharddrivetobeunreadable.

3) Onlinedatarecovery:

    o ThisisanotherpopularmethodofdatarecoverySydneybusinessusetorestoredeletedor rlostfiles.

    o Itisamethodofdatarecoverythatisperformedovertheinternetwithoutnecessar ilyhavingthecomputerorthedriveinpossession.

SolvedQuestions

ShortAnswerTypeQuestions.

Q.1Whatisthedifferencebetweenfileandfolder.Ans:

-.

Sr.No.	Key	File	Folder
1	Extension	Filesmayormaynothaveextensions.	Folders do not haveextensions.
2	Container	A File can not contain another file/folder.	Afoldercancontainanynumberoffile/folders.
3	Memorysize	A file has certain size and	Afolder hasno size of its own. It derives

| 4 | Attributes | Name,Extension,Date,Time,Lengthand Protection (Read-Only,hidden etc.) | Name,Date,TimeandProtection (Read-Only,hiddenetc.) |

Q.2WhatdoyoumeanbyISAM?*(2016-Winter)*

Ans:-i.ItstandsforIndexedSequentialAccessMethod.

ii.ISAMisamethodforcreating,maintaining,andmanipulatingcomputerfilesofdatasothatrecordscanberetrievedsequentiallyorrandomlybyoneormorekeys.

iii.Inthismethod,eachrecordhastheaddressofitsdata block,searchingarecordinahugedatabaseisquickandeasy.

iv. Thismethodsupportsrangeretrievalandpartialretrievalofrecords.

Q.3DefineOCR.

Ans:-i.Standsfor"OpticalCharacterRecognition.

ii.OCRis atechnology thatrecognizestextwithinadigitalimage.

iii.Itiscommonlyusedtorecognizetextinscanneddocuments,butitservesmanyotherpurposesaswell.

Q.4Whatisfolder.*(2017-Winter)*

Ans:-AFolderisacollectionoftables,charts,orotheroutputsintheReporttree.

- Itisthesameideaashavingfoldersonyourcomputer.

- Theycreatedbyright-clickingontheReporttreeandselectingAddFolder.

- Foldersarealsocalleddirectoriesbecauseofthewaytheyorganizedatawithinthefilesystemofastoragedevice.

LongAnswerTypeQuestions.

Q.1Whatisfileaccess?Explainthevarioustypeoffileaccessmethod.*(2014-Winter)(2015-Winter)*
Ans:-
Afileaccessdefinitioncancontrolaccesstodatainspecifiedtablesandcolumns,ortotablesandcolumnsforwhichaccessisnotgrantedexplicitly.Youdefineaccesspermissionsbycreatinganaccesslistforatable,column,orthedefault.
Whenafileisused,informationisreadandaccessedintocomputermemoryandthereareseveral ways to access this information of the file. Some systems provide only one accessmethodforfiles.
Therearethreewaystoaccessafileintoacomputersystem:Sequential-Access,DirectAccess,IndexsequentialMethod.
1. **SequentialAccess–**
- Dataisaccessedonerecordrightafteranotherrecordinanorder.

- Whenweusereadcommand,itmoveaheadpointerbyone
- Whenweusewritecommand,itwillallocatememoryandmovethepointertotheendofthefile
- Suchamethodisreasonablefortape.

2. **DirectAccess–**
   Anothermethodisdirectaccessmethodalsoknownasrelativeaccessmethod.Afiled-length logical record that allows the program to read and write record rapidly. in noparticularorder.Thedirectaccessisbasedonthediskmodelofafilesincediskallowsrandom access to any file block. For direct access, the file is viewed as a numberedsequenceofblockorrecord.Thus,wemayreadblock14thenblock59andthenwec anwrite block 17. There is no restriction on the order of reading and writing for a directaccessfile.

3. **Indexsequentialmethod –**
   It is the other method of accessing a file which is built on the top of the sequentialaccess method. These methods construct an index for the file. The index, like an indexinthebackofabook,containsthepointertothevariousblocks.Tofindarecordinthefile, wefirstsearchtheindexandthenbythehelpofpointerweaccessthefiledirectly.

Q. 2Discussaboutthe Datastoragedevices.

Ans:-A storage device is a piece of computer hardware used for saving, carrying and pulling outdata. It can keep and retain information short-term or long-term. It can be a device insideor outside a computer or server. Other terms for storage device is storage medium orstoragemedia.

A storage device is one of the basic elements of any computer device. It almost saves alldataandapplicationsinacomputerexceptforhardwarefirmware.Itcomesindifferentsha pesandsizesdependingontheneedsandfunctionalities.

Therearetwodifferenttypesofstoragedevices:

	PrimaryStorageDevice	**SecondaryStorageDevice**
Size	Smaller	Larger
DataRetention	Temporary	Permanent
Location	Internal	Internal/External
E.g	RAM,ROM	MagneticStorageDevice,Floppydiskette,Harddrive,Magneticstrip,Cassettetape,etc.
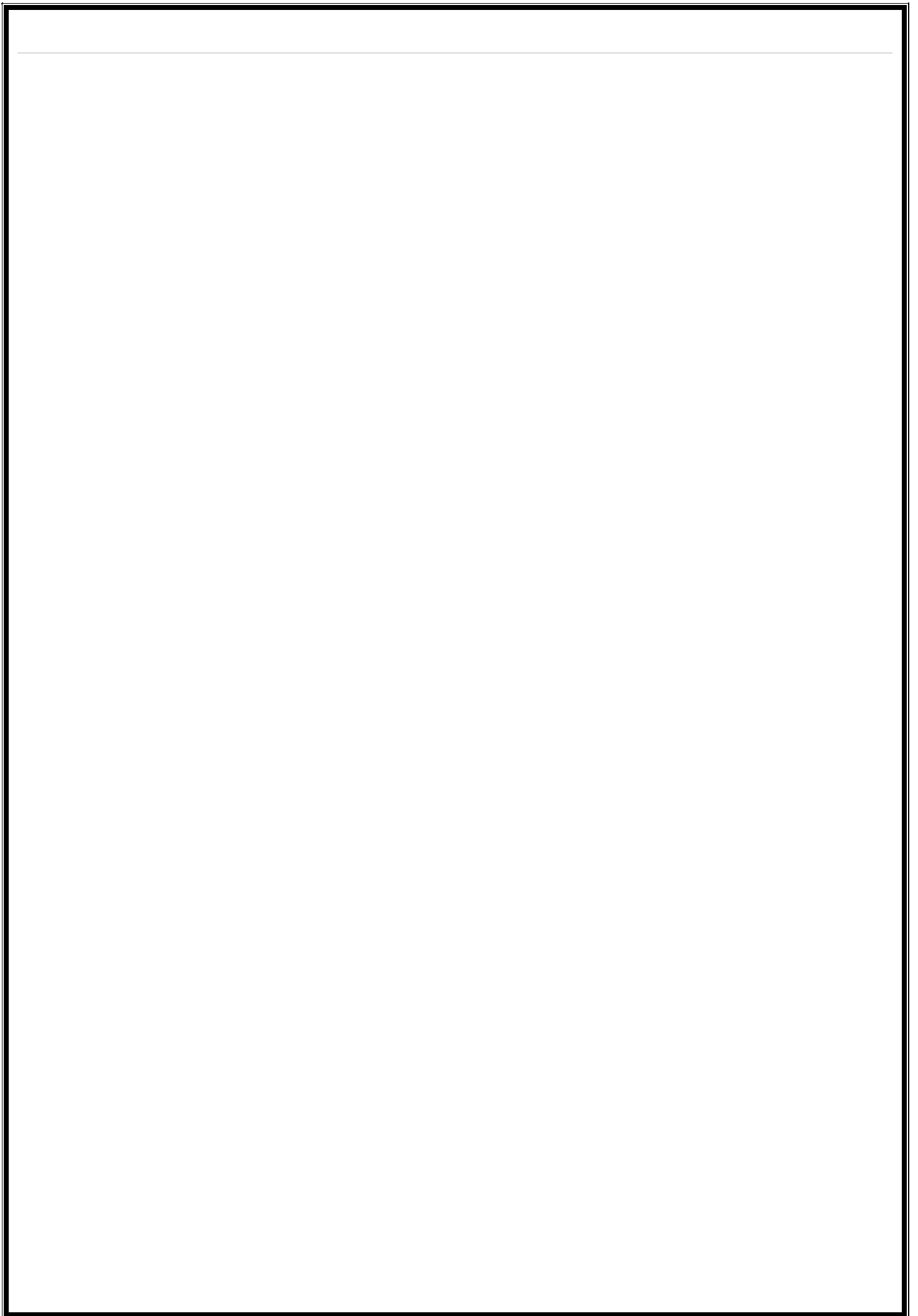
EXERCISE

ShortAnswerTypeQuestions.

    Q.1 WhatisthedifferencebetweenRandomAccessmethodandsequentialaccessmethod? *(2017-Winter)*

    Q.2 WhatisDataprocessinganddiscussaboutsomeoperationsthatcanbeperformedondata?

LongAnswerTypeQuestions.

    Q.1 Whatdoyoumeanbyfileaccess?Explainthevarioustypesoffileaccesstechniques.*(2017-Summer)*

    Q.2 DiscussabouttheDataRetrieval.

****

CHAPTER–5:PROBLEMSOLVINGMETHODOLOGY

Problemsolving

Solvingproblems is thecoreofcomputerscience.Programmers mustfirstunderstand howahumansolves aproblem,thenunderstand howtotranslatethis "algorithm"intosomethingacomputercando,andfinallyhowto"write"thespecificsyntax(requiredbyaco mputer)togetthejobdone.Itissometimesthecasethatamachinewillsolveaprobleminacompletelydifferen twaythanahuman.

ComputerProgrammersareproblemsolvers.Inordertosolveaproblemonacomputeryoumust:

1. Knowhowtorepresenttheinformation(data)describingtheproblem.
2. Determinethestepstotransformtheinformationfromonerepresentationintoanother

5.1 Algorithm,Pseudo code andFlowchart

5.1.1 Algorithm

Analgorithmisasetofspecificstepstosolveaproblem.Thinkofitthisway:ifyouweretotell your 3 year old niece to play your favorite song on the piano (assuming the niece has neverplayed a piano), you would have to tell her where the piano was, and how to sit on the bench, andhowtoopenthecover,andwhichkeystopress,andwhichordertopressthemin,etc,etc,etc.

Definition:

➢ Analgorithmisawell-definedprocedurethatallowsacomputertosolveaproblem.
➢ Algorithmisdefinedasthestep-by-stepsolutionofprobleminuser's language.
➢ Itisconsideredasaneffectiveprocedureforsolvingaprobleminfinitenumberofsteps.
➢ Anotherwaytodescribeanalgorithmisasequenceofunambiguousinstructions.
➢ Infact,itisdifficulttothinkofataskperformedbyyourcomputerthatdoesnotusealgorith ms.

ThecharacteristicsofAlgorithmare

- Precise
- Unambiguous
- Finitetermination
- Uniquesolution

Example:

1. Algorithmto findoutsumof two numbersto betakenasinput.

Step-1 Read the 1ˢᵗ number

xStep-

2Readthe2ⁿᵈnumberyStep-

3Sum=x+y

Step-4PrintSum

Thisisanexamplewhereonlysequenceisexhibited

2. Algorithmtofindoutlargerbetweentwonumberstobetakenasinput.

Step-1 Read the 1ˢᵗ number

xStep-

2Readthe2ⁿᵈnumberyStep-

3Ifx>y

 Then Print

 xElseifx<yT

 henPrinty

 ElsePrint"BothareEqual"

ThisisanexamplewhereBranchingisexhibited

3. Algorithmtofindoutsumoffirst10naturalnumbers.

Step-1i=1,Sum=0

Step-

2Repeatstep3and4whilei<>10Step-

3Sum=Sum+i

Step-4i=i+1Step-

5PrintSum

ThisisanexamplewhereRepetitionisexhibited

5.1.2 Pseuodocode

It is a concise description algorithm in English language that uses programming languageconstructs. It contains outlines of the program that can be easily converted to program. It focuseson the logic of the algorithm without giving stress on the syntax of programming language. This ismeant for understanding the logic of the program easily. Flowchart can be considered as analternative to pseudo code. Several constructs/key words of programming language can be usedinthealgorithmtowritethepseudocode.Someofthemare

If ... Endif

Do while ... end
doWhile...endwhil
e

Repeat...untilFor

...endforCase
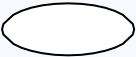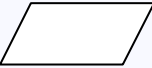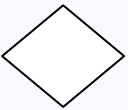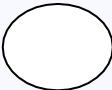
...............endcase

CallRetur

n

5.1.3 **Flowchart**

Flowchart is a graphical or symbolic representation of the process of solution to a problemor algorithm. It helps to visualize the complex logic of the solution of the problem in a simplifiedmanner through diagrammatic representation. Each step of the algorithm is presented using asymbol and a shortdescription. Thedifferent symbols usedfortheflowchartare

Symbol	Purpose	Description
→	Flow line	Indicatestheflowoflogicbyconnectingsymbols.
⬭	Terminal(Stop/Start)	Representsthestartandtheendofaflow chart.
▱	Input/output	Used forinput and output operation.
▭	Processing	Usedforarithmeticoperationsanddata-manipulations.
◇	Decision	Usedfordecisionmakingbetweentwoorm orealternatives.
◯	On-pageConnector	Usedtojoindifferentflowline
⌂	Off-pageConnector	Usedtoconnecttheflowchartportiononadif ferentpage.
▭	PredefinedProcess/Functio n	Representsagroupofstatementspe rformingoneprocessingtask.

5.2 GenerationofProgrammingLanguages

ProgrammingLanguage

Programminglanguageisatooltoexpressthelogicorinstructionsforunderstandingofthecomputer.Anyprogramminglanguagehastwocomponents:

a) Syntax

b) Semantics

Syntax refers to the rules to be followed for writing valid program statements. Compilercan detect errors in syntax while compiling the program. Semantics is associated with logic   of theprogram.Compilercannotdetectthesemanticerror.Theuserofprogrammercandiagnosesemantic error.

There are good numbers of High level languages, each meant for specific area of dataprocessing.CommonlyknownlanguagesareBASIC, FORTRAN, COBOL, Pascal, C, C++ etc.While FORTRAN is good for Numerical and scientific calculation, COBOL is good for Businessapplicationsinvolvinglargeamountofdatahandling.

GenerationsofProgrammingLanguage

TheProgramminglanguagescanbeclassifiedinto4generations1stGen

eration:MachineLanguage

2ndGeneration:AssemblyLanguage3rdGenera

tion:HighLevelLanguage4thGeneration:Very

HighLevelLanguage

MachineLevellanguagecontainsinstructionsinbinaryformi.e.in0sand1s.Thuswritinginstructionwasverydifficultandneedsheavyexpertise.Thiswasusedinearlydayscomputers.

Assembly level language instructions were written using symbolic codes known as mnemonics. Incomparison to Machine language, it is relatively easier to write program, but still it requires lot ofexpertise.Atranslatorcalledassemblerisusedtotranslateassemblylanguageprogramtomachinelevellanguage.

High level language contains instructions in English like words so that user will feel easierto formulate and write the logical statements of the program. Here the logic may spread overmultiple statements as against a single statement in assembly language. It uses a translator calledcompiler for translation of High level language program to machine level language program.TherearemanyHighlevellanguagesusedforprogrammingsuchasBASIC,FORTRAN,COBOL,

PASCAL,C,C++etc.

PASCAL,C,C++etc.

VeryHighLevellanguageotherwisecalledas4GLusesnonprocedurallogicalstatements. Atypicalexampleof4GListhequerylanguagesuchasSQL.

5.3 StructuredProgrammingLanguage

Structured Programming is also known as Modular Programming. In this type of programmingtechnique, the program shall be broken into several modules. This helps in managing

memoryefficientlyastherequiredmoduleoftheprogramwillbeloadedintothememoryonlyandnotth eentireprogram.Thiswill

alsoenhancecodereuse.Writing,understanding,debuggingandmodifyingtheindividualmoduleofthe programisalsoeasier.

5.4 ExamplesofProblemsolvingthroughFlowchart

Example

1. **Addtwo numbersentered by the user.**
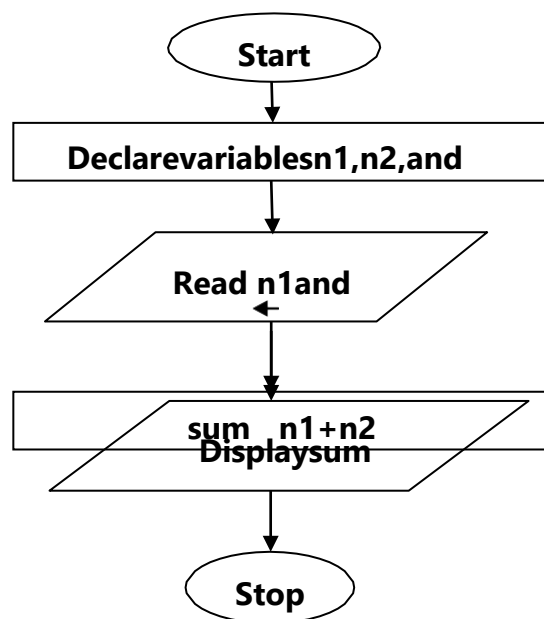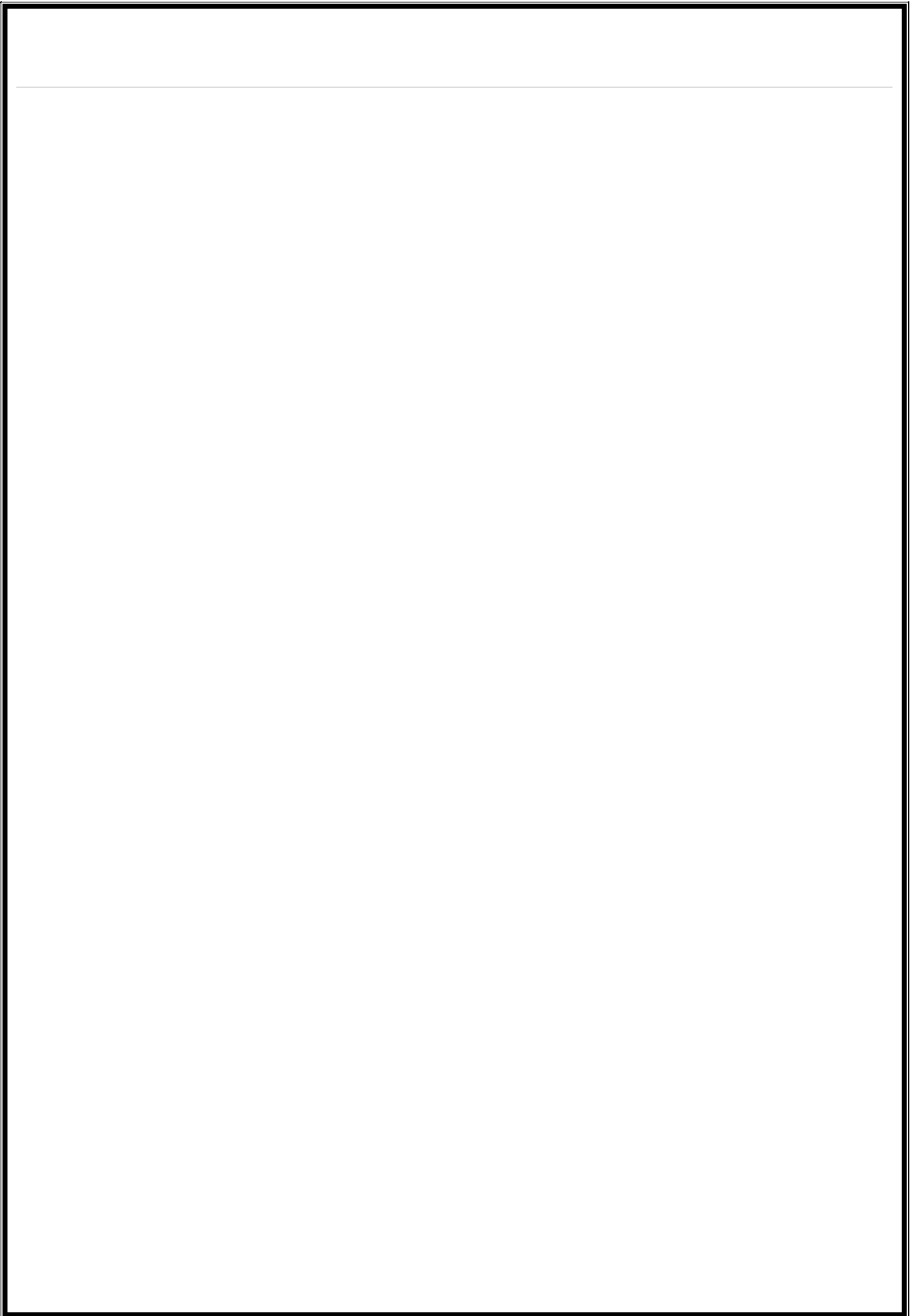
2. **Flowcharttocalculatetheaverageoftwonumbers**

```
        ( Start )
           │
           ▼
      ╱──────────╲
     ╱  Read       ╲
    ╱   num1,nu     ╲
    ╲───────────────╱
           │
           ▼
    ┌──────────────┐
    │ Average=(nu  │
    │ m1+num2)/2   │
    └──────────────┘
           │
           ▼
      ╱──────────╲
     ╱   Print     ╲
     ╲─────────────╱
           │
           ▼
        ( Stop )
```
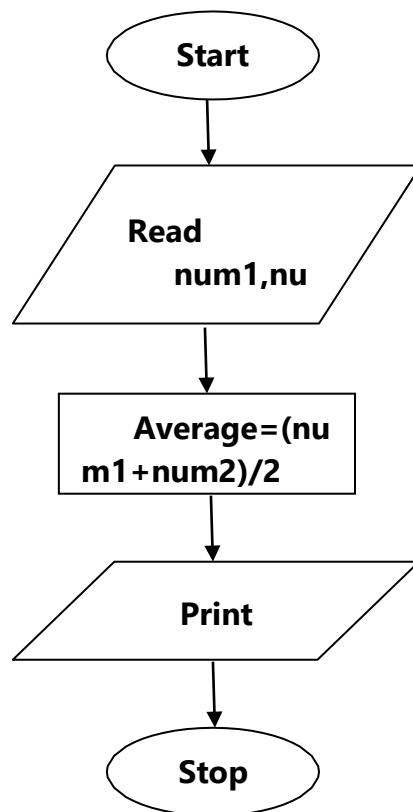
3. **Flowchartto Calculatethe Interestof a BankDeposit**

```
        ( Start )
           │
           ▼
      ╱──────────╲
     ╱   Input     ╲
     ╲─────────────╱
           │
           ▼
      ╱──────────╲
     ╱ InputYears  ╲
     ╲─────────────╱
           │
           ▼
      ╱──────────╲
     ╱ InputRate   ╲
     ╲─────────────╱
           │
           ▼
    ┌──────────────┐
    │  Compound    │
    └──────────────┘
           │
           ▼
      ╱──────────╲
     ╱WriteInterest╲
     ╲─────────────╱
           │
           ▼
        ( Stop )
```
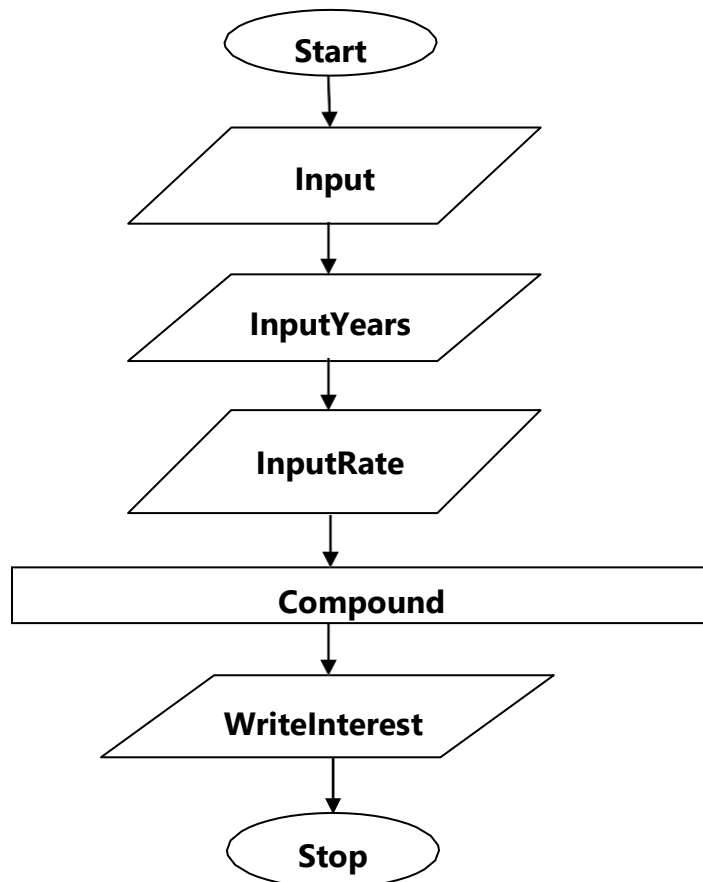
4. Flowchart to calculate the area of a circle.

```
        ┌─────────────┐
        │    Start    │
        └──────┬──────┘
               │
          ╱─────────╱
         ╱  Input r ╱
        ╱─────────╱
               │
        ┌─────────────┐
        │   Area =    │
        │   πr²       │
        └──────┬──────┘
               │
          ╱───────────╱
         ╱ Print Area ╱
        ╱───────────╱
               │
        ┌─────────────┐
        │    Stop     │
        └─────────────┘
```
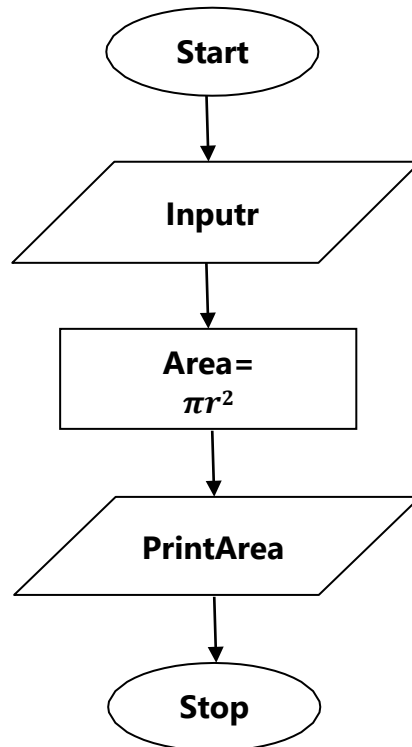
5. Flowchart to calculate the area of a triangle.

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

The flowchart for the circle uses the formula $Area = \pi r^2$.

The flowchart for the triangle uses $S = \dfrac{a+b+c}{2}$ and $Area = \sqrt{s(s-a)(s-b)(s-c)}$.
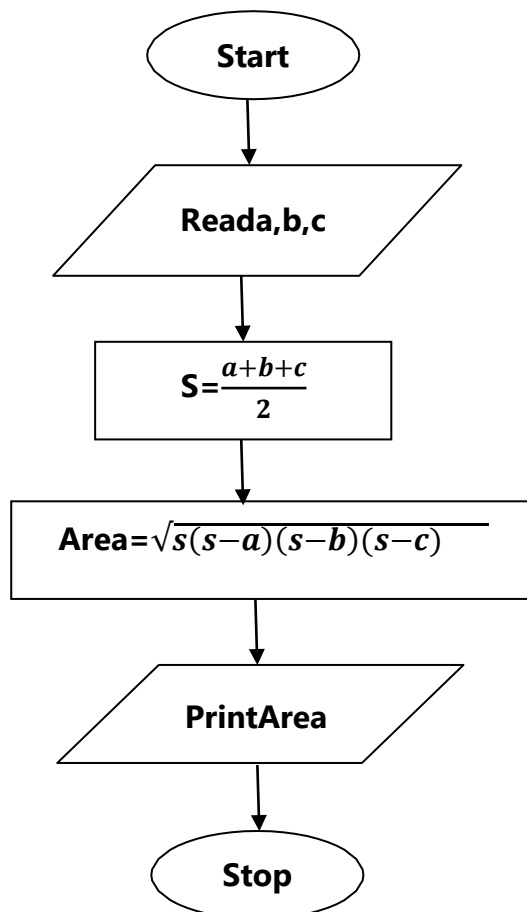
6. **Findthelargestamongthreedifferentnumbersenteredbytheuser.**

```
                        ┌─────────┐
                        │  Start  │
                        └─────────┘
                             │
                             ▼
                ┌────────────────────────┐
                │  Declarevariablesa,band │
                └────────────────────────┘
                             │
                             ▼
                    ╱───────────────╲
                   ╱  Read a,bandc   ╲
                   ╲                 ╱
                    ╲───────────────╱
                             │
          False              ▼              True
       ┌─────────────────< isa>b? >─────────────────┐
       │                                            │
       ▼                                            ▼
  True ╱──────────╲    False         False    ╱──────────╲ True
 ┌───<   isb>c?    >────────┐   ┌────────────<   isa>c?    >───┐
 │    ╲──────────╱          │   │             ╲──────────╱    │
 ▼                          ▼   ▼                              ▼
╱────────╲            ╱────────────╲                    ╱────────╲
│ printb │            │   printc    │                   │ printa │
╲────────╱            ╲────────────╱                    ╲────────╱
     │                      │                                │
     └──────────────────────┤────────────────────────────────┘
                            ▼
                       ┌─────────┐
                       │  Stop   │
                       └─────────┘
```
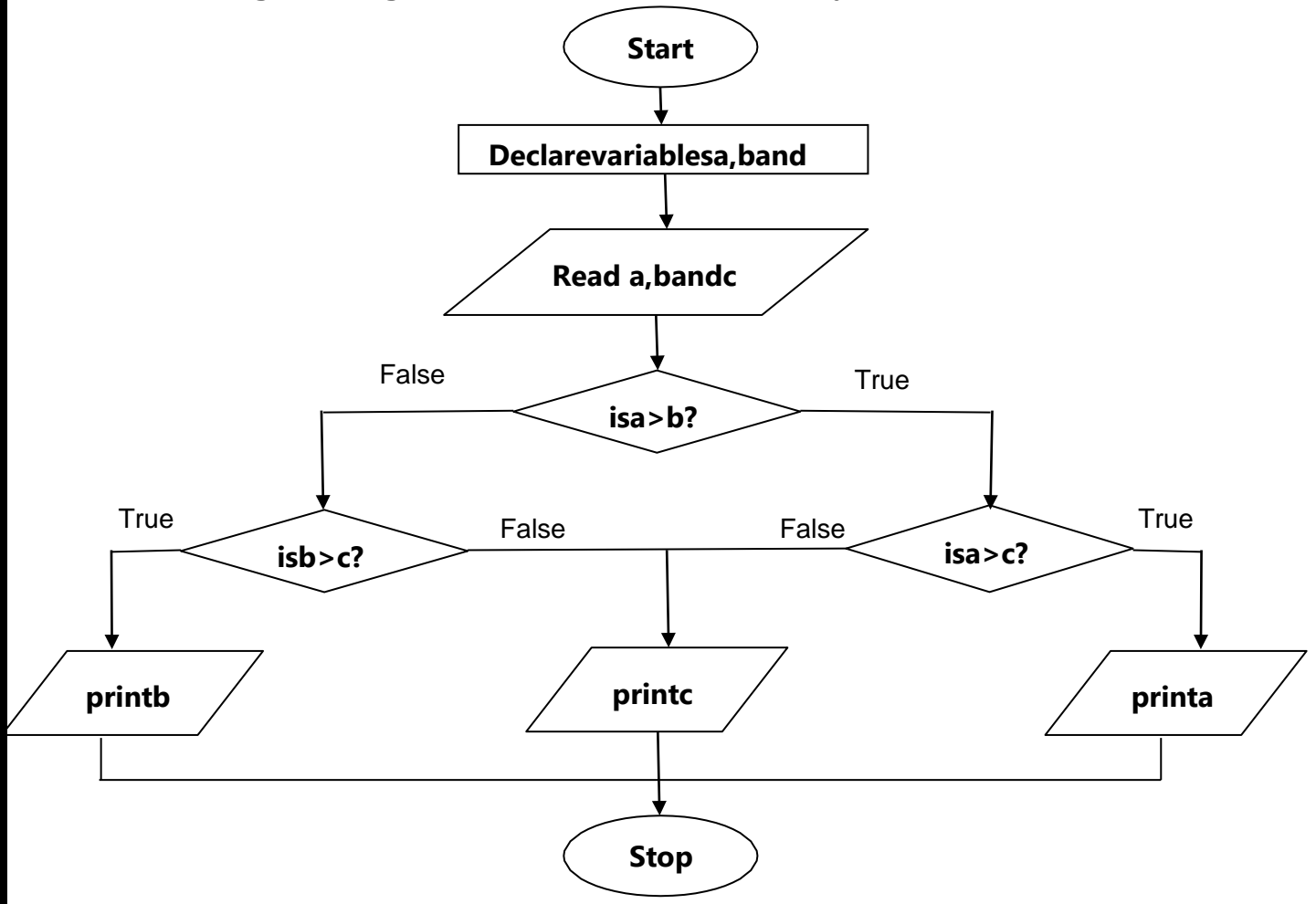
7. Find all the roots of a quadratic equation $ax^2+bx+c=0$

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

r1←(-b+√D)/2a r2

Write "roots are Imaginary"

Display r1 and r2

Stop
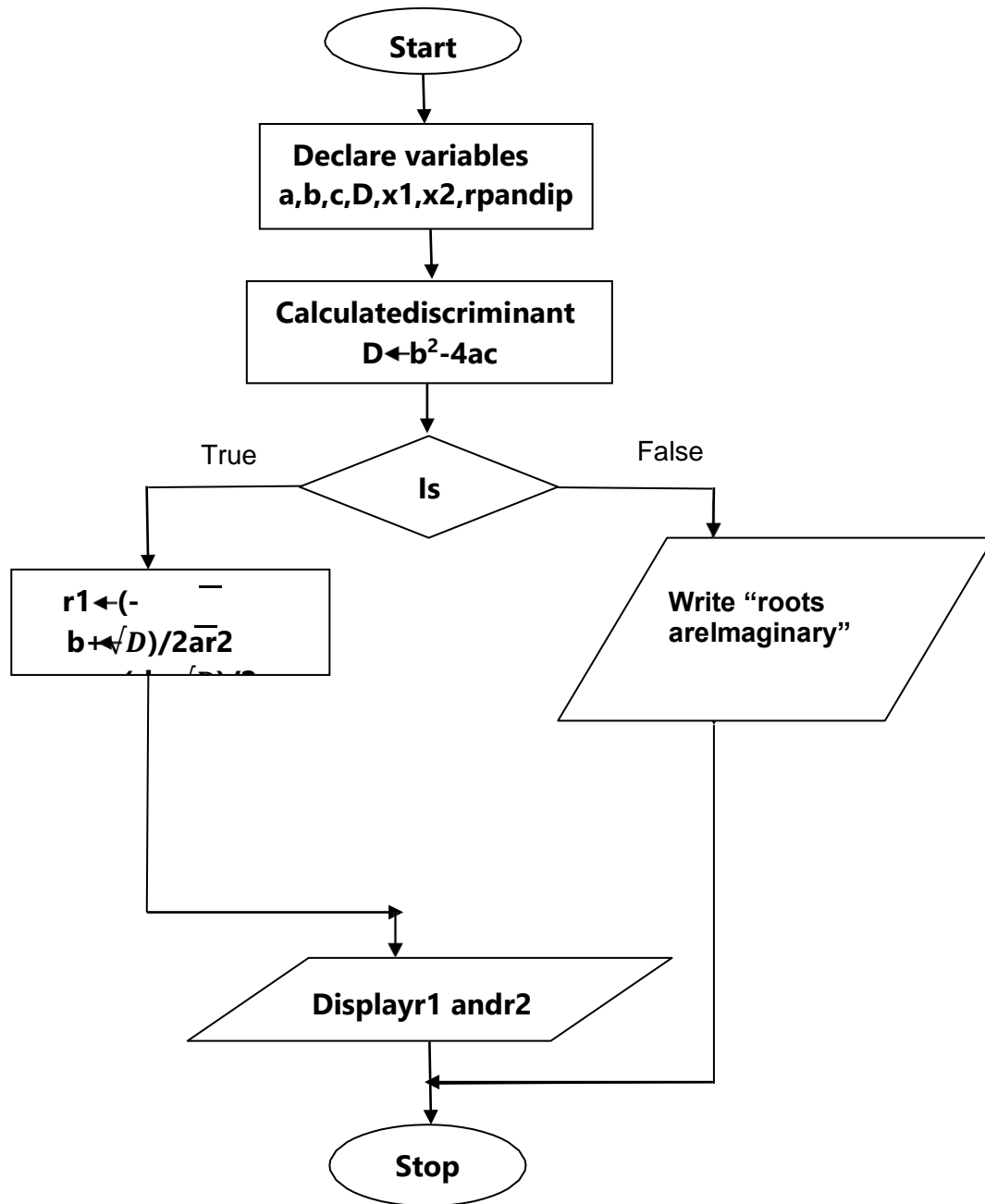
8. **FlowcharttoDetermineandOutputWhetherNumberNisEvenorOdd**

```
                    ( Start )
                        |
                        v
                   / Read N /
                        |
                        v
              [ Remainder=Nmodulo ]
                        |
                        v
          YES      < IsRemainder      NO
      +-----------<     =0?     >-----------+
      |            \          /             |
      v                                     v
 [ Answer=EVE ]                      [ Answer=OD ]
      |                                     |
      +-----------> / OutputAnswer / <------+
                        |
                        v
                    ( Stop )
```
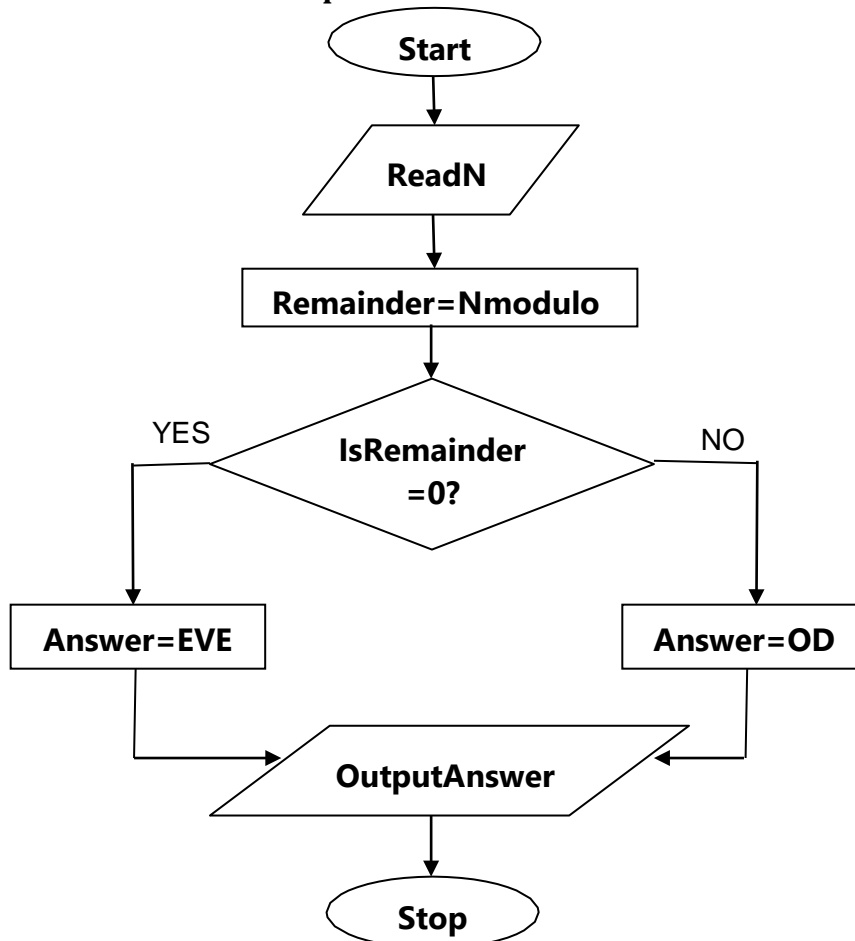
9. **Flowcharttofindoutlargerbetweentwonumberstobetakenasinput**

```
                    ( Start )
                        |
                        v
                    / Read /
                        |
                        v
                   < Isx>y? >------Yes------> / Printx / ------+
                        |                                      |
                        | No                                   |
                        v                                      |
                   < Isx<y? >------Yes------> / Printy / ------+
                        |                                      |
                        | No                                   |
                        v                                      |
              / PrintBothEqual / <-----------------------------+
                        |
                        v
                    ( Stop )
```
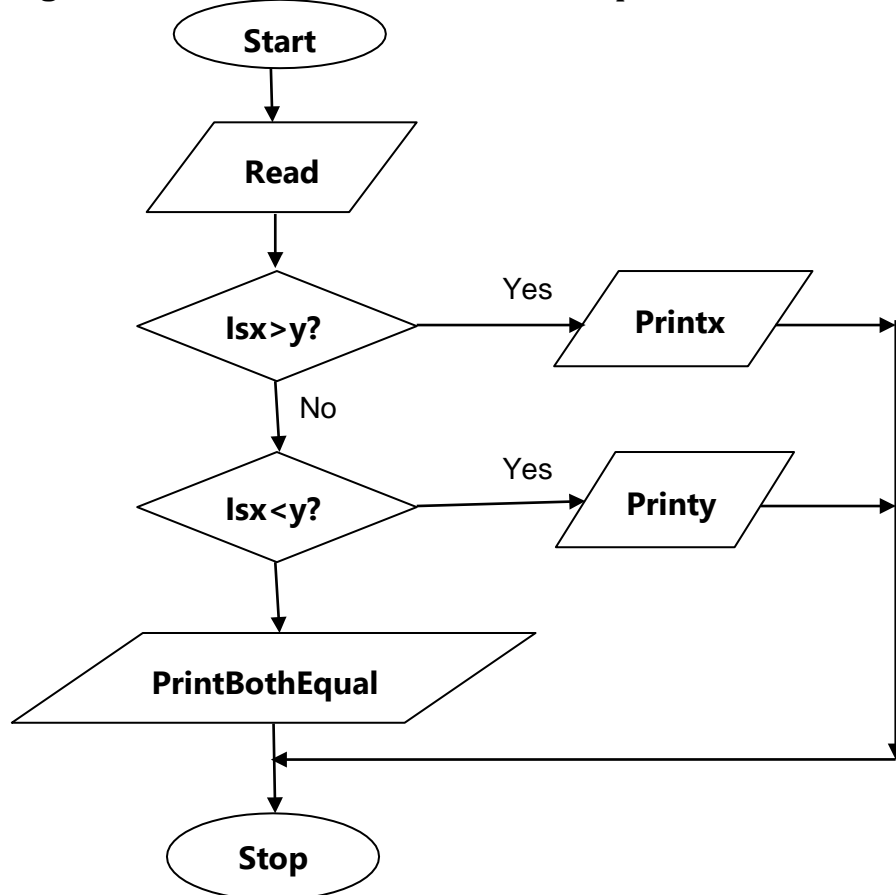
10. FlowcharttoDetermineWhetheraTemperatureisBeloworAbovetheFreezingPoint

```
              ( Start )
                  |
             / Readtemp /
                  |
         [ Reaminder=Nmodulo ]
                  |
    YES      < Istemp<32? >      NO
     |                            |
/ Print*BelowFreezing* /   / Print*AboveFreezing* /
          |                      |
             / OutputAnswer /
                  |
              ( Stop )
```
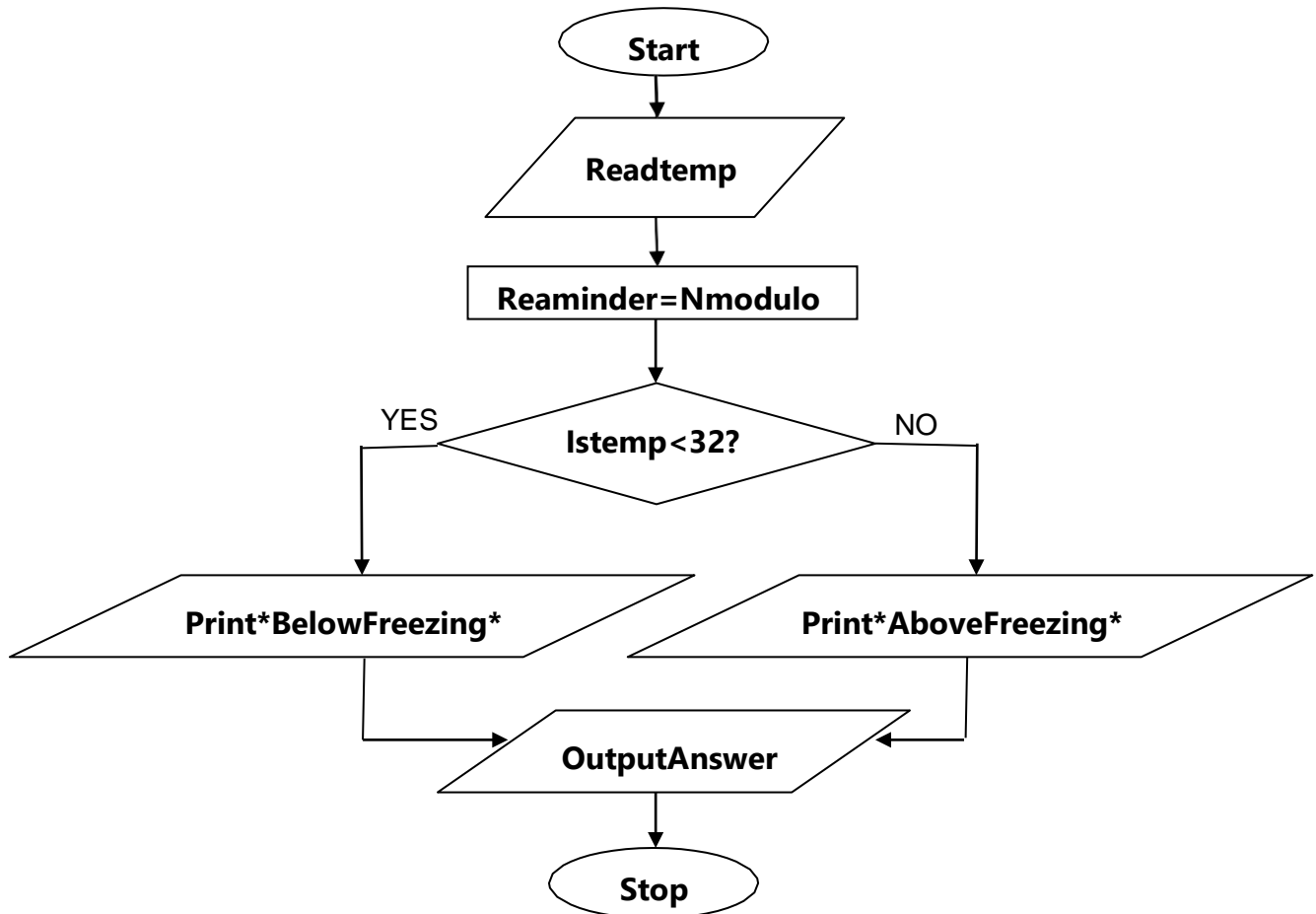
11. FlowcharttoDetermine WhetherAStudentPassedtheExam orNot

```
              ( Start )
                  |
         / Inputm1,m2,m3,m4 /
                  |
        [ Grade=(m1+m2+m3+m4) ]
                  |
    YES     < IfGrade<60? >      NO
     |                            |
  / Print*Fail* /           / Print*Pass* /
          |                      |
              ( Stop )
```
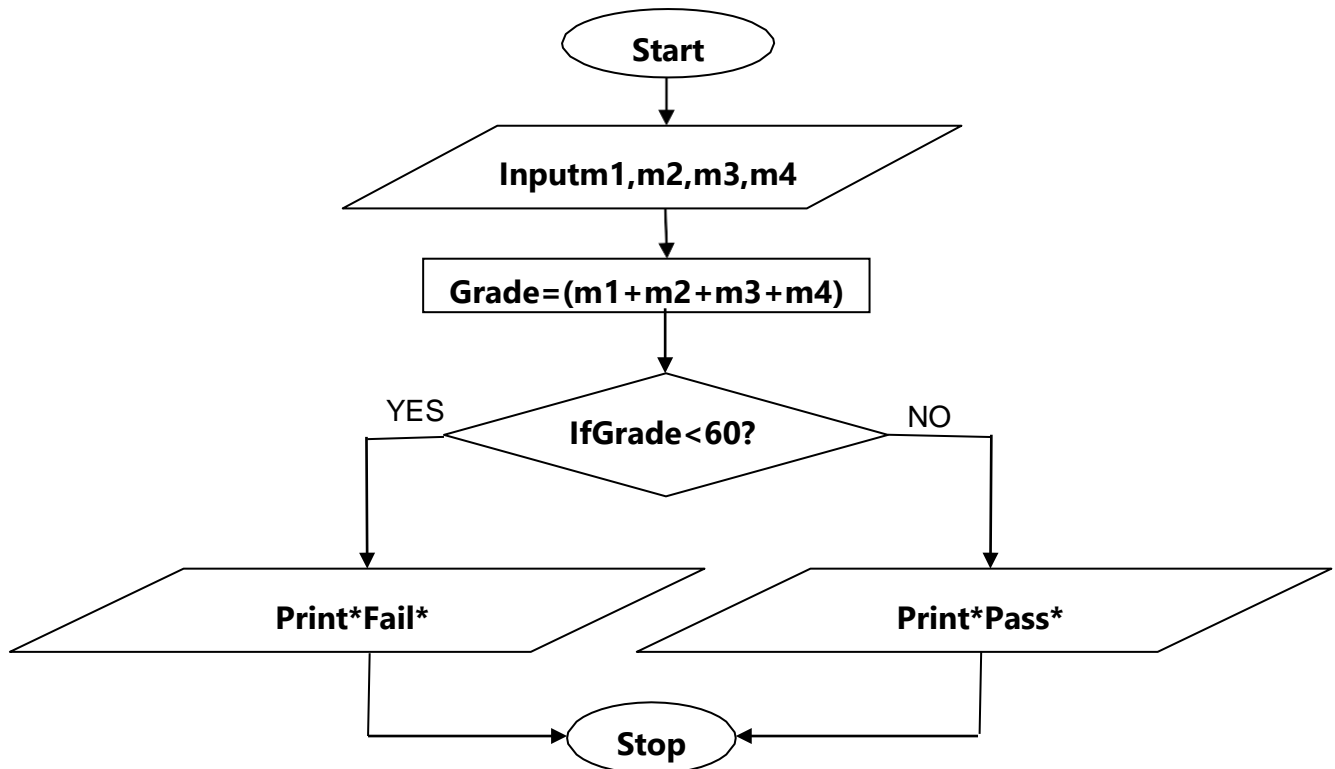
12. Flowchart to find out sum of first 10 natural numbers

```
              ┌─────────────┐
              │    Start    │
              └─────────────┘
                     │
            ┌─────────────────┐
            │  i=1,Sum=0      │
            └─────────────────┘
                     │
            ┌─────────────────┐
            │   Sum=Sum+i     │◄──────────┐
            └─────────────────┘           │
                     │                    │
            ┌─────────────────┐           │
            │     i=i+1       │           │
            └─────────────────┘           │
                     │                    │
                  ╱──────╲                │
                 ╱   Is   ╲── NO ─────────┘
                 ╲        ╱
                  ╲──────╱
                     │ YES
              ╱─────────────╲
              │  Print Sum   │
              ╲─────────────╱
                     │
              ┌─────────────┐
              │    Stop     │
              └─────────────┘
```
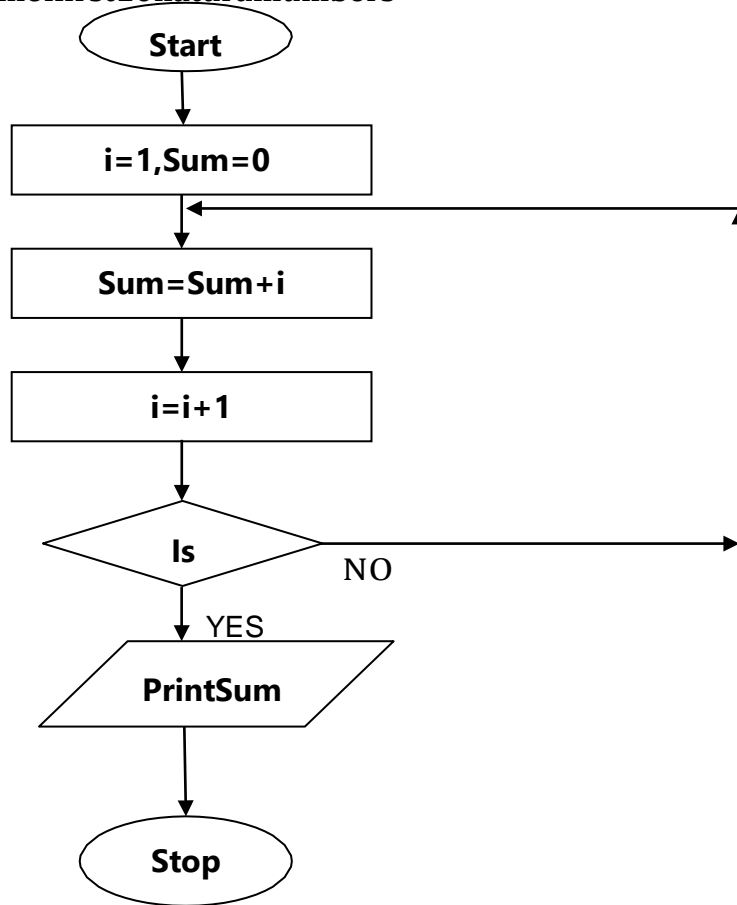
SolvedQuestions

ShortAnswerTypeQuestions.

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.

4) Effectiveness

For analgorithm to be effective, it means that all those steps that are required to get to output must be feasible with the available resources.

5) 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 Flow Chart? 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 info. 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.

Q.1Writeanalgorithmsandflowchartofthefollowings:

    a. Tofindsum&averageof3numbers.

Ans:-Algorithm

- Step1:Start.
- Step2:Readthethreenumbersuppose"a","b","c"formtheuser.
- Step3:Sum=a+b+c;
- Step4:Avg.=Sum/3.
- Step5:Display"Sum"and"Avg".
- Step6 :End.

    Flowchart:
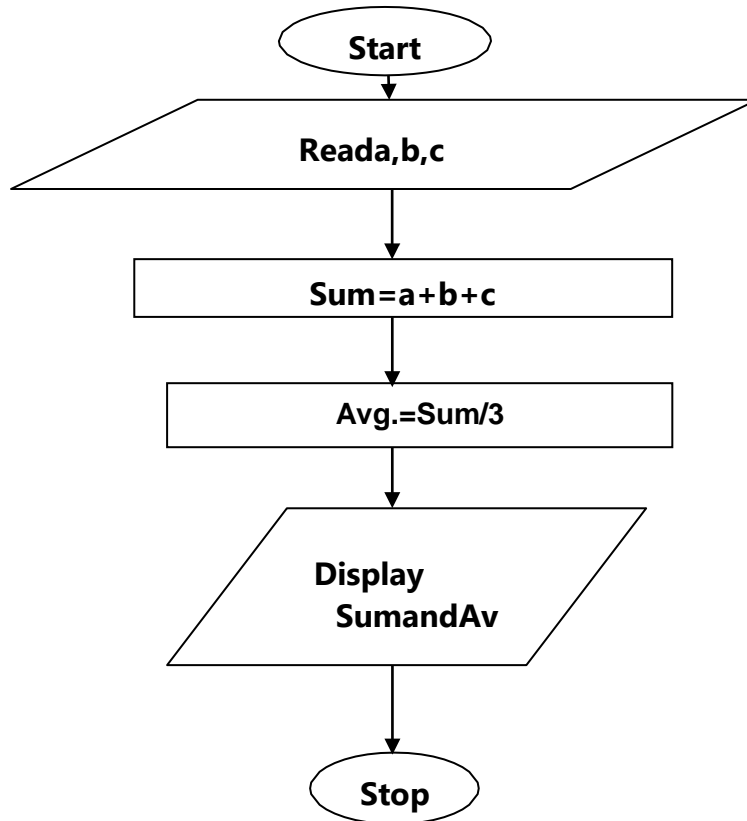
    b. ToconverttemperaturefromdegreeCelsiustoFahrenheit.Algorithm

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

Flowchart

```
              ( Start )
                 |
                 v
         /─────────────/
        /    ReadC     /
       /─────────────/
                 |
                 v
       ┌──────────────────┐
       │   F=(9*C)/5+32    │
       └──────────────────┘
                 |
                 v
      /──────────────────/
     /  DisplayFahrenheit /
    /──────────────────/
                 |
                 v
             ( Stop )
```
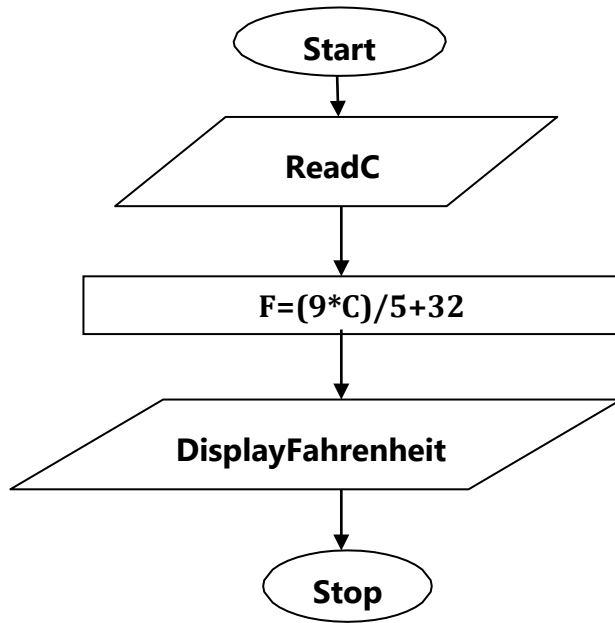
EXERCISE

ShortAnswerTypeQuestions.

Q.1 What is a flowchart? *(2014-Summer)*

Q2 Give the flowchart symbols for keeping, I/O statement and decision statement.

LongAnswerTypeQuestions

Q.1 Draw a flowchart to find sum of 10 random numbers. *(2017-Winter)*

Q2 Write an algorithms and flowchart of the followings:

    a. To calculate square of number n.

    b. To identify whether entered number ed is 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

6.1 Constants,VariablesandDatatypesinC

TheCLanguage

C is a professional programmer's language. It was designed to get in one's way as little aspossible.KernighanandRitchiewrotetheoriginallanguagedefinitionintheirbook,*TheCProgramming*

Language

(below),aspartoftheirresearchatAT&T.UnixandC++emergedfromthesamelabs.ForseveralyearsIusedAT&Tasmylongdistancecarrierinappreciationofallthat

CS research, but hearing "thank you for using AT&T" for the millionth time has used up thatgoodwill.

ImportantPoints

- ➢ TheCLanguageisdevelopedbyDennisRitchieforcreatingsystemapplicationsthatdirectly interactwith thehardwaredevicessuchasdrivers, kernels,etc.
- ➢ Cprogrammingisconsideredasthebaseforotherprogramminglanguages,thatiswhyitisknown asmotherlanguage.
- ➢ It canbedefined bythefollowing ways:
  1. Motherlanguage
  2. System programminglanguage
  3. Procedure-orientedprogramminglanguage
  4. Structuredprogramminglanguage
  5. Mid-levelprogramminglanguage

1) Casamotherlanguage

Clanguageisconsideredasthemotherlanguageofallthemodern programminglanguages because most of the compilers, JVMs, Kernels, etc. are written in C language, andmost of the programming languages follow C syntax, for example, C++, Java, C#, etc. Itprovidesthecoreconceptslikethearray,strings,functions,filehandling,etc.thatarebeingused inmanylanguageslikeC++,Java,C#,etc.

2) Casasystemprogramminglanguage

A system programming language is used to create system software. C language is a systemprogramming language because it can be used to do low-level programming (for exampledriver and kernel). It is generally used to create hardware devices, OS, drivers, kernels, etc.Forexample,LinuxkerneliswritteninC.

Itcan't beused forinternet programminglikeJava, .Net,PHP, etc.
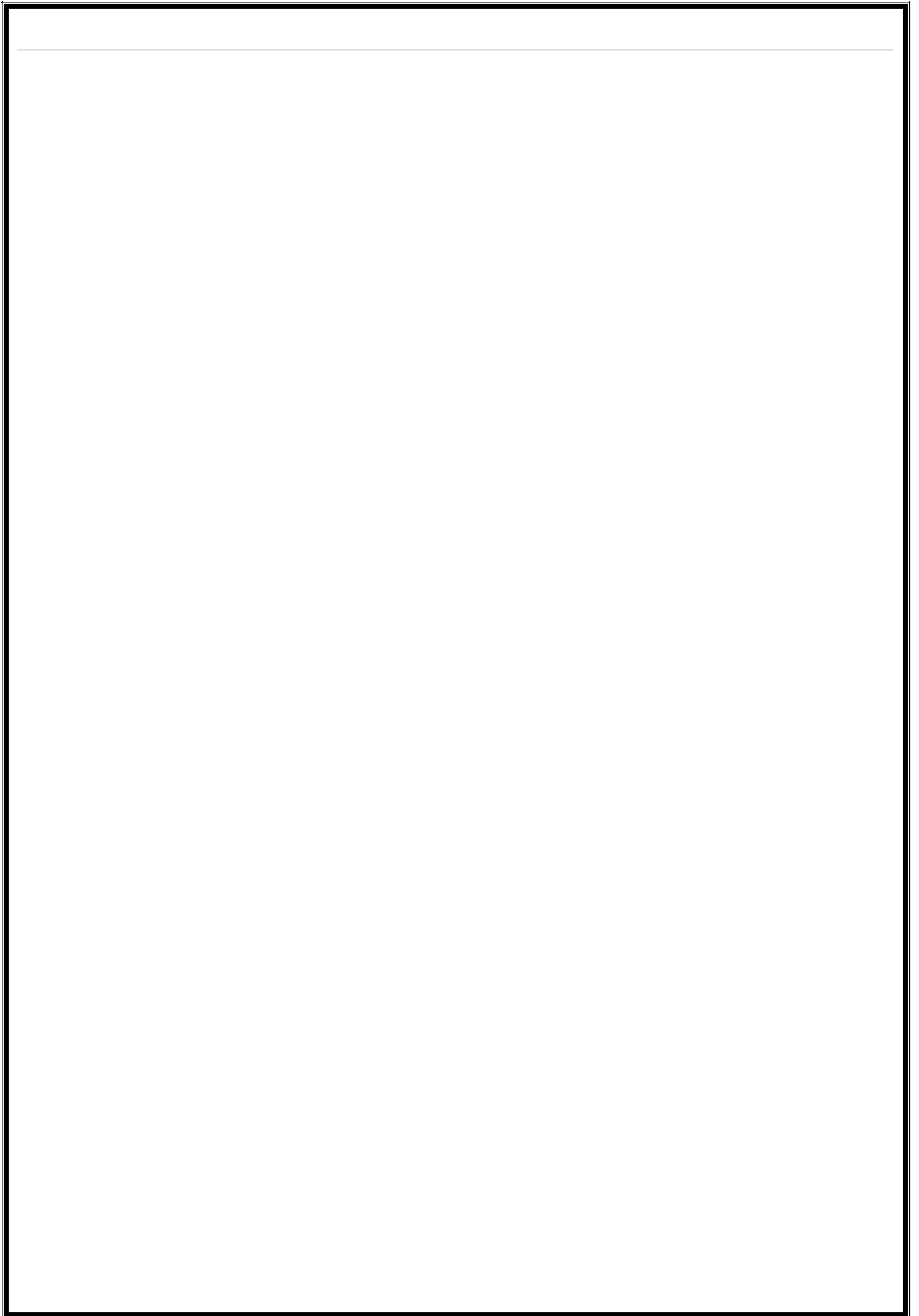
3) C asaprocedurallanguage

Aprocedureisknownasafunction,method,routine,subroutine,etc.Aprocedurallanguage specifies aseries of steps fortheprogramtosolvethe problem.

Aprocedurallanguagebreakstheprogramintofunctions,datastructures,etc.

C is a procedural language. In C, variables and function prototypes must be declared beforebeingused.

4) Casastructuredprogramminglanguage

Astructuredprogramminglanguageisasubsetoftheprocedurallanguage.Structuremeanstobreakaprogramintopartsorblockssothatitmaybeeasytounderstand.

IntheClanguage,webreaktheprogramintopartsusingfunctions.Itmakestheprogrameasiertounderstandandmodify.

5) Casamid-levelprogramminglanguage

C is considered as a middle-level language because it supports the feature of both low-leveland high-level languages. C language program is converted into assembly code, it supportspointerarithmetic(low-level),butitismachineindependent(afeatureofhigh-level).

A Low-level language is specific to one machine, i.e., machine dependent. It is machinedependent,fasttorun.Butitisnoteasytounderstand.

A High-Level language is notspecific toone machine, i.e., machine independent. It is easytounderstand.

QuickHistoryofC

- ➤ DevelopedatBellLaboratoriesintheearlyseventiesbyDennisRitchie.
- ➤ Bornoutoftwoother languages–BCPL(BasicControlProgrammingLanguage)andB.
- ➤ C introduced such things as character types, floating point arithmetic, structures, unionsandthepreprocessor.
- ➤ The principal objective was to devise a language that was easy enough to understand to be"high-level"–i.e.understoodbygeneralprogrammers,butlow-levelenoughtobeapplicabletothewritingofsystems-levelsoftware.
- ➤ The language should abstract the details of how the computer achieves its tasks in such awayastoensurethatCcouldbeportableacrossdifferenttypesofcomputers,thusallowing the UNIX operating system to be compiled on other computers with a minimumofre-writing.
- ➤ C as a language was in use by 1973, although extra functionality, such as new types, wasintroducedupuntil1980.

- In1978,BrianKernighanandDennisM.RitchiewrotetheseminalworkTheCProgrammingLanguage,whichisnowthestandardreferencebookforC.
- AformalANSIstandardforCwasproducedin1989.
- In 1986, a descendant of C, called C++ was developed by Bjarne Stroustrup, which is inwideusetoday. Manymodern languagessuchas C#,Javaand Perlare based on C andC++.
- UsingClanguagescientific,businessandsystem-levelapplicationscanbe developedeasily.

6.1.1 Constants

In C programming language, a constant is similar to the variable but the constant hold onlyonevalueduringtheprogramexecution.Thatmeans,onceavalueisassignedtotheconstant,thatvaluecan'tbechangedduringtheprogramexecution.Oncethevalueisassignedtotheconstant,itisfixedthroughout theprogram.Aconstantcanbedefinedasfollows...

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

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

Integerconstants

An integer constant can be a decimal integer or octal integer or hexadecimal integer. Adecimal integer value is specified as direct integer value whereas octal integer value is prefixedwith'o'andhexadecimalvalueisprefixedwith'OX'.

An integerconstant can alsobeunsigned type of integerconstant orlong type of integerconstant.Unsignedintegerconstantvalueis

suffixedwith'u'andlongintegerconstantvalueissuffixedwith'l'whereasunsignedlongintegerconstantvalueissuffixedwith'ul'.

Example

125---- > DecimalIntegerConstant

O76 ---- >OctalIntegerConstant

OX3A ----->HexaDecimalIntegerConstant

50u----->UnsignedIntegerConstant

30l----->LongIntegerConstant

100ul ---->UnsignedLongIntegerConstant

FloatingPointconstants

A floating-point constant must contain both integer and decimal parts. Some times it mayalso contain the exponent part. When a floating-point constant is represented in exponent form,thevaluemustbesuffixedwith'e'or'E'.

Example

Thefloating-pointvalue3.14isrepresentedas3E-14inexponentform.

CharacterConstants

Acharacterconstantisasymbolenclosedinsinglequotation.Acharacterconstanthasamaximuml engthofonecharacter.

Example

'A'

'2'

'+'

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

StringConstants

➢ A string constant is a collection of characters, digits, special symbols and escape sequencesthatareenclosedindoublequotations.

➢ Wedefinestringconstantinasinglelineasfollows..."Thi

sisDiplomasmartclass"

➢ Wecandefinestringconstantusingmultiplelinesasfollows..."Thi

s\

is\

Diplomasmartclass"

➢ Wecanalsodefinestringconstantbyseparatingitwithwhitespaceasfollows..."This"

"is""Diplomasmartclass"

Alltheabovethreedefinesthesamestringconstant.

CreatingconstantsinC

➢ Inacprogramminglanguage,constantscanbecreatedusingtwoconcepts...

• Usingthe"**const**"keyword

• Using"**#define**"preprocessor

Using the "const" keyword

- ➢ We create a constant of any datatype using 'const' keyword. To create a constant, we prefix the variable declaration with 'const' keyword.

- ➢ The general syntax for creating constant using 'const' keyword is as follows...

constdatatypeconstantName;

OR

constdatatypeconstantName=value;

Example

constintx=10;

Here,'x'isaintegerconstantwithfixedvalue10.

ExampleProgram

```
#include<stdio.h>
#include<conio.h>
voidmain()
{
   inti=9;
   constintx=10;i=1
   5;
   x=100;//createsanerrorprintf("i=%
   d\nx=%d",i,x);
}
```

The above program gives an error because we are trying to change the constant variable 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...#de fineCONSTANTNAMEvalue

Example

#definePI3.14

Here,PIisaconstantwithvalue3.14

ExampleProgram

```
#include<stdio.h>
#include<conio.h>
#definePI3.14void
main()
{
   intr,area;
printf("Pleaseentertheradiusofcircle:");scanf("%d",
&r);
   area=PI*(r*r);
```

```
        printf("Areaofthecircle=%d",area);
        }
```

6.1.2 Variables

Variables in a c programming language are the named memory locations where the usercan store different values of the same datatype during the program execution. That means avariable is a name given to a memory location in which we can store different values of the samedata type. In other words, a variable can be defined as a storage container to hold values of thesamedatatypeduringtheprogramexecution.Theformaldefinitionofadatatypeisasfollows.

Variableisanamegiventoamemorylocationwherewecanstoredifferentvaluesofthesamedatatypeduringtheprogramexecution.

Every variable in c programming language must be declared in the declaration sectionbefore it is used. Every variable must have a data type that determines the range and type ofvaluesbestoredandthesizeofthememorytobeallocated.

Avariablenamemaycontainletters,digitsandunderscoresymbol.Thefollowingaretherulestospecifyavariablename...

- Variablenameshouldnotstartwithadigit.
- Keywordsshouldnotbeusedasvariablenames.
- Avariablenameshouldnotcontainanyspecialsymbolsexceptunderscore(_).
- A variable name can be of any length but compiler considers only the first 31 characters ofthevariablename.

DeclarationofVariable

Declarationofavariabletellsthecompilertoallocatetherequiredamountofmemorywiththe 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 globalvariablesorinsideanyblockor function.Butitmustbeatthebeginningofblockor function.

DeclarationSyntax:

        datatypevariableName;

Example

    intnumber;

Theabovedeclarationtellstothecompilerthatallocates2bytesofmemorywiththename "number"andallowsonlyinteger valuesinto thatmemorylocation.

6.1.3 Datatypes

Datausedinc programis classifiedintodifferenttypes basedon its properties.Inthe Cprogramminglanguage,adatatypecanbedefinedasasetofvalueswithsimilarcharacteristics.Allthevalues inadatatypehavethesameproperties.

Data types in the c programming language are used to specify what kind of value can bestored in a variable. The memory size and type of the value of a variable are determined by thevariable data type. In a c program, each variable or constant or array must have a data type andthis data type specifies how much memory is to be allocated and what type of values are to bestoredinthatvariableorconstantorarray.Theformaldefinitionofadatatypeisasfollows...

TheDatatypeisasetofvaluewithpredefinedcharacteristics.datatypesareusedtodeclarevariable,constants,arrays,pointers,andfunctions.

Inthecprogramminglanguage,data typesareclassifiedasfollows...

- ➢ Primarydatatypes(BasicdatatypesORPredefineddatatypes)
- ➢ Deriveddatatypes(SecondarydatatypesORUser-defineddatatypes)
- ➢ Enumerationdatatypes
- ➢ Voiddatatype

```
                    ┌─1. Basic Datatypes (Primary Datatpyes)
                    │      Interger, Floating Point
                    │      Double & Charachter
                    ├─2. Enumerated types
                    │      Used to define variables that can only
    Datatypes ──────┤      assign certain integer values
                    ├─3. void type
                    │      The void type indicates that no value.
                    │      That means an Empty value (nothing)
                    └─4. Derived types
                           User created datatypes like Array,
                           structures, unions...
```
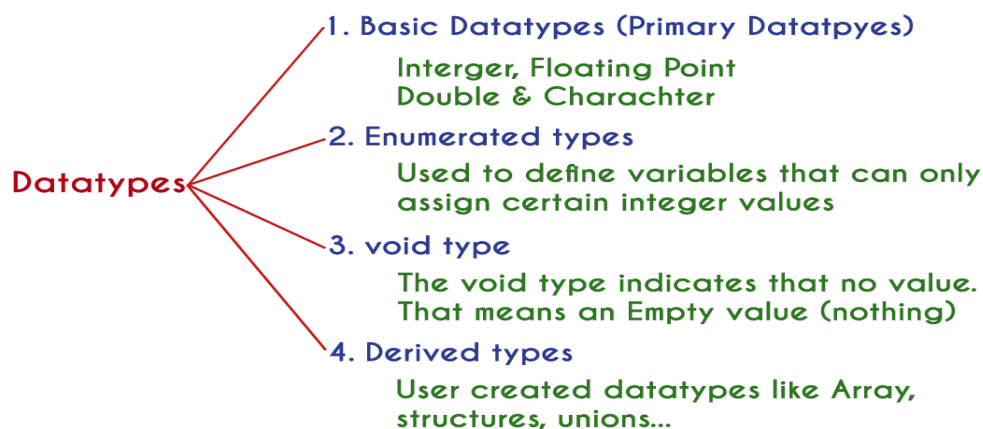
Primarydatatypes

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

- 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
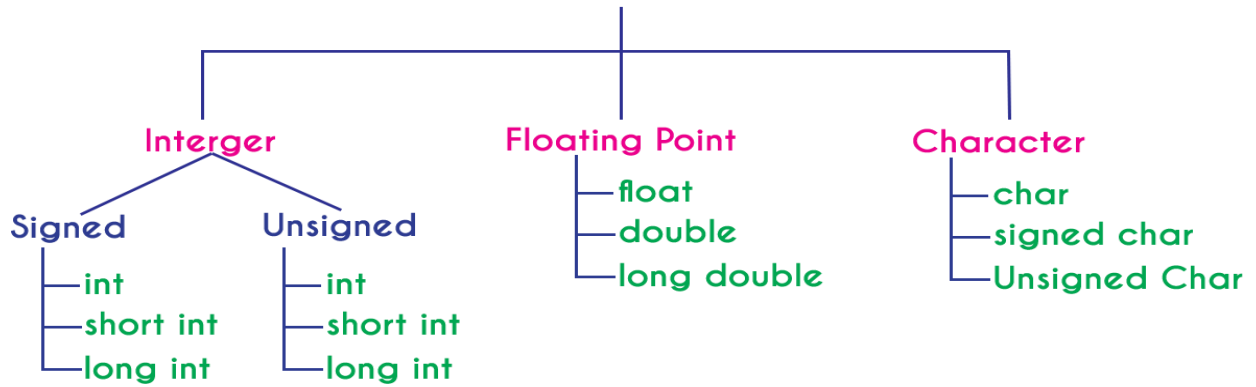
IntegerDatatype(int)

The integer data type is a set of whole numbers. Every integer value does not have the decimalvalue. We use the keyword "**int**" to represent integer data type in c. We use the keyword int todeclare 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 providescompletedetailsabouttheintegerdatatype.

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

FloatingPointdatatypes

Floating-pointdatatypesareasetofnumberswiththedecimalvalue.Everyfloating-pointvaluemustcontainthedecimalvalue.Thefloating-pointdatatypehas twovariants...

- float
- double

We use the keyword "float" to represent floating-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 types.

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

Character datatype

The character data type is a set of characters enclosed in single quotations. The following 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

void datatype

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.

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

An enumerated data type is a user-defined data type that consists of integer constants and eachintegerconstantisgivenaname.Thekeyword"enum"isusedtodefinetheenumerateddatatype.**Deriveddatatypes**

Derived data types are user-defined data types. The derived data types are also called as user-defined data types or secondary data types. In the c programming language, the derived datatypesarecreatedusingthefollowingconcepts...

- ➢ Arrays
- ➢ Structures
- ➢ Unions

6.2 ManagingInputandOutputoperations.

OutputFunctions

C programming language provides built-in functions to perform output operation. Theoutput operations are used to display data on user screen (output screen) or printer or any file.Thecprogramminglanguageprovidesthefollowing**built-in**outputfunctions...

- • printf()
- • putchar()
- • puts()
- • fprintf()

printf()function

The printf() function is used to print string or data values or a combination of string anddatavaluesontheoutputscreen(Userscreen).Theprintf()functionisbuilt-infunctiondefinedina header file called "stdio.h". When we want to use printf() function in our program we need toincludetherespectiveheaderfile(stdio.h)usingthe#includestatement.Theprintf()functionhasthe ollowingsyntax...

Syntax:

printf("messagetobedisplay!!!");

ExampleProgram

```
#include<stdio.h>
#include<conio.h>
voidmain()
{
printf("Hello!WelcometoDiplomasmartclass!!!");
}
Intheaboveexampleprogram,weusedtheprintf()functiontoprintastringontothe
```

outputscreen.

Outputoftheprogramis   **Hello!WelcometoDiplomasmartclass!!!**

Theprintf()functionisalsousedtodisplaydatavalues.Whenwewanttodisplaydatavaluesweuseformatstringofthedatavalue tobedisplayed.

Syntax:

printf("formatstring",variableName);

ExampleProgram:

```
#include<stdio.h>
#include<conio.h>
voidmain()
{
  int i =
  10;floatx=5.
  5;
printf("%d%f",i,x);
}
```

Intheaboveexampleprogram,weusedtheprintf()functiontoprintdatavaluesofvariables i and x on to the output screen. Here i is an integer variable so we have used formatstring%dandxisafloatvariablesowehave usedformatstring%f.

Theprintf()functioncanalsobeusedtodisplaystringalongwithdatavalues.

Todisplaytheoutputindifferentlinesoraswewish,weusesomespecialcharacterscalledescape sequences. Escape sequences are special characterswith special functionality used inprintf() function to format the output according to the user requirement. In the C programminglanguage,wehavethefollowingescapesequences...

Escapesequence	Meaning
\n	Moves thecursortoNew Line
\t	InsertsHorizontalTab(5charactersspace)
\v	InsertsVerticalTab(5linesspace)
\a	Beepsound
\b	Backspace(removesthepreviouscharacterfrom itscurrentposition)
****	InsertsBackwardslashsymbol
\?	InsertsQuestionmarksymbol
\'	InsertsSinglequotationmarksymbol
\"	InsertsDoublequotationmarksymbol
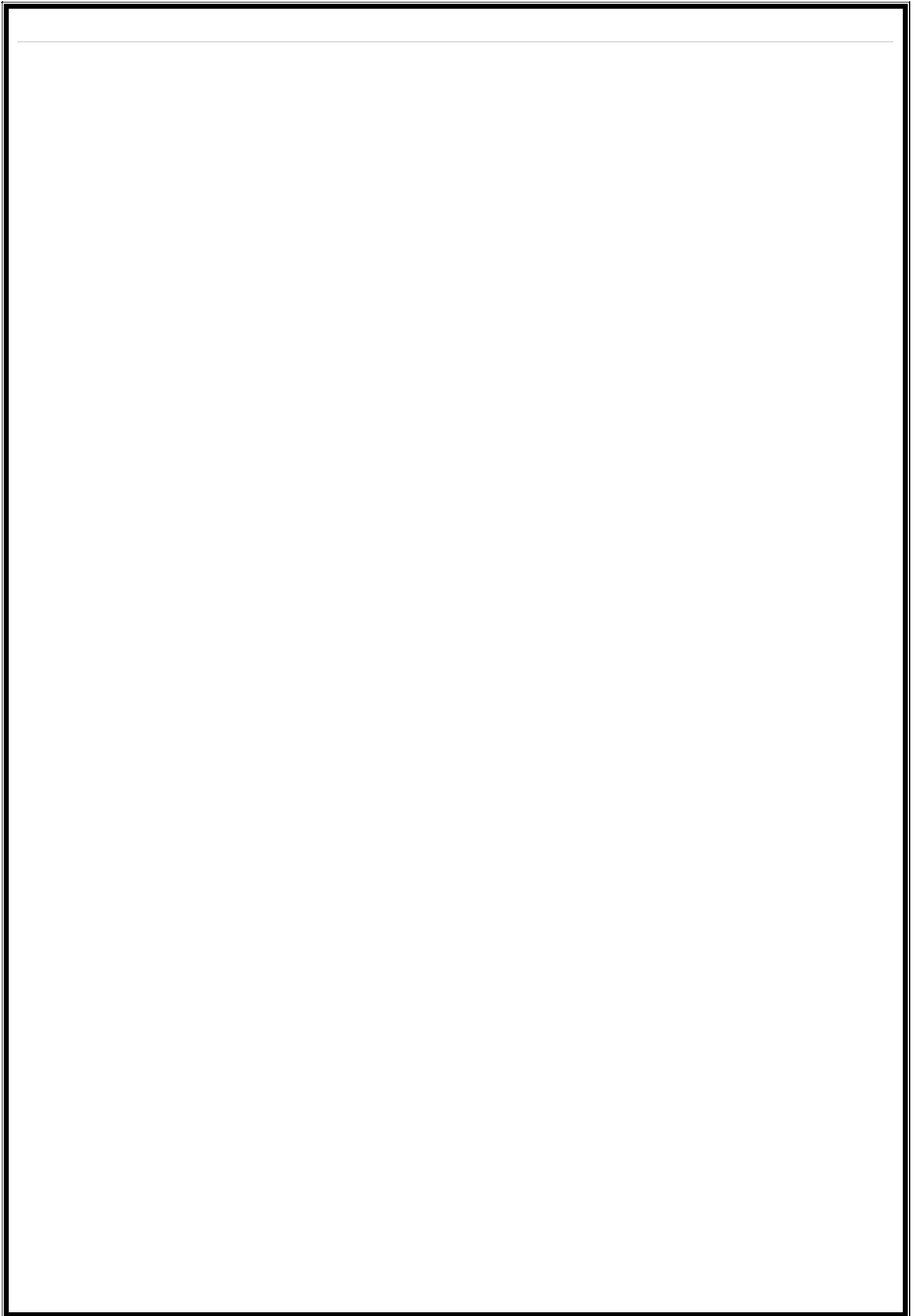
Consider the following example program...ExampleProgram:

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

Output:-

```
WelcometoDiploma
smartclass
theperfectwebsiteforlearning
```

putchar()function

Theputchar()functionisusedtodisplayasinglecharacterontheoutputscreen.Theputchar() functions prints the character which is passed as a parameter to it and returns the samecharacter as a return value. This function is used to print only a single character. To print multiplecharactersweneedtowritemultipletimesorusealoopingstatement.Considerthefollowingexampl eprogram...

```
#include<stdio.h>
#include<conio.h>
voidmain()
{
  charch='A';putc
har(ch);
}
```

puts()function

The puts() function is used to display a string on the output screen. The puts() functionsprintsastringorsequenceofcharacterstillthenewline.Considerthefollowingexampleprogr am...

ExampleProgram

```
#include<stdio.h>
#include<conio.h>
voidmain()
{
  char name[30];
printf("\nEnteryourfavourite website:
  ");gets(name);
  puts(name);
}
```

fprintf()function

Thefprintf()functionisusedwiththeconceptoffiles.Thefprintf()functionisusedtoprinta   line into the file. When you want to use fprintf() function the file must be opened in writingmode.

InputFunctions

Cprogramminglanguageprovides built-in functions toperform inputoperations.Theinput operations are used to read user values (input) from the keyboard. The c programminglanguageprovidesthefollowingbuilt-ininputfunctions.

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

scanf()function

The scanf()function is usedto read multipledata values of different data types from thekeyboard.Thescanf()functionisbuilt-

infunctiondefinedinaheaderfilecalled"stdio.h".Whenwewanttousescanf()functioninourprogram,weneedtoincludetherespectiveheaderfile(stdio.h)using#includestatement.Thescanf()functionhasthefollowingsyntax...

Syntax:

scanf("formatstrings",&variableNames);

ExampleProgram

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

Intheaboveexampleprogram,weusedthescanf()functiontoreadanintegervaluefromthekeyboardandstoreitintovariable'i'.

Output:-

Enter any integer

value:53Youhaveentered53n

umber

Thescanf()functionisalsousedtoreadmultipledatavaluesofdifferentorthesamedatatypes.Considerthefollowingexampleprogram...

ExampleProgram

```
#include<stdio.h>
#include<conio.h>
voidmain()
```

```
{
int i;floa
tx;
```

```
printf("\nEnteroneintegerfollowedbyonefloatvalue:");scanf("%d%f",
&i,&x);
printf("\nintegervalue=%d,floatvalue=%f",i,x);
}
```

Output:-
Enter one integer followed by one float value :
5932.8integervalue=59,floatvalue=32.8

Intheaboveexampleprogram,weusedthescanf()functiontoreadoneintegervalueandonefloatv

aluefromthekeyboard.Here'i'isanintegervariablesowehaveusedformatstring

%d,and'x'isafloatvariablesowehaveusedformatstring%f.

Thescanf()functionreturnsanintegervalueequaltothetotalnumberofinputvaluesreadusingsca

nffunction.

ExampleProgram
```
#include<stdio.h>
#include<conio.h>
voidmain()
{
  int
  i,a,b;flo
  at x;
printf("\nEntertwointegersandonefloat:");i=sca
nf("%d%d%f",&a,&b,&x);printf("\nTotalinputs
read:%d",i);
}
```

getchar()function

The getchar() function is used to read a character from the keyboard andreturn it to the

program.Thisfunctionisusedtoreadasinglecharacter.Toreadmultiplecharactersweneedtowritemultiple

timesorusealoopingstatement.Considerthefollowingexampleprogram...

ExampleProgram
```
#include<stdio.h>
#include<conio.h>
voidmain()
{
  charch;
printf("\nEnteranycharacter:");ch
=getchar();
printf("\nYouhaveentered:%c\n",ch);
}
```
Output:-
Enteranycharacter:HYo
uhaveentered:H
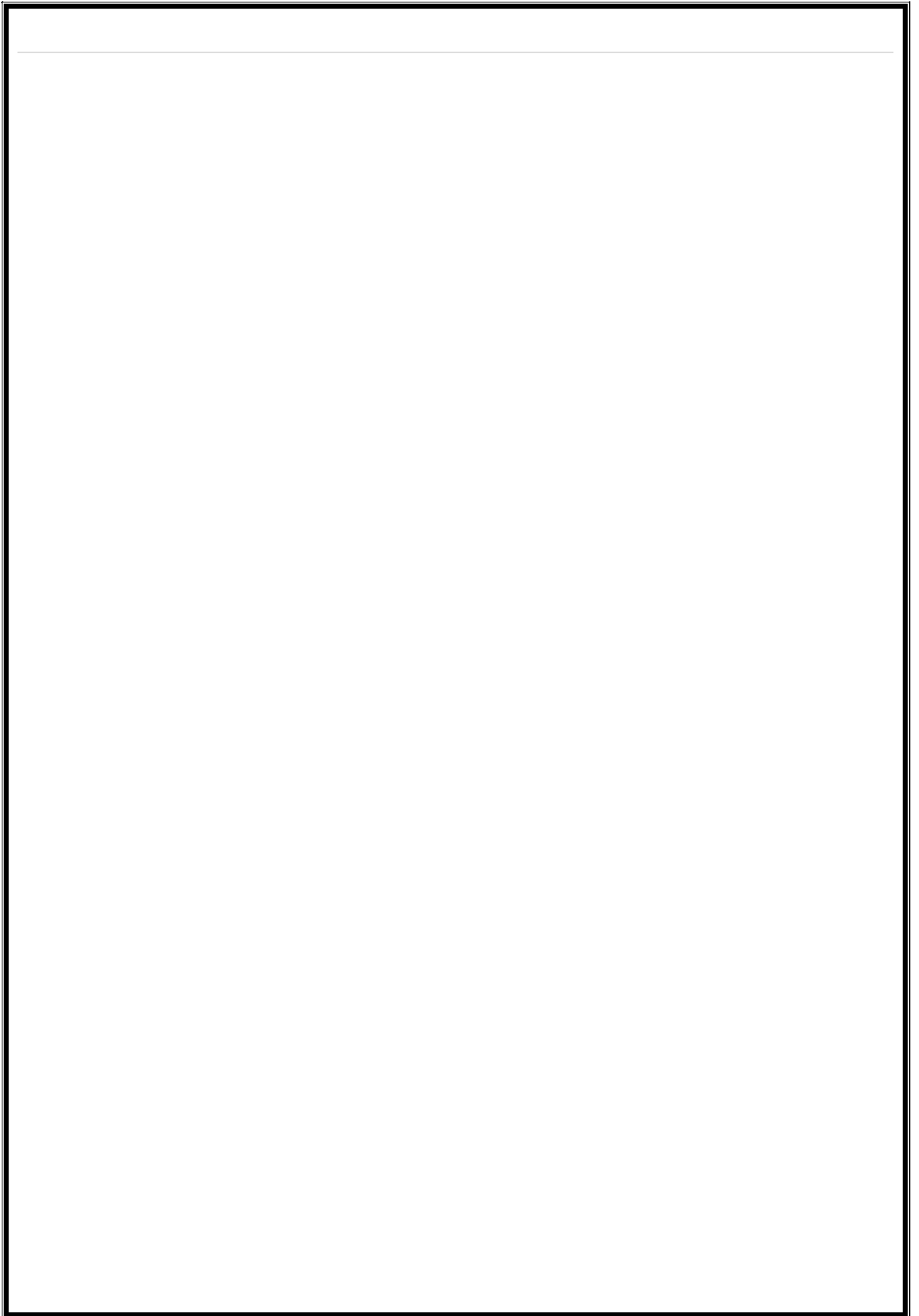
getch()function

Thegetch() function is similartogetcharfunction. Thegetch() function is usedtoread acharacter from the keyboard and return it to the program. This function is used to read a singlecharacter. To read multiple characters we need to write multiple times or use a looping statement.Considerthefollowingexampleprogram...

ExampleProgram

```
#include<stdio.h>
#include<conio.h>
voidmain()
{
  charch;
printf("\nEnteranycharacter:");ch
=getch();
printf("\nYouhaveentered:%c",ch);
}
```

gets()function

The gets()function isused toread aline ofstring and stores it intoa characterarray. Thegets()functionreadsalineofstringorsequenceofcharacterstillanewlinesymbolenters.Considerthefollowingexampleprogram...

ExampleProgram

```
#include<stdio.h>
#include<conio.h>
voidmain()
{
  char name[30];
printf("\nEnteryourfavourite website:
  ");gets(name);
printf("%s",name);
}
```

fscanf()function

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

6.3 Operators,Expressions,Type conversion&Typecasting

6.3.1 Operators

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

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

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

The arithmetic operators are the symbols that are used to perform basic mathematicaloperationslikeaddition,subtraction,multiplication,divisionandpercentagemodulo.Thefollowingtableprovidesinformationaboutarithmetic operators.

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

- The addition operator can be used with numerical data types and character data type.When it is used with numerical values, it performs mathematical addition and when it isusedwith characterdatatypevalues, itperformsconcatenation (appending).
- Theremainderofthedivisionoperatorisusedwithintegerdatatypeonly.

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

Therelationaloperatorsarethesymbolsthatareusedtocomparetwovalues.Thatmeanstherelationaloperatorsareusedtochecktherelationshipbetweentwovalues.EveryrelationaloperatorhastworesultsTRUEorFALSE.Insimplewords,therelationaloperatorsareusedtodefineconditionsinaprogram.Thefollowingtable providesinformationaboutrelationaloperators.

Operator	Meaning	Example
<	ReturnsTRUEifthefirstvalueis smaller than second valueotherwisereturns FALSE	10 <5isFALSE
>	ReturnsTRUEifthefirstvalueislarg er than second value otherwisereturnsFALSE	10>5isTRUE
<=	ReturnsTRUEifthefirstvalueis smallerthanorequaltosecondvalueot herwisereturnsFALSE	10<=5isFALSE
>=	ReturnsTRUEifthefirstvalueislarg erthanorequaltosecond valueotherwisereturnsFALSE	10>=5isTRUE
==	ReturnsTRUEifbothvaluesare equalotherwisereturnsFALSE	10==5isFALSE
!=	ReturnsTRUEifbothvaluesarenot equal otherwise returns FALSE	10!=5isTRUE

LogicalOperators(&&,||,!)

Thelogicaloperatorsarethesymbolsthatareusedtocombinemultipleconditionsintooneconditi on.Thefollowingtableprovides informationaboutlogicaloperators.

Operator	Meaning	Example
&&	LogicalAND - Returns TRUE if all conditions are TRUEotherwisereturnsFA LSE	10<5&&12>10isFALSE
||	LogicalOR- ReturnsFALSEifallconditionsareF ALSEotherwise returnsTRUE	10<5||12>10isTRUE
!	LogicalNOT- ReturnsTRUEifconditionisFLASEa ndreturns FALSEifitisTRUE	!(10<5&&12>10)isTRUE

- LogicalAND-

  ReturnsTRUEonlyifallconditionsareTRUE,ifanyoftheconditionsisFALSEthencompletecondi

tionbecomesFALSE.

- LogicalOR-

  ReturnsFALSEonlyifallconditionsareFALSE,ifanyoftheconditionsisTRUEthencompletecond

  itionbecomesTRUE.

Increment&DecrementOperators(++&--)

   Theincrementanddecrementoperatorsarecalledunaryoperatorsbecausebothneedonlyone operand. The increment operators add one to the existing value of the operand and thedecrement operator subtracts one from the existing value of the operand. The following tableprovidesinformationaboutincrementanddecrementoperators.

Operator	Meaning	Example	
++	Increment	Adds one to existing 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 after theoperand(a++).Ifitisusedinfrontoftheoperand,wecallitaspre-incrementorpre-decrementandifitisusedaftertheoperand,wecallitaspost-incrementorpost-decrement.

Pre-IncrementorPre-Decrement

   In the case of pre-increment, the value of the variable is increased by one before theexpression evaluation. In the case of pre-decrement, the value of the variable is decreased by onebeforetheexpressionevaluation.Thatmeans,whenweusepre-incrementorpre-decrement,firstthevalueofthevariableisincrementedordecrementedbyone,thenthemodifiedvaluei susedintheexpressionevaluation.

ExampleProgram

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

Post-IncrementorPost-Decrement

   Inthecaseofpost-increment,thevalueofthevariableisincreasedbyoneaftertheexpressionevaluation.Inthecaseofpost-decrement,thevalueofthevariableisdecreasedbyoneaftertheexpressionevaluation.Thatmeans,whenweusepost-incrementorpost-decrement,firstthe expression is evaluated with existing value, then the value of the variable is incremented ordecrementedbyone.
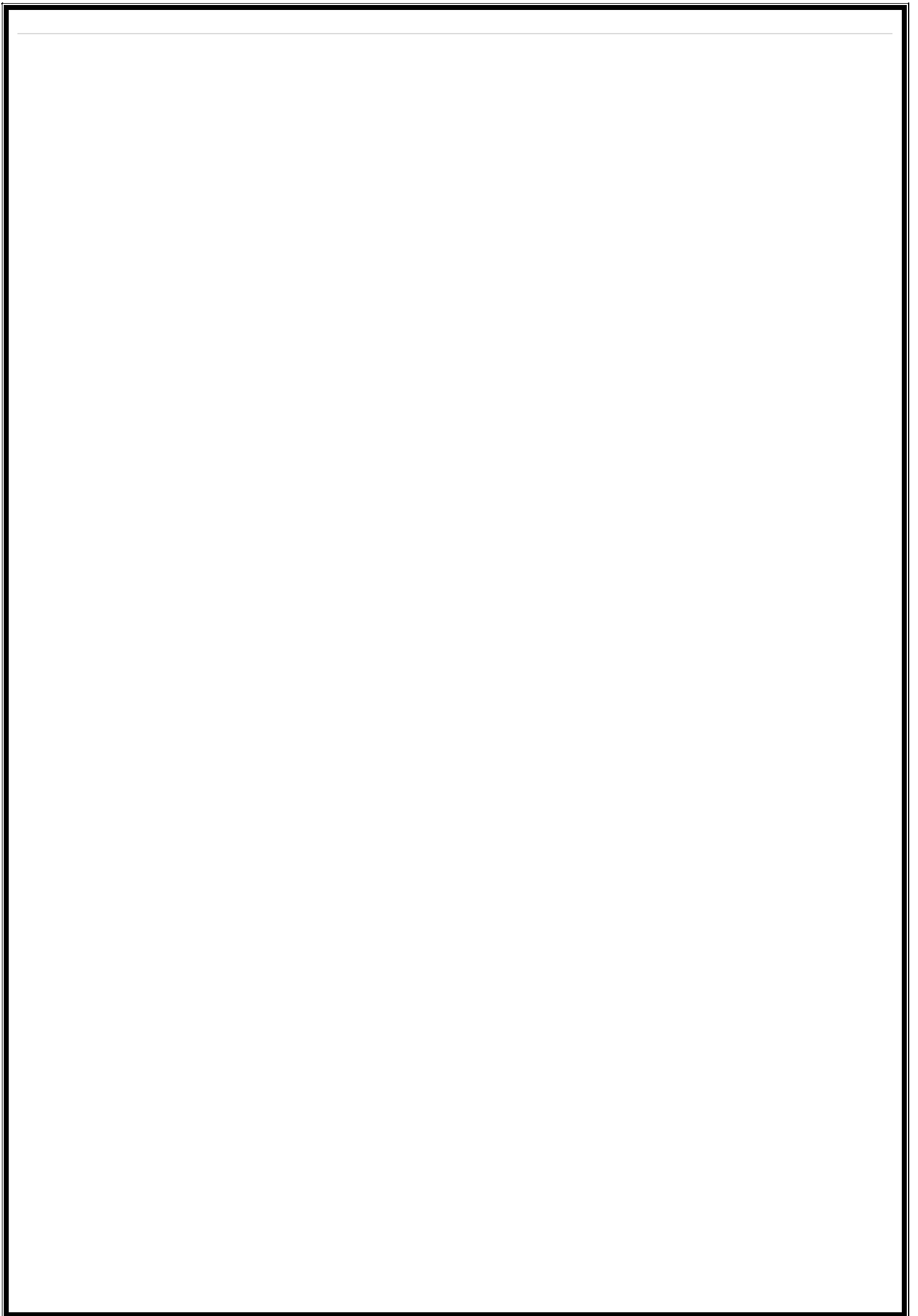
ExampleProgram

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

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

Theassignmentoperatorsareusedtoassignright-handsidevalue(Rvalue)totheleft-handsidevariable(Lvalue).Theassignmentoperatorisusedindifferentvariantsalongwitharithmeticoperators. The following table describes all the assignment operators in the C programminglanguage.

Operator	Meaning	Example
=	Assigntheright-handsidevaluetoleft-handsidevariable	A=15
+=	Addbothleftandright-handsidevaluesandstoretheresultintoleft-handside variable	A+=10⇒A=A+10
-=	Subtractright-handsidevaluefromleft-handsidevariablevalueandstorethe resultintoleft-handsidevariable	A-=B⇒A=A-B
*=	Multiplyright-handsidevaluewithleft-handsidevariablevalueandstoretheresult intoleft-hand sidevariable	A*=B⇒A=A*B
/=	Divideleft-handsidevariablevaluewithright-handsidevariablevalueandstore theresultintotheleft-handsidevariable	A/=B⇒A=A/B

%=	Divide left-hand side variable value withright-hand side variable value and storetheremainderintotheleft-handside variable	A%=B⇒A=A%B

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

Thebitwiseoperators areusedtoperform bit-leveloperations inthecprogramminglanguage. When we use the bitwise operators, the operations are performed based on the binaryvalues.ThefollowingtabledescribesallthebitwiseoperatorsintheCprogramminglanguage. LetusconsidertwovariablesAandBasA=25(11001)andB=20(10100).

Operator	Meaning	Example
&	theresultofBitwiseANDis1ifallthe bitsare1otherwiseitis0	A&B⇒16(10000)
|	theresultofBitwiseORis0ifallthe bitsare0otherwiseitis1	A|B⇒29(11101)
^	theresultofBitwiseXORis0ifallthe bitsaresameotherwiseitis1	A^B⇒13(01101)
~	theresultofBitwiseoncecomplementis negationofthebit(Flipping)	~A⇒6(00110)
<<	theBitwiseleftshiftoperatorshiftsall thebitstotheleftbythespecifiednumberofp ositions	A<<2⇒100(1100100)
>>	theBitwiserightshiftoperatorshiftsalltheb itstotherightbythespecified numberofpositions	A>>2⇒6(00110)

ConditionalOperator(?:)

Theconditionaloperatorisalsocalledaternaryoperatorbecauseitrequiresthreeoperands. This operator is used for decision making. In this operator, first we verify a condition,then we perform one operation out of the two operations based on the condition result. If thecondition is TRUE the first option is performed, if the condition is FALSE the second option isperformed.Theconditionaloperatorisusedwiththefollowingsyntax.

Condition?TRUEPart:FALSEPart;

Example

A=(10<15)?100:200;⇒A valueis100

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

Thefollowingarethespecialoperatorsincprogramminglanguage.

sizeofoperator

Thisoperatoris usedtofind thesize of thememory(inbytes) allocatedforavariable.Thisoperatorisusedwiththefollowingsyntax.

sizeof(variableName);

Example

sizeof(A);⇒theresultis2ifAisaninteger

Pointeroperator (*)

Thisoperatorisusedtodefinepointervariablesincprogramminglanguage.

Commaoperator(,)

Thisoperatorisusedtoseparatevariableswhiletheyaredeclaring,separatetheexpressionsinfunctioncalls,etc.

Dotoperator(.)

Thisoperatorisusedtoaccessmembersofstructureorunion.

OperatorPrecedenceandAssociativity

WhatisOperatorPrecedence?

Operatorprecedenceisusedtodeterminetheorderofoperatorsevaluatedinanexpression. In c programming language every operator has precedence (priority). When there ismore than one operator in an expression the operator with higher precedence is evaluated firstandtheoperatorwiththeleastprecedenceisevaluatedlast.

WhatisOperatorAssociativity?

Operator associativity is used to determine the order of operators with equal precedenceevaluatedinanexpression.Inthecprogramminglanguage,whenanexpressioncontainsmultipleoperators with equal precedence, we use associativity to determine the order of evaluation ofthoseoperators.

Incprogramminglanguagetheoperatorprecedenceandassociativityareasshowninthefollowingtable.

Precedence	Operator	OperatorMeaning	Associativity
1	() [] -> .	functioncallarr ayreference structurememberaccess structurememberaccess	LefttoRight
2	! ~ + - ++ -- & *sizeo f (type)	negation 1'scomplementU naryplusUnary minus increment operatordecrement operatoraddress of operatorpointer returnssizeofavariable typeconversion	RighttoLeft
3	* / %	multiplication divisionremain der	LefttoRight
4	+ -	addition subtraction	LefttoRight
5	<< >>	leftshift rightshift	LefttoRight
6	< <= > >=	lessthan lessthanorequaltogreate rthan greaterthanorequal to	LefttoRight
7	== !=	equalto notequalto	LefttoRight
8	&	bitwiseAND	LefttoRight
9	^	bitwiseEXCLUSIVE OR	LefttoRight
10	|	bitwiseOR	LefttoRight
11	&&	logicalAND	LefttoRight
12	||	logicalOR	LefttoRight

13	?:	conditionaloperator	LefttoRight
14	=	assignment	RighttoLeft
	*=	assign	
	/=	multiplicationassign	
	%=	divisionassign	
	+=	remainderassignadd	
	-=	itionassign	
	&=	subtractionassignbit	
	^=	wiseANDassignbitwi	
	|=	seXORassignbitwise	
	<<=	ORassignleftshift	
	>>=	assignrightshift	
15	,	separator	LefttoRight

Intheabovetable,theoperatorprecedencedecreasesfromtoptobottomandincreasesfrombottomtotop.

6.3.2 Expressions

Whatisanexpression?

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

IntheCprogramminglanguage,anexpressionis definedas follows.

Anexpressionisacollectionofoperatorsandoperandsthatrepresentsaspecificvalue.

Intheabovedefinition,anoperatorisasymbolthatperformstaskslikearithmeticoperations,logicaloperations,andconditionaloperations,etc.

Operandsarethevaluesonwhichtheoperatorsperformthetask.Hereoperandcanbeadirectvalueorvariableoraddressofmemorylocation.

ExpressionTypesinC

IntheCprogramming language,expressions aredividedintoTHREEtypes.Theyareasfollows...

- InfixExpression
- PostfixExpression
- PrefixExpression

Theaboveclassificationisbasedontheoperatorpositionintheexpression.

InfixExpression

- Theexpressioninwhichtheoperatorisusedbetweenoperandsiscalledinfixexpression.
- Theinfixexpressionhasthefollowinggeneralstructure.

Operand1OperatorOperand2

PostfixExpression

- Theexpressioninwhichtheoperatorisusedafteroperandsiscalledpostfixexpression.
- Thepostfixexpressionhasthefollowinggeneralstructure.

Operand1Operand2Operator

PrefixExpression

- Theexpressioninwhichtheoperatorisusedbeforeoperandsiscalledaprefixexpression.
- Theprefixexpressionhasthefollowinggeneralstructure.

OperatorOperand1Operand2

6.3.3 TypeConversionandTypeCasting

In a programming language, the expression contains data values of the same datatype or differentdata types. When the expression contains similar datatype values then it is evaluated without anyproblem. But if the expression contains two or more different datatype values then they must beconverted to the single datatype of destination datatype. Here, the destination is the locationwhere the final result of that expression is stored. For example, the multiplication of an integerdata value with the float data value and storing the result into a float variable. In this case, theintegervaluemustbeconvertedtofloatvaluesothatthefinalresultisafloatdatatypevalue.

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

- TypeConversion
- TypeCasting

TypeConversion

Thetypeconversionistheprocessofconvertingadatavaluefromonedatatypetoanotherdata type automatically by the compiler. Sometimes type conversion is also called implicit typeconversion.The implicit type conversionisautomatically performed bythe compiler.

Forexample,incprogramminglanguage,whenweassignanintegervaluetoafloatvariable the integer value automatically gets converted to float value by adding decimal value 0.Andwhenafloat valueisassignedto aninteger variablethefloat valueautomatically gets

convertedtoanintegervaluebyremovingthedecimalvalue.Tounderstandmoreabouttypeconversiono
bservethefollowing...

inti=10;floatx

=15.5;charch=

'A';

i=x;=======>xvalue15.5isconvertedas15andassignedtovariablei

x=i;=======>Hereivalue10isconvertedas10.000000andassignedtovariablexi=ch;==

=====>HeretheASCIIvalueofA(65)isassignedtoi

ExampleProgram

```
#include<stdio.h>
#include<conio.h>
voidmain()
{
  inti=95;
  floatx=90.99;c
  harch='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 integervariable. Here, the compiler automatically converts the float value (90.99) into integer value (90)by removing the decimal part of the float value (90.99) and then it is assigned to variable

i.Similarly,whenweassignx=i,theintegervalue(90)getsconvertedtofloatvalue(90.000000)byadding zeroasthedecimalpart.

Typecasting

Typecasting is also called an explicit type conversion. Compiler converts data from onedata type to another data type implicitly. When compiler converts implicitly, there may be a dataloss. In such a case, we convert the data from one data type to another data type using explicittypeconversion.Toperformthisweusetheunarycastoperator.Toconvertdatafromonetypeto anothertypewespecifythetargetdatatypeinparenthesisasaprefixtothedatavaluethathastobeconver ted.

Thegeneralsyntaxoftypecastingisasfollows.

(TargetDatatype)DataValue
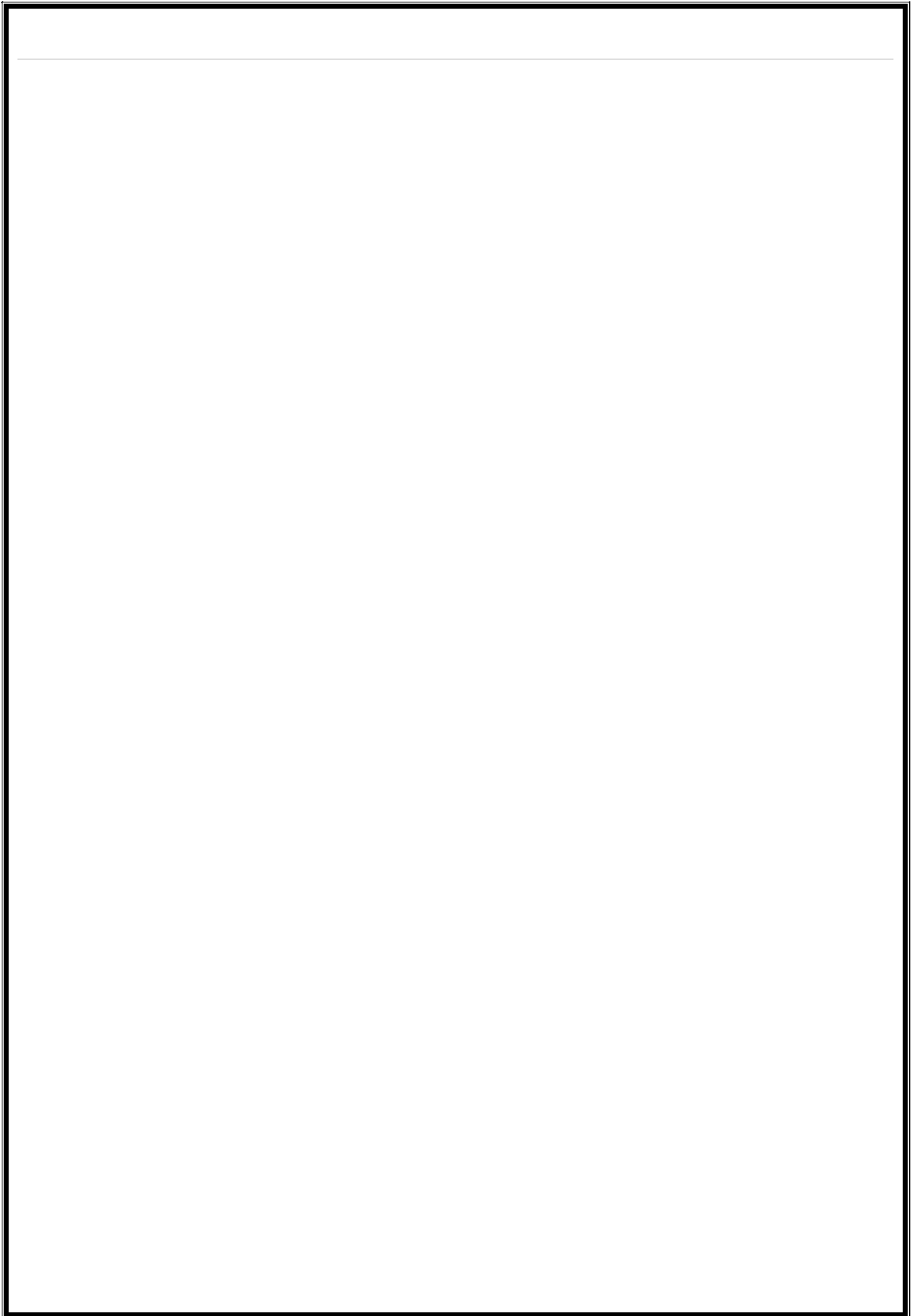
Example

inttotalMarks=450,maxMarks=600;floata

verage;

average=(float)totalMarks/maxMarks*100;

Intheaboveexamplecode,bothtotalMarksandmaxMarksareintegerdatavalues.Whenweperformt otalMarks/maxMarkstheresultisafloatvalue,butthedestination(average)datatypeisafloat.Soweusetype castingtoconverttotalMarksandmaxMarksintofloatdatatype.

ExampleProgram

```
#include<stdio.h>
#include<conio.h>
voidmain()
{
   int a, b, c
   ;floatavg;
   printf("Enteranythreeintegervalues:");
   scanf("%d%d%d",a,b,
   c);avg=(a+b+c)/3;
   printf("avg before casting = &f", avg
   \n);avg=(float)(a+b+c)/3;
   printf("avgaftercasting=%f",avg\n);ret
   urn0;
}
```

Comments

Comments in C are enclosed by slash/star pairs: /* .. comments .. */ which maycrossmultiplelines.C++introducedaformofcommentstartedbytwoslashesandextendingtothee ndoftheline:

//commentuntilthelineend

The//commentformissohandythatmanyCcompilersnowalsosupportit,althoughitisnottechn icallypartoftheClanguage.

Along with well-chosen function names, comments are an important part of well writtencode. Comments should not just repeat what the code says. Comments should describe what

thecodeaccomplisheswhichmuchmoreisinterestingthanatranslationofwhateachstatementdoes.Co mmentsshould alsonarrate what is trickyornon-obviousabouta section ofcode.

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

ControlStructures

C uses curly braces ({}) to group multiple statements together. The statements execute inorder. Some languages let you declare variables on any line (C++). Other languages insist thatvariables are declared only at the beginning of functions (Pascal). C takes the middle road -- variables may be declared within the body of a function, but they must follow a '{'. More modernlanguageslikeJavaandC++allowyoutodeclarevariablesonanyline,whichishandy.

WhatisDecisionMakingStatement?

In the C programming language, the program execution flow is line by line from top tobottom. That means the c program is executed line by line from the main method. But this type ofexecution flow may not be suitable for all the program solutions. Sometimes, we make somedecisions or we may skip the execution of one or more lines of code. Consider a situation, wherewe 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 cweusethestatementscalleddecisionmakingstatements.

Decision-makingstatementsarethestatementsthatareusedtoverifyagivenconditionanddecidewhetherablockofstatementsgetsexecutedornotbasedontheconditionresult.

Inthecprogramminglanguage,therearetwodecision-makingstatementstheyareasfollows.

1. ifstatement
2. switchstatement

ifstatementin c

In c, if statement is used to make decisions based on a condition. The if statement verifiesthe given condition and decides whether a block of statements are executed or not based on theconditionresult.Inc,ifstatementis classifiedintofourtypesasfollows...

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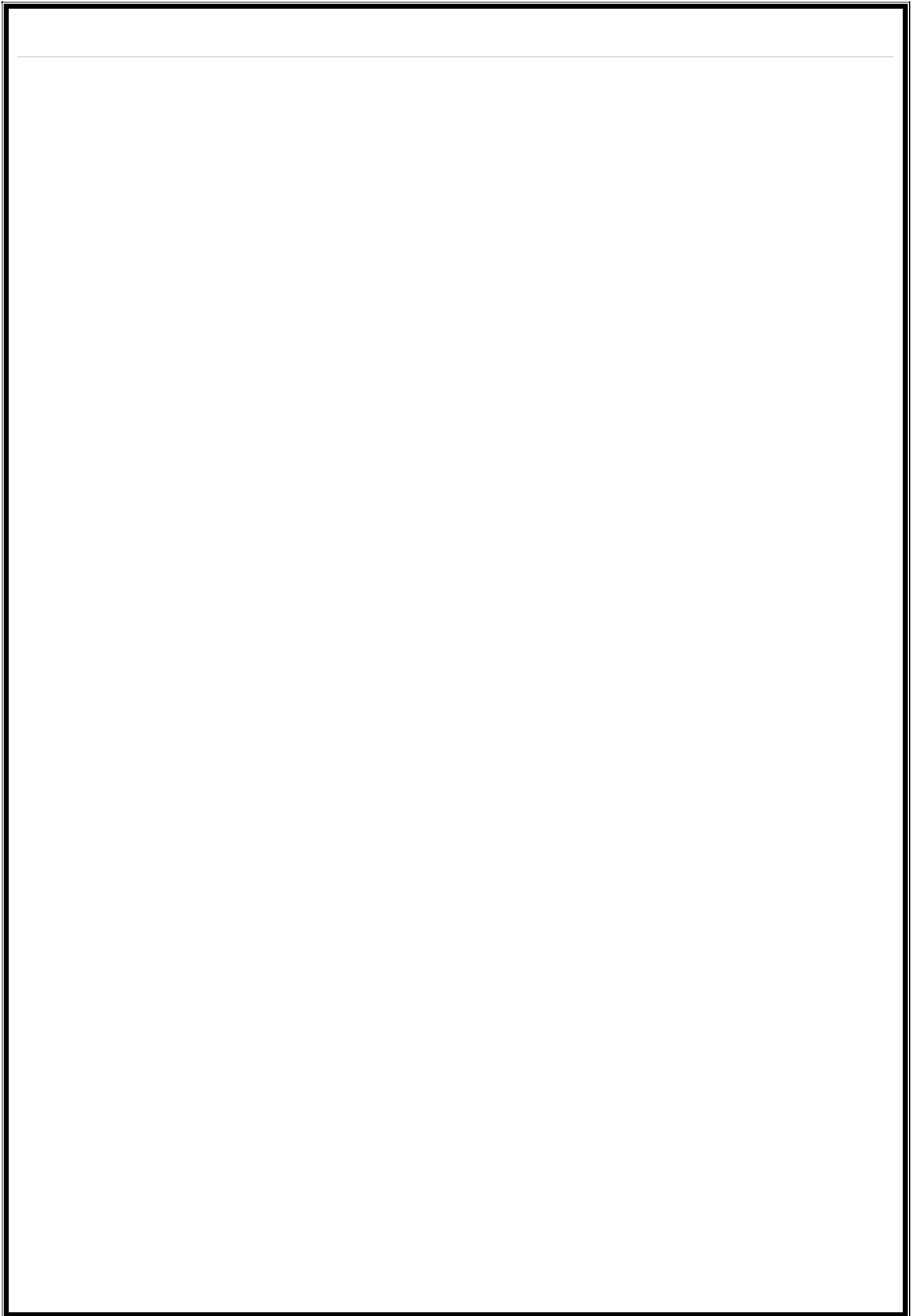
Simple if statement

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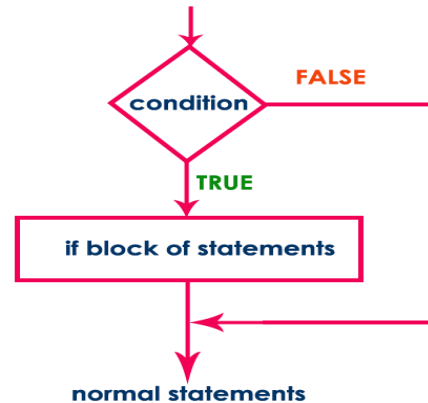
Simple if statement is used when we have only one option that is executed or skipped based on a condition.

if-else statement

The if-else statement is used to verify the given condition and executes only one out of the

Syntax

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

Execution flow diagram
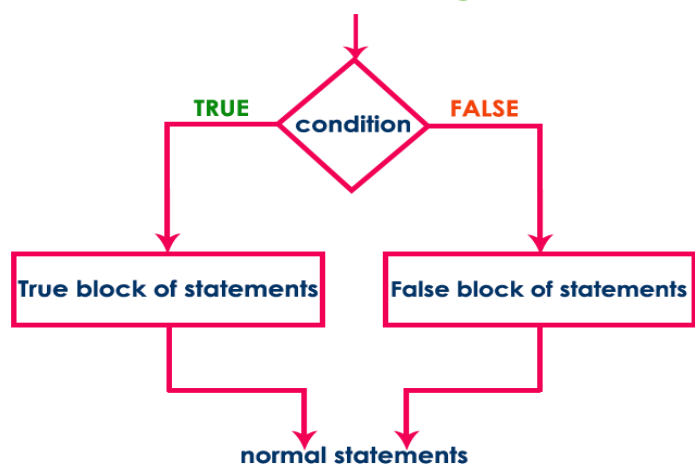
two blocks of statements based on the condition result. The if-else statement evaluates the specified condition. If it is TRUE, it executes a block of statements (True block). If the condition is FALSE, it executes another block of statements (False block). The general syntax and execution flow of the if-else statement is as follows.

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

Nested ifstatement

      Writingaifstatementinsideanotherifstatementiscallednestedifstatement.Thegeneralsyntaxofthen estedifstatementisasfollows...

```
Syntax

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

Thenestedifstatementcanbedefinedusinganycombinationofsimpleif&if-elsestatements.

<u>if-else-ifstatement(if-elseladder)</u>

Writingaifstatementinsideelseofanifstatementiscalledif-else-ifstatement.Thegeneralsyntaxoftheif-else-ifstatementisasfollows...

```
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>intmain(
)
{
  int   x   =
  20;int y =
  22;if(x<y)
  {
     printf("Variablexislessthany");
  }
  return 0;
}
```

Output:

VariablexislessthanyProg

ram2:(Simpleifstatement)

```
#include
<stdio.h>intmain(
)
{
  int i =
  10;if(i>15
  )

  {
   printf("10islessthan15");
  }
printf("IamNotinif");
}
```

Output:

IamNotinifProgram3:(

if-elsestatement)

```
#include<stdio.h>

intmain()
{
  int i =
  20;if(i<15
  )
        printf("iissmallerthan15");
 else
        printf("iis greaterthan 15");
return0;
}
```

Output:

iisgreaterthan15

Program4:(if-elsestatement)

```
#include
<stdio.h>intmain(
)
{
  intage;
 printf("Enteryourage:");scanf("%d",
 &age);
 if(age>=18)
{
        /*Thisstatementwillonlyexecuteifthe
         *abovecondition(age>=18)returnstrue
         */
        printf("Youareeligibleforvoting");
}
  else
{
        /*Thisstatementwillonlyexecuteifthe
         *conditionspecifiedinthe"if"returnsfalse.*/printf("Youar
        enot eligiblefor voting");
}
  return0;
}
```

Output:

Enteryourage:14

YouarenoteligibleforvotingPr

ogram5:(Nested-ifstatement)

```
#include
<stdio.h>intmain(
)
{
 intvar1,var2;
 printf("Inputthevalueofvar1:");sc
 anf("%d",
 &var1);printf("Inputthevalueofva
 r2:");scanf("%d",&var2);
 if(var1!=var2)
  {
        printf("var1isnotequaltovar2\n");
        //Nestedifelseif
        (var1>var2)
        {

        }                   }
        else
        {
}
```

```c
printf("var1isgr
eaterthanvar2\
n");



printf("var2isgr
eaterthanvar1\
n");
```

```c
printf("var1isgr
eaterthanvar2\
n");
```

```c
        }
```

```
        else
        {
                printf("var1isequaltovar2\n");
        }
          return0;
        }
```

Output:

**Inputthevalueofvar1:12In
putthevalueofvar2:21var1
is not equal to
var2var2isgreaterthanvar
1**

Program6:(Nested-ifstatement)

```
        #include
        <stdio.h>intmain(
        )
        {
           inti=10;if(
           i==10)
           {
              //Firstifstatementif
              (i<15)
        printf("iissmallerthan15\n");
                //Nested-ifstatementwillonlybeexecutedifstatementaboveistrueif(i<12)
                    printf("iissmallerthan12too\n");
                else
                    printf("iis greaterthan 15");
           }
           return0;
        }
```

Output:

iissmallerthan15

i is smaller than 12

tooProgram7:(if-else-

ifstatement)

```
        #include
         <stdio.h>intmain(
         )
         {
           inti=20;if(
           i== 10)
              printf("iis10");e
           lseif(i==15)
                printf("i is
         }
```

```
                15");elseif(i==2
                0)
                    printf("iis20");e
                 lse
                    printf("iisnotpresent");




        }
```

Output:

iis20

Program8:(if-else-ifstatement)

```
#include
<stdio.h>intmain(
)
{
  intvar1,var2;
  printf("Inputthevalueofvar1:");sc
  anf("%d",
  &var1);printf("Inputthevalueofva
  r2:");scanf("%d",&var2);
  if(var1!=var2)
  {
        printf("var1isnotequaltovar2\n");
  }
  elseif(var1>var2)
 {
        printf("var1isgreaterthanvar2\n");
 }
elseif(var2>var1)
 {
        printf("var2isgreaterthanvar1\n");
 }
else
{
        printf("var1isequaltovar2\n");
}
  return0;
}
```

Output:

Input the value of

var1:12Input the value of

var2:21var1isnotequaltov

ar2

'switch'statement inC

Consider a situation in which we have many options out of which we need to select onlyone 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. Thistype 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. In the switch

statement,weprovideavaluethatistobecomparedwithavalueassociatedwitheachoption.Whenevert

hegiven value matches the value associated with an option, the execution starts from that option. In the switch statement, every option is defined as a case.

The switch statement has the following syntax and execution flow diagram.

Syntax

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


Flow Diagram
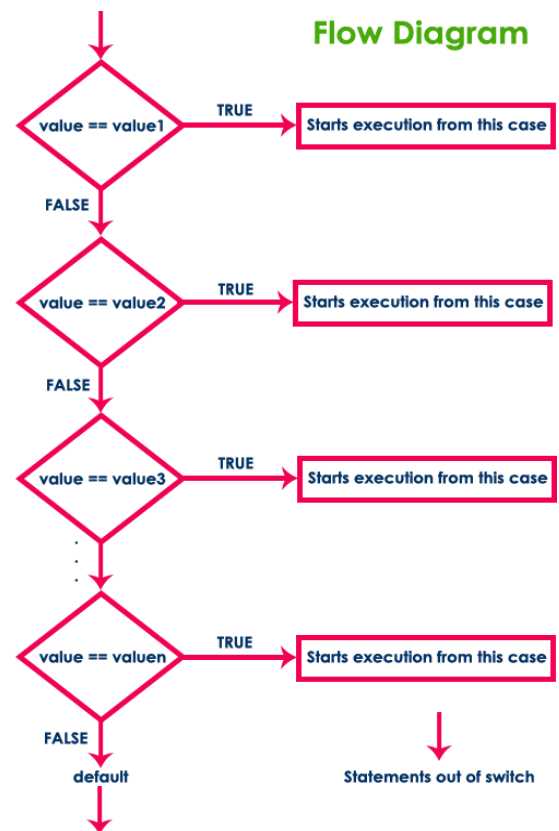
The switch statement contains one or more cases and each case has a value associated with it.   At first switch statement compares the first case value with the switchValue, if it gets matched the execution starts from the first case. If it doesn't match the switch statement compares the second case 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:
Program1:
```
    #include<stdio.h>
    #include<conio.h>
    voidmain()
    {
      intn;clrs
cr();
printf("Enteranydigit:");sca
nf("%d",&n);
```

```
        switch(n)
        {
                case0:printf("ZERO");br
                eak;
                case1:printf("ONE");bre
                ak;
                case2:printf("TWO");br
                eak;
                case3:printf("THREE");brea
                k;
                case4:printf("FOUR");br
                eak;
                case5:printf("FIVE");bre
                ak;
                case6:printf("SIX");brea
                k;
                case7:printf("SEVEN");brea
                k;
                case8:printf("EIGHT");brea
                k;
                case9:printf("NINE");br
                eak;
                default:printf("NotaDigit");
         }
        getch();
        }
```

Output:

Enteranydigit:5FI

VE

Program2:

```
        #include
        <stdio.h>intmain(
        )
        {
           intnum=2;switch(num+
           2)
           {
              case1:printf("Case1:Valueis:%d",num);case2:
              printf("Case2:Valueis:%d",num);case3:printf(
              "Case3:Valueis:%d",num);default:printf("Defa
              ult:Valueis:%d",num);
           }
           return 0;
        }
```

Output:

Default:valueis:2

Loopingstatements

Considerasituationinwhichweexecuteasinglestatementorblockofstatementsrepeatedly for the required number of times. Such kind of problems can be solved using loopingstatementsinC.Forexample,assumeasituationwhereweprintamessage100times.Ifwewanttoperformthattaskwithoutusingloopingstatements,wehavetoeitherwrite100printfstatements or we have to write the same message 100 times in a single printf statement. Both arecomplexmethods.Thesametaskcanbeperformedveryeasilyusingloopingstatements.

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

Clanguageprovidesthreeloopingstatements...

- whilestatement
- do-whilestatement
- forstatement

whileStatement

Thewhilestatementisusedtoexecuteasinglestatementorblockofstatementsrepeatedlyas long as the given condition is TRUE. The while statement is also known as Entry controlloopingstatement.Thewhilestatementhasthefollowingsyntax...

Thewhilestatementhasthefollowing executionflowdiagram...

At first, the given condition is evaluated. If the condition is TRUE, the single statement orblockofstatementsgetsexecuted.Oncetheexecutiongetscompletedtheconditionisevaluated

Syntax:

```
while( condition )
{
    ...
    block of statements;
    ...
}
```
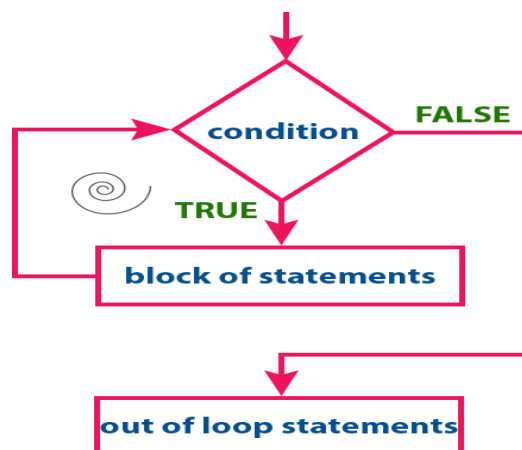
again.IfitisTRUE,againthesamestatementsgetexecuted.Thesameprocessisrepeateduntiltheconditi on is evaluated to FALSE. Whenever the condition is evaluated to FALSE, the executioncontrolmovesoutofthewhileblock.

Examples:

Program1:

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

Output:

Evennumbersupto10are0   2   4   6   8   10

Program2:

```
#include
<stdio.h>intmain(
)
{
  intcount=1;
  while(count<=4)
  {
      printf("%d",count);coun
      t++;
  }
  return 0;
}
```

Output:

1234

'do-while'statement

Thedo-whilestatementisusedtoexecuteasinglestatementorblockofstatementsrepeatedly as long as given the condition is TRUE. The do-while statement is also known as theExitcontrolloopingstatement.Thedo-whilestatementhasthefollowingsyntax...

Syntax:

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

The do-while statement has the following execution flow diagram...
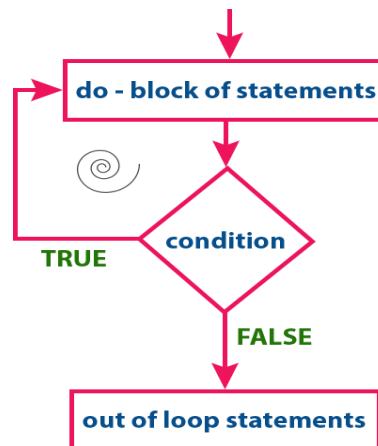
At first, the single statement or block of statements which are defined in do block are executed. After the execution of the do block, the given condition gets evaluated. If the condition is evaluated to TRUE, the single statement or block of statements of do block are executed again. Once the execution 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:Progr

am1:

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

Output:

Value of variable j is:
0Value of variable j is:
1Value of variable j is:
2Valueofvariablejis:3

Program2:

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

Output:

**whilevsdo-
whileOutofloop**

'for'statement

The for statement is used to execute a singlestatementorablock ofstatements repeatedlyaslongasthegivenconditionisTRUE.Thefo rstatement has the following syntax and executionflowdiagram...

Atfirst,theforstatementexecutesinitializationf ollowedbyconditionevaluation. IftheconditionisevaluatedtoTRUE,thesinglestatemen t or block of statements of for statement areexecuted. Once the execution gets completed, themodification statementis executedand again thecondition is evaluated. If it is TRUE, again the samestatementsareexecuted.Thesameprocessisrep eated until the condition is evaluated to FALSE.Whenever the condition is evaluated to FALSE, theexecutioncontrol movesout of theforblock.

Syntax:

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

Execution flow diagram:

Examples:

Program1:

```
//Printthenaturalnumbersfrom1to10#include<
stdio.h>
intmain()
{
  inti;
  for(i=1;i<11;++i)
  {
printf("%d",i);
  }
  return 0;
}
```

Output:

12345678910
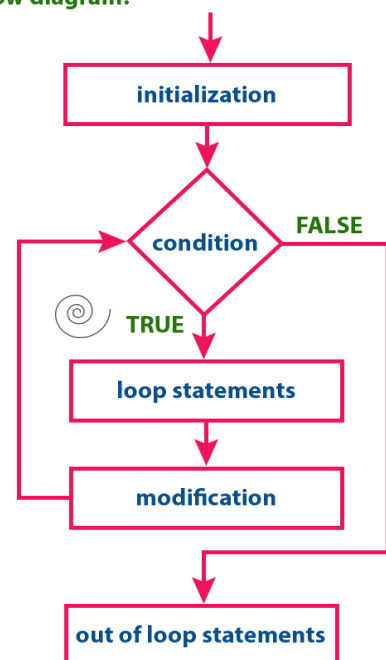
Program2:

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

Output:

0,0

0,1

0,2

0,3

1,0

1,1

1,2

1,3

break,continueandgotoinC

In c, there are control statements that do not need any condition to control the programexecutionflow.Thesecontrolstatementsarecalledasunconditionalcontrolstatements.Cprogramminglanguageprovides thefollowingunconditionalcontrolstatements...

- **break**
- **continue**
- **goto**

Theabovethreestatementsdonotneedanyconditiontocontroltheprogramexecutionflow.

"break"statement

InC,thebreakstatementisusedtoperformthefollowingtwothings...

- breakstatementisusedtoterminatetheswitchcasestatement

- breakstatementisalsousedtoterminateloopingstatementslikewhile,do-whileandfor.

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

Examples:

Program1:

```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("\ncame outside of loop i=%d",i);

}
```

Output:

012345
came outside of loop i =
5Program2:

```c
#include
 <stdio.h>int main(
 )
{
   /* local variable definition
    */int a=10;
   /*while loop execution*/while
(a<20)
{
printf("value of a:%d\n",a);a
    ++;
if(a> 15)
{
        break;/*terminate the loop using break statement*/
    }
  }
  return 0;
}
```

Output:

value of a:10v
alue of a:11va
lue of a:12val
ue of a:13valu
e of a:14value

ofa:15

continuestatement

Thecontinuestatementisusedtomovetheprogramexecutioncontroltothebeginningoftheloopingstatement.Whenthecontinuestatementisencounteredinaloopingstatement,theexecution control skips the rest of the statements in the looping block and directly jumps to thebeginning of the loop. The continue statement can be used with looping statements like while, do-whileandfor.

Whenweusecontinuestatementwithwhileanddo-whilestatementstheexecutioncontroldirectlyjumpstothecondition.Whenweusecontinuestatement withforstatementtheexecutioncontroldirectlyjumpstothemodificationportion(increment/decrement/anymodification)oftheforloop.

Examples:
Program1:
```
#include<stdio.h>
voidmain()
{
    inti=0;while
    (i!=10)
    {
 printf("%d",i);
        continue;
i++;
    }
}
```
Output:
Infiniteloop
Program2:

```
#include<stdio.h>i
ntmain(){
inti=1;//initializingalocalvariable
//startingaloopfrom1to10for(i=1;i<=10;i++)
{
if(i==5)
{//if valueofi is equalto5,itwill
continuetheloopcontinue;
}
printf("%d\n",i);
}//endofforloopret
urn0;
}
```
Output:

1
2

3
4
6
7
8
9
10

gotostatement

Thegotostatementisusedtojumpfromonelinetoanotherlineintheprogram.Usinggotostatementwecanjumpfrom top to bottom orbottomtotop.To jumpfromoneline to anotherline,thegotostatementrequiresalabel.Labelisanamegiventotheinstructionorlineintheprogram. Whenweuseagotostatementintheprogram,theexecutioncontroldirectlyjumpstothelinewiththespecified label.

Examples:

Program1:

```
#include
<stdio.h>intmain(
)
{
 intnum,i=1;
printf("Enterthenumberwhosetableyouwanttoprint:");scanf("%d",&num);
 table:printf("%d x %d =
%d\n",num,i,num*i);i++;
 if(i<=10)go
totable;
}
```

Output:

Enterthenumberwhosetableyouwanttoprint:1010
x1=10
10x2=20
10x3=30
10x4=40
10x5=50
10x6=60
10x7=70
10x8=80
10x9=90
10x10=100

Program2:

```
#include
<stdio.h>intmain(
)
{
 inti,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("cameoutoftheloop");
      }
```

Output:

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

6.5 ProgrammingAssignmentsusing theabovefeatures.

SomemoreExamples:

ProgramtoCheckEvenorOdd

```
    #include
    <stdio.h>intmain(
    )
    {
      intnum;
      printf("Enteraninteger:");scanf("%d
      ",&num);
      if(num%2==0)//Trueifnumisperfectlydivisibleby2printf("%diseve
        n.",num);
      else
        printf("%disodd.",num);retur
  n0;
    }
```

Output

Enteraninteger:-7
-7is odd.

ProgramtoCheckVowelorconsonant

```c
#include
<stdio.h>intmain(
)
{
  charc;
  int lowercase_vowel,
  uppercase_vowel;printf("Enter an
  alphabet: ");scanf("%c",&c);
  //evaluatesto1ifvariablecisalowercasevowel
  lowercase_vowel=(c=='a'||c=='e'||c=='i'||c=='o'||c=='u');
  //evaluatesto1ifvariablecisauppercasevowel
  uppercase_vowel=(c=='A'||c=='E'||c=='I'||c=='O'||c=='U');
  //evaluatesto1(true)ifcisavowel
  if
    (lowercase_vowel||uppercase_vowel)printf("%c
    isavowel.",c);
  else
    printf("%cisaconsonant.",c);return0;
}
```

Output

Enter an alphabet:
GGisaconsonant.

ProgramtoCheck LeapYear

```c
#include
<stdio.h>intmain(
)
{
  intyear;
  printf("Enterayear:");s
  canf("%d",&year);
  //leapyearifperfectlyvisibleby400if(y
    ear% 400== 0)
    {
      printf("%disaleapyear.",year);
    }
  //notaleapyear ifvisibleby100
  //butnotdivisibleby400elseif(
  year%100==0)
    {
      printf("%disnotaleapyear.",year);
    }
//leapyearifnotdivisibleby100
//butdivisibleby4elsei
f(year%4==0)
{
printf("%disaleapyear.",year);
}
```

```
//allotheryearsarenotleapyearels
e
```

```c
        {
        printf("%disnotaleapyear.",year);
        }
          return 0;
        }
```
Output
    Enterayear:190019
00isnotaleapyear.

ProgramtoCheckAlphabet

```c
        #include
        <stdio.h>intmain(
        )
        {
          charc;
          printf("Entera character:
          ");scanf("%c",&c);
          if((c>='a'&&c<='z')||(c>='A'&&c<='Z'))printf("%ci
            san alphabet.",c);
          else
              printf("%cisnotanalphabet.",c);return
          0;
        }
```
Output
    Enteracharacter:*
     ***isnotan alphabet**

TofindtheFactorialofaNumber

```c
        #include
        <stdio.h>intmain(
        )
        {
          intn,i;
          unsignedlonglongfact=1;printf("Ente
          raninteger:");scanf("%d",&n);
          //showserroriftheuserentersanegativeintegerif(n
          <0)
              printf("Error!Factorialofanegativenumberdoesn'texist.");
          else
           {
              for(i=1;i<=n;++i)
              {
                fact*=i;
              }
           printf("Factorialof%d=%llu",n,fact);
          }
        return 0;
        }
```
Output
    Enteraninteger:5Factorialo

f10=120

MultiplicationTableUpto10

```c
#include
<stdio.h>intmain(
)
{
    intn,i;
    printf("Enteraninteger:");scanf("%d"
    ,&n);
    for(i=1;i<=10;++i)
     {
       printf("%d*%d=%d\n",n,i,n*i);
     }
    return 0;
}
```

Output

```
Enteraninteger:99
*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>in
tmain(){
    intn,rev=0,remainder;printf("Entera
    ninteger:");scanf("%d",&n);
    while(n!=0){remainder
      =n%10;
      rev=rev*10+remainder;n/
      =10;
    }
     printf("Reversednumber=%d",rev);retu
     rn0;
}
```

Output

Enter an integer:
2345Reversednumber=54
32

ProgramtoCheckPalindrome

```c
#include
<stdio.h>intmain(
)
{
```

```
intn,reversedN=0,remainder,originalN;printf("Enteranin
teger:");
```

```c
    scanf("%d",&n);origina
    lN=n;
    //reversedintegerisstoredinreversedNwhil
    e(n!=0){
        remainder=n%10;
        reversedN=reversedN*10+remainder;n/
        =10;
    }
    //palindromeiforignalNandreversedNareequalif(or
    iginalN==reversedN)
        printf("%disapalindrome.",originalN);else
        printf("%disnotapalindrome.",originalN);re
    turn0;

}
```

Output

    Enter aninteger:
     10011001isapalindrom
     e.

SimpleCalculatorusingswitchStatement

```c
    #include
    <stdio.h>intmain(
    )
    {
        charoperator;double
        first,second;
        printf("Enteranoperator(+,-
        ,*,):");scanf("%c",&operator);printf("
        Entertwooperands:");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);brea
            k;
        default:printf("Error!operatorisnotcorrect");
        }
        return 0;
    }
```

Output

    Enteranoperator(+,-
    ,*,):*Entertwooperands:1.54.
    51.5*4.5=6.75

SolvedQuestions

ShortAnswerTypeQuestions.

Q.1 NameofthefirstdeveloperofCprogramminglanguages.

Ans:-DennisRitchie

Q.2 WhatarethevarioustypesofstatementavailableinCprogram?

Ans:-Chasthreetypesofstatement.

(i) Assignment=

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

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

Q.3 Whatis the purpose of i/ostatementin'C'?

Ans:-It is used to display a string inputted by gets() function. It isalso used to display an text(message)onthescreenforprogramsimplicity.

-InputOutput Statement.

Q.4 ExplaintheimportanceofC-language?

Ans:- C is highly portable and is used for scripting system applications which form a major part ofWindows,UNIX,andLinuxoperatingsystem.Cisa general-purpose programminglanguageandcanefficientlyworkonenterpriseapplications,games,graphics,andapplicationsrequiringcalculations,etc.

LongAnswerTypeQuestions.
Q.1 **Givethegeneralstructureofa'C'program,anddiscussabouteachofthelines.***(2017-Winter)*
Ans:- Programming in C is a difficult task for someone who is completely oblivious to the basicstructureofaCprogram.Aftercompletingthistutorial,youwouldlearnhowtheStructureof C Program looks likeand soonyouwouldbecomfortable writingyourown programswithease! PartofCprogram
1. # include <stdio.h> – This command is a preprocessor directive in C that includes allstandardinput-outputfilesbeforecompiling anyCprogramsoastomakeuseofallthosefunctionsinourCprogram.
2. intmain()– Thisisthelinefromwheretheexecutionoftheprogramstarts.Themain()functionstartstheexecutionofanyProgram.
3. {(Openingbracket)– Thisindicatesthebeginningofanyfunctionintheprogram(Hereitindicatesthebeginningof themainfunction).
4. /*somecomments*/–Whateverisinside/*——-*/arenotcompiledandexecuted;theyare only written for user understanding or for making the program interactive byinserting a comment line. These are known as multiline comments. Single linecomments arerepresentedwiththehelpof 2forwardslashes"//——".
5. printf("HelloWorld")–Theprintf()commandisincludedintheCstdio.hlibrary,which

helps to display the message on the output screen.
6. **getch() –** This command helps to hold the screen.
7. **return 0 –** This command terminates the C program and returns a null value, that is, 0.
8. **}(Closing brackets)-**
   This indicates the end of the function.(Here it indicates the end of the main function)

Q.2 **WAP in C to find the real roots of a quadratic equation.** *(2017-Summer)*
Ans:-

```
#include
<stdio.h>#include
<math.h>intmain(
)
{
 inta,b,c,d;
 doubleroot1,root2;
 printf("Entera,bandcwherea*x*x+b*x+c=0\n");scanf("%d
 %d%d",&a,&b,&c);
 d=b*b -
  4*a*c;if(d<0)
{//complexroots,iisforiota(√-1,squarerootof-1)
printf("Firstroot=%.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("Firstroot=%.2lf\
n",root1);printf("Secondroot=%.2lf\n",
root2);
}
 return 0;
}
```

EXERCISE

ShortAnswerTypeQuestions.

Q.1   DifferentiatebetweenNumericandCharacterConstant?

Q.2   Howcanyouuseasymbolicstatement?

Q.3   Whatdoyoumeanbyoperatorandoperand?

Q.4   WhatarethevarioustypesofOperatorusedintheCprogramming?

(2016-Summer)

Q.5   Differentiatebetweenlogicalandbitwiseoperator?

Q.6   Differentiatebetweenincrementanddecrementoperator?

Q.7   Differentiatebetween pre and post increment/decrement operator?

(2013-Summer)

Q.8   Differentiatebetweenunaryplusandunaryminusoperator?

Q.9   Whyconditionaloperatoriscalledternaryoperator?

Q.10   DefineOperator?

Q.11   Whatistherelationofarithmeticoperatorwithrelationaloperator?Explainwitha

nappropriateexpression?

Q.12   Howcanexpressionwithincrementanddecrementoperatorswillbesolved?

Q.13   Differentiatebetweenif-elseandelse-ifstatement?

Q.14   Differentiatebetweenladderifandswitchstatement?(2017-Summer)

Q.15   Whatdoyoumeanbyconditionalcontrolstatement?

Q.16   DefineaniterativestatementinaCprogram.

Q.17   Givethegeneralsyntaxofswitch……casestatementinC.

Q.18   Differentiatebetweendo-whileandwhile…..dostatementinC.

LongAnswerTypeQuestions

Q.1   WAPinCtoprintall2-DigitOddNumbers.

Q.2   WAPinCtoCalculateandprintthefactorialofagivennumber.

Q.3   WAPinCtoComputeandprintthesumofthefollowingseries.*(2017-Winter)*

$$S=1+1/x+1/x^2+1/x^3+1/x^4 \text{.........................} 1/x^n$$

Q.4   WAPinCtocalculatethesumofthedigitsofagivennumber.

Q.5   WAPinCtoComputeandprintthesimpleinterestandcompoundinterest.

Q.6 WAP in C to compute $(a+b)^2$.

Q.7 WAP in C to interchange value of two variables without using third variable.

Q.8 WAP in to find the sum of the given series. **(2015-Winter)**

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

Q.9 WAP in C to print.

*

**

***

Q.10 WAP in C to find the prime number. (2017-Summer)

Q.11 WAP in C to find greatest number among three integer numbers. *(2015-Winter)*

Q.12 WAP in C to compute and print the sum of the following series. *(2017-Winter)*

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

Q.13 WAP in C to find whether a number is Armstrong number or not.

****

CHAPTER–7: ADVANCED FEATURES OF C

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

Functions

➢ A function is a group of statements that together perform a task. Every C program has atleast one function, which is main (), and all the most trivial programs can define additionalfunctions.

➢ You can divide up your code into separate functions. How you divide up your code amongdifferentfunctionsisuptoyou,butlogicallythedivisionissuchthateachfunctionperforms aspecifictask.

➢ Afunctiondeclarationtellsthecompileraboutafunction'sname,returntype,andparameters.Afunctiondefinitionprovidestheactualbodyofthefunction.

➢ Afunctioncanalsobereferredasamethodorasub-routineoraprocedure,etc.

Defining a Function

➢ Thegeneralform ofafunctiondefinitioninCprogramminglanguageisasfollows–

   o returntypefunctionname(parameterlist){
   o bodyofthefunction
   o }

➢ AfunctiondefinitioninCprogrammingconsistsofafunctionheaderandafunctionbody. Hereareallthepartsofafunction–

   • **Return Type –** A function may return a value. The return type is the data type of thevaluethefunctionreturns.Somefunctionsperformthedesiredoperationswithoutreturningavalue.Inthiscase,thereturntypeisthekeywordvoid.

   • **Function Name –** This is the actual name of the function. The function name and theparameterlisttogetherconstitutethefunctionsignature.

   • **Parameters –** A parameter is like a placeholder. When a function is invoked, youpass a value to the parameter. This value is referred to as actual parameter orargument.Theparameterlistreferstothetype,order,andnumberoftheparametersofa function.Parametersareoptional;thatis,afunctionmaycontainnoparameters.

   • **Function Body –** The function body contains a collection of statements that definewhatthefunctiondoes.

ParametersinCfunctions

- AParameteristhesymbolicnamefor"data"thatgoesintoafunction.Therearetwowaystopassparameters inC:PassbyValue,PassbyReference.

  ### CallbyValue
  - Pass by Value, means that a copy of the data is made and stored by way of the nameof the parameter. Any changes to the parameter have NO affect on data in the callingfunction.
  - In call by value method, the value of the actual parameters is copied into the formalparameters. In other words, we can say that the value of the variable is used in thefunctioncallinthecallbyvaluemethod.
  - In call by value method, we cannot modify the value of the actual parameter by theformalparameter.
  - Incallbyvalue,differentmemoryisallocatedforactualandformalparameterssincetheval ue of the actualparameteriscopied into the formal parameter.
  - The actual parameter is the argument which is used in the function call whereasformal parameteristhe argument whichisused inthefunction definition.

  ### CallbyReference
  - A reference parameter "refers" to the original data in the calling function. Thus, anychangesmade to the parameterarealso madeto theoriginalvariable.
  - In call by reference, the address of the variable is passed into the function call as theactualparameter.
  - Thevalueoftheactualparameterscanbemodifiedbychangingtheformalparameterssincethe addressoftheactualparametersispassed.
  - In call by reference, the memory allocation is similar for both formal parameters andactualparameters.Alltheoperationsinthefunctionareperformedonthevaluestoredatth eaddressoftheactualparameters,andthemodifiedvaluegetsstoredatthesameaddress.

- Therearetwowaystomakeapassbyreferenceparameter:

  ### ARRAYS
  - ArraysarealwayspassbyreferenceinC.Anychangemadetotheparametercontainingthe arraywillchangethevalueoftheoriginalarray.

  ### Theampersand(&)usedinthefunctionprototype.Function(&parametername)
  - 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 totheparameteralsomodifytheoriginalvariablecontainingthedata.

  ### CallbyValueExample:Swappingthevaluesofthetwovariables(SwappingnotPossible)

```
#include<stdio.h>
void swap(int , int); //prototype of the
functionintmain()
{
   inta=10;int
   b=20;
   printf("Beforeswappingthevaluesinmaina=%d,b=%d\n",a,b);swap(a,b);
   printf("Afterswappingvaluesinmaina=%d,b=%d\n",a,b);//Thevalueofactualparametersd
onotchangebychangingtheformalparametersincallbyvalue,a=10,b=20
}
```

```c
voidswap(inta1,intb1)
{
    int
    temp;te
    mp =
    a;a=b;b=
    temp;
printf("Afterswappingvaluesinfunctiona=%d,b=%d\n",a,b);//Formalparameters,a
=20,b=10
}
```

Output

Beforeswappingthevaluesinmaina=10,
b=20Afterswappingvaluesinfunctiona=20,b=10A
fterswappingvaluesinmaina=10,b=20

Call by reference Example:
Swappingthevaluesofthetwovariables

```c
#include<stdio.h>
voidswap(int*,int*);//prototypeofthefunctionintma
in()
{
    inta=10;int
    b= 20;
    printf("Beforeswappingthevalues in main a=%d,b =%d\n",a,b);//printing the
valueofaandbinmain
    swap(&a,&b);
    printf("Afterswappingvaluesinmaina=%d,b=%d\n",a,b);//Thevaluesofactualparametersd
ochangeincallbyreference,a=10,b=20
}


voidswap(int*a,int*b)
{
    inttemp;te
    mp=*a;
    *a=*b;
    *b=temp;
printf("Afterswappingvaluesinfunctiona=%d,b=%d\n",*a,*b);//Formalparameters,a=20,b=
10
}
```

Output:

Beforeswappingthevaluesinmaina=10,b=20After
swappingvaluesinfunctiona=20,b=10Afterswapp
ingvaluesinmaina=20,b=10

7.2 ScopeofVariablesandStorageClasses,Recursion,FunctionandTypesofRecursion

7.2.1 Scopeofvariables

- When we declare a variable in a program, it cannot be accessed against the scope rules.Variablescanbeaccessedbasedontheirscope.Thescopeofavariabledecidestheportion ofaprograminwhichthevariablecanbeaccessed.Thescopeofthevariableisdefinedasfollows...
- Scopeofavariableistheportionoftheprogramwhereadefinedvariablecanbeaccessed.
- Thevariablescopedefinesthevisibilityofvariableintheprogram.Scopeofavariabledepen dsonthepositionofvariabledeclaration.
- InCprogramminglanguage,avariablecanbedeclaredinthreedifferentpositionsandtheyar easfollows...
  - ❖ Beforethefunctiondefinition(GlobalDeclaration)
  - ❖ Insidethefunctionorblock(LocalDeclaration)
  - ❖ Inthefunctiondefinitionparameters(FormalParameters)

Beforethefunctiondefinition(GlobalDeclaration)

ExampleProgram

```
#include<stdio.h>
#include<conio.h>
int num1, num2
;voidmain()
{
voidaddition();voids
ubtraction();
voidmultiplication();clrs
cr();
num1=10;n
um2 =20 ;
printf("num1=%d,num2=%d",num1,num2);additio
n();
subtraction();multip
lication();getch();
}
voidaddition()
{
intresult;
result=num1+num2;printf("\nad
dition=%d",result);
}
```

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

Output:

Insidethefunctionorblock(LocalDeclaration)

ExampleProgram

```
#include<stdio.h>
#include<conio.h>
voidmain()
{
voidaddition();int
num1,num2;clrsc
r();
num1=10;n
um2=20;
printf("num1=%d,num2=%d",num1,num2);additio
n();
getch();
}
voidaddition()
{
intsumResult;
sumResult=num1+num2;printf("\nad
dition=%d",sumResult);
}
```

Output:

Inthefunctiondefinitionparameters(FormalParameters)

ExampleProgram

```
#include<stdio.h>
#include<conio.h>
voidmain()
{
voidaddition(int,int);int
num1,num2;clrscr();
num1=10;n
um2=20;
addition(num1,num2);getc
h();
}
voidaddition(inta,intb)
{
intsumResult;sum
Result=a+b;
printf("\naddition=%d",sumResult);
}
```

7.2.2 StorageClasses

➢ StorageclassesinCareusedtodeterminethelifetime,visibility,memorylocation,andinitial valueofavariable.Therearefourtypesofstorageclassesin C

- Automatic
- External
- Static
- Register

Automatic

➢ Automaticvariablesareallocatedmemoryautomaticallyatruntime.

➢ Thevisibilityoftheautomaticvariablesislimitedtotheblockinwhichtheyaredefined.

➢ Thescopeoftheautomaticvariablesislimitedtotheblockinwhichtheyaredefined.

➢ Theautomaticvariablesareinitializedtogarbagebydefault.

➢ Thememoryassignedtoautomaticvariablesgetsfreeduponexitingfromtheblock.

➢ Thekeywordusedfordefiningautomaticvariablesisauto.

➢ Everylocalvariableis automaticinCbydefault.

Example

```c
#include
<stdio.h>intmain(
)
{
inta;//autoch
arb;
floatc;
printf("%d%c%f",a,b,c);//printinginitialdefaultvalueofautomaticvariablesa,b,andc.
return 0;
}
```

Output:

garbagegarbagegarbage

Static

➢ Thevariablesdefinedasstaticspecifiercanholdtheirvaluebetweenthemultiplefunctioncalls.

➢ Staticlocalvariablesarevisibleonlytothefunctionortheblockinwhichtheyaredefined.

➢ Asamestaticvariablecanbedeclaredmanytimesbutcanbeassignedatonlyonetime.

➢ Defaultinitialvalueofthestaticintegralvariableis0otherwisenull.

➢ Thevisibilityofthestaticglobalvariableislimitedtothefileinwhichithasdeclared.

➢ Thekeywordusedtodefinestaticvariableisstatic.

Example

```c
#include<stdio.h>st
aticcharc;
staticinti;stati
cfloatf;
static char
s[100];voidmain(
)
{
printf("%d%d%f%s",c,i,f);//theinitialdefaultvalueofc,i,andfwillbeprinted.
}
```
Output:000.000000(null)

Register

➢ Thevariablesdefinedastheregisterisallocatedthememoryintothe CPUregistersdepe ndinguponthesizeofthememoryremaininginthe CPU.

➢ Wecannotdereferencetheregistervariables,i.e.,wecannotuse&operatorfortheregistervariable.

➢ Theaccesstimeoftheregistervariablesisfasterthantheautomaticvariables.

➢ Theinitialdefaultvalueoftheregisterlocalvariablesis0.

➢ The register keyword is used for the variable which should be stored in the CPU register.However,itiscompiler'schoicewhetherornot;thevariablescanbestoredintheregist er.

➢ Wecanstorepointersintotheregister,i.e.,aregistercanstoretheaddressofavariable.

➢ Staticvariablescannotbestoredintotheregistersincewecannotusemorethanonestoragespecierf orthesamevariable.

Example

```
#include
<stdio.h>intmain(
)
{
 registerinta;//variableaisallocatedmemoryintheCPUregister.Theinitialdefaultvalueofais0.
printf("%d",a);
}
```

Output:

0

External

➢ Theexternalstorageclassisusedtotellthecompilerthatthevariabledefinedasexternisdeclared withanexternallinkageelsewhereintheprogram.

➢ Thevariablesdeclaredasexternarenotallocatedanymemory.Itisonlydeclarationandinten dedtospecifythatthevariableisdeclaredelsewhereintheprogram.

➢ Thedefaultinitialvalueofexternalintegraltypeis0otherwisenull.

➢ Wecanonlyinitializetheexternvariableglobally,i.e.,wecannotinitializetheexternalvariab lewithinanyblockormethod.

➢ Anexternalvariablecanbedeclaredmanytimesbutcanbeinitializedatonlyonce.

➢ Ifavariableisdeclaredasexternalthenthecompilersearchesforthatvariabletobeinitializedsom ewhereintheprogramwhichmaybeexternorstatic.Ifitisnot,thenthecompilerwillshowanerror .

Example

```
#include
<stdio.h>intmain(
)
{
 externinta;pri
 ntf("%d",a);
}
```

Output

main.c:(.text+0x6):undefinedreferenceto`a'collect2

:error:ldreturned1exitstatus

7.2.3 RecursionFunction

➢ Recursion is the process of repeating items in a self-similar way. In programminglanguages,ifaprogramallowsyoutocallafunctioninsidethesamefunction,t henitiscalledarecursivecallofthefunction.

```
voidrecursion()
{
recursion();/*functioncallsitself*/
}
intmain(){recursion
();
}
```

➢ The C programming language supports recursion, i.e., a function to call itself. But whileusing recursion, programmers need to be careful to define an exit condition from thefunction,otherwiseitwillgointoaninfiniteloop.

➢ Recursivefunctionsareveryusefultosolvemanymathematicalproblems,suchascalc ulatingthe factorialof anumber, generating Fibonacciseries, etc.

7.2.4 TypesofRecursion

Recursionaremainlyoftwotypesdependingonweatherafunctioncallsitselffromwithinitselfw eathertwofunctioncalloneanothermutually.

Thus,thetwotypesofrecursionare:

- Directrecursion
- Indirectrecursion

Recursionmaybefurthercategorizedas:

- Linearrecursion
- Binaryrecursion
- Multiplerecursion

7.3 OneDimensionalArrayandMultidimensionalArray,StringOperationsandPointers

7.3.1 One-dimensionalarray

- Conceptuallyyoucanthinkofaone-dimensionalarrayasarow,whereelementsarestoredoneafteranother.
- Syntax:datatypearray_name[size];
- datatype:Itdenotesthetypeoftheelementsinthearray.
- array_name:Nameofthearray.It mustbeavalididentifier.
- size:Numberofelementsanarraycanhold.herearesomeexampleofarraydeclarations:

    intnum[100];fl

    oat

    temp[20];char

    ch[50];

7.3.2 MultidimensionalArrays

- Thesimplestformofmultidimensionalarrayisthetwo-dimensionalarray.Atwo-dimensionalarrayis,inessence,alistofone-dimensionalarrays.Todeclareatwo-dimensionalintegerarrayofsize[x][y],youwouldwritesomethingasfollows–

    typearrayName[x][y];

- WheretypecanbeanyvalidCdatatypeandarrayNamewillbeavalidCidentifier.
- Atwo-dimensionalarraycanbeconsideredasatablewhichwillhavexnumber ofrowsandynumberofcolumns.
- Atwo-dimensionalarraya,whichcontainsthreerowsandfourcolumnscanbeshownasfollows–

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

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

7.3.3 Stringoperations

➢ Stringsareactuallyone-dimensionalarrayofcharactersterminatedbyanullcharacter'\0'.Thusanull-terminatedstringcontainsthecharactersthatcomprisethestringfollowedbyanull.

➢ The following declaration and initialization create a string consisting of the word "Hello".Toholdthenullcharacterattheendofthearray,thesizeofthecharacterarraycontainingthe string isone morethanthe number of charactersin the word "Hello."

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

➢ Ifyoufollowtheruleofarrayinitializationthenyoucanwritetheabovestatementas follows–

    chargreeting[]="Hello";

➢ FollowingisthememorypresentationoftheabovedefinedstringinC/C++–

➢ Actually,youdonotplacethenullcharacterattheendofastringconstant.TheCcompilerautomatically places the '\0' at the end of the string when it initializes the array. Let us trytoprinttheabovementionedstring–LiveDemo

```
#include
<stdio.h>intmain(
)
{
   chargreeting[6]={'H','e','l','l','o','\0'};printf("Greet
   ingmessage:%s\n",greeting);return0;
}
```

7.3.4 Pointers

➢ Apointerisavariablewhosevalueistheaddressofanothervariable,i.e.,directaddressofthememorylocation.Likeanyvariableorconstant,youmustdeclareapointerbeforeusingittostoreanyvariableaddress.Thegeneralformofapointervariabledeclarationis–

                        type*var-name;

➢ Here, type is the pointer's base type; it must be a valid C data type and var-name is thenameofthepointervariable.Theasterisk*usedtodeclareapointeristhesameasteriskusedformultiplication.

HowtoUsePointers?

➢ Thereareafewimportantoperations,whichwewilldowiththehelpofpointersveryfrequently.

- Wedefineapointervariable,
- assigntheaddressofavariabletoapointerand

- Finallyaccessthevalueattheaddressavailableinthepointervariable.

➢ Thisisdonebyusingunaryoperator*thatreturnsthevalueofthevariablelocatedattheaddressspe cifiedbyitsoperand.Thefollowingexamplemakesuseoftheseoperations–

```
#include<stdio.h>in
tmain(){
intvar=20;/*actualvariabledeclaration*/int
*ip;/*pointervariabledeclaration*/
ip=&var;/*storeaddressofvarinpointervariable*/print
f("Addressofvar variable: %x\n",&var);
/* address storedin
pointervariable*/printf("Addressstoredinipvariable
:%x\n",ip);
/* access the value using the pointer
*/printf("Valueof*ipvariable:%d\n",*ip);
return0;
}
```

7.4 PointerExpressionandPointerArithmeticProgramming,Assi gnmentsusingtheabovefeatures.

➢ Pointersareusedtopointtoaddressthelocationofavariable.Apointerisdeclaredbypreced ingthenameofthepointerbyanasterisk(*).

➢ Syntax:

datatype*pointer_name;

➢ Whenweneedtoinitializeapointerwithvariable'slocation,weuseampersandsign(&) beforethevariablename.

// Declaration of integer

variableintvar=10;

// Initialization of pointer

variableint*pointer=&var;

➢ Theampersand(&)isusedtogettheaddressofavariable.Wecandirectlyfindthelocationofanyid entifierbyjustprecedingitwithanampersand(&)sign.

Example:
```
// This code prints the address of
x#include<stdio.h>
intmain()
{
 intx=10;
//Printsaddressofx
 printf("Addressofvariablex=%p",&x);ret
 urn0;
}
```

PointerArithmeticProgramming

pointerincis
anaddress,whichisanumericvalue.Therefore,youcanperformarithmeticoperationsonapo interjustasyoucanonanumericvalue.Therearefourarithmeticoperatorsthatcanbeusedon pointers:++,--,+,and-

Tounderstandpointerarithmetic,letusconsiderthatptrisanintegerpointerwhichpo intstotheaddress1000.Assuming32-
bitintegers,letusperformthefollowingarithmeticoperationonthepointer−ptr++

Aftertheaboveoperation,theptrwillpointtothelocation1004becauseeachtimeptris incremented,itwillpointtothenextintegerlocationwhichis4bytesnexttothecurrentlocatio n.Thisoperationwillmovethepointertothenextmemorylocationwithoutimpactingtheactu alvalueatthememorylocation.Ifptrpointstoacharacterwhoseaddressis1000,thentheabov eoperationwillpointtothelocation1001becausethenextcharacterwillbeavailableat1001.

IncrementingaPointer

We prefer using a pointer in our program instead of an array because thevariable pointer can be incremented, unlike the array name which cannot beincrementedbecauseitisaconstantpointer.Thefollowingprogramincrementsthevar iable pointerto accesseachsucceeding element ofthe array –

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

Output
Addressofvar[0]=bf882b30Value
ofvar[0]=10
Addressofvar[1]=bf882b34Va
lueofvar[1]
=100Addressofvar[2]=bf882b
38Valueofvar[2]=200

DecrementingaPointer

Thesameconsiderationsapplytodecrementingapointer,whichdecreasesits valuebythenumberofbytesofitsdatatypeasshownbelow–

```
#include
<stdio.h>const  int
MAX = 3;intmain()
{
  intvar[]={10,100,200};
 inti,*ptr;
 ptr = &var[MAX-1];/* let us have array address in pointer
 */for(i=MAX;i>0;i--)
 {
   printf("Addressofvar[%d]=%x\n",i-
   1,ptr);printf("Value of var[%d] = %d\n", i-1,
   *ptr );ptr--;/* movetothe previouslocation */
 }
  return 0;
}
```

Output

Addressofvar[2]=bfedbcd8V
alue of var[2] =
200Addressofvar[1]=bfedbc
d4Value of var[1] =
100Addressofvar[0]=bfedbc
d0Valueofvar[0]=10

PointerComparisons

Pointersmaybecomparedbyusingrelationaloperators,suchas==,<,and>.Ifp1an dp2pointtovariablesthatarerelatedtoeachother,suchaselementsofthesamearray,the np1andp2canbemeaningfullycompared.

Thefollowingprogrammodifiesthepreviousexample–onebyincrementingthe variable pointer so long as the address to which it points is either less than orequaltothe address ofthe lastelement ofthearray, whichis &var[MAX-1]–

Example

```
#include
<stdio.h>const  int
MAX = 3;intmain()
{
 intvar[]={10,100,200};
 inti,*ptr;
 /*letushaveaddressofthefirstelementinpointer*/ptr=va
 r;
 i=0;
 while(ptr<=&var[MAX-1])
 {
   printf("Addressofvar[%d]=%x\n",i,ptr);printf("Value
   ofvar[%d]=%d\n",i,*ptr);
   /*pointtothenextlocation*/ptr++;
  i++;
 }
 return 0;
}
```

Output

Addressofvar[0]=bfdbcb20Value

ofvar[0]=10

Addressofvar[1]=bfdbcb24Va

lueofvar[1]=100Addressofvar

[2]=bfdbcb28Valueofvar[2]=2

00

7.5 StructureandUnion(Onlyconcepts,NoProgramming)

Whatisastructure?

> AstructureisauserdefineddatatypeinC.Astructurecreatesadatatypethatcanbeusedtogroupitems ofpossiblydifferenttypesintoasingletype.

Howtocreateastructure?

"**struct**"keywordisusedtocreateastructure.

Followingisanexample

structaddress

{

  char name[50];

charstreet[100];c

harcity[50];char

state[20];intpin;

};

Howtodeclarestructurevariables?

➢ Astructurevariablecaneitherbedeclaredwithstructuredeclarationorasaseparatedeclarationlikebasictypes.

➢ Avariabledeclarationwithstructuredeclaration.

```
structPoint
{
    intx,y;
}p1;
```
Thevariablep1isdeclaredwith'Point'.

➢ Avariabledeclarationlikebasicdatatypesstr

```
uctPoint
{
    intx,y;
};
intmain()
{
        structPointp1;//Thevariablep1isdeclaredlikeanormalvariable
}
```

Union

➢ A union is a special data type available in C that allows storing different data types inthesamememorylocation.

➢ Youcandefineaunionwithmanymembers,butonlyonemembercancontainavalueatanygiventime.

➢ Unionsprovideanefficientwayofusingthe samememorylocationformultiplepurposes.

DefiningaUnion:

➢ To define a union, you must use the union statement in the same way as you didwhiledefiningastructure.

➢ Theunionstatementdefinesanewdatatypewithmorethanonememberforyourprogram.

➢ Theformatoftheunionstatementisasfollows:union

[unionname]

{

memberdefinition;mem

berdefinition;

...

memberdefinition;

};

	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.

StandardLibraryFunctions

Manybasichousekeepingfunctionsareavailabletoa Cprograminformof standardlibrary functions. To call these, a program must #include the appropriate .h file. Most compilerslink in the standard library code by default. The functions listed in the next section are the mostcommonlyusedones,buttherearemanymorewhicharenotlistedhere.

stdio.h   fileinputandoutput

ctype.h   charactertests

string.h   stringoperations

math.h

              mathematicalfunctionssuchassin()andcos()stdl

ib.h   utilityfunctions suchas

malloc()andrand()assert.h   theassert()debuggingmacro

stdarg.h

              supportforfunctionswithvariablenumbersofargumentsset

| jmp.h | supportfornon-localflowcontroljumps |
| signal.h | supportforexceptionalconditionsignals |

time.h	dateandtime
limits.h,	float.hconstantswhichdefinetyperangevaluessuchasINT_MAX

ExamplesofadvanceprogramminginC

ExampleofArrayInCprogrammingtofindouttheaverageof4integers

```
#include
<stdio.h>intmain(
)
{
  int  avg  =
  0;int   sum
  =0;intx=0;
  intnum[4];/*Array-declaration–length4*/
  for(x=0;x<4;x++)/*Weareusingforlooptotraversethroughthe*/
  {
    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);return0;
}
```

Output:

Enternumber1

10

Enternumber2

10

Enternumber3

20

Enternumber4

40

Averageofenterednumberis:20

Exampletoprinttheaddressofarrayelements

```
#include<stdio.h>i
ntmain()
{
 intval[7]={11,22,33,44,55,66,77};
 /*forlooptoprintvalueandaddressofeachelementofarray*/for(inti=0;
 i<7;i++)
 {
  printf("val[%d]:valueis%dandaddressis%d\n",i,val[i],&val[i]);
 }
 return 0;
}
```

Output:

val[0]:valueis11andaddressis1423453232val

[1]:valueis22andaddressis1423453236val[2]

:valueis33andaddressis1423453240val[3]:va

lueis44andaddressis1423453244val[4]:value

is55andaddressis1423453248val[5]:valueis6

6andaddressis1423453252val[6]:valueis77a

ndaddressis1423453256

Example:PassingPointertoaFunctioninC

```
#include<stdio.h>
voidsalaryhike(int*var,intb)
{
   *var=*var+b;
}
intmain()
{
  intsalary=0,bonus=0;
  printf("Entertheemployeecurrentsalary:");scanf("%d",&
  salary);
  printf("Enterbonus:");scanf("%d",
  &bonus);salaryhike(&salary,bonu
  s);printf("Finalsalary:%d",salary);
  return0;

}
```

Output:
```
Entertheemployeecurrentsalary:10000En
terbonus:2000
Finalsalary:12000
```

ExampleforSwappingtwonumbersusingPointers

```c
#include<stdio.h>
voidswapnum(int*num1,int*num2)
{
  inttempnum;tempnu
m=*num1;
  *num1=*num2;
  *num2=tempnum;
}
intmain()
{
  intv1=11,v2=77;printf("Beforeswa
  pping:");printf("\nValueofv1is:%d
  ",v1);printf("\nValueofv2is:%d",v2
  );
  /*callingswapfunction*/swapnum(
  &v1,&v2);printf("\nAfterswapping:
  ");printf("\nValueofv1is:%d",v1);pr
  intf("\nValueofv2is:%d",v2);

}
```

Output:

```
Beforeswapping:
Valueofv1is:11V
alueofv2is:77Aft
erswapping:
Value  of  v1  is:
77Valueofv2is:11
```

Example:Programtofindthesizeofanarray

```c
#include
<stdio.h>intmain(
)
{
  doublearr[]={11,22,33,44,55,66};
  intn;
  /*Calculating the size ofthe array with thisformula.
   * n=sizeof(array_name)/sizeof(array_name[0])
   * Thisisauniversalformulatofindnumberofelementsin
   * anarray,whichmeansitwillworkforarraysofalldata
   * typessuchasint,char,floatetc.
   */
  n = sizeof(arr) /
  sizeof(arr[0]);printf("Sizeofthearray
  is:%d\n",n);return0;
}
```

Output:

Size of the array is: 6

Example:ProgramtoCalculate StandardDeviation

```
#include
<math.h>#include
<stdio.h>
floatcalculateSD(floatdata[]);in
tmain()
{
    inti;
    floatdata[10];
    printf("Enter10elements:");f
    or(i=0;i<10;++i)scanf("%f",&
    data[i]);
    printf("\nStandardDeviation=%.6f",calculateSD(data));retur
    n0;
}
floatcalculateSD(floatdata[])
{
    float sum = 0.0, mean, SD =
    0.0;inti;
    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);
}
```

OutputEnter10elements:1

```
2
3
4
5
6
7
8
9
10
StandardDeviation=2.872281
```

Example:Programto AddTwoMatrices

```
#include
<stdio.h>intmain(
)
{
    intr,c,a[100][100],b[100][100],sum[100][100],i,j;
    printf("Enterthenumberofrows(between1and100):");scanf("%d",&
    r);
    printf("Enterthenumberofcolumns(between1and100):");scanf("%
```

```
d",&c);
printf("\nEnterelementsof1stmatrix:\n");for
(i=0;i<r;++i)
```

```c
        for(j=0;j<c;++j)
        {
          printf("Enterelementa%d%d:",i+1,j+1);scanf("%d",
          &a[i][j]);
        }
        printf("Enterelementsof2ndmatrix:\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)//addingtwomatricesfor(j=0;j
          <c;++j)
          sum[i][j]=a[i][j]+b[i][j];
          printf("\nSumoftwomatrices:\n");
                                          //printingtheresultf
        or(i=0;i<r; ++i)
          for(j=0;j<c;++j)
          {
            printf("%d",sum[i][j]);if(
            j==c-1)
            {
              printf("\n\n");
            }
          }
      return 0;
    }
```

Output

```
Enterthenumberofrows(between1and100):2Enterthe
numberofcolumns(between1and100):3Enterelements
of1stmatrix:
Enter  element a11:
2Enter element a12:
3Enter element a13:
4Enter element a21:
5Enter element a22:
2Enterelementa23:3
Enter   elements   of   2nd
matrix:Enterelementa11:-4
Enter  element  a12:
5Enter  element  a13:
3Enter  element  a21:
5Enter  element  a22:
6Enter  element  a23:
3Sumoftwomatrices:
-28  7
10 86
```

Example:MultiplyMatricesbyPassingittoaFunction

```c
#include<stdio.h>
//functiontogetmatrixelementsenteredbytheuser
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,intr2,intc2)
{
  // Initializing elements of matrix mult to
  0.for(inti=0;i<r1; ++i)
  {
    for(intj=0;j<c2;++j)
    {
      result[i][j] = 0;
    }
  }

//Multiplyingfirstandsecondmatricesandstoringitinresultfor(inti=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];
       }
     }
   }
}
//functiontodisplaythematrix
voiddisplay(intresult[][10],introw,intcolumn){printf("\
  nOutputMatrix:\n");
  for(inti=0;i<row;++i){
    for(intj=0;j<column;++j){printf("
      %d",result[i][j]);
      if(j==column-
        1)printf("\n");
    }
  }
}

intmain()
```

```
    {
      intfirst[10][10],second[10][10],result[10][10],r1,c1,r2,c2;pri
      ntf("Enterrowsandcolumnforthefirstmatrix:");scanf("%d%d
      ",&r1,&c1);
      printf("Enterrowsandcolumnforthesecondmatrix:");scanf(
      "%d%d",&r2,&c2);
      //Takinginputuntil
      //1stmatrixcolumnsisnotequalto2ndmatrixrowwhile
      (c1!=r2)
       {
         printf("Error!Enterrowsandcolumnsagain.\n");printf("E
         nterrowsandcolumnsforthefirstmatrix:");scanf("%d%d",
         &r1,&c1);
         printf("Enterrowsandcolumnsforthesecondmatrix:");scanf("%d%
         d",&r2,&c2);
       }
      getMatrixElements(first, r1, c1);// get elements of the first
      matrixgetMatrixElements(second, r2, c2);// get elements of the second
      matrixmultiplyMatrices(first,second,result,r1,c1,r2,c2);//multiplytwomatrices.displ
      ay(result,r1,c2);//displaytheresult
      return 0;

    }
```

Output

```
    Enterrowsandcolumnforthefirstmatrix:23
    Enterrowsandcolumnforthesecondmatrix:32

    Enterelements:E
    ntera11:2
    Entera12:-3
    Entera13:4
    Entera21:53
    Entera22:3
    Entera23:5

    Enterelements:E
    ntera11:3
    Entera12:3
    Entera21:5
    Entera22:0
    Entera31:-3
    Entera32:4

    OutputMatrix:
    -2122

    159179
```

Example:ProgramtoFindtheTransposeofaMatrix

```c
#include
<stdio.h>intmain(
)
{
    inta[10][10],transpose[10][10],r,c,i,j;pri
    ntf("Enterrowsandcolumns:");scanf("%
    d%d",&r,&c);
    //Assigningelementstothematrixprintf(
    "\nEntermatrixelements:\n");for(i=0;i<
    r;++i)
      for(j=0;j<c;++j)
      {
        printf("Enterelementa%d%d:",i+1,j+1);scanf("%d",
        &a[i][j]);
      }

   //Displayingthematrixa[][]

     printf("\nEnteredmatrix:\n");f
     or(i=0;i<r;++i)
      for(j=0;j<c;++j)
      {
         printf("%d",
         a[i][j]);if(j==c-
         1)printf("\n");
      }


   //FindingthetransposeofmatrixAfor(i=
     0;i<r; ++i)
       for(j=0;j<c;++j)
       {
          transpose[j][i]=a[i][j];
       }

     //Displayingthetransposeofmatrixa

     printf("\nTransposeofthematrix:\n");for(i
     =0;i<c;++i)
       for(j=0;j<r;++j)
      {
        printf("%d",
        transpose[i][j]);if(j==r-1)
          printf("\n");
      }
    return 0;
}
```

Output

Enterrowsandcolumns:23
Entermatrixelements:
Enterelementa11:1E
nterelementa12:4Ent
erelementa13:0Enter
element a21: -
5Enterelementa22:2
Enterelementa23:7

Enteredmatrix:
140
-527

Transposeofthematrix:1-
5
42
07

UsingCallbyReference

```c
#include<stdio.h>
voidcyclicSwap(int*a,int*b,int*c);intm
ain()
{
    inta,b,c;
    printf("Entera,bandcrespectively:");scanf("
    %d %d %d",&a,
    &b,&c);printf("Valuebeforeswapping:\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);return0;
}
voidcyclicSwap(int*n1,int*n2,int*n3)
{
    inttemp;
    //swappingincyclicordertemp=
    *n2;
    *n2=*n1;
    *n1=*n3;
    *n3=temp;
}
```

Output

Entera,bandcrespectively:12
3
Value before
swapping:a=1

b=2
c=3
Value afterswapping:
a=3
b=1
c=2

SolvedQuestions

ShortAnswerTypeQuestions.

Q.1 **Whatisan array? What is itsimportance inC?** *(2015-Summer)*

Ans:- Arrays akindof datastructurethat can storeafixed-sizesequential collection of elements ofthesametype.Anarrayisusedtostoreacollectionofdata,butitisoftenmoreusefultothinkofanarraya sacollectionofvariablesofthesametype.

Q.2 **Whatisasingledimensionalarray?Howcanitbeinitialized?**

Ans:- 1D Arrays in C language – A list of items can be given one variable name using only onesubscriptandsuchavariableiscalledsinglesub-scriptedvariableoronedimensionalarray.

Q.3 **Whatarethevariousstringoperations?**

Ans:-strcat-concatenatetwostrings.strchr-stringscanningoperation.strcmp-comparetwostrings.strcpy-copyastring.

Q.4 **Howcanyoureverseastring?**
Ans:-

```
Cprogramtoreverseastringint
main()
{
chars[100];
printf("Enterastringtoreverse\n");gets(s);strre
v(s);
printf("Reverseofthestring:%s\n",s);retu
rn0;
}
```

LongAnswerTypeQuestions.
Q.1 **Writeaprogramtofindthesumofevennumbersofanarray?** *(2017-Summer)*
Ans:

```
#include<stdio.h>
main()
{
 inta[10],i,sum=0;printf("Enter
upto5Values:");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:
```
     Enterupto5Values:23547TotalSu
     mofEvenvaluesis:6
```

**Q.2 Writeaprogramwhichprintsthesmallestelement?An
s:**
```
     #include<stdio.h>

     intmain()
     {
       inta[30],i,num,smallest;printf("\nEn
       ternoofelements:");scanf("%d",&nu
       m);
       //Readnelementsinanarrayfor(i=
       0;i<num;i++)
         scanf("%d",&a[i]);
       //Considerfirstelementassmallestsmall
       est=a[0];
       for(i=0;i<num;i++)
       {
         if(a[i]<smallest)
         {
           smallest=a[i];
         }
       }
       //Printout theResult
       printf("\nSmallestElement:%d",smallest);retu
       rn(0);
     }
```

Output:
```
         Enternoofelements:51144
         225599
         SmallestElement:11
```

EXERCISE

ShortAnswerTypeQuestions.

Q.1   Whatisamulti-dimensionalarray?Howisitinitialized?*(2017-Summer)*

Q.2   Howcana two-dimensionalarraybe declaredinC program?

Q.3   Whatisbuilt-infunction?Givesomeexampleofthesefunctions?

Q.4   GivesomeexamplesofFunctionPrototypes?

Q.5   Differentiatebetweenstrcat()andstrcpy()?

Q.6   Howcanyouapplyarithmeticoperationsonstrings?

Q.7   Howisastructuredifferentorsimilarfrom/toanarray?

Q.8   Howcanyoucreatestructurevariables?*(2015-Summer)*

Q.9   Howcanyoudefinearraywithinstructures?

Q.10   Defineaunion?*(2014-Winter)*

Q.11   Howcanyoudeclareaunion?

Q.12   Defineapointer?*(2015-Winter)(2016-Winter)*

Q.13   Whatistherelationbetweenpointersandarrays?*(2015-Summer)*

Q.14   Whatisthefunctionofmalloc()libraryfunction?

Q.15   Whatisthemeaningofreference?

Q.16   Whatisaddressoperator?

Q.17   Giveanexampleofpointer initialization?

Q.18   Brieflyexplaintheassociationbetweenonedimensionalarraysandpointers?

Q.19   Explaintherelationbetweenpointersandfunctions?

LongAnswerTypeQuestions

Q.1   Writeaprogramwhichreplaceseveryblankspaceinastringwithunderscore?

Q.2   Howcanyoucalculatethesizeofanarray?Illustratewiththehelpofexample.*(2014-Summer)*

Q.3   Howwecancallafunctionby

       i.   Reference

      ii.   Value

Q.4   WriteaCprogramwhichillustratespassingofargumentsbyreference?*(2016-Summer)*

Q.5   Writeaprogramwhichreadsastringandprintsthenumberofwordsinit?

Q.6   Whatisthedifferentbetweenputc()andputs()andputchar()functions?**(2016-Winter)**

****

Chapter-wiseMultipleChoiceQuestions

CHAPTER-1:MCQ

Q.1The"0"and"1"inthebinarynumberingsystemarecalledBinarydigitsorknownas:

    a) Bytes

    b) Kilobytes

    c) Bits

    d) Kilobits

Ans:c)Bits

Q.2ThegenerationbasedonVLSImicroprocessor:

    a) 1st

    b) 2nd

    c) 3rd

    d) 4th

Ans:d)4th

Q3 ULSIstandsfor?

    a) UltraLargeScaleIntegration

    b) UnderLowerScaleIntegration

    c) UltraLowerScaleIntegration

    d) UnderLargeScaleIntegration

Ans:a)UltraLargeScaleIntegration

Q.4Theperiodof_____generationwas1952-1964.

    a) 1st

    b) 2nd

    c) 3rd

    d) 4th

Ans:b)2nd

Q.5Thebrainofanycomputersystemis:

    a) ALU

    b) Memory

    c) CPU

    d) ControlUnit

Ans:c)CPU

Q.6 CD-ROM is a:

    a) Semiconductor memory

    b) Memory register

    c) Magnetic memory

    d) None of above

Ans: d) None of above

Q.7 A hybrid computer:

    a) Resembles digital computer

    b) Resembles analogue computer

    c) Resembles both a digital and analogue computer

    d) None of the above

Ans: c) Resembles both a digital and analogue computer

Q.8 What was the computer invented by Attanasoff and Clifford?

    a) Mark I

    b) ABC

    c) Z3

    d) None of above

Ans: b) ABC

Q.9 Which of the following is not an input device?

    a) OCR

    b) Optical scanners

    c) Voice recognition device

    d) COM (Computer Output to Microfilm)

Ans: d) COM (Computer Output to Microfilm)

Q.10 When was vacuum tube invented?

    a) 1900

    b) 1906

    c) 1910

    d) 1880

Ans: b) 1906

CHAPTER-2:MCQ

Q1 **Whatdoespartnumber,partdescriptionandnumberofpartsorderedbelongto?**

a) Output

b) Input

c) Feedback

d) Control

Ans:b)Input

Q2 **CPUismainlyresponsiblefor:**

a) Calculations

b) Processingthedata

c) Both1and2

d) Neither1nor2

Ans:c)Both1and2

Q3 **Whatistheuseofcontrolunitofamicroprocessor?**

a) Toacceptinputdatafromkeyboard

b) Toperformarithmeticandlogicfunctions

c) Tostoredatainmemory

d) Alloftheabove

Ans:b)Toperformarithmeticandlogicfunctions

Q4 **IntheCPUofacomputer,thelogicalunitismainlyresponsiblefor:**

a) Controlflowofinformation

b) Comparingnumbers

c) Producingresult

d) Mathematicaloperation

Ans: b)Comparingnumbers

Q5 CPU is made up of two main components, and they are:

   a) Registers and main memory

   b) Control unit and registers

   c) ALU and bus

   d) Control unit and ALU

Ans: d) Control unit and ALU

Q6 A bit is the measuring unit of the width of a processor's data path. Commonly used data path is of :

   a) 24 bits

   b) 32 bits

   c) 8 bits

   d) 16 bits

Ans: c) 8 bits

Q7 What is the combination with which central processing unit is made?

   a) Arithmetic logic and control unit

   b) Control and storage

   c) Control and output unit

   d) All of the above

Ans: a) Arithmetic logic and control unit

Q8 Which language is the set of rules that tells the computer what operation to perform?

   a) Programming language

   b) Command language

   c) Procedural language

   d) Structures

Ans: a) Programming language

Q9 Which one of the following statement is true for the machine language?

    a)   Programs were first written in this language

    b)   Computer understands only this language

    c)   It differs from computer to computer

    d)   All of the above

Ans: d) All of the above

Q10 The language which is understood by the computer is:

    a)   Machine language

    b)   Low level language

    c)   High level language

    d)   All of the above

Ans: a) Machine language

CHAPTER-3:MCQ

Q1 **Junke-mailisalsocalled:**

a) spam

b) spoof

c) snifferscript

d) spool

Ans:a)spam

Q2 **OfficeLANS,whicharescatteredgeographicallyonlargescale,canbeconnectedbytheuseofc orporate:**

a) CAN

b) DAN

c) LAN

d) WAN

Ans:d)WAN

Q3 **Thedeviceusedtocarrydigitaldataonanaloguelinesiscalledas:**

a) Modem

b) Multiplexer

c) Modulator

d) Demodulator

Ans:a)Modem

Q4 **Malicioussoftwareisknownas:**

a) Badware

b) Malware

c) Maliciousware

d) Illegalware

Ans:b)Malware

Q5 **Aprogramthatperformsausefultaskwhilesimultaneouslyallowingdestructiveactsis:**

a) Worm

b) Trojanhorse

c) Virus

d) Macrovirus

Ans:b)Trojanhorse

Q.6 What is the name of an application program that gathers user information and sends it to someone through the Internet?

    a) A virus

    b) Spybot

    c) Logic bomb

    d) Security patch

Ans: b) Spybot

Q.7 ISDN stands for:

    a) Integrated Services Digital Network

    b) Integrated Subscriber Digital Network

    c) Internet Services Digital Network

    d) Integrated Several Digital Network

Ans: a) Integrated Services Digital Network

Q.8 Which of the following is a network topology?

    a) LAN

    b) WAN

    c) MAN

    d) BUS

Ans: d) BUS

Q.9 The first web browser is:

    a) Mosaic

    b) Netscape

    c) Internet explorer

    d) Collabra

Ans: a) Mosaic

Q.10 Which one of following are set of rules and procedures to control the data transmission over the internet:

    a) IP address

    b) Domains

    c) Protocol

    d) Gateway

Ans: c) Protocol

CHAPTER-4:MCQ

Q.1 Which one of following is collection of related fields that can be treated as a unit by some application program:

    a) field

    b) record

    c) file

    d) database

Ans:b)record

Q2 Which of the following is not a part of the usage information?

    a) data created

    b) identity of creator

    c) owner

    d) last date modified

Ans:c)owner

Q3 Several instructions execution simultaneously in:

    a) processing

    b) parallel processing

    c) serial processing

    d) multitasking

Ans:b)parallelprocessing

Q4 A term that refers to the way in which the nodes of a network are linked together:

    a) network

    b) topology

    c) connection

    d) interconnectivity

Ans:b)topology

Q5 The Details view show all of the following about a file EXCEPT:

    a) name

    b) size

    c) type

    d) password

Ans:d)password

Q.6 Aneasywaytosortfilesisto:

    a) right clickona filein Detailsview

    b) clickonthecolumnheaderinDetailsview

    c) clickthesorticoninDetailsview

    d) alphabetizethem

Ans:b)clickonthecolumnheaderinDetailsview

Q.7 After creating a file managementsystem on your computer,you shoulddoallof thefollowingEXCEPT:

    a) deletefilesthatarenolongerneeded

    b) movefilestoappropriatefolders

    c) renamefolderstobemoremeaningful

    d) runtheTaskManagement

Ans:a)deletefilesthatarenolongerneeded

Q.8 Whenyouright-clickonafolderontheharddriveandchooseDelete,thefiles:

    a) areerased

    b) gointotheRecycleBin

    c) aremovedintotheheadersectionoftheharddrive

    d) gointotheOldDocumentsfolder

Ans:b)gointotheRecycleBin

Q.9 One of the firststepswhen creating afile management system isto :

    a) createnewfolders

    b) deletefilesthatwillbemoved

    c) change to Detailsview

    d) selectmultiplefiles

Ans:a)createnewfolders

Q.10 Foldernamesshould:

    a) usenumbersonly

    b) beasshortaspossible

    c) notcontainspaces

    d) bemeaningfulandrecognizable

Ans:d)bemeaningful andrecognizable

CHAPTER-5:MCQ

Q1 AnAlgorithmrepresentedintheformofprogramminglanguagesis_____

    a) Flowchart

    b) Pseudocode

    c) Program

    d) None

Ans:c)Program

Q2 Keepthestatementlanguage_____whilewritingapseudocode.

    a) Dependent

    b) Independent

    c) Casesensitive

    d) Capitalized

Ans:b)Independent

Q3 FlowchartsandAlgorithmsareusedfor

    a) BetterProgramming

    b) EasytestingandDebugging

    c) EfficientCoding

    d) All

Ans:d)All

Q4 Whichofthefollowingisnotakeyword?

    a) Read

    b) Write

    c) Start

    d) Endif

Ans:c)Start

Q5 isusedto showhierarchy in apseudo code.

    a) Indentation

    b) CurlyBraces

    c) RoundBrackets

    d) Semicolon

Ans:a)Indentation

Q.6 _____

_____ are identified by their addresses, we give them names(fieldnames/variablenames) using words.

   a) Memoryvariables

   b) Memory Locations

   c) MemoryAddresses

   d) Datavariables

Ans:b)MemoryLocations

Q.7 beginswithlowercaseletters.

   a) Keywords

   b) Variables

   c) Tokens

   d) Functions

Ans:b)Variables

Q.8 Asymbolusedforgrouping.

   a) ()

   b) {}

   c) []

   d) ""

Ans:a)()

Q.9 AstatementusedtoclosetheIFblock.

   a) ELSE

   b) ELSEIF

   c) END

   d) ENDIF

Ans:d)ENDIF

Q.10 Instructurallanguage,wecan'taddanewsortof

   a) Loop

   b) Function

   c) Variable

   d) Constant

Ans:a)Loop

CHAPTER-6:MCQ

Q1 **WhoinventedCLanguage.?**

    a) CharlesBabbage

    b) Grahambel

    c) DennisRitchie

    d) SteveJobs

Ans:c)DennisRitchie

Q2 **Cis   typeofprogramminglanguage.?**

    a) ObjectOriented

    b) Procedural

    c) Bitlevellanguage

    d) Functional

Ans:b)Procedural

Q3 **ACprogramisacombinationof.?**

    a) Statements

    b) Functions

    c) Variables

    d) Alloftheabove

Ans:d)Alloftheabove

Q4 **TypesofIntegersare.?**

    a) short

    b) int

    c) long

    d) Alltheabove

Ans:d)Alltheabove

Q5 **ChooseacorrectstatementaboutCbreak;statement.?**

    a) break;statementcanbeusedinsideswitchblock

    b) break;statementcanbeusedwithloopslikefor,whileanddowhile.

    c) break;statementcausesonlythesameorinnerloopwherebreak;ispresenttoquitsuddenly

.

    d) Alltheabove.

Ans:d)Alltheabove.

Q6 **WhatistheoutputoftheCProgram.?**

```
intmain()
{
    if(4<5)
        printf("Hurray..\n");
        printf("Yes");
    else
        printf("England")

    return 0;
}
```

   a) Hurray..Yes

   b) Hurray..

      Yes

   c) Compilererror

   d) Noneoftheabove

Ans:c)Compilererror

Q7 **Operator%inCLanguageiscalled.?**

   a) PercentageOperator

   b) QuotientOperator

   c) Modulus

   d) Division

Ans:c)Modulus

Q8 **CanyouuseCModuloDivisionoperator%withfloatandint?**

   a) Onlyintvariables=Okay

   b) Onlyfloatvariables=Okay

   c) int orfloat combination = Okay

   d) Numeratorintvariable,Denominatorany variable= Okay

Ans:a)Onlyintvariables=Okay

Q9 **Whichloopisfasterin C Language, for, whileorDoWhile.?**

    a)   for

    b)   while

    c)   dowhile

    d)   All workatsamespeed

   Ans:d)Allwork atsame speed

Q10 **What istheoutput ofCprogramwith switchstatement orblock.?**

```
intmain()
{
inta;

switch(a);
{
printf("DEER");
}

printf("LION");
}
```

   a)   LION

   b)   DEERLION

   c)   Compilererror

   d)   Noneoftheabove

  Ans:b)DEERLION

CHAPTER-7:MCQ

Q.1ChoosecorrectstatementaboutFunctionsinCLanguage.

a) AFunctionisagroupofcstatementswhichcanbereusedanynumberoftimes.

b) EveryFunctionhasareturntype.

c) EveryFunction may nomay notreturnavalue.

d) Alltheabove.

Ans:d)Alltheabove.

Q.2Afunctionwhichcallsitselfiscalleda_____function.

a) SelfFunction

b) AutoFunction

c) RecursiveFunction

d) StaticFunction

Ans:c)RecursiveFunction

Q.3HowmanyvaluescanaCFunctionreturnatatime.?

a) OnlyOneValue

b) Maximumoftwovalues

c) Maximum ofthreevalues

d) Maximumof8values

Ans:a)OnlyOneValue

Q.4WhataretypesofFunctionsinCLanguage.?

a) LibraryFunctions

b) User Defined Functions

c) BothLibraryandUser Defined

d) Noneoftheabove

Ans:c)BothLibrary andUserDefined

Q.5EveryCProgramshouldcontainwhichfunction.?

a) printf()

b) show()

c) scanf()

d) main()

Ans:d)main()

Q.6 What is the maximum number of statements that can present in a C function.?

    a) 64

    b) 128

    c) 256

    d) None of the above

Ans: d) None of the above

Q.7 Arguments passed to a function in C language are called _____ arguments.

    a) Formal arguments

    b) Actual Arguments

    c) Definite Arguments

    d) Ideal Arguments

Ans: b) Actual Arguments

Q.8 An array Index starts with.?

    a) -1

    b) 0

    c) 1

    d) 2

Ans: b) 0

Q.9 What is the output of C program with arrays and pointers.?

```
int main()
{
int a[3]={20,30,40};
int
*p[3];p=
&a;
printf("%d",*p[0]);
}
```

    a) 20

    b) address of element 20

    c) Garbage value

    d) Compiler error

Ans: d) Compiler error

Q.10 What is actually passed to PRINTF or SCANF functions.?

    a) Value of String

    b) Address of String

    c) End address of String

    d) Integer equivalent value of String

Ans: b) Address of String

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