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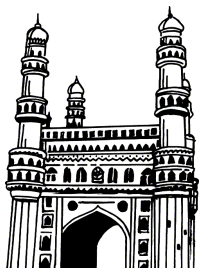

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UNIT I

Data and Information: Introduction, Types of Data, Simple Model of a Computer, Data Processing Using a Computer, Desktop Computer.

Acquisition of Numbers and Textual Data: Introduction, Input Units, Internal Representation of Numeric Data, Representation of Characters in Computers, Error-Detecting Codes

1.1 Data and Information

1.1.1 Introduction

Q1. What is Data? How data differ from information.

Ans : **(Imp.)**

Data

Data is a raw and unorganized fact that required to be processed to make it meaningful. Data can be simple at the same time unorganized unless it is organized. Generally, data comprises facts, observations, perceptions numbers, characters, symbols, image, etc.

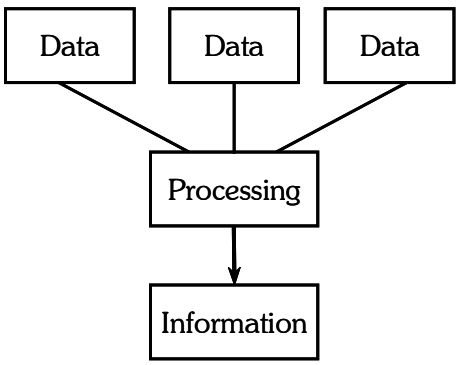
Data is always interpreted, by a human or machine, to derive meaning. So, data is meaningless. Data contains numbers, statements, and characters in a raw form.

Information

Information is a set of data which is processed in a meaningful way according to the given requirement. Information is processed, structured, or presented in a given context to make it meaningful and useful.

It is processed data which includes data that possess context, relevance, and purpose. It also involves manipulation of raw data.

Information assigns meaning and improves the reliability of the data. It helps to ensure undesirability and reduces uncertainty. So, when the data is transformed into information, it never has any useless details.



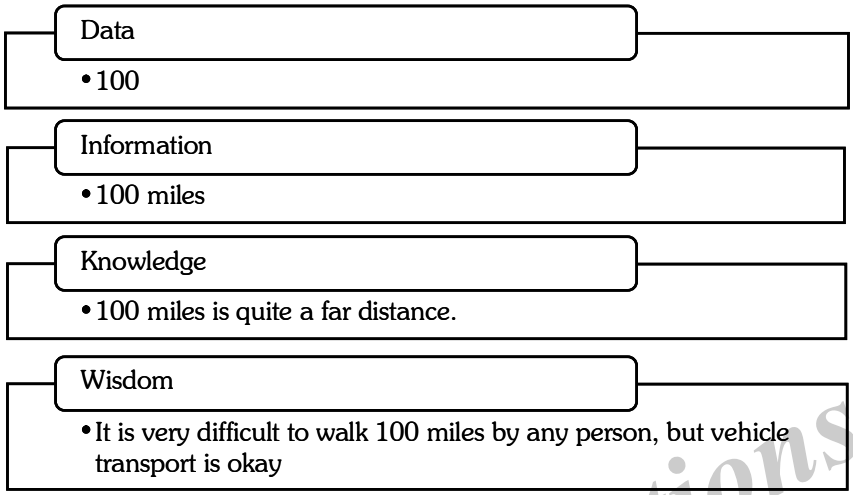
S.No	Parameters	Data	Information
i)	**Description**	Qualitative (or) Quantitative Variables which helps to develop ideas or conclusions.	It is a group of data which carries news and meaning.
ii)	**Etymology**	Data comes from a Latin word, datum, which means "To give something." Over a time "data" has become the plural of datum.	Information word has old French and middle English origins. It has referred to the "act of informing.". It is mostly used for education or other known communication.
iii)	**Format**	Data is in the form of numbers, letters, or a set of characters.	Ideas and inferences
iv)	**Represented in**	It can be structured, tabular data, graph, data tree, etc.	Language, ideas, and thoughts based on the given data.
v)	**Meaning**	Data does not have any specific purpose.	It carries meaning that has been assigned by interpreting data.
vi)	**Interrelation**	Information that is collected	Information that is processed.
vii)	**Feature**	Data is a single unit and is raw. It alone doesn't have any meaning.	Information is the product and group of data which jointly carry a logical meaning.
viii)	**Dependence**	It never depends on Information	It depended on Data.
ix)	**Measuring unit**	Measured in bits and bytes. quantity, etc.	Measured in meaningful units like time,
x)	**Support for Decision making**	It can't be used for decision making	It is widely used for decision making.
xi)	**Contains**	Unprocessed raw factors	Processed in a meaningful way
xii)	**Knowledge level**	It is low-level knowledge.	It is the second level of knowledge.
xiii)	**Characteristic**	Data is the property of an organization and is not available for sale to the public	Information is available for sale to the public.
xiv)	**Dependency**	Data depends upon the sources for collecting data.	Information depends upon data.
xv)	**Example**	Ticket sales on a band on tour. gives information which venue is profitable for that business.	Sales report by region and venue. It
xvi)	**Significance**	Data alone has no signifiance.	Information is significant by itself.
xvii)	**Meaning**	Data is based on records and observations and, which are stored in computers or remembered by a person.	Information is considered more reliable than data. It helps the researcher to conduct a proper analysis.
xviii)	**Usefulness**	The data collected by the researcher, may or may not be useful.	Information is useful and valuable as it is readily available to the researcher for use.
xix)	**Dependency**	Data is never designed to the specific need of the user.	Information is always specific to the requirements and expectations because all the irrelevant facts and figures are removed, during the transformation process.

Q2. Given example do describe DIKW.

Ans :

DIKW is the model used for discussion of data, information, knowledge, wisdom and their interrelationships. It represents structural or functional relationships between data, information, knowledge, and wisdom.

Example



1.1.2 Types of data

Q3. Explain various types of data.

Ans :

The versatility of IT comes from the ability to process a variety of data types which are

1. Numeric
2. Text
3. Image
4. Audio
5. Video

1. Numeric

Numerical data is a data type expressed in numbers, rather than natural language description. Sometimes called quantitative data, numerical data is always collected in number form. Numerical data differentiates itself with other number form data types with its ability to carry out arithmetic operations with these numbers.

For example, numerical data of the number of male students and female students in a class may be taken, then added together to get the total number of students in the class. This characteristic is one of the major ways of identifying numerical data.

2. Text

Text data usually consists of documents which can represent words, sentences or even paragraphs of free flowing text. The inherent unstructured (no neatly formatted data columns!) and noisy nature of textual data makes it harder for machine learning methods to directly work on raw text data.

Examples

i) Word processing.

ii) Dictionary

3. Image

Image data is most often used to represent graphic or pictorial data. The term *image* inherently reflects a graphic representation, and in the *GIS world*, differs significantly from raster data. Most often, image data is used to store remotely sensed imagery, e.g. satellite scenes or orthophotos, or ancillary graphics such as photographs, scanned plan documents, etc. Image data is typically used in GIS systems as background display data (if the image has been rectified and georeferenced); or as a graphic attribute. Remote sensing software makes use of image data for image classification and processing. Typically, this data must be converted into a raster format (and perhaps vector) to be used analytically with the GIS.

Examples

i) Finger print recognition

ii) Photo album

iii) House plan

4. Audio

All multimedia file formats are capable, by definition, of storing sound information. Sound data, like graphics and video data, has its own special requirements when it is being read, written, interpreted, and compressed. Before looking at how sound is stored in a multimedia format we must look at how sound itself is stored as digital data.

All of the sounds that we hear occur in the form of analog signals. An analog audio recording system, such as a conventional tape recorder, captures the entire sound wave form and stores it in analog format on a medium such as magnetic tape.

Because computers are now digital devices it is necessary to store sound information in a digitized format that computers can readily use. A digital audio recording system does not record the entire wave form as analog systems do (the exception being Digital Audio Tape [DAT] systems). Instead, a digital recorder captures a wave form at specific intervals, called the sampling rate. Each captured wave-form snapshot is converted to a binary integer value and is then stored on magnetic tape or disk.

Examples

i) Flight data recorder

ii) Digital audio recording

iii) Music synthesis

iv) Internet telephone

5. Video

Digital video is an electronic representation of moving visual images (video) in the form of encoded digital data. This is in contrast to analog video, which represents moving visual images with analog signals. Digital video comprises a series of digital images displayed in rapid succession.

Example

i) Movie applications

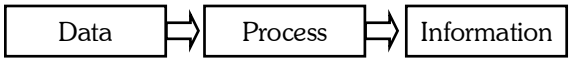
1.1.3 A simple Model of a Computer

Q4. What is data processing ? Explain various steps involved in data processing.

Ans : **(Aug.-21)**

Data processing

Data processing is a process of converting raw facts or data into a meaningful information.



Stages of Data Processing

i) **Collection**

Collection of data refers to gathering of data. The data gathered should be defined and accurate.

ii) Preparation

Preparation is a process of constructing a dataset of data from different sources for future use in processing step of cycle.

iii) Input

Input refers to supply of data for processing. It can be fed into computer through any of

input devices like keyboard, scanner, mouse, etc.

iv) Processing

The process refers to concept of an actual execution of instructions. In this stage, raw facts or data is converted to meaningful information.

v) Output and Interpretation

In this process, output will be displayed to user in form of text, audio, video, etc. Interpretation of output provides meaningful information to user.

vi) Storage

In this process, we can store data, instruction and information in permanent memory for future reference.

Q5. What is data processing cycle?

Ans :

Data processing cycle as the term suggests a sequence of steps or operations for processing data i.e., processing raw data to the usable and readable form. The processing of data can be done by number of data processing methods and processing systems.

Stages of Data Processing

1. Input

The raw data after collection needs to be fed in the cycle for processing. This is considered the first step and called input.

2. Processing

Once the input is provided the raw data is processed by a suitable or selected processing method. This is the most important step as it provides the processed data in the form of output which will be used further.

3. Output

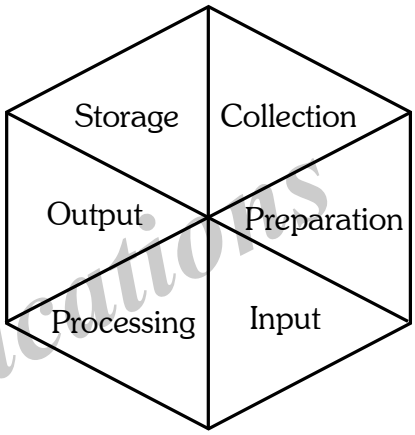
This is the outcome and the raw data provided in the first stage is now "processed" and the data is useful and provides information and no longer called data. Output is also understood as meaningful information or useful information.

Q6. Explain the steps in data processing cycle.

Ans :

Data Processing Cycle

The data processing cycle consists of a series of steps where raw data (input) is fed into a process (CPU) to produce actionable insights (output). Each step is taken in a specific order, but the entire process is repeated in a cyclic manner. The first data processing cycle's output can be stored and fed as the input for the next cycle.



a) Data Collection

Collection process is the first step which provides the data. Collecting data is a hard work in its own, but is the most essential on which the results depend. This data collection can be done in various ways by primary or secondary sources. This data might include census data, data acquired by GDP or other monetary figures, data about a number of industries, profit of a company, etc. Depending upon the data requirement its source must be identified from which data will be collected. Also identification of datasets and data items is done at this stage.

b) Preparation/ Sieving

Some people consider this as a part of processing but does not involve any processing. Preparation includes sorting and filtering of data which will finally be used as input. This stage required you to remove the extra or unusable data to make processing

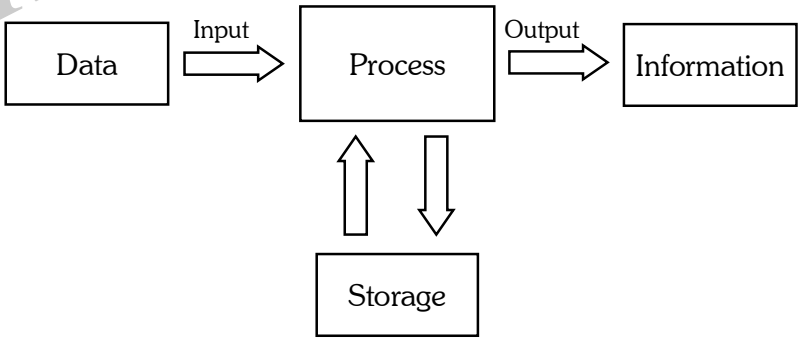
faster and better. This is a broad step in reducing the quantity of data to yield in a better result. It is also sometime referred as data cleaning.

c) **Input** This is the feeding of collected data, raw and sieved data for processing. If the inputs is not given properly or entered wrong, then the result will be adversely affected. This is because software follows the rule of "Garbage in – garbage out." Utmost care should be taken to provide the right data and minimum errors in data entry. The quality of input will determine the quality of output. Use verified data is available so as to improve the processed information.

d) **Processing:** This is the step where data is processed by electronic data processing, mechanical processing, processing system or other means. The processed data is one who gives information to the user and can be put to use. The raw data cannot be understood and thus needs processing which is done in this step. Processing of data may take time depending processing power, complexity of the data, computer systems and the volume of input data. The step of preparation mentioned above helps in making this process faster.

e) **Output/ Result:** This is the last step of the data processing cycle as the processed data is delivered in the form of information/ results in this step. Once the result or output is received, it may further be processed or interpreted. This is done by the user or software for further value addition. This output can also be used directly in presentations or the records. This output may even be saved as to be used as an input for further data processing which then becomes a part of a cycle which is being discussed. If this data is not used as input, then this complete process cannot be considered as cycle and will remain to be a one-time activity of data processing. For using this data as input, it must be stored or simultaneously be available for further processing. Data storage can be done by various means.

f) **Storage:** Once collected, the need for data entry emerges followed by storage. Storage can be done in physical form by use of papers, in notebooks or in any other physical form. With the emergence and growing emphasis on Computer System, Big Data & Data Mining, the data collection is large and storage is done in data center. A number of operations need to be performed for meaningful analysis and presentation. The data stored in digital form facilitates sharing, access control, security controls and its processing.



Q7. Draw and explain block diagram of a computer.

Ans : **(Aug.-21)**

Mainly computer system consists of three parts, that are central processing unit (CPU), Input Devices, and Output Devices. The Central Proces-sing Unit (CPU) is divided into two parts again: arithmetic logic unit (ALU) and the control unit (CU). The set of instruction is in the form of raw data.

A large amount of data is stored in the computer memory with the help of primary and secondary storage devices. The CPU is like the heart/ brain of the computer. The user does not get the desired output, without the necessary option taken by the CPU. The Central processing unit (CPU) is responsible for the processing of all the instructions which are given by the user to the computer system.

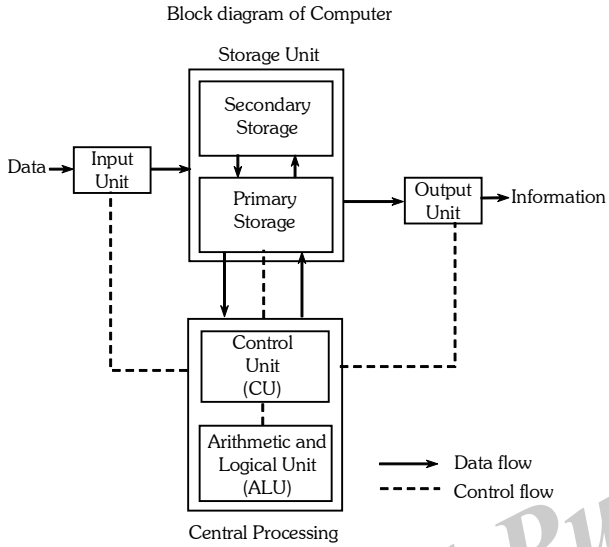


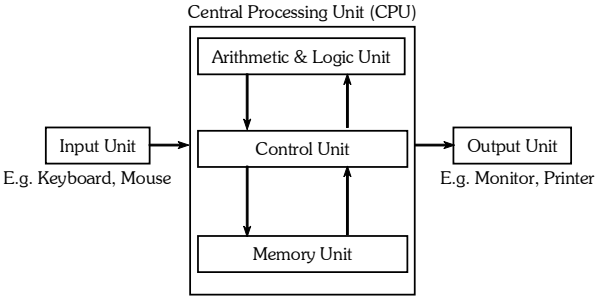
Fig.: Block Diagram of the computer.

The data is entered through input devices such as the keyboard, mouse, etc. This set of instruction is processed by the CPU after getting the input by the user, and then the computer system produces the output. The computer can show the output with the help of output devices to the user, such as monitor, printer, etc.

- CPU (Central Processing Unit)
- Storage Unit
- ALU (Arithmetic Logic Unit)
- Control Unit

Central Processing Unit (CPU)

The computer system is nothing without the Central processing Unit so, it is also known as the brain or heat of computer. The CPU is an electronic hardware device which can perform different types of operations such as arithmetic and logical operation.



The CPU contains two parts: the arithmetic logic unit and control unit. We have discussed briefly the arithmetic unit, logical unit, and control unit which are given below:

Control Unit

The control unit (CU) controls all the activities or operations which are performed inside the computer system. It receives instructions or information directly from the main memory of the computer.

When the control unit receives an instruction set or information, it converts the instruction set to control signals then; these signals are sent to the central processor for further processing. The control unit understands which operation to execute, accurately, and in which order.

Arithmetic and Logical Unit

The arithmetic and logical unit is the combinational digital electronic circuit that can perform arithmetic operations on integer binary numbers. It presents the arithmetic and logical operation. The outputs of ALU will change asynchronously in response to the input. The basic arithmetic and bitwise logic functions are supported by ALU.

Storage Unit

The information or set of guidelines are stored in the storage unit of the computer system. The storage unit provides the space to store the data or instruction of processed data. The information or data is saved or hold in computer memory or storage device. The data storage is the core function and fundamental of the computer components.

1.1.4 Data processing using a computer

Q8. Explain data processing using a computer.

Ans : **(Imp.)**

Data Processing Using A Computer

To fix our ideas we will take an example to show how data is processed to obtain information. The steps followed are:

1. Analyse the given data processing task and understand *what is to be done.*
2. Having understood the task to be performed find a method to do it.
3. Express the method to be followed as a step-by-step procedure which is called an *algorithm.*
4. Express the algorithm using a precise notation called a programming language obtaining what is called a computer program. Programs can be interpreted and executed by a computer's processing system.
5. Input the program to be executed and store it in the memory of the computer. Keep the data to be processed ready and waiting at the input unit.
6. Order the computer to start executing the program.
7. The computer interprets the program stored in its memory. When a command to "READ" data is encountered (which is normally at the beginning of the program) it reads data waiting at the input unit and stores it in the memory of the computer.

   It then continues following the program step by step and carries out the data processing task which has been programmed.
8. At the end of the program being executed (or during the execution of a program), an instruction(s) will be found to write the result(s) via the output unit. This is the processed data, that is, the information which is required. It may also send the results to another computer connected to it.

We will now illustrate the steps given above with an example.

Example

Finding Vowels in a Text The task to be performed:

Find the number of vowels in a given text.

Method

Read the text character by character. If the character is a vowel, that is, it is a, *e*, i, o, u or A, E, I, O, U, count it as a vowel. When the end of the text is reached, output the count as the number of vowels.

Algorithm

Step 1: Create a counter to count the number of vowels and store 0 in it. count-vowels = 0

Step 2: CaH vowel = a, *e*, i, o, u or A, E, I, O, U

Repeat Step 3 to Step 5 until the end of input text is reached. Go to Step 6 when no more characters are left in the text.

Step 3: Read a character from the string of characters (or text) waiting at the input unit.

Store it in input-character.

Step 4: If input-character = vowel

then Add 1 to count-vowels and continue else continue

Step 5: Move to next character.

Remark: We now go back to Step 3

Step 6: Output count-vowels.

Remark: This step is reached when end of input text is reached.

Step 7: Stop

Observe that the algorithm is independent of the length of text and what is contained in the text. Given any text, the algorithm will find the number of vowels in it. In other words, the method is general and not dependent on specific data input. This is what gives the power to a computer. Once an algorithm is written, it may be used for all tasks of the same type. This property of an algorithm which makes it independent of input data, is called data independence of algorithm.

The algorithm is often pictorially shown as a flowchart. Flowchart is easy to understand for beginners. They use a notation standardized by the International Standards Organization. We have shown the algorithm as a flowchart in Fig. using the standard notation. Flowcharts are used to document algorithms.

The model of computer used in this section was first proposed by John von Neumann, a computer scientist, in 1945. The major contribution of von Neumann is the idea of storing the program in the memory and executing it by taking one instruction at a time from it to the processor which interprets and executes it. Storing a program in memory is essential if a series of instructions are to be executed repeatedly. In the algorithm given in this section, Steps 3 to 5 are repeated again and again until no more characters are left in the input text. These steps cannot be carried out unless they are stored in a memory and are thus available for repeated reference and interpretation.

Storing a program in memory also makes the operation of computers *automatic*. Unlike a simple pocket calculator where one has to press buttons after each operation is carried out, the instructions stored in the memory of a computer are taken one by one automatically to the processing system, interpreted and executed without any human intervention.

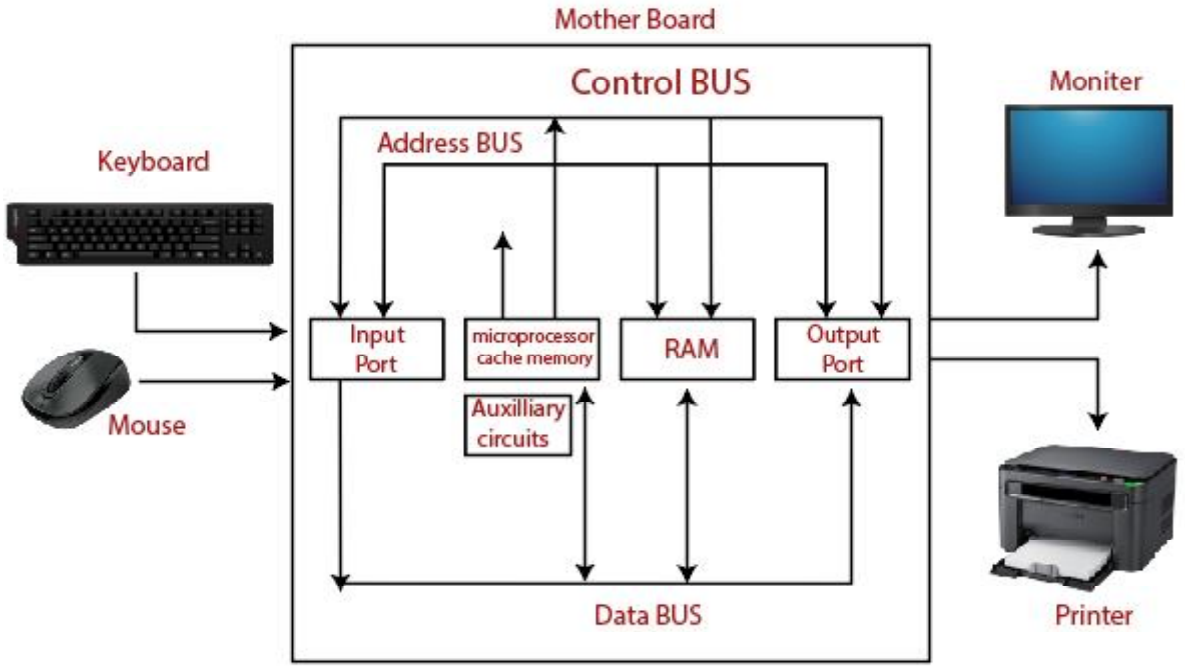
1.1.5 Desktop Computer

Q9. Briefly explain general components connected to desktop computer.

Ans : **(Imp.)**

Components of Computer System

The hardware and software exist on the computer. The information which is stored through the device is known as computer software. The hardware components of the computer system are related to electronic and mechanical parts, and the software component is related to data and computer programs. Many elements are connected to the main circuit board of the computer system called a "motherboard."



Components of a Computer System

- Processor.
- Main Memory.
- Secondary Memory.
- Input Devices.
- Output Devices.

These are mainly five components of the computer system. The computer hardware, computer software, and liveware exist in the element of the computer system.

Processor

The processor is an electric circuitry within the computer system. The Central processing unit is the central processor or main processor of the computer system. The processor carries out the instructions of the computer program with the help of basic arithmetic and logic, input/output operations.

Main Memory

The Random Access Memory is the main memory of the computer system, which is known as RAM. The main memory can store the operating system software, application software, and other information. The Ram is one of the fastest memory, and it allows the data to be readable and writeable.

Secondary memory

We can store the data and programs on a long-term basis in the secondary memory. The hard disks and the optical disks are the common secondary devices. It is slow and cheap memory as compare to primary memory. This memory is not connected to the processor directly.

It has a large capacity to store the data. The hard disk has a capacity of 500 gigabytes. The data and programs on the hard disk are organized into files, and the file is the collection of data on the disk. The secondary storage is direct access by the CPU; that's why it is different from the primary storage.

The hard disk is about 100 times the capacity of the main memory. The main difference between primary and secondary storage is speed and capacity. There are several large blocks of data which are copied from the hard disk into the main memory.

Input Devices

The user provides the set of instruction or information to the computer system with the help of input devices such as the keyboard, mouse, scanner, etc. The data representation to the computer system is in the form of binary language after that the processor processes the converted data. The input unit implements the data which is instructed by the user to the system.

We can enter the data from the outside world into the primary storage as the input through input devices. The input devices are the medium of communication between the outside world and the computer system.

There are some important features of input devices which are given below:

1. The input devices receive or accept the data or instruction from the user, who exist in the outside world.
2. These devices convert the data or instruction into the machine-readable form for further processing.
3. The input device performs like the connection between the outside world and our computer system.
4. The keyboard and mouse are common examples of input devices.
5. When the whole procedure is finished, we get the desired output from the output devices such as monitor, printer, etc.

Output Devices

The output devices produce or generate the desired result according to our input, such as a printer, monitor, etc. These devices convert the data into a human-readable form from binary code.

The computer system is linked or connected to the outside world with the help of output devices. The primary examples of output devices are a printer, projector, etc.

These devices have various features which are given below:

1. These devices receive or accept the data in the binary form.
2. The output devices convert the binary code into the human-readable form.
3. These devices produce the converted result and show to the user.

1.2 Acquisition of Numbers and Textual Data

1.2.1 Introduction

Q10. What is data acquisition? Explain with an example.

Ans : **(Dec.- 21, Imp.)**

Five types of data which are normally processed by computers: numbers, text, pictures, audio and video. The first three are time-invariant, that is, they do not depend on time as an explicit variable. Audio and video, on the other hand, are time-dependent and thus require a different method of acquisition. We will describe how numeric and textual data are acquired, that is, input to a computer.

Data Acquisition

Data acquisition consists of the following steps:

1. Reading of data of relevance in an application using a device.
2. Converting the data which is read to a form which is storable in a computer's memory.
3. Applying a transformation on this converted data in order to reduce the amount of storage required.

Data is read using several different types of input units. The data which is read is encoded to a binary form for storage in memory. Sometimes this encoded form is processed to reduce the storage space needed to store the data.

Example: Preparing a Bill of Sale

To fix our ideas on input and output we will see how a sales clerk in a shop uses a small computer (usually a PC, that is, a Personal Computer), to prepare a bill of sale.

A customer having purchased some items brings them to the cash counter. The clerk presses a key on the keyboard of the computer and a bill form such as the one shown in Table is displayed on the Video Display Unit of the computer.

Table: Bill Displayed on the Video Display Unit

Sl.No.	Item Code	Item Name	Price/Unit	Quantity	Total Price
1.	|				

Insertion point

A digit 1 will be displayed in the serial number column and a small vertical line called a cursor (or insertion point) will appear below item code column. The clerk takes the first item which has a printed label attached to it. The contents of the label is shown in Table.

Table: Item Label

Item code	Item Name	Price
45789	Blue Jeans	585.50

The clerk types the item code, name and price using the keyboard. If there are two items of the same type bought by the customer, the clerk enters 2 as quantity and presses a key called a *function key.* As soon as the key is pressed, the computer multiplies the price/unit by the quantity and displays it in the total price column. The clerk then presses another key on the keyboard to go to the next line. The display

now shows 2 under the Serial No. column, and the cursor advances to the next column ready to receive the item code of the second item. The clerk can now enter the second item's code, name, price, quantity as before. This procedure is continued by the clerk till data of all the items purchased by the customer are entered. As soon as the last item line is entered and the total price for the item is calculated and displayed, the clerk presses a function key. This leads to the calculation of the grand total of all prices. The cursor now advances to the next line, and displays the grand total. The clerk now presses another function key which will command the computer to print the bill using a printer attached to the computer. Observe that the bill has company name, etc., preprinted. Only the data about each item, price, quantity, etc., is printed by the PC. The bill can now be given to the customer to receive payment.

Table: Bill printed by the Computer

ABC GENERAL STORES 285,
6th Main Street
Gandhinagar
Bangalore 560 037

Serial No.	Item Code	Item Name	Price	Qty.	Total Price
1.	45789	Blue Jeans	585.50	2	1171.00
2.	78494	Black Belt	125.25	1	125.25
3.	94862	Socks	55.25	4	221.00
			Grand Total		**1517.25**
Thank You. Visit again					

In this example we saw that the clerk entered the data into a computer using a keyboard. The keyboard is called an input device.

The data on items are entered by the clerk manually using the keyboard. This is called manual data entry. The entered data is used by the processor which does arithmetic operations of additions and multiplications and displays the final bill on the video display.

The video display unit is an output device. The bill is printed by a printer attached to the computer. The printer is also an output device.

1.2.2 Input Units

Q11. Explain various input devices of a computer system.

Ans :

Input unit

Computer need to receive data and instruction in order to solve any problem. Therefore we need to input the data and I structions into the computers. The input unit consists of one or more input devices.

Following are some of the important input devices which are used in a computer:

- Keyboard
- Mouse
- Joy Stick
- Light pen
- Track Ball

- Scanner
- Graphic Tablet
- Microphone
- Magnetic Ink Card Reader (MICR)
- Optical Character Reader (OCR)
- Bar Code Reader
- Optical Mark Reader (OMR)

Keyboard

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

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

The keys on the keyboard are as follows:

S.No.	Keys	Description
1.	Typing Keys	These keys include the letter keys (A-Z) and digit keys (09) which generally give the same layout as that of typewriters.
2.	Numeric Keypad	It is used to enter the numeric data or cursor movement. Generally, it consists of a set of 17 keys that are laid out in the same configuration used by most adding machines and calculators.
3.	Function Keys	The twelve function keys are present on the keyboard which are arranged in a row at the top of the keyboard. Each function key has a unique meaning and is used for some specific purpose.
4.	Control keys	These keys provide cursor and screen control. It includes four directional arrow keys. Control keys also include Home, End, Insert, Delete, Page Up, Page Down, Control (Ctrl), Alternate (Alt), Escape (Esc).
5.	Special Purpose	KeysKeyboard also contains some special purpose keys such as Enter, Shift, Caps Lock, Num Lock, Space bar, Tab, and Print Screen.

Mouse

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

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

Advantages

- Easy to use
- Not very expensive
- Moves the cursor faster than the arrow keys of the keyboard.

Joystick

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

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

Light Pen

Light pen is a pointing device similar to a pen. It is used to select a displayed menu item or draw pictures on the monitor screen. It consists of a photocell and an optical system placed in a small tube.

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

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 the ball, the pointer can be moved.

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

Scanner

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

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

Digitizer

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

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

Microphone

Microphone is an input device to input sound that is then stored in a digital form.

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

Magnetic Ink Card Reader (MICR)

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

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

Optical Character Reader (OCR)

OCR is an input device used to read a printed text.

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

Bar Code Readers

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

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

Optical Mark Reader (OMR)

OMR is a special type of optical scanner used to recognize the type of mark made by pen or pencil. It is used where one out of a few alternatives is to be selected and marked.

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

1.2.3 Internal representation of numeric data

Q12. Why should all data can be converted into zeros and ones?

(OR)

Describe the internal representation of numeric data ?

Ans : **(Imp.)**

Internal Representation of Numeric Data

Once a data is fed to a computer it is converted to a form which is efficient to store and easy to interpret by the hardware of the machine. This is called the internal representation of data. This should be contrasted with the external representation which is the form that is easy for humans to read and understand. For example, we use the decimal system to represent numbers for our use; this is the external representation. Another example of external representation is the bar code we described in the last section. A decimal number is represented in another form called binary for storing in the memory of a computer. This is the internal representation.

The question that will now be foremost in your minds is: Why should all data be converted to zeros and ones? The answer is simple. Physical devices used to store and process data in computers (as of today) are two-state devices. A switch, for example, is a two-state device. It can be either ON or OFF. Very reliable recording or reading on a magnetic surface (such as the one used in hard disks) is achieved when the surface is magnetized in either one of two opposite directions. The two states in this case are magnetic field aligned left to right (S→N) or right to left (N←S). Electronic devices such as transistors used in computers function most reliably when operated as switches, that is, either in conducting mode or in non-conducting mode. Thus, all data to be stored and processed using computers are transformed or coded as strings of two symbols, one symbol to represent each state. The two symbols normally used are 0 and 1. They are known as bits, an abbreviation for binary digits.

Q13. How do we represent numbers using bits?

Ans :

The simplest way is to represent each digit in a number by a unique string of bits. There are 4(2 × 2) unique combinations of 2 bits, namely:

00 01 10 11

This is because each bit can be either 0 or 1. There are 2 bits giving 2×2 = 4 possible unique stringsof 2 bits each. There are 2 × 2 × 2 = 8 unique strings of three bits each, i.e.

000 001 010 011 100 101 110 111

There are ten decimal digits 0, 1, 2, 3, 4, 5, 6. 7, 8, 9. Thus 3-bits strings are not sufficient to represent 10 digits. We need at least 4 bits. The number of unique 4 bits strings are $2\times2\times2\times2 = 16$ and they are:

0000	0001	0010	0011	0100	0101	0110	0111
1000	1001	1010	1011	1100	1101	1110	1111

We can arbitrarily pick any 10 of these 16 strings and assign each of them to represent 0, 1,2, ..., 9. This is known as binary encoding of decimal digits. One of these assignments is shown in the following Table. This is called natural binary coded decimal digits (NBCD).

Table: Representation of Decimal Digits by Binary Strings

0000	0001	0010	0011	0100	0101	0110	0111	1000	1001
0	1	2	3	4	5	6	7	8	9

Observe that out of the 16 possible combinations of 4 bits, only 10 are used. It is thus not very efficient. It is, however, very easy to do the encoding. If we want to store a 4-digit number 2358 using this encoding scheme, the representation is obtained by looking up Table and replacing each digit by its 4-bit equivalent is shown below:

2	3	5	8
0010	0011	0101	1000

Example

Binary Encoding of Decimal Numbers What is the binary encoding of the decimal number 589048?

Solution

Replace each digit by its 4-digit binary code by looking up Table. The encoded binary string is:

0101 1000 1001 0000 0100 1000

In this method of representing, we ignore the fact that a decimal number has a value. The fact that a decimal number has a value is irrelevant in some applications. For example, the item code used in such as 45781 is used to uniquely represent an item name. A code is used instead of item name as a name may not be unique. If we want to perform arithmetic operations, for example, add two decimal numbers, then value is important. In such a case, instead of encoding a decimal number in binary, we convert its value to an equivalent binary string which also has a value. For example, the item price has a value. This has to be multiplied by the quantity bought to find the "total price". We have to add the total prices to find the grand total. Value is important for performing arithmetic operations. Thus, the item price and quantity should be converted to binary and stored in the memory.

Q14. Explain the process of converting binary numbers to decimal with example.

Ans :

Conversion of Binary Numbers to Decimal

Consider, for example, the decimal number 4903. The value of each digit in this number is determined by

- The digit itself;
- The position of the digit in the number; and
- The base or radix of the number system.

The base of a number system is defined as the number of distinct symbols used to represent numbers in the system. The decimal system uses the ten symbols, 0, 1, 2, 3, 4, 5, 6, 7, 8 and 9, and its base is thus 10.

Given a decimal integer, we assign it a value by first assigning weights to each digit position. The weights are unit for the rightmost digit, ten, hundred, thousand, and so on for successive digits to its left.

We multiply each digit by its weight and add all products to obtain the *value* of the number. The value of the decimal number 4903 is calculated as follows:

4×1000	$+ 9 \times 100$	$+ 0 \times 10$	$+ 3 \times 1$		
4000	+ 900	+ 0	+ 3	=	4903
Thousands Position	Hundreds Position	Tens Position	Units position		

The notation used to express numbers above is known as the positional system. If a number system has only two symbols, then its base is 2. Such a system is known as a binary system. The two symbols used in the system, namely, 0 and 1, are binary digits or *bits.* Numbers in this system are strings of bits. For example, a binary number is shown below:

1	0	1	0	1
↓				↓
Most significant bit				Least significant bit

The rightmost bit is called the least significant bit, and the leftmost bit the most significant bit. The weights assigned to bits in this system are powers of 2, namely, $2^0 = 1$, $2^1 = 2$, $2^2 = 4$, ... In order to find the decimal value of a binary number, we multiply its least significant bit by weight 1, the next bit to its left by 2 and so on. Thus the decimal value of the binary number 10101 is calculated as follow:

1	0	1	0	1	
1×2^4	$+ 0 \times 2^3$	$+ 1 \times 2^2$	$+ 0 \times 2^1$	$+ 1 \times 2^0$	
16	+ 0	+ 4	+ 0	+ 1	= 21

Example

What is the decimal equivalent of 10010101?

Sol :

Decimal equivalent

$= (1 \times 128) + (0 \times 64) + (0 \times 32) + (1 \times 16) + (0 \times 8) + (1 \times 4) + (0 \times 2) + (1 \times 1)$

$= 149.$

Q15. Explain representation of fractions with examples.

Ans :

Decimal fractions are interpreted as follows:

0.235	=	2×10^{-1}	+	3×10^{-2}	+	$5 \times 10–3$
↑		↑		↑		↑
Decimal point		One-tenth Position		One-hundredth Position		One-thousandth Position

Table : Powers of 2

Power of 2	Decimal equivalent	Power of 2	Decimal equivalent	Abbreviation
2^0	1	2^{10}	1024	1K
2^1	2	2^{11}	2048	2K
2^2	4	2^{12}	4096	4K
2^3	8	2^{20}	1048576	1M
2^4	16	2^{21}	2097152	2M
2^5	32	2^{22}	4194304	4M
2^6	64	2^{30}	1073741824	1G
2^7	128	2^{31}	2147483648	2G
2^8	256	2^{40}	1099511627776	IT
2^9	512	2^{41}	2199023255532	2T

Observe

Observe e that negative powers of 10 are used as weights to multiply the digits in the fractional part of the number.

A binary fraction is represented by a string of Is and Os on the right of a binary point. The bits are multiplied by negative powers of 2 to obtain the decimal value of the binary fraction as shown below:

$$0.1011 = 1 \times 2^{-1} + 0 \times 2^{-2} + 1 \times 2^{-3} + 1 \times 2^{-4}$$

$$\uparrow \quad \uparrow \quad \uparrow \quad \uparrow \quad \uparrow$$

$$\text{Binary Point} = 1/2 + 0 + 1/8 + 1/16$$

$$= 11/16 = 0.6875 \text{ (in decimal)}$$

We give below some more examples of binary numbers and their decimal equivalents:

Example 1

$$(111011.101)^2 = 1 \times 2^5 + 1 \times 2^4 + 1 \times 2^3 + 0 \times 2^2 + 1 \times 2^1 + 1 \times 2^0 + 1 \times 2^{-1} + 0 \times 2^{-2} + 1 \times 2^{-3}$$

$$= 32 + 16 + 8 + 0 + 2 + 1 + 1/2 + 0 + 1/8$$

$$= (59.625)_{10}$$

Example 2

$$(11000.0011)^2 = 1 \times 2^4 + 1 \times 2^3 + 0 \times 2^2 + 0 \times 2^1 + 0 \times 2^0 + 0 \times 2^{-1} + 0 \times 2^{-2} + 1 \times 2^{-3} + 1 \times 2^{-4}$$

$$= 16 + 8 + 1/8 + 1/16$$

$$= (24.1875)10$$

Note that we have used the subscript 2 to indicate that the number is binary, and the subscript 10 to indicate that the number is decimal. This notation to represent the base of a number is useful to prevent misinterpretation of numbers.

Q16. Explain Hexadecimal representation of numbers with examples.

Ans :

The binary equivalent of a 10 digit number will be approximately 32 bits long. It is difficult to write such long strings of Is and Os and convert them to equivalent decimal numbers without making mistakes. The *hexadecimal* system, which uses 16 as base, is a convenient notation to express binary numbers. This system, by definition, uses 16 symbols, viz., 0, 1,2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F. Note that the symbols A, B, etc., now represent numbers in hexadecimal. As 16 is fourth power of 2, namely 2^4, there is a one-to-one correspondence between a hexadecimal digit and its binary equivalent. We need only 4 bits to represent a hexadecimal digit following Table gives a table of hexadecimal digits and their binary and decimal equivalents.

Table: Binary, Hexadecimal and Decimal Equivalents

Binary number	Hexadecimal equivalent	Decimal equivalent	Binary number	Hexadecimal equivalent	Decimal equivalent
0000	0	0	1000	8	8
0001	1	1	1001	9	9
0010	2	2	1010	A	10
0011	3	3	1011	B	11
0100	4	4	1100	C	12
0101	5	5	1101	D	13
0110	6	6	1110	E	14
0111	7	7	1111	F	15

A binary number can be quickly converted to its hexadecimal equivalent by grouping together successively 4 bits of the binary number, starting with the least significant bit and replacing each 4-bit group with its hexadecimal equivalent given in Table. The following examples illustrate this.

Example 1

Binary number	0111	1100	1101	1110	0011
Hexadecimal equivalent:	7	C	D	E	3

Example 2

Binary number 001000111110000-0010110

Grouped binary number	0001	0001	1111	0000	.	0010	1100
Hexadecimal equivalent:	1	1	F	0	.	2	C

Observe that, in groups are formed from left to right for the fractional part of the number and from right to left for the integer part. If the number of bits in the integer part is not a multiple of 4, we insert leading Os, as these have no significance for the integer part. If the number of bits in the fractional part is not a multiple of 4, then we introduce trailing Os, as these have no significance in the fractional part.

Conversion from hexadecimal to decimal system is simple. It uses the fact that the base of the hexadecimal system is 16. We give below two examples of hexadecimal to decimal conversion.

Example 3

$D6C1 = D \times 16^3 + 6 \times 16^2 + C \times 16^1 + 1 \times 16^0$

$= 13 \times 16^3 + 6 \times 16^2 + 12 \times 16 + 1 \times 16^0$

$= 53248 + 1536 + 192 + 1$

$= (54977)_{10}$

Example 4

$(F9A . BC3)_{16} = F \times 16^2 + 9 \times 16^1 + A \times 16^0 + B \times 16^{-1} + C \times 16^{-2} + 3 \times 16^{-3}$

$= (15 \times 256) + (9 \times 16) + (10 \times 1) + 11/16 + 12/256 + 3/4096$

$= 3840 + 144 + 10 + 11/16 + 12/256 + 3/4096$

$= (3994.7351074)_{10}$

Q17. Explain decimal to binary conversion with examples.

Ans :

As memiened at the beginning of this section, decimals are used by people whereas binary representation is used by computers. For decimal numbers whose value is not significant in an application, we encode the decimal number by replacing each of the digits by its 4-bit string equivalent given in Table. However, when the value of the number is important, we have to convert decimal to binary. The method of converting a decimal integer to its binary equivalent is based on the fact that any decimal integer may be expressed as a sum of powers of 2 as shown below:

$d = (23)_{10} = (1 \times 2^4) + (0 \times 2^3) + (1 \times 2^2) + (1 \times 2^1) + (1 \times 2^0)$

$= (10111)^2$

The easiest way to find the coefficients of the powers of 2 is to divide the given number by 2, and the successive quotients by 2. Division is terminated when a quotient becomes zero. The binary equivalent of the decimal number is given by the sequence of remainders obtained during division. The least significant bit of the binary number is the first remainder obtained and its most significant bit is the lasf remainder. The procedure is illustrated now:

Example 1

Find the binary equivalent of $(23)_{10}$

Solution:

		Remainder	
2	23		
2	11	1	→ Least significant bit
2	5	1	
2	2	1	
2	1	1	
	0	1	→ Most significant bit

$(23)_{10} = (10111)_2$

Example 2

Find the binary equivalent of 36

Sol :

		Remainder	
2	36		
2	18	0	→ Least significant bit
2	9	0	
2	4	1	
2	2	0	
2	1	0	
2	0	1	→ Most significant bit

$(36)_{10} = (100100)_2$

Decimal fractions may also be converted to binary. The method is based on observing that a decimal fraction is expressed as a sum of negative powers of 2. Successive multiplication of the fraction by 2 would give the coefficients of the negative powers of 2.

Example 3

Find the binary equivalent of 0.8125

Sol :

$$(0.8125)_{10} = 0.5 + 0.25 + 0.0625$$
$$= 1 \times 2^{-1} + 1 \times 2^{-2} + 0 \times 2^{-3} + 1 \times 2^{-4}$$
$$2 \times (0.8125)_{10} = 2 \times (1 \times 2^{-1} + 1 \times 2^{-2} + 0 \times 2^{-3} + 1 \times 2^{-4})$$
$$= 1 + (1 \times 2^{-1} + 0 \times 2^{-2} + 1 \times 2^{-3})$$
$$= 1 + 0.625$$
$$2 \times 0.625 = 2 \times (1 \times 2^{-1} + 0 \times 2^{-2} + 1 \times 2^{-3})$$
$$= 1 + (0 \times 2^{-1} + 1 \times 2^{-2})$$
$$= 1 + 0.25$$
$$2 \times 0.25 = 2 \times (0 \times 2^{-1} + 1 \times 2^{-2})$$
$$= 0 + 0.5$$
$$2 \times 0.5 = 2 \times 2^{-1}$$
$$= 1$$

Thus, $(0.8125)_{10} = (0.1101)_2$

It is clear from this example that, if we multiply a decimal fraction by 2, the integer part of the answer will be the most significant bit of the binary fraction. The fractional part of the answer is multiplied by 2 to obtain the next significant bit of the binary fraction. The procedure is continued till the fractional part of the product is 0. The method is illustrated below with examples:

Example 4

Find the binary equivalent of $(0.5625)_{10}$

Sol :

Product	Integer part of the product	
$0.5625 \times 2 = 1.125$	1	$\rightarrow$ Most significant bit
$0.125 \times 2 = 0.25$	0	
$0.25 \times 2 = 0.5$	0	
$0.5 \times 2 = 1.0$	1	$\rightarrow$ Least significant bit

$(0.5625)_{10} = (0.1001)_2$

Example 5

Find the binary equivalent of 0.3

Sol :

Product	Integer part of the product	
$0.3 \times 2 = 0.6$	0	$\rightarrow$ Most significant bit
$0.6 \times 2 = 1.2$	1	
$0.2 \times 2 = 0.4$	0	
$0.4 \times 2 = 0.8$	0	
$0.8 \times 2 = 1.6$	1	
$0.6 \times 2 = 1.2$	1	$\rightarrow$ Least significant bit

Thus, $(0.3)_{10} = (0.01001(1001))_2$

This example shows that the binary fraction equivalent of a terminating decimal fraction may not terminate. If a finite number of bits are to be used, the binary fraction is truncated.

Example 6

A leather belt costs Rs. 125.25. What is the binary equivalent of this value when it is stored in a computer?

Sol :

The binary equivalent of 125 is found by successive division as follows:

		Remainder
2	125	
2	62	1
2	31	0
2	15	1
2	7	1
2	3	1
2	1	1
	0	1

$(125)_{10} = (1111101)_2$

The binary equivalent of 0.25 is found as follows:

$0.25 \times 2 = 0.50 \quad 0 \quad \rightarrow$ Most significant bit of fraction

$0.5 \times 2 = 1.0 \quad 1$

$0.0 \times 2 = 0 \quad 0$

$(0.25)_{10} = 0.01$

Thus, 125.25 = 1111101.01

1.2.4 Representation of characters in computers

Q18. Explain the representation of characters in computer.

Ans : **(Imp.)**

A text consists of letters of a language such as English, punctuation marks, e.g., comma (,), semicolon (;), special characters like –, +, *, etc. The set of characters which is valid for a computer is called its *character set.* Nowadays, the number of valid characters is quite large, including characters of many languages like Hindi, Tamil, Chinese, etc. The external representation of text is for catering to humans. For example, this paragraph you are reading is text and it is in a printed form suitable for you to read. For storing this in a computer (suitable for processing) it is necessary to *encode* the characters using strings of bits. One type of processing may be to find the number of vowels in this page you are reading. Another may be to sort a set of names of students in a class and arrange them in alphabetical order. Encoding is representing each character using a unique string of bits. We saw that there are $2\times2\times2\times2 = 16$ unique strings of 4 bits, and we use 10 out of these 16 to code decimals. If we want to encode the 26 capital (or upper case) letters of English, 4 bits are not sufficient as they can represent only 16 symbols. Five bits, however, are sufficient as there are 32 ($2\times2\times2\times2\times2 = 32$) strings of 5 bits each. Twenty six out of Jhese 32 strings of 5 bits may be picked to code the 26 letters as illustrated in Table.

Table: Illustrating the Coding of English Letters

Bit string	Letter	Bit string	Letter
00000	A	10000	Q
00001	B	10001	R
00010	C	10010	S
00011	D	10011	T
00100	E	10100	U
00101	F	10101	V
00110	G	10110	W
00111	H	10111	X
01000	I	11000	Y
01001	J	11001	Z
01010	K	11010	
01011	L	11011	
01100	M	11100	Not used
01101	N	11101	
01110	O	11110	
01111	P	11111	

Data processing using computers requires processing of not only the 26 capital (or upper case) English letters but also the 26 small (or lower case) English letters, 10 digits and around 32 other characters, such as punctuation marks, arithmetic operator symbols, parentheses, etc. The total number of characters to be coded is thus: 26 + 26 + 10 + 32 = 94. With strings of 6 bits each, it is possible to code only 2^6 = 64 characters. Thus, 6 bits are insufficient for coding. If we use strings of 7 bits each we will have 2^7 = 128 unique strings and can thus code up to 128 characters. Strings of 7 bits each are thus quite sufficient to code 94 characters.

Coding of characters has been standardized to facilitate exchange of recorded data between computers. The most popular standard is known as ASCII (American Standard Code for Information Interchange). This uses 7 bits to code each character. Besides codes for characters, in this standard, codes are defined to convey information such as end of line, end of page, etc., to the computer. These codes are said to be for non-printable control characters. Table gives the ASCII code for both printable and non-printable control characters. Columns 1 and 2 are non-printable codes. The entry CR, for example, indicates carriage return (or end of line) control character. The most significant bits of the code are given in Table as column headings and the least significant bits of the code are given as row headings. Thus the code for A, for example, is identified from the table by finding the column and row bits. The column gives bits 100 as bits b_6, b_5, b_4, and the row gives bits 0001 for b_3, b_2, b_1, b_0.

Table: ASCII Code for Characters

Least significant	**Most significant bits b_6 b_5 b_A**							
b_3 b_2 b_x b_0	**000**	**001**	**010**	**011**	**100**	**101**	**110**	**111**
0000	NUL	DLE	SPACE	0	@	P		p
0001	SOH	DC1	!	1	A	Q	a	q
0010	STX	DC2	“	2	B	R	b	r
0011	ETX	DC3	#	3	C	S	c	s
0100	EOT	DC4	$	4	D	T	d	t
0101	ENQ	NAK	%	5	E	U	e	u
0110	ACK	SYN	&	6	F	V	f	v
0111	BEL	ETB	‘	7	G	W	g	w
1000	BS	CAN	(	8	H	X	h	x
1001	HT	EM	)	9	I	Y	i	y
1010	LF	SUB	*	:	J	Z	j	z
1011	VT	ESC	+	;	K	[	k	{
1100	FF	FS	‘	<	L	\	l	|
1101	CR	GS	-	=	]	]	m	}
1110	SO	RS	.	>	N	^	n	~
1111	SI	US	/	?	O	–	o	DEL

Thus the code for A is:

b_6	b_5	b_4	b_3	b_2	b_1	b_0
1	0	0	0	0	0	1

The internal representation of the string RAMA J is:

1010010	1000001	1001101	1000001	0100000	1001010
R	A	M	A	SPACE	J

Observe that the blank between RAMA and J also needs a code. This code is essential to leave a blank between RAMA and J when the string is printed.

Observe that in ASCII code digits are encoded using 7 bit codes. Thus if an item code, say, is a combination of letters and digits we use the 7 bit equivalent of each character to encode it. In ASCII code, digits are considered as printable characters rather than numbers with value.

Example

The licence number of a car is KA02M47. What is its ASCII code?

Sol :

1001011	1000001	0110000	0110010	1001101	0110100	0110111
K	A	0	2	M	4	7

In addition to ASCII, another code known as ISC1I (Indian Standard Code for Information Interchange) has been standardized by the Bureau of Indian Standards. The full description of this code is available in the document IS: 13194-91 published by the Bureau of Indian Standards. It is an 8-bit code which allows English and Indian script alphabets to be used simultaneously. It retains the standard ASCII code for English. It extends Table 2.9 by adding columns 1010, 1011, upto 1111 (Observe that Table as shown has columns 0000 to 0111 only). With this addition, it is possible to define 96 more characters.

A common code for all Indian languages is feasible as all Indian scripts have a common origin from the Brahmi script. The phonetic nature of Indian languages is used to design the code. All consonants have an implicit vowel.

A string of bits used to represent a character is known as a byte. Characters coded in ISCII need 8 bits for each character. Thus a byte, in this case, is a string of 8 bits. A character coded in ASCII will need only 7 bits. The need to accommodate characters of languages other than English was foreseen while designing ASCII and therefore 8 bits were specified to represent characters. Thus a byte is commonly understood as a string of 8 bits.

Recently, a new coding scheme for characters, called Unicode, has been standardized specifically to accommodate a large number of special symbols such as Greek characters α, β, ν, etc., mathematical symbols such as $\Rightarrow$, and non-English characters. It uses 16 bits (2 bytes) to represent each character. As $2^{16} = 65536$, the number of different characters which can be coded using Unicode is very large. Unicode has, however, defined codes from $(0000)_{16}$ to $(FFFD)_{16}$ hexadecimal which is 65534 codes, 2 less than 65536. Thus any character of any language in the world can be represented with this large number. It is important to note that the first 128 characters of Unicode are identical to ASCII codes. Thus Unicode is compatible with existing ASCII and ISCII coded data stored in computers.

1.2.5 Error detecting codes

Q19. Define error. Explain error detecting codes.

Ans :

Errors may occur in recording data on magnetic surfaces due to bad spots on the surface. Errors may also be caused by electrical disturbances during data transmission between units. It is therefore necessary to device methods to guard against such errors. The main principle used for this purpose in coded data is the introduction of extra bits in the code to aid error detection. A common method is the use of a *parity check bit* along with each character code. A parity check bit is appended to the 7 bits of the code of each character in such a way that the total number of Is in each character code is *even.* For instance, the ASCII code of the letter E is 1000101. The number of Is in this string is odd. A parity check bit 1 is appended to this string to obtain a code which is now 8 bits long and has an even number of Is in it. The code for E with an even parity bit appended is 10001011.

↑

Even parity bit

If the ASCII code of a character has already an even number of Is in it, then the parity check bit to be appended is 0. For example, the ASCII code of A is 1000001 and its code with an appended parity check bit is 10000010, where 0 is the parity bit appended as the least significant bit. All characters now have 8-bit codes including the parity check bit. Whenever a character is read from storage or received from a remote location, the number of Is in its code (including the parity bit) is counted. It has to be even. If it is odd, then at least one bit has changed from 0 to 1 or from 1 to 0. Thus, a single error in any of the 8 bits of the code will definitely be detected. Two errors cannot be detected by this scheme as the total number of Is in the code will remain even when two bits change from 0 to 1 or 1 to 0. As the probability of more than one bit changing is in practice very small, this scheme of using a single parity check bit is commonly accepted as adequate.

Instead of appending a parity check bit which makes the total number of Is in the code even, one may choose to append a parity check bit which makes the total number of Is in the code odd. Such a parity check bit is known as an odd parity check bit. This scheme also facilitates detection of a single error in a code.

Codes have also been deviced which use more than one check bit to not only detect but also correct errors. These are called error-correcting codes. We will not discuss these codes in this book. In this chapter we studied how to represent and store numbers and characters in a computer. In the next chapter we will study how pictures are represented and stored in a computer.

Short Question and Answers

1. Define data and Information.

Ans :

Data

Data is a raw and unorganized fact that required to be processed to make it meaningful. Data can be simple at the same time unorganized unless it is organized. Generally, data comprises facts, observations, perceptions numbers, characters, symbols, image, etc.

Data is always interpreted, by a human or machine, to derive meaning. So, data is meaningless. Data contains numbers, statements, and characters in a raw form.

Information

Information is a set of data which is processed in a meaningful way according to the given requirement. Information is processed, structured, or presented in a given context to make it meaningful and useful.

It is processed data which includes data that possess context, relevance, and purpose. It also involves manipulation of raw data.

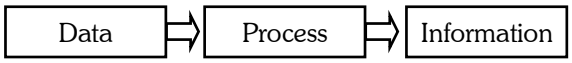
Information assigns meaning and improves the reliability of the data. It helps to ensure undesirability and reduces uncertainty. So, when the data is transformed into information, it never has any useless details.

2. What is data processing ?

Ans :

Data processing

Data processing is a process of converting raw facts or data into a meaningful information.



Stages of Data Processing

i) Collection

Collection of data refers to gathering of data. The data gathered should be defined and accurate.

ii) Preparation

Preparation is a process of constructing a dataset of data from different sources for future use in processing step of cycle.

iii) Input

Input refers to supply of data for processing. It can be fed into computer through any of input devices like keyboard, scanner, mouse, etc.

iv) Processing

The process refers to concept of an actual execution of instructions. In this stage, raw facts or data is converted to meaningful information.

v) Output and Interpretation

In this process, output will be displayed to user in form of text, audio, video, etc. Interpretation of output provides meaningful information to user.

vi) Storage

In this process, we can store data, instruction and information in permanent memory for future reference.

3. What is data processing cycle?

Ans :

Data processing cycle as the term suggests a sequence of steps or operations for processing data i.e., processing raw data to the usable and readable form. The processing of data can be done by number of data processing methods and processing systems.

Stages of Data Processing

i) Input

The raw data after collection needs to be fed in the cycle for processing. This is considered the first step and called input.

ii) Processing

Once the input is provided the raw data is processed by a suitable or selected processing method. This is the most important step as it provides the processed data in the form of output which will be used further.

iii) Output

This is the outcome and the raw data provided in the first stage is now "processed" and the data is useful and provides information and no longer called data. Output is also understood as meaningful information or useful information.

4. What is the use of control unit?

Ans :

The control unit (CU) controls all the activities or operations which are performed inside the computer system. It receives instructions or information directly from the main memory of the computer.

When the control unit receives an instruction set or information, it converts the instruction set to control signals then; these signals are sent to the central processor for further processing. The control unit understands which operation to execute, accurately, and in which order.

5. What is the use of ALU?

Ans :

The arithmetic and logical unit is the combinational digital electronic circuit that can perform arithmetic operations on integer binary numbers. It presents the arithmetic and logical operation. The outputs of ALU will change asynchronously in response to the input. The basic arithmetic and bitwise logic functions are supported by ALU.

6. What is data acquistion.

Ans :

Data acquisition consists of the following steps:

i) Reading of data of relevance in an application using a device.

ii) Converting the data which is read to a form which is storable in a computer's memory.

iii) Applying a transformation on this converted data in order to reduce the amount of storage required.

Data is read using several different types of input units. The data which is read is encoded to a binary form for storage in memory. Sometimes this encoded form is processed to reduce the storage space needed to store the data.

7. Conver D6C1 into Decimals.

Ans :

$D6C1 = D \times 16^3 + 6 \times 16^2 + C \times 16^1 + 1 \times 16^0$

$= 13 \times 16^3 + 6 \times 16^2 + 12 \times 16 + 1 \times 16^0$

$= 53248 + 1536 + 192 + 1$

$= (54977)_{10}$

Find the binary equivalent of $(23)_{10}$

8. Find the binary equivalent of $(23)_{10}$.

Ans :

		Remainder	
2	23		
2	11	1	→ Least significant bit
2	5	1	
2	2	1	
2	1	1	
	0	1	→ Most significant bit

$(23)_{10} = (10111)_2$

9. Find the binary equivalent of 0.8125.

Ans :

$(0.8125)_{10} = 0.5 + 0.25 + 0.0625$

$= 1 \times 2^{-1} + 1 \times 2^{-2} + 0 \times 2^{-3} + 1 \times 2^{-4}$

$2 \times (0.8125)_{10} = 2 \times (1 \times 2^{-1} + 1 \times 2^{-2} + 0 \times 2^{-3} + 1 \times 2^{-4})$

$= 1 + (1 \times 2^{-1} + 0 \times 2^{-2} + 1 \times 2^{-3})$

$= 1 + 0.625$

$2 \times 0.625 = 2 \times (1 \times 2^{-1} + 0 \times 2^{-2} + 1 \times 2^{-3})$

$= 1 + (0 \times 2^{-1} + 1 \times 2^{-2})$

$= 1 + 0.25$

$2 \times 0.25 = 2 \times (0 \times 2^{-1} + 1 \times 2^{-2})$

$= 0 + 0.5$

$2 \times 0.5 = 2 \times 2^{-1}$

$= 1$

Thus, $(0.8125)_{10} = (0.1101)_2$

Choose the Correct Answer

1. Information is _____ [b]
   (a) Data (b) Processed Data
   (c) Manipulated input (d) Computer output
2. For taking decisions data must be _____ [c]
   (a) Very accurate (b) Massive
   (c) Processed correctly (d) Collected from diverse sources
3. ALU stands for _____ [a]
   (a) Athematic logic unit (b) Application logic unit
   (c) Array logic unit (d) None of the above
4. Brain of the computer system is _____ [b]
   (a) ALU (b) CPU
   (c) Memory (d) Control Unit
5. Which is a computer program? [d]
   (a) Operating system (b) Application package
   (c) Utility software (d) All of the above computer programs
6. Desktop PC has a "tower" design, with a system unit that sits upright and can be placed on either desk or floor, is [b]
   (a) Horizontal oriented system (b) Vertical oriented system
   (c) Flat oriented system (d) Circular oriented system
7. These devices provide a means of communication between a computer and outer world. [a]
   (a) I/O (b) Storage
   (c) Compact (d) Drivers
8. If $(101.01)_2=(x)_{10}$, then what is the value of x? [d]
   (a) 505.05 (b) 10.101
   (c) 101.01 (d) 5.25
9. Decimal number system is the group of _____ numbers. [b]
   (a) 0 or 1 (b) 0 to 9
   (c) 0 to 7 (d) 0 to 9 and A to F
10. Hexadecimal number system has _____ base. [d]
    (a) 2 (b) 8
    (c) 10 (d) 16
11. The number system based on '0' and '1' only, is known as [a]
    (a) Binary system (b) Barter system
    (c) Number system (d) Hexadecimal system

Fill in the blanks

1. _____ octal number equivalent to binary number (110101)2?
2. _____ value of the binary number 101.
3. _____ is hexadecimal number equivalent to binary number (1111 1001)2?
4. _____ octal number equal to decimal number (896)10.
5. When a key is pressed on keyboard _____ standard is used for converting the key strokes into the corresponding bits
6. The list of codded instructions is called _____
7. _____ device primarily used to provide hardcopy.
8. _____ unit is responsible for converting the data received from the user into a computer understandable format?
9. The only language which the computer understands is _____
10. The smallest unit of data in computer is _____

ANSWESRS

1. 65
2. 5
3. F9
4. 1600
5. ASCII
6. Computer program
7. Printer
8. Input
9. Binary
10. Bit

One Mark Question and Answers

1. List out various types of data.

Ans :

The versatility of IT comes from the ability to process a variety of data types which are

i) Numeric
ii) Text
iii) Image
iv) Audio
v) Video

2. List of various input devices of a computer.

Ans :

Following are some of the important input devices which are used in a computer:

- Keyboard
- Mouse
- Joy Stick
- Light pen
- Track Ball
- Scanner
- Graphic Tablet
- Microphone
- Magnetic Ink Card Reader (MICR)
- Optical Character Reader (OCR)
- Bar Code Reader
- Optical Mark Reader (OMR)

3. What is the decimal equivalent of 10010101?

Ans :

Decimal equivalent

$= (1 \times 128) + (0 \times 64) + (0 \times 32) + (1 \times 16) + (0 \times 8) + (1 \times 4) + (0 \times 2) + (1 \times 1)$

$= 149.$

4. Find the binary equivalent of 36

Ans :

		Remainder	
2	36		
2	18	0	→ Least significant bit
2	9	0	
2	4	1	
2	2	0	
2	1	0	
2	0	1	→ Most significant bit

$(36)_{10} = (100100)_2$

5. The licence number of a car is KA02M47. What is its ASCII code?

Ans :

1001011	1000001	0110000	0110010	1001101	0110100	0110111
K	A	0	2	M	4	7

UNIT II

Data Storage: Introduction, Storage Cell, Physical Devices Used as Storage Cells, Random Access Memory, Read Only Memory, Secondary Storage, Compact Disk Read Only Memory (CDROM), Archival Store

Central Processing Unit: Introduction, Structure of a Central Processing Unit, Specifications of a CPU, Interconnection of CPU with Memory and I/O Units, Embedded Processors.

2.1 Data Storage

2.1.1 Introduction

Q1. Why we need different types of storage units in a computer? Explain with a case study.

Ans :

Caselet

All of you would have gone to a railway reservation office to reserve accommodation in a train or to a bus reservation office for reserving seats in a bus. Railway reservation is now done using computers. Many bus tickets, particularly for long distance travel, are also reserved using computers. We will explain how different storage devices are used in such reservation systems. The principles used in reservations on trains and buses are the same. We will, however, take the reservation on trains as it is more complex and thus more interesting. The following steps are followed in reservation of berth(s) in a train.

Step 1

You fill up a form in which you write down the train number, train name. Starting station, destination, date of travel, name of passenger(s) with age and sex and preference of berth(s) and onward reservation, if any. You give this form to the reservation clerk who has a computer terminal in front of her.

Step 2

The clerk enters the data from the form given by you using the keyboard of the terminal. This data is temporarily stored in a memory of the terminal as it is required for immediate reference for booking.

Step 3

Using the data on train number, date of travel, origin and destination stations, the computer retrieves data on availability of berths in the specified train on specified date from a large storage device called a secondary storage. This data is stored in a secondary storage as the data on reservation on trains is very large. Data on over 500 trains are stored and for each train data is needed for 60 days as reservations can be done 60 days before the date of journey. If 1000 berths are there in each train, the data will be: No. of trains × No. of days × No. of berths per day × No. of bytes needed for information on each berth = 500 × 60 × 1000 ×100 = 3 GB.

Step 4

Using the data stored in step 2, a program retrieves data on the specified train on the specified day from the secondary memory and brings it to the main memory of the computer which processes the reservation request. The reason it is brought to the main memory is to allow the processor to compare the seat status with your request for a berth.

Step 5

The berth availability data is compared with your berth request by the processor (which uses an appropriate program stored in the main memory). If berth is available, a ticket is printed with a unique identification number (called PNR) for later reference. The berth is marked as booked and the new information on available berths is written back in the secondary memory.

We thus see from this case that there is a need for a main memory from which data is taken for processing. The amount of data stored in the main

memory is relatively small. The main memory is also essential to store program which processes the data. We also saw that there is a need for much larger secondary memory for storing data which needs to be accessed frequently and a portion brought to the main memory for processing. Data in the secondary memory should be "on-line", that is, it should be available whenever needed within a short period for processing while the customer is waiting. By a short period we mean a few thousandth's of a second, that is, a few milliseconds.

There is a need for one more level of memory for the railway reservation system. We now explain why. The reservation data is very important and should not be accidentally must from the secondary memory. Accidental loss may occur due to hardware fault, software failure, or human error. If this occurs it is essential to restore the data. If at the end of each day all the data from the secondary storage unit is "backed up", that is, a copy is made and stored in another memory device which can be removed from the computer and kept in a safe place such as a steel almirah then it is possible to restore the data in the secondary storage using this backed-up data. Such a storage unit which is not required on-line but is needed to save data for use when required is called an archival memory unit.

Apart from the need to back up data from secondary store, there is another need for archival storage. In the railway reservation system, the data on berths stored in the secondary memory is not required after the arrival of a train at its destination. It should thus be removed from the secondary memory. A question which arises is, should it be removed and kept elsewhere. It should not be deleted but kept at least for some time due to the following reasons:

1. It may be needed to refund cost of tickets to customers if the train is cancelled.
2. It may be needed for legal purposes.
3. The archival data may be used later for further analysis to find out information such as seasonal variation of traffic and length of waiting list to enable adding coaches, etc.

The archival storage must be able to store large amount of data in a compact removable storage device at a low cost per byte. The archival store must be able to store data for a long period; the data in it should not vanish after a period of time.

This case has shown us the need for three types of memory, namely:

1. The main memory which has a very short access time (tens of nano seconds) and relatively small size (usually millions of bytes).
2. A secondary memory which has storage of the order of gigabytes. Its access time may be longer, around hundreds of milliseconds.
3. An archival memory which has a large storage capacity (several hundred gigabytes), is removable, compact and low cost per byte of storage.

2.1.2 Memory cell

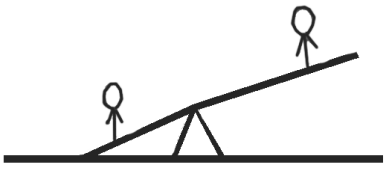
Q2. What is memory cell? List out various properties of a cell.

Ans : **(Dec.-21)**

Memory Cell

Memories in computers are made using what we call memory cells. A variety of memory cells are used to fabricate memories. A common characteristic of all cells used in today s computers is that they can be in one of two stable states. By a stable state we mean that the cell remains in that state unless it is intentionally disturbed. A simple example of a system with two stable states is a seesaw you find in children's playground. It is shown in Figure. The seesaw will remain in state 1 as long as a child sits as shown. If a heavier child sits on the opposite end of the seesaw, it will go to stable state 2.

Stable State 1



Stable State 2

Fig.: A Seesaw in one of the Two Stable States

The other properties of a memory cell which are important in today's memories are:

1. Whether continuous supply of power is necessary for a cell to continue to remain in a stable state.
2. Whether a bit once written is permanently stored and cannot be altered by a user.
3. The time needed to write/read a bit in a cell.

A typical memory cell is shown in Figure.

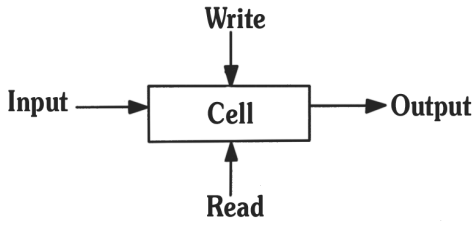


Fig.: A memory cell

This is a binary cell as it can be placed in one of two stable states. The two stable states are called the '1' state and '0' state. We have shown the cell with four lines an input line, an output line, a read line, and a write line. The input line is to feed the data to be written. The data stored in the cell appears on the output line. When data is to be written a signal is placed on the write line. When data in a cell is to be a read, a signal is placed in the read line.

In all computers today data (1 or 0) is written in a cell using electricity to supply energy. Hence an appropriate voltage is applied to the input line corresponding to the data to be written. Thus, if a 1 is to be written in a cell, a voltage representing a 1 is fed to the input line. A write signal is applied on the write line and the cell goes to a state representing 1. If a 0 is to be written in a cell, another voltage representing 0 is fed to the input line. When a write signal is applied to the write lines, the cell goes to the stable state representing 0.

If the data written in the cell is to be read, then a signal is applied to the read line and a voltage corresponding to 1 or 0, depending on what is stored in the cell appears on the output line.

A number of different physical devices are used as cells in memory. Some "ideal" properties a cell should possess are:

1. It should have two stable states.
2. While a cell is in a stable state, it should not consume any energy. Even if it does, it must be very small.
3. It should be possible to switch between 0 and 1 states any number of times without losing the data.
4. Each cell should occupy very little space.
5. The time taken to write/read must be very small.
6. The data stored in a cell must not be lost with passage of time.
7. The cost of each cell must be very small.

There is no device which satisfies all the properties specified above. Usually, the lower the read/write time, the higher is the cost of a cell. Also, the faster a cell, more is the energy it consumes. We will first describe some physical devices used today as memory cells. A collection of these cells makes up a memory.

2.1.3 Physical Devices used as Memory Cell

Q3. List out various physical devices used as memory cells.

Ans : **(Imp.)**

A number of different physical devices have been used to construct memories of computers. We will describe some of the common ones used now to construct memories.

1. A Capacitor Storage Cell

In we show a capacitance used as a memory cell. A capacitance can be in two states: a state in which it is fully charged, and another in which it is fully discharged. We can call the charged state the "1" state, and the discharged state '0' state. If a 1 is to be written in the cell of Figure, a voltage V is applied to the input line and a write signal is applied to write line. The write signal closes switch SI and the voltage V applied to input charges the capacitance, thereby storing 1 in it. The state of capacitor is read by applying a signal to the read line. This signal closes switch S2 and the status of C is read, either charged in which case the voltage at output is V, or discharged, in which case the voltage at output is 0.

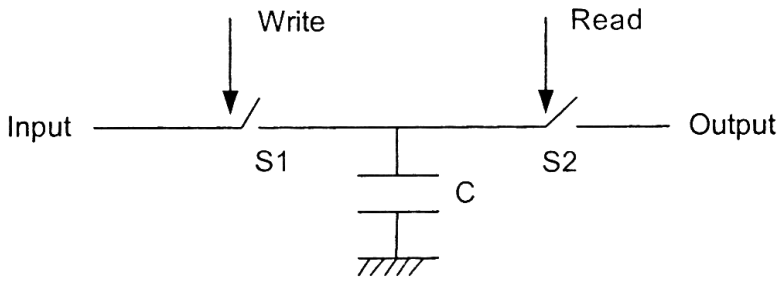


Fig.: A Capacitor Storage Cell

The major advantage of this technology is that it is inexpensive. The area required to fabricate a cell is very small, around 0.25 microcm^2. Thus 1 million cells occupy only 0.25 cm^2. The major disadvantage of this cell is it is volatile, that is, the data stored in the cell is lost unless it is refreshed. This is due to the fact that a charged capacitor gradually discharges as real capacitors are non-ideal and have a resistive path through which discharge takes place. Thus, a capacitor storing a 1 should be periodically charged, i.e., its memory should be refreshed. The readout from this cell is also destructive. In other words, when a charge in the capacitor is read, it discharges and the cell goes to 0 state. This storage cell is the one used to fabricate what is known as Dynamic Random Access Memory (DRAM).

2) A flip-flop Storage Cell

A flip-flop is a storage device which uses four semiconductor switches to store either a 0 or a 1. In following Figure we show a memory cell which uses a flip-flop to store a 0 or a 1.

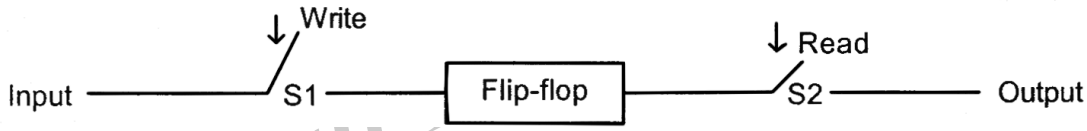


Fig.: A memory cell swings flip-flop.

If a 1 is applied to input and a write signal is applied to the Write line, SI closes and 1 is written in the flip-flop. The flip-flop will remain in this state storing a 1 unless : is disturbed. If the data stored in the flip-flop is to be read, a read signal is applied 1 the Read line which closes S2, and the data stored in the flip-flop appears on the output ne. If a 0 is fed to input and a write signal is applied, then a 0 is written in the flip-flop. The major advantages of a flip-flop compared to a capacitor are:

- It takes lesser time to store a bit in it as compared to a capacitor memory cell.
- The data stored in a cell is not lost with passage of time. There is no need to refresh the memory.
- The readout from a flip-flop is non-destructive. In other words, when data is read from a flip-flop, it is not erased.

The major disadvantages of a flip-flop as compared to a capacitor are:

- Flip-flops are more expensive.
- Flip-flops occupy more space as they use four semiconductor switches.
- They need continuous application of power to maintain their state. When power fails, the stored data is lost. It is thus volatile.

Flip-flop based memory cells are used to fabricate what is known as Static Random Access Memory (SRAM).

3) Magnetic Storage Cell

The physical device used as a magnetic storage cell is a magnetic recording surface. The method used to store data (1 or 0) on a magnetic surface is shown in Figure.

If a 1 is to be written on the magnetic surface, a current is sent through a coil wound an a magnetic write head. This current creates a magnetic field (as shown in the figure) in the gap in the write head. A plastic or metal surface is coated with a ferro-magnetic material. This surface is kept very close to the write head. The field in the gap of the lead magnetizes the surface in the same direction as the field as shown in the figure. Observe that a right to left magnetization (<-) is taken as a 1. If a 0 is to be written, the current in the coil is sent in the opposite direction. In this case the magnetic field n the gap is from left to right (->), and the surface also is magnetized in the same direction which we call a 0. In order to write a sequence of Is and Os, the magnetic surface is moved (in one direction). The direction of the current through the coil of the write head is adjusted as needed to write a 1 or a 0. Bits are thus recorded on the surface as shown in Figure.

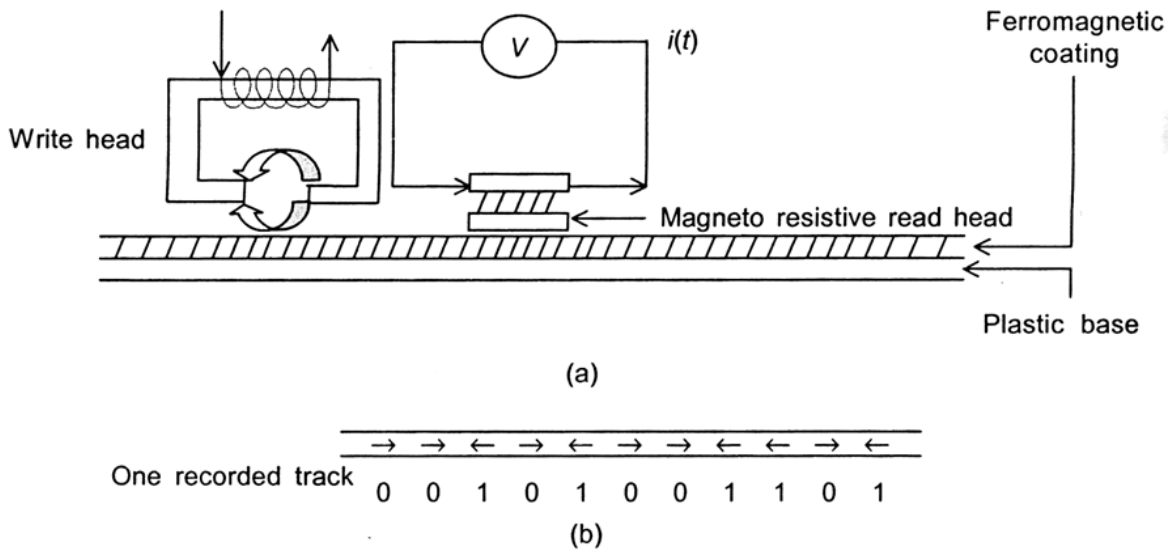


Fig.: Magnetic Storage Cell

To read data stored on the surface, a read head is used. The read head is called a magneto resistive head. The resistance of this head increases if a magnet with S $\rightarrow$ N alignment is placed below it and the resistance decreases if the alignment of a magnet below it is opposite, namely, N $\leftarrow$ S. The current i(t) flowing through the head is proportional to the resistance of the head. Thus, if the current increases we say that a 1 is read (1 is N $\leftarrow$ S), and if it decreases then a 0 is read. Recording on a magnetic surface is used in magnetic hard disk, floppy disk, and magnetic tape.

4) A Polycarbonate Cell

This type of cell is used in what are known as laser disks or compact disks. The surface of a thin polycarbonate substrate is coated with a reflecting material, usually aluminium. Over this, a protective layer is coated figure. To write bits on this surface a laser beam is used. Wherever a 1 is to be written, the beam is turned on and burns a 'pit' up to the reflective layer. Wherever a 0 is to be written, the laser beam is defocused and no 'pit' is burnt. A sequence of cells, each cell being a pit or no pit (no 'pit' is called a

'land') are traced along a spiral track on the surface as the disk is rotated. Reading is achieved by rotating the disk and moving a laser beam along a track. Wherever there is a 'land' light reflects from the reflective layer and no light gets reflected from a 'pit'. The reflecting light is sensed by an electronic light sensing device and converted to an electrical signal representing a 0 or 1.

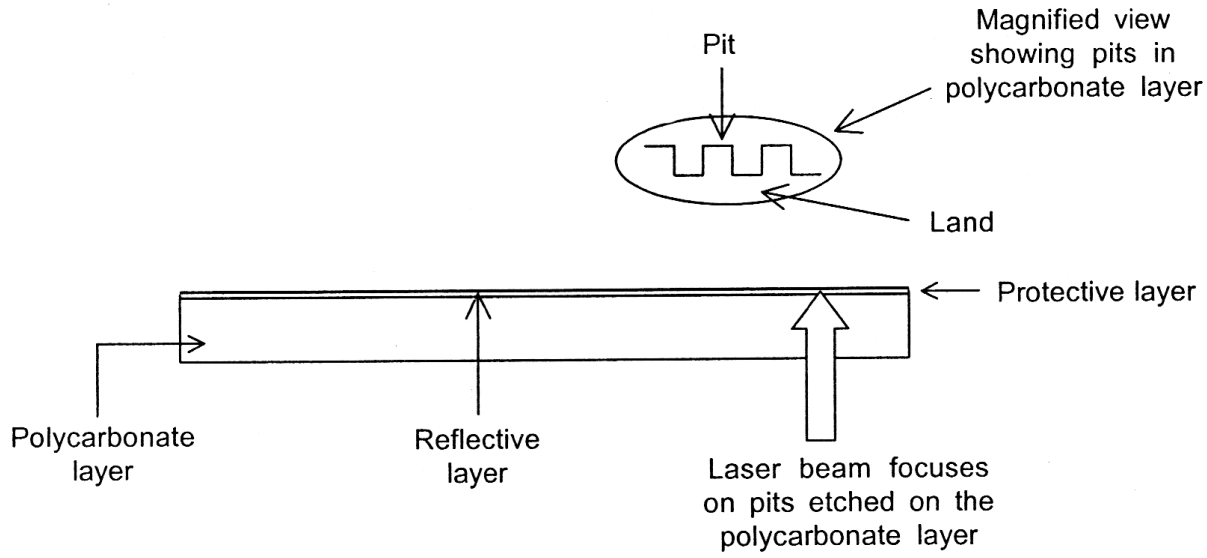
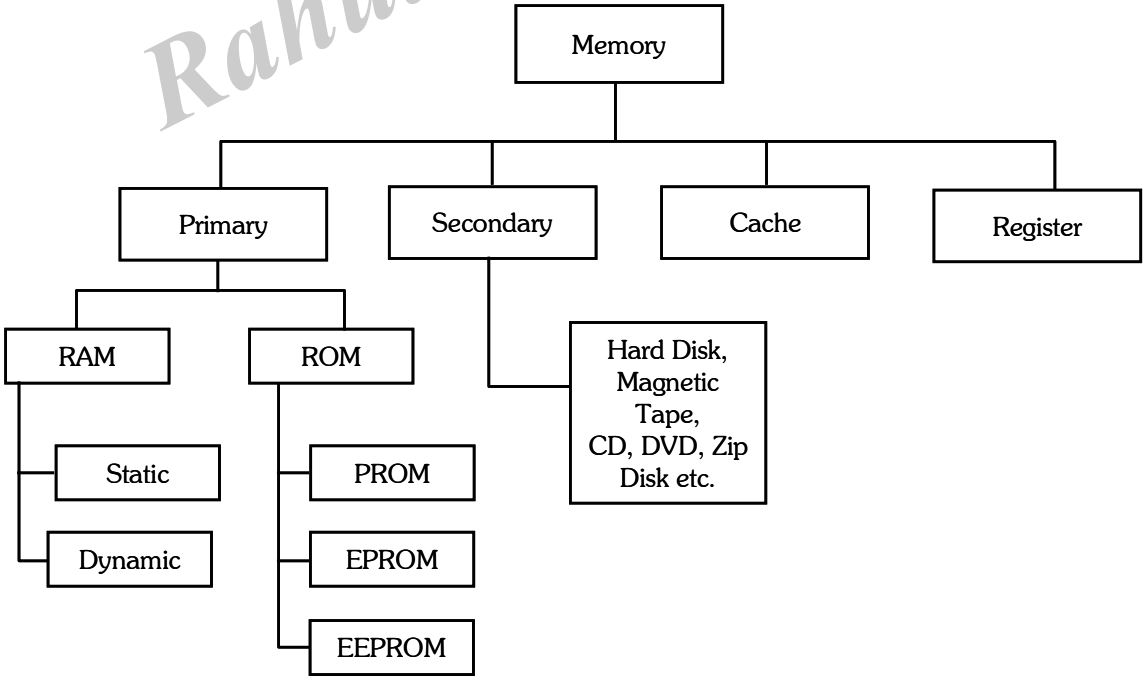


Fig.: Memory Cell on Polycarbonate Layer

2.1.4 Random access memory

Q4. Explain the classification of memory.

Ans :



1. Primary or Main Memory

Primary memory is also known as the computer system's main memory that communicates directly within the CPU, Auxiliary memory and the Cache memory. Main memory is used to kept programs or data when the processor is active to use them. When a program or data is activated to execute, the processor first loads instructions or programs from secondary memory into main memory, and then the processor starts execution. Accessing or executing of data from primary memory is faster because it has a cache or register memory that provides faster response, and it is located closer to the CPU. The primary memory is volatile, which means the data in memory can be lost if it is not saved when a power failure occurs. It is costlier than secondary memory, and the main memory capacity is limited as compared to secondary memory.

The primary memory is further divided into two parts:

i) RAM (Random Access Memory)

ii) ROM (Read Only Memory)

2. Secondary Memory

Secondary memory is a permanent storage space to hold a large amount of data. Secondary memory is also known as external memory that representing the various storage media (hard drives, USB, CDs, flash drives and DVDs) on which the computer data and program can be saved on a long term basis. However, it is cheaper and slower than the main memory. Unlike primary memory, secondary memory cannot be accessed directly by the CPU. Instead of that, secondary memory data is first loaded into the RAM (Random Access Memory) and then sent to the processor to read and update the data. Secondary memory devices also include magnetic disks like hard disk and floppy disks, an optical disk such as CDs and CDROMs, and magnetic tapes.

3. Cache Memory

It is a small-sized chip-based computer memory that lies between the CPU and the main memory. It is a faster, high performance and temporary memory to enhance the performance of the CPU. It stores all the data and instructions that are often used by computer CPUs. It also reduces the access time of data from the main memory. It is faster than the main memory, and sometimes, it is also called CPU memory because it is very close to the CPU chip.

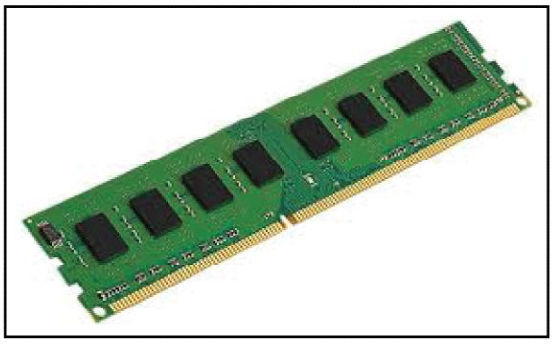
Register Memory

The register memory is a temporary storage area for storing and transferring the data and the instructions to a computer. It is the smallest and fastest memory of a computer. It is a part of computer memory located in the CPU as the form of registers. The register memory is 16, 32 and 64 bits in size. It temporarily stores data instructions and the address of the memory that is repeatedly used to provide faster response to the CPU.

Q5. Explain in detail RAM.

Ans : **(Dec.-21)**

Random Access Memory (RAM) is one of the faster types of main memory accessed directly by the CPU. It is the hardware in a computer device to temporarily store data, programs or program results. It is used to read/write data in memory until the machine is working. It is volatile, which means if a power failure occurs or the computer is turned off, the information stored in RAM will be lost. All data stored in computer memory can be read or accessed randomly at any time.



There are two types of RAM:

(i) SRAM

(ii) DRAM

(i) DRAM: DRAM (Dynamic Random-Access Memory) is a type of RAM that is used for the dynamic storage of data in RAM. In

DRAM, each cell carries one-bit information. The cell is made up of two parts: a capacitor and a transistor. The size of the capacitor and the transistor is so small, requiring millions of them to store on a single chip. Hence, a DRAM chip can hold more data than an SRAM chip of the same size. However, the capacitor needs to be continuously refreshed to retain information because DRAM is volatile. If the power is switched off, the data store in memory is lost.

Characteristics of DRAM

1. It requires continuously refreshed to retain the data.
2. It is slower than SRAM
3. It holds a large amount of data
4. It is the combination of capacitor and transistor
5. It is less expensive as compared to SRAM
6. Less power consumption

ii) SRAM: SRMA **(Static Random-Access Memory)** is a type of RAM used to store static data in the memory. It means to store data in SRAM remains active as long as the computer system has a power supply. However, data is lost in SRAM when power failures have occurred.

Characteristics of Static Ram

1. It does not require to refresh.
2. It is faster than DRAM
3. It is expensive.
4. High power consumption
5. Longer life
6. Large size
7. Uses as a cache memory

Q6. What are the differences between SRAM and DRAM.

Ans :

SRAM	DRAM
It is a Static Random-Access Memory.	It is a Dynamic Random Access Memory.
The access time of SRAM is slow.	The access time of DRAM is high.
It uses flip-flops to store each bit of information.	It uses a capacitor to store each bit of information.
It does not require periodic refreshing to preserve the information.	It requires periodically refreshing to preserve the information.
It uses in cache memory.	It is used in the main memory.
The cost of SRAM is expensive.	The cost of DRAM is less expensive.
It has a complex structure.	Its structure is simple.
It requires low power consumption.	It requires more power consumption.

Q7. Write any 4 advantages and disadvan-tages of RAM

Ans :

Advantages of RAM

- It is a faster type of memory in a computer.
- It requires less power to operate.
- Program loads much faster
- More RAM increases the performance of a system and can multitask.
- Perform read and write operations.
- The processor can read information faster than a hard disc, floppy, USB, etc.

Disadvantages of RAM

- Less RAM reduces the speed and perfor-mance of a computer.
- Due to volatile, it requires electricity to preserve the data.
- It is expensive than ROM
- It is unreliable as compared to ROM
- The Size of RAM is limited.

Q8. Draw and explain block diagram of memory which stores 4096, 8-bit words.

Ans : **(Imp.)**

Random Access Memory

The main memory of a computer is made using either capacitor storage cells or flip-flops (as physical device) to store data. A set of cells are strung together to form a unit called a word. As each cell stores a bit, a word consists of a set of bits. The number of bits in a word is called word length. A word is always treated as an entity and is written into or read from a memory as a unit. Words to be written are first entered in a small temporary storage unit called a register. This temporary storage is known as the Memory Data Register (MDR, for short). When a word is read from memory, it is also stored in MDR, overwriting its contents.

The location in the memory where a word is to be stored is called the *address* of the word. When a word is to be stored in a memory, it is first stored in MDR. The address where this word is to be stored is entered in another register called Memory Address Register (MAR, for short). The memory control circuits issue a write signal and the contents of MDR are written in the address specified by MAR. If a word is to be read, its address is entered in MAR and a read signal is issued by the memory's control circuits. This results in the contents of the word whose address is in MAR to be copied from the memory to MDR.

It is thus clear that the memory unit described above is organized as a number of addressed locations, each location storing a word. The address normally starts at 0, and the highest address equals the number of words that can be stored in the memory. If a memory has 4096 locations, each location storing a byte (8 bits), the address starts with 0 and ends with 4095. The MAR should have 12 bits, the address starting with 0 and end with 111111111111 or FFF (Hex). The MDR should have 8 bits to accommodate 8 bits of a word.

Figure depicts the block diagram of the memory which stcfres 4096, 8-bit words. The figure shows a MAR which is 12 bits long, and MDR which is 8 bits long.

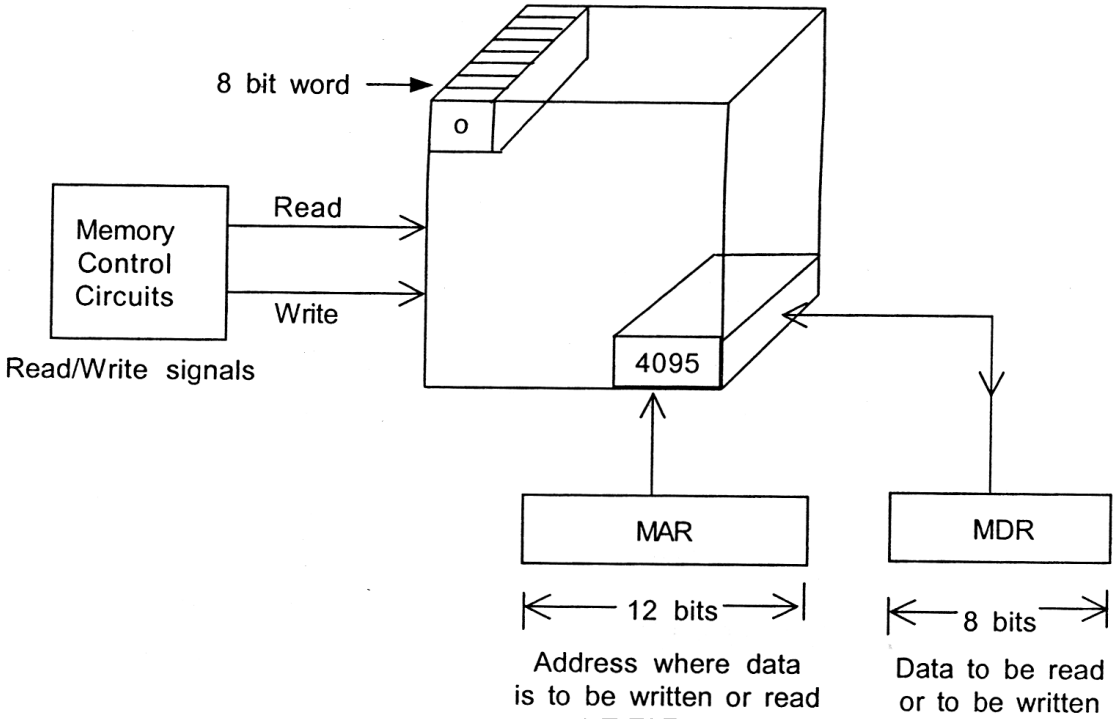


Fig.: A Random Access Memory

The memory control circuits generate read/write signal. Two parameters of great interest to users are (i) the size of the memory, and (ii) the speed of the memory.

Q9. A RAM has 256 MB memory and 16 bytes are accessed in each memory read/write. What is the size of MAR and MDR of this memory?

Ans :

The capacity of memory is 256 MB. If any byte is to be accessed it should be possible to address any byte. As there are 256 MB = 2^{28} bytes, the number of bits in MAR is 28 bits. As 16 bits are retrieved in each memory cycle, the size of MDR must be such as to accommodate all the bits retrieved. Thus the size of MDR is 16 bits.

The size of a memory is specified using bytes as the unit. The memory size is 256 MB. The speed of a memory is specified by three parameters: access time, write time and cycle time. Assume that the address from which data is to be read is placed in MAR and at time t_0 a read signal is issued. If the required data is available in MDR at t_1, the interval $(t_1 - t_0)$ is known as access time or read time. Assume the address at which data is to be written is placed in MAR and data to be written is placed in MDR and a write signal issued at time A. If the data is written in the specified address at time t_3, then $(t_3 - t_2)$ is called the write time. The interval between t_0 at which read/write signal is issued to a memory and the time t_4 at which next such instruction can be safely issued, namely $(t_4 - t_0)$, is known as the cycle time of the memory.

If the time to read/write a word in a memory is independent of the address, then this memory is called a Random Access Memory (RAM). The main memory used to store data and programs is normally a RAM. The speed of data processing is directly dependend on the speed of RAM.

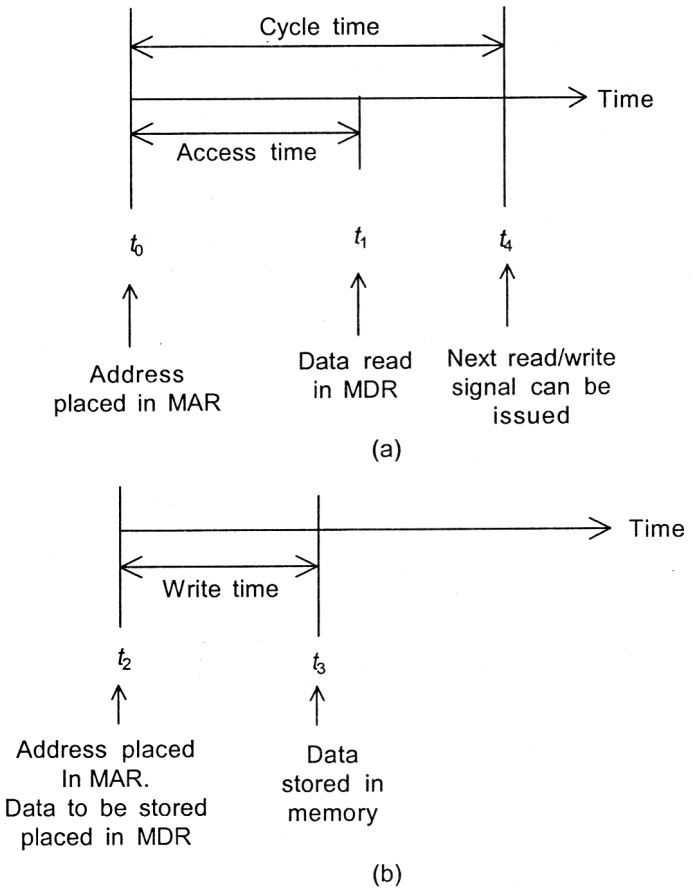


Fig.: Defining access time, Write time and cycle time of RAM

Q10. Explain in detail ROM. Discuss various types of ROM's.

Ans :

Read-Only Memory (ROM)

ROM is a memory device or storage medium that is used to permanently store information inside a chip. It is a read-only memory that can only read stored information, data or programs, but we cannot write or modify anything. A ROM contains some important instructions or program data that are required to start or boot a computer. It is a non-volatile memory; it means that the stored information cannot be lost even when the power is turned off or the system is shut down.

Types of ROM

There are five types of Read Only Memory:

1. MROM (Masked Read Only Memory)

MROM is the oldest type of read-only memory whose program or data is pre-configured by the integrated circuit manufacture at the time of manufacturing. Therefore, a program or instruction stored within the MROM chip cannot be changed by the user.

2. PROM (Programmable Read Only Memory

It is a type of digital read-only memory, in which the user can write any type of information or program only once. It means it is the empty PROM chip in which the user can write the desired content or program only once using the special PROM programmer or PROM burner device; after that, the data or instruction cannot be changed or erased.

3. EPROM (Erasable and Programmable Read Only Memory)

It is the type of read only memory in which stored data can be erased and re-program-med only once in the EPROM memory. It is a non-volatile memory chip that holds data when there is no power supply and can also store data for a minimum of 10 to 20 years. In EPROM, if we want to erase any stored data and re-programmed it, first, we need to pass the ultraviolet light for 40 minutes to erase the data; after that, the data is re-created in EPROM.

4. EEPROM (Electrically Erasable and Programmable Read Only Memory)

The EEROM is an electrically erasable and programmable read only memory used to erase stored data using a high voltage electrical charge and re-programmed it. It is also a non-volatile memory whose data cannot be erased or lost; even the power is turned off. In EEPROM, the stored data can be erased and reprogrammed up to 10 thousand times, and the data erase one byte at a time.

5. Flash ROM

Flash memory is a non-volatile storage memory chip that can be written or programmed in small units called Block or Sector. Flash Memory is an EEPROM form of computer memory, and the contents or data cannot be lost when the power source is turned off. It is also used to transfer data between the computer and digital devices.

Q11. Write any 3 advantages and disadvan-tages of ROM.

Ans :

Advantages of ROM

1. It is a non-volatile memory in which stored information can be lost even power is turned off.
2. It is static, so it does not require refreshing the content every time.
3. Data can be stored permanently.
4. It is easy to test and store large data as compared to RAM.
5. These cannot be changed accidently
6. It is cheaper than RAM.
7. It is simple and reliable as compared to RAM.
8. It helps to start the computer and loads the OS.

Disadvantages of ROM

1. Store data cannot be updated or modify except to read the existing data.
2. It is a slower memory than RAM to access the stored data.
3. It takes around 40 minutes to destroy the existing data using the high charge of ultraviolet light.

Q12. State the differences between RAM and ROM

Ans : **(Imp.)**

RAM	ROM
It is a Random-Access Memory.	It is a Read Only Memory.
Read and write operations can be performed.	Only Read operation can be performed.
Data can be lost in volatile memory when the power supply is turned off.	Data cannot be lost in non-volatile memory when the power supply is turned off.
It is a faster and expensive memory.	It is a slower and less expensive memory.
Storage data requires to be refreshed in RAM.	Storage data does not need to be refreshed in ROM.
The size of the chip is bigger than the ROM chip to store the data.	The size of the chip is smaller than the RAM chip to store the same amount of data.
Types of RAM: DRAM and SRAM	Types of ROM: MROM, PROM, EPROM, EEPROM

Q13. Explain Structure of ROM.

Ans :

Like a RAM, ROM also is an addressable random access memory. In Figure we depict a 4 KB ROM with 8 bits per word. ROM uses semiconductor memory cells which can be permanently placed in one of two states, 0 or 1, by a process called *fusing*. It is a non-destructive, non-volatile memory. In other words, when we read data stored in it, a copy of the data is delivered; the original remains in the memory. It is non-volatile, that is, when power is turned off, the data stored in it is not lost. With passage of time also the data stored in a ROM is not lost. In other words, the data stored in a ROM is retained indefinitely. Just like in a RAM, to read a data stored in ROM, the address of the data is placed in MAR and a read signal is issued. A copy of the data in the addressed location appears in MDR from which it can be used for an application.

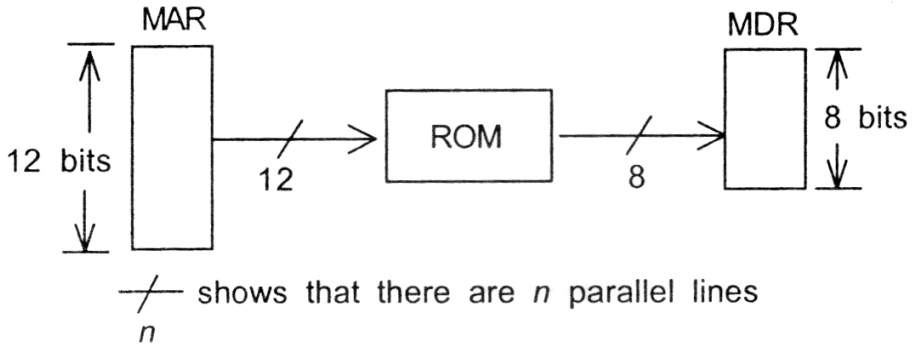


Fig.: Structure of a ROM

Q14. How a seven segment display commonly used in digital watches and calculators can be designed using a ROM?

Ans :

An important application of ROM is to store tables which do not change. As an example, let us see how a seven-segment display commonly used in digital watches and calculators can be designed using a ROM.

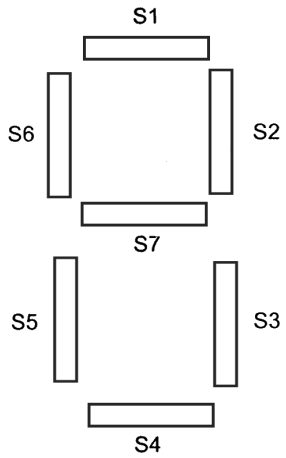


Fig.: A seven Segment Display

A table showing numbers their binary equivalents) as input and segments of the display to be lighted for each number is given in Table.

Table : Contents of ROM for Seven Segment Display

Digit	Input	Output						
		Segments						
		S1	S2	S3	S4	S5	S6	S7
0	0000	1	1	1	1	1	1	0
1	0001	0	1	1	0	0	0	0
2	0010	1	1	0	1	1	0	1
3	0011	1	1	1	1	0	0	1
4	0100	0	1	1	0	0	1	1
5	0101	1	0	1	1	0	1	1
6	0110	0	0	1	1	1	1	1
7	0111	1	1	1	0	0	0	0
8	1000	1	1	1	1	1	1	1
9	1001	1	1	1	1	0	1	1

S1, S2, S3, S4, S5, S6, S7 are segments (a light emitting device) which can be either lighted or not lighted.

Let us examine line 1 of Table. When the input is 0, all the lights except S7 in the seven segment display should light up. This is shown by putting a 1 for the segment to be lighted and 0 for the segment which is to remain dark. This table can be stored in a ROM. When 4 bits corresponding to the number to be displayed is placed in the MAR of a ROM, the seven bits corresponding to SI, S2, S3, ..., S7 appear in the MDR. These bits are used to light up the appropriate lamps. For example, if we place 0 10 1 in the MAR (corresponding to the number 5), the output bits are SI = 1, S2 = 0, S3 = 1, S4 = 1, S5 = 0, S6 = 1, S7 = 1. Thus the segments SI, S3, S4, S6 and S7 will light up as shown in Fig. 6.11, and thus 5 is displayed.

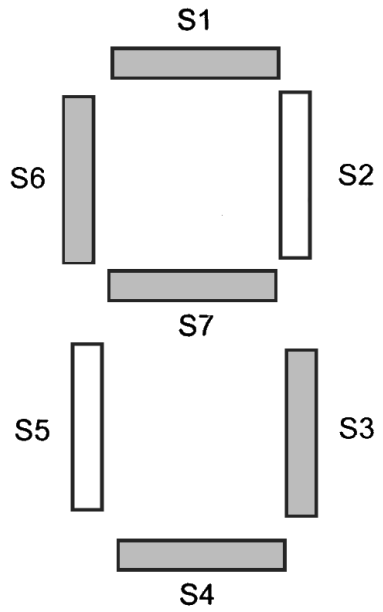


Fig.: Displaying 5 with seven segment display

Another application of ROM is for storing small programs used to control devices such as washing machines, building lifts, etc. A ROM which has data written in it during manufacture in a factory is known as factory programmed ROM. Factory programmed ROMs are used when large quantities of the ROM are needed. The ROM with a seven-segment table will be factory programmed. ROM with program for a washing machine will also be factory programmed.

2.1.5 Secondary storage

Q15. What is secondary memory ? List out its features.

Ans :

Secondary memory is a permanent storage space to hold a large amount of data. Secondary memory is also known as external memory that representing the various storage media (hard drives, USB, CDs, flash drives and DVDs) on which the computer data and program can be saved on a long term basis. However, it is cheaper and slower than the main memory. Unlike primary memory, secondary memory cannot be accessed directly by the CPU. Instead of that, secondary memory data is first loaded into the RAM (Random Access Memory) and then sent to the processor to read and update the data. Secondary memory devices also include magnetic disks like hard disk and floppy disks, an optical disk such as CDs and CDROMs, and magnetic tapes.

Features of Secondary Memory

- Its speed is slower than the primary/ main memory.
- Store data cannot be lost due to non-volatile nature.
- It can store large collections of different types, such as audio, video, pictures, text, software, etc.
- All the stored data in a secondary memory cannot be lost because it is a permanent storage area; even the power is turned off.
- It has various optical and magnetic memories to store data.

Q16. Explain various types of secondary memory.

Ans :

The following are the types of secondary memory devices:

1. Hard Disk

A hard disk is a computer's permanent storage device. It is a non-volatile disk that

permanently stores data, programs, and files, and cannot lose store data when the computer's power source is switched off. Typically, it is located internally on computer's motherboard that stores and retrieves data using one or more rigid fast rotating disk platters inside an air-sealed casing. It is a large storage device, found on every computer or laptop for permanently storing installed software, music, text documentation, videos, operating system, and data until the user did not delete.

2. Floppy Disk

A floppy disk is a secondary storage system that consisting of thin, flexible magnetic coating disks for holding electronic data such as computer files. It is also known as Floppy Diskette that comes in three sizes like 8 inches, 5.5 inches and 3.5 inches. The stored data of a floppy disk can be accessed through the floppy disk drive. Furthermore, it is the only way through a new program installed on a computer or backup of the information. However, it is the oldest type of portable storage device, which can store data up to 1.44 MB. Since most programs were larger, that required multiple floppy diskettes to store large amounts of data. Therefore, it is not used due to very low memory storage.

3. CD (Compact Disc)

A CD is an optical disk storage device, stands for Compact Disc. It is a storage device used to store various data types like audio, videos, files, OS, Back-Up file, and any other information useful to a computer. The CD has a width of 1.2 mm and 12 cm in height, which can store approximately 783 MB of data size. It uses laser light to read and write data from the CDs.

Types of CDs

i) **CD-ROM (Compact Disc Read Only Memory):** It is mainly used for bulk size mass like audio CDs, software and computer games at the time of manufacture. Users can only read data, text, music, videos from the disc, but they cannot modify or burnt it.

ii) **CD-R (Compact Disc Recordable):** The type of Compact Disc used to write once by the user; after that, it cannot be modified or erased.

iii) **CD-RW (Compact Disc Rewritable):** It is a rewritable CD disc, often used to write or delete the stored data.

4. DVD Drive/Disc

DVD is an optical disc storage device, stands for Digital Video Display or Digital Versatile Disc. It has the same size as a CD but can store a larger amount of data than a compact disc. It was developed in 1995 by Sony, Panasonic, Toshiba and Philips four electronics companies. DVD drives are divided into three types, such as DVD ROM (Read Only Memory), DVD R (Recordable) and DVD RW (Rewritable or Erasable). It can store

multiple data formats like audio, videos, images, software, operating system, etc. The storing capacity of data in DVD is 4.7 GB to 17 GB.

5. Blu Ray Disc (BD)

Blu Ray is an Optical disc storage device used to store a large amount of data or high definition of video recording and playing other media files. It uses laser technology to read the stored data of the Blu-ray Disk. It can store more data at a greater density as compared to CD/ DVD. For example, compact discs allow us to store 700 MB of data, and in DVDs, it provides up to 8 GB of storage capacity, while Blu-ray Discs provide 28 GB of space to store data.

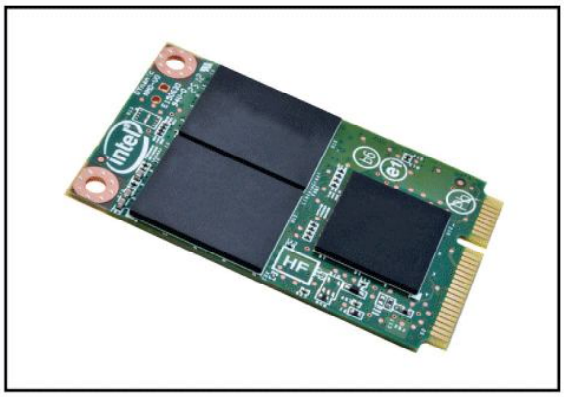
6. Pen Drive

A pen drive is a portable device used to permanently store data and is also known as a USB flash drive. It is commonly used to store and transfer the data connected to a computer using a USB port. It does not have any moveable part to store the data; it uses an integrated circuit chip that stores the data. It allows the users to store and transfer data like audio, videos, images, etc. from one computer to any USB pen drive. The storing capacity of pen drives from 64 MB to 128 GB or more.

Q17. What is cache memory? Write any 2 advantages and disadvantages of cache memory.

Ans :

It is a small-sized chip-based computer memory that lies between the CPU and the main memory. It is a faster, high performance and temporary memory to enhance the performance of the CPU. It stores all the data and instructions that are often used by computer CPUs. It also reduces the access time of data from the main memory. It is faster than the main memory, and sometimes, it is also called CPU memory because it is very close to the CPU chip. The following are the levels of cache memory.



1. **L1 Cache:** The L1 cache is also known as the onboard, internal, or primary cache. It is built with the help of the CPU. Its speed is very high, and the size of the L1 cache varies from 8 KB to 128 KB.
2. **L2 Cache:** It is also known as external or secondary cache, which requires fast access time to store temporary data. It is built into a separate chip in a motherboard, not built into the CPU like the L1 level. The size of the L2 cache may be 128 KB to 1 MB.
3. **L3 Cache:** L3 cache levels are generally used with high performance and capacity of the computer. It is built into a motherboard. Its speed is very slow, and the maximum size up to 8 MB.

Advantages of Cache Memory

1. Cache memory is the faster memory as compared to the main memory.
2. It stores all data and instructions that are repeatedly used by the CPU for improving the performance of a computer.
3. The access time of data is less than the main memory.

Disadvantage of Cache Memory

1. It is very costly as compared to the Main memory and the Secondary memory.
2. It has limited storage capacity.

Q18. Differentiate between Primary and secondary memory.

Ans : **(Dec.-21)**

Primary Memory	Secondary Memory
It is also known as temporary memory.	It is also known as a permanent memory.
Data can be access directly by the processor or CPU.	Data cannot be accessed directly by the I/O processor or CPU.
Stored data can be a volatile or non-volatile memory.	The nature of secondary memory is always non-volatile.
It is more costly than secondary memory.	It is less costly than primary memory.
It is a faster memory.	It is a slower memory.
It has limited storage capacity.	It has a large storage capacity.
It required the power to retain the data in primary memory.	It does not require power to retain the data in secondary memory.
Examples of primary memory are RAM, ROM, Registers, EPROM, PROM and cache memory.	Examples of secondary memory are CD, DVD, HDD, magnetic tapes, flash disks, pen drive, etc.

Q19. Draw and explain a magnetic disk memory. And also explain and explain how to calculate total number of cylinders with an example.

(OR)

A disk has 5268 tracks on each surface. It has 6 plates. How many tracks are there per cylinder? How many tracks are there in the disk.

Ans :

Magnetic disks are smooth metal plates coated on both sides with a thin film of magnetic material. A set of such magnetic plates are fixed to a spindle one below the other to make up a disk pack. The disk pack is sealed and mounted on a disk drive. Such a disk drive is known as a Winchester disk drive. The disk drive consists of a motor to rotate the disk pack about its axis at a speed of around 7200 revolutions per second. The drive also has a set of magnetic heads mounted on arms. The arm assembly is capable of moving in or out in radial direction. Data is recorded on the surface of a disk by the magnetic heads while the disks rotate about their common axis. Thus recording is on concentric tracks on each disk surface. A set of corresponding tracks on all surfaces of a disk pack is called a cylinder. If a disk has n platters, there are 2n surfaces and thus 2n tracks per cylinder. A track is divided into sectors. A sector is the smallest addressable unit in a disk. Thus, Writing/Reading of a disk is in sectors. If a string of bytes to be written is less than the capacity of a sector then the last byte is duplicated to fill up available sector space and the

result is stored in a sector. If a disk has p sectors per track and a sector stores s bytes, then the storage in each track is p x s bytes. If the disk has t tracks per surface and there are m surfaces, the total capacity of the disk is:

Total capacity = p × s ×1 × m bytes

Example

A hard disk has 5268 tracks on each surface. It has six plates. How many tracks are there per cylinder? What is the total number of cylinders in the disk? How many tracks are there in the disk?

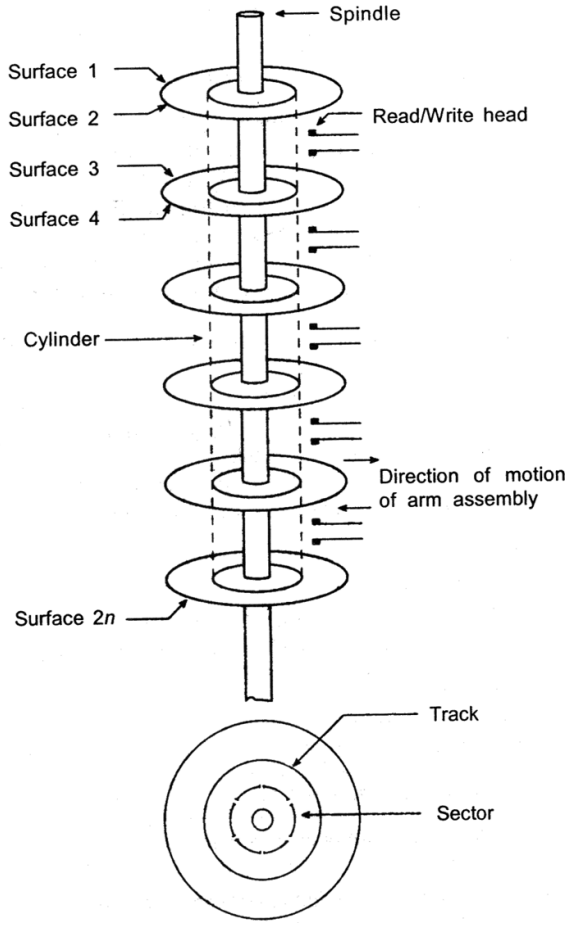


Fig.: A magnetic Disk Memory

Solution:

There are six plates and hence 12 surfaces. The corresponding tracks in all the surfaces constitute a cylinder. Thus there are 12 tracks in each cylinder. Total number of cylinders = Tracks per surface = 5268. Total number of tracks = Tracks per surface × number of surfaces = 5268 × 12 = 63216.

Q20. Why floppy disk drives are becoming obsolete and being replaced by flash memories.

Ans :

Another secondary memory which is popular is a floppy disk drive. The capacity of a floppy disk is thousand times smaller than that of a hard disk. Further, the time to access data stored in a floppy drive is at least 10 times slower compared to a hard disk. The cost of a floppy drive is however lower. Nowadays floppy disk is not used as an on-line memory as it is slow and also because data in it may be lost due to wear and tear. The wear and tear is due to the fact that the read/write head is in physical contact with the disk surface during its operation.

Floppy disks are made of magnetic oxide-coated thin Mylar sheets thickness of a sheet of paper. This flexible sheet is cut into circular pieces 3.5 inches (or 8.9 cm). As the material used for storage of data is not a hard plate but a flexible circular sheet, it is called a "floppy disk". The floppy disk is packaged in a 3.5 inch square hard plastic envelope with a long slit for read/write head access, and a hole in the centre for mounting the disk drive hub. The floppy disk along with the envelope is slipped into the drive mechanism. The mechanism holds the envelope, and the flexible disk is rotated inside the envelope by the drive mechanism. The inner side of the envelope is smooth and permits free rotation of the magnetic sheet. The read/write head is held in physical contact with the floppy disk. The slit for read/write remains closed until the disk is inserted into the drive. The slit opens when the disk starts spinning. The head is moved radially along the slit. Data is recorded in concentric tracks.

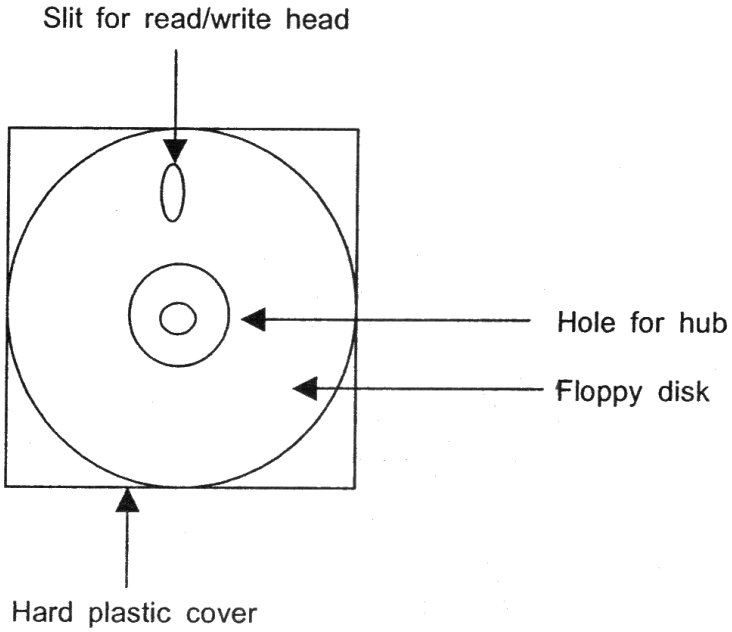


Fig.: A Floppy Disk

The capacity of a floppy disk is 1.44 MB and the transfer rate is around 40 KB/s. For reading or writing on the disk, the head is to be in contact with the disk surface. Thus both the disk and the head wear out. Manufacturers guarantee 2 million read/write operations on a floppy disk. You should contrast this with a hard disk drive where the read/write head floats on a thin layer of air and it is called non-contact recording and there is no wear and tear. The read/write speed of a hard disk is also much higher.

We must emphasize again the need to distinguish between a drive mechanism and the medium in which data is recorded. In the case of a floppy disk, the medium is a floppy disk which is removable from the drive. As the disk is removable, it can be used to record data which can be sent by mail or by courier. For example, if you write an article for a magazine it can be stored in a floppy disk and mailed to the magazine. This is called soft copy. The printed text is called the hard copy.

In contrast to this, hard disks are sealed inside an enclosure and fixed to the drive, they are not removable. One major disadvantage of floppy disk is its limited storage capacity. Floppy disk technology, however, is making rapid strides. Some of the technology used in hard disks such as non-contact recording and magneto-resistive heads are being used in the design of recent floppy disk drives. Sony and Fuji have a new recording format called HiFD for storing data on a floppy disk. With this technology it is possible to store 200 MB on a 3.5 inch floppy disk and it is backward compatible with the more common 1.44 MB floppy disk. The major application of a floppy disk nowadays is as a medium in which data can be downloaded from a computer and sent by mail. The limited capacity makes it difficult to download multimedia such as audio or video files on a floppy. Thus floppy is becoming obsolete and being replaced by flash memories.

2.1.6 Compact Disk Read only Memory (CDROM)

Q21. Explain in detail about CDROM.

Ans :

A CDROM disk is a circular shiny metal-like disk whose diameter is 5.25 inches. It can store 650 MB which is equivalent of 3,00,000 pages of printed text. As the name implies, we assume that data on a CDROM is pre-recorded and it is read using a CDROM drive.

The data on a CDROM is recorded as a sequence of lands and pits along spiral tracks. The data stored on CDROM is read by inserting the disk in the drive. A drive in the motor rotates the disk at a speed of 360 revolutions per second. A sharply focused laser beam senses pits and lands as the disk rotates. This is converted to Is and 0s by an electronic interface unit.

CDROM disk speed is indicated using the notation nx, where x is an integer indicating the original nominal speed of 150 KB/s and n is the factor by which it is to be multiplied. Thus a CDROM drive specified as 52x has a speed of 52 x 150 KB/s = 7.8 MB/s.

A standard has been evolved for storing data on CDROM. Such a standard is essential to widely distribute recorded CDs which can be read by different manufacturers' computers which may also use different operating systems.

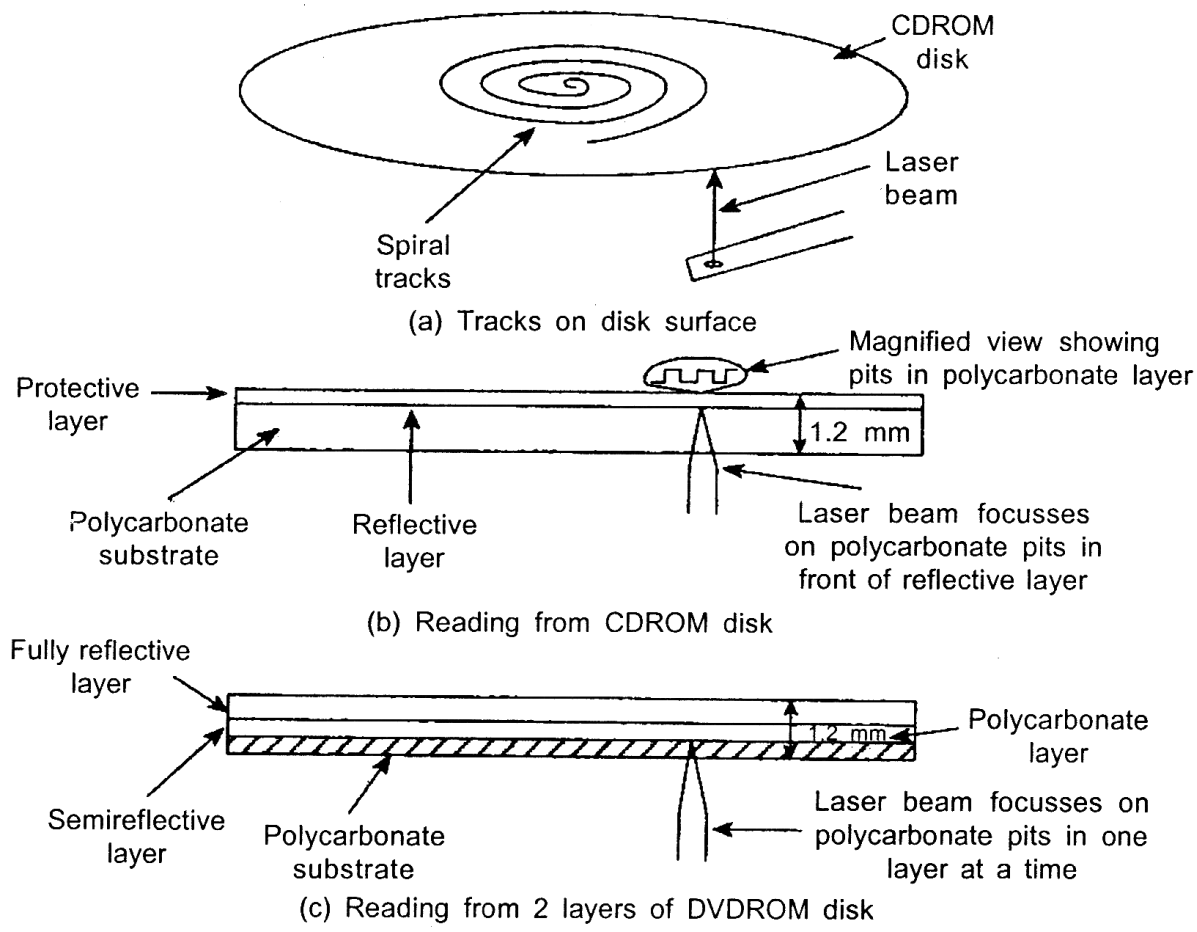


Fig.: CDROM and DVDROM

The current standard is called ISO 9660, standardized by the International Standards Organization which has been accepted by all CDROM vendors. This standard defines a Volume Table of Contents (VTOC) which allows opening any one of 140,000 files with a single seek using directories in the CDROM. A software developed by Microsoft Corporation known as MSCDEX (Microsoft CD Extension) allows reading of CDROMs on a PC. MSCDEX makes a CDROM look like a large hard disk to a programmer. Nowadays most software is distributed on CDROMs by vendors and thus it is essential to have a CDROM drive on a PC or any other computer.

Major applications of CDROMs are:

1. Distribution of software.
2. Distribution of large texts such as encyclopedias, big manuals, conference proceedings, etc.
3. Distribution of multimedia files—that is, text, audio, graphics and video clips used in education and entertainment. CDROMs used to record movies are often called Video Cassette Disk (VCD).

If a CDROM is properly handled, it is estimated that it can preserve stored data for 100 years. The only problem is that with development of technology, the models'of CDROM readers will change and old CDROMs may not be compatible with new readers.

CDROM - Recordable

Hitherto the primary method of producing and distributing CDROM has been to store the data to be recorded on a CDROM on a magnetic tape in ISO 9660 format and send it to a CDROM producer who creates a CDROM master using expensive equipment. This master is used to produce multiple copies which are tested and labelled. This is economical for producing a large number of copies. For producing a single copy or a few copies, a writable CD drive is required. When data is written using such a drive, it should be readable on any standard CDROM reader. Such a CD writer is available now.

The medium used as a writable CD is of standard CD size (5.25 inches diameter disk) made of polycarbonate with a groove cut on it. The groove is covered by a photosensitive dye above which there is a layer of gold (called reflective layer) and finally a protective layer. The writable CD is mounted on the CD writer and is rotated by a motor. A laser beam is used to write data on the disk. For writing a 1, the laser beam is turned on. The laser beam fuses the dye to the substrata forming a pit. When a 0 is to be written, the laser beam is not turned on, thus leaving a "land". When this disk is inserted in a CD reader, it will sense "lands" and "pits" and correctly interpret the sequence of Os and Is written on the CDROM.

Data to be written on a CD is first stored in a hard disk using ISO 9660 format. It is streamed at the rate of 300 KB/s to the CD writer which steers it to the write head which is a laser beam. The beam is modulated depending on whether a 0 or a 1 is to be written. The writer's laser drive head writes the data. Writing has to be done in one session, that is, a whole CDROM has to be recorded in one go. The recorded disk can be read on any ordinary CDROM drive. Once a blank CD is written, it cannot be erased and rewritten. Thus, CDROM is not a read/write memory like a floppy disk. Recently, rewritable CDROM media have emerged. In this type of CDROM if a mistake is made in writing, the entire CD contents has to be erased and new data will have to be rewritten.

Digital Versatile Read Only Memory (DVDROM)

DVDROM uses the same general principle as a CDROM. Pre-recorded DVDROMs are more common. Recordable DVDROMs are slowly appearing in the market but as of now they are not widely used. Pre-recorded DVDROMs are primarily used to store large video files as their capacity is very high compared to CDROM.

A DVDROM reader also uses a laser beam to read pits and lands as in a CDROM. The wavelength of the laser beam is however much smaller. Data is recorded on two different layers on the disk. The pits are much smaller as a shorter wavelength laser beam gives a smaller focused spot. This allows more data to be recorded on a track and also allows tracks to be closer to one another. The capacity of DVDROM is thus 8.5 GB which is much higher than the 650 MB capacity of CDROM. Another variety of DVDROM has data recorded on both sides. This, of course, requires the DVDROM to be reversed to read the reverse side. With double sided data recording, the capacity is double that of a single side record, that is, 17 GB.

The lx speed of DVDROM is 1.38 MB/s as against 150 KB/s of CDROMs. The high capacity of DVDROMs allows them to store full length movies (1½ to 3 hours) in a compressed form.

2.1.7 Archival Memory

Q22. What is archival Memory ? What are the properties of archival memory?

Ans :

By archival memory we mean a storage device used to store data to be preserved. It is necessary to keep a duplicate copy of important data being used in an on-line application so that if there is a failure of the secondary memory we can use the copy to restore the data and continue work. We also saw that some of the data after they are used and not required for further on-line processing are removed from the on-line storage and a duplicate copy kept either for legal purposes or for further analysis. These duplicates are kept in what are known as archival storage units.

The main properties of an archival storage unit are:

1. The medium used for storage should be removable from the drive.
2. It should be a writable memory.
3. The size must be appropriate for the application - normally quite large - a few gigabytes.
4. It should not be volatile - it should retain data stored in it for a considerable time.

2.2 CENTRAL PROCESSING UNIT (CPU)

2.2.1 Introduction

Q23. Define CPU.7

Ans :

Stands for "Central Processing Unit." The CPU is the primary component of a computer that processes instructions. It runs the operating system and applications, constantly receiving input from the user or active software programs. It processes the data and produces output, which may stored by an application or displayed on the screen.

The CPU contains at least one processor, which is the actual chip inside the CPU that performs calculations. For many years, most CPUs only had one processor, but now it is common for a single CPU to have at least two processors or "processing cores." A CPU with two processing cores is called a dual-core CPU and models with four cores are called quad-core CPUs. High-end CPUs may have six (hexa-core) or even eight (octo-core) processors. A computer may also have more than one CPU, which each have multiple cores. For example, a server with two hexa-core CPUs has a total of 12 processors.

While processor architectures differ between models, each processor within a CPU typically has its own ALU, FPU, register, and L1 cache. In some cases, individual processing cores may have their own L2 cache, though they can also share the same L2 cache. A single frontside bus routes data between the CPU and the system memory.

Q24. List out various types of CPU's.

Ans : **(Imp.)**

Types of CPU

CPUs are mostly manufactured by Intel and AMD, each of which manufactures its own types of CPUs. In modern times, there are lots of CPU types in the market. Some of the basic types of CPUs are described below:

1. Single Core CPU

Single Core is the oldest type of computer CPU, which was used in the 1970s. It has only one core to process different operations. It can start only one operation at a time; the CPU switches back and forth between different sets of data streams when more than one program runs. So, it is not suitable for multitasking as the performance will be reduced if more than one application runs. The performance of these CPUs is mainly dependent on the clock speed. It is still used in various devices, such as smartphones.

2. Dual Core CPU

As the name suggests, Dual Core CPU contains two cores in a single Integrated Circuit (IC). Although each core has its own controller and cache, they are linked together to work as a single unit and thus can perform faster than the single-core processors and can handle multitasking more efficiently than Single Core processors.

3. Quad Core CPU

This type of CPU comes with two dual-core processors in one integrated circuit (IC) or chip. So, a quad-core processor is a chip that contains four independent units called cores. These cores read and execute instructions of CPU. The cores can run multiple instructions simultaneously, thereby increases the overall speed for programs that are compatible with parallel processing.

Quad Core CPU uses a technology that allows four independent processing units (cores) to run in parallel on a single chip. Thus by integrating multiple cores in a single CPU, higher performance can be generated without boosting the clock speed. However, the performance increases only when the computer's software supports multiprocessing. The software which supports multiprocessing divides the processing load between multiple processors instead of using one processor at a time.

2.2.2 The structure of a CPU

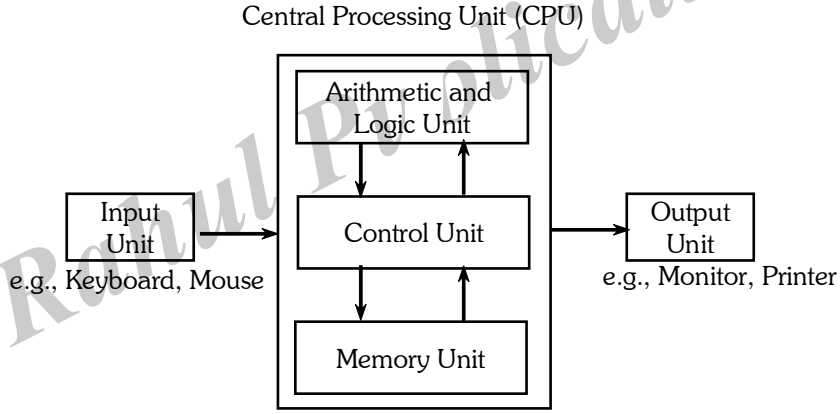
Q25. Draw and explain block diagram of CPU.

(OR)

Explain organization of CPU and other units of a computer.

Ans : **(Dec.-21)**

The computer system is nothing without the Central processing Unit so, it is also known as the brain or heat of computer. The CPU is an electronic hardware device which can perform different types of operations such as arithmetic and logical operation.



The CPU contains two parts: the arithmetic logic unit and control unit. We have discussed briefly the arithmetic unit, logical unit, and control unit which are given below:

i) Control Unit

The control unit (CU) controls all the activities or operations which are performed inside the computer system. It receives instructions or information directly from the main memory of the computer.

When the control unit receives an instruction set or information, it converts the instruction set to control signals then; these signals are sent to the central processor for further processing. The control unit understands which operation to execute, accurately, and in which order.

ii) Arithmetic and Logical Unit (ALU)

The arithmetic and logical unit is the combinational digital electronic circuit that can perform arithmetic operations on integer binary numbers It presents the arithmetic and logical operation. The outputs of ALU will change asynchronously in response to the input. The basic arithmetic and bitwise logic functions are supported by ALU.

iii) Storage Unit

The information or set of guidelines are stored in the storage unit of the computer system. The storage unit provides the space to store the data or instruction of processed data. The information or data is saved or hold in computer memory or storage device. The data storage is the core function and fundamental of the computer components.

Q26. Explain Representative instruction set interpreted by a CPU.

Ans :

The CPU is designed to interpret and carry out a number of operations, called its instruction set. The instruction set consists of a variety of operations required to solve problems. A representative set of instructions is given in Table.

Table: Representative Instruction Set Interpreted by a CPU

Type of operation	Mnemonics	Examples
Arithmetic	ADD, SUB, MUL, DIV, INC, DEC	Add, Subtract, Multiply, Divide, Increment, Decrement
Logical	COM, AND, OR, NOT	Compare, Bit operations (AND, OR, NOT)
Control	JMP, JNE, JEQ, STOP	Jump, Jump if negative, Jump if equal, Stop
Memory	LOAD, STO	Load register from memory, Store register in memory.
Input/Output	READ, DIS, PRT	Read, Display, Print

Normally an instruction should specify the following:

1. The operation to be performed.
2. The location in which the operands are stored in the main memory. The place in main memory where the operand is stored is called the address of the operand. The number of addresses specified in an instruction depends on the type of CPU. Some processors specify only one address, whereas others specify two or three operand addresses.
3. From which address in main memory the next instruction is to be taken. Normally, instructions are stored in successive addresses and instructions are executed sequentially. The normal flow is changed in some programs based on some inputs or results of previous operations.

Q27. Explain in detail how instructions get executed in CPU with a basic example program.

Ans :

We will describe the working of CPU using this idea. We will start with a very simple example of adding two numbers. A program to add two numbers stored in addresses A and B is given as Table. These instructions are stored in memory.

Table: A Program to Add Two Numbers

Address where an instruction is stored in memory	An instruction		Explanation
	Operation code	Address of operand	
01	READ	A	Read number from input and store in address A of memory
02	READ	B	Read number from input and store in address B of memory
03	LOAD	A	Take number from address A and put it in CPU register
04	ADD	B	Add to CPU Register number stored in address B of memory
05	STO	C	Take the sum from CPU register and store in C of memory
06	DIS	C	Display on VDU the number stored in C
07	STOP		Stop execution

1. Read and store the program in the main memory of the computer. One instruction is stored in each address of memory.
2. Place the address of first instruction in an instruction counter in CPU.
3. Retrieve the instruction from the main memory. The address from where it should be retrieved is specified in the instruction counter (here it is 01). Place the instruction in a register called Instruction Register of CPU (A register is a temporary store in which data can be placed. When new data is placed in a register, the earlier contents are automatically erased and new value is stored.
4. Add 1 to instruction counter so that it now has the address of the next instruction in memory.

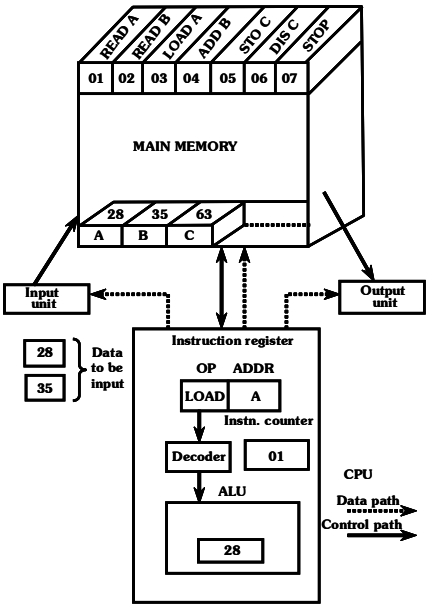


Fig.: Instruction storage in main memory and logical units in CPU for executing instructions.

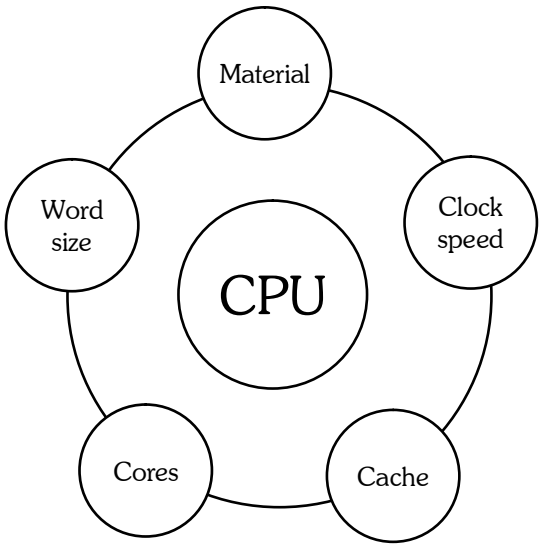
5. In step 3 instruction from address 01 was placed in the instruction register. The instruction register consists of two parts, one part is used to store the operation code and the other the address of the operand. Decode the operation code.
6. The operation code is READ. The address part is A. Thus a command is issued to the input unit to read the data waiting at the input unit and place it in address A in the main memory.
7. The CPU refers to the address specified in the instruction counter (which is now 02). It retrieves the instruction from there, namely, READ B and places it in the instruction register. On decoding it, the CPU sends a command to the input unit to read the data waiting there and store it in address B in the main memory.
8. The next instruction is now placed in the instruction register. The operation code is LOAD and the address is A. This instruction commands that the contents of address A be taken and placed in ALU register in the CPU. Thus the number 28 is stored in it.
9. The next instruction is ADD B. On decoding this instruction, the contents of B, namely, 35, is added to the contents of ALU register. The sum is 63 which is now in the ALU register.
10. The next instruction is STO C. When decoded it commands that the contents of the ALU register be stored in address C of main memory. Thus the sum 63 is stored in address C of main memory.
11. The next instruction is DIS C. When decoded, it commands that the contents of C, namely, 63, be displayed.
12. The last instruction is STOP, which stops the CPU from doing anything more.

2.2.3 Specifications of CPU

Q28. Explain various characteristics of CPU.

Ans : **(Dec.-21, Imp.)**

Not all CPUs are equal! There are a number of reasons for this.



i) Materials

Just like cars or phones or anything else you buy, CPUs are made up of materials and some materials have a better quality than others. The quality of materials that make up a processor will affect the reliability, speed and performance of a CPU. A component in a CPU that is very slow and poorly made will slow down the overall performance of the CPU.

ii) Clock speed

CPUs have a clock inside them, ticking away. Instructions are carried out each time a tick of the clock happens. Some instructions only need one clock tick whereas others will need more than one. The faster the clock, the more instructions you can carry out in any second. A typical clock these days might be 4 Gigahertz or 4 billion ticks a second, for example.

iii) Cache

Although CPUs fetch instructions from RAM, there is another place in can get instructions from, called 'cache'. Cache is just like RAM but much faster to read from and write to compared to RAM. The computer cleverly puts data into cache that it needs again and again. It is a lot quicker for the CPU to get data from cache than RAM. The more cache a computer has, the better the CPU will perform.

iv) Cores

A CPU traditionally had one 'core' but processors these days might be dual-core or quad-core, for example. A core is actually a processor

with its own cache. So a dual-core CPU has not one but two processors. A quad core CPU has four processors. Two brains (or four brains) are better than one! Each brain can be working on different parts of a program at the same time and so this speeds up the overall CPU's performance.

v) Word size

Processors work on instructions and data, which it has fetched from RAM. These instructions and data are in binary. If a processor can work on this number: 0111 0011 1111 1111 then it is said to be a 16 bit processor. But if a processor can work on 32 bits (a 32 bit processor) in one go or even on 64 bits (a 64 bit processor) in one go then it can work on more data and more instructions for every tick of the CPU's clock. The word size simply refers to the number of a bits a CPU can work on in one go. The bigger the word size, the better the CPU's performance will be.

2.2.4 Interconnection of CPU with memory and I/O Units

Q29. Draw and explain configuration of buses connecting CPU with main memory and I/O Units.

Ans : **(Imp.)**

Instructions to be executed by a CPU are retrieved from the main memory interpreted by it and executed. CPU coordinates the execution of instructions. The CPU is connected to the main memory by a set of parallel wires called a bus. Bits are transferred from memory to CPU and back via a bus. There are two buses which connect CPU to memory. One is the address bus which carries the address bits to the MAR of memory from the CPU and the other is called the data bus which carries the data/instructions from CPU to the MDR of memory. Besides these two buses, there is also one more bus called control bus which controls a large number of operations such as Read/Write from or to memory and also input/output operations. The number of parallel wires constituting a bus is called bus width. If MAR has 24 bits (16 MB memory), then the address bus width is 24. Normally we retrieve an instruction from memory and place it in CPU in one memory read cycle. Thus the size of the data bus from the memory to CPU equals the number of bits in an instruction also called CPU word length. Most current CPUs, for example, Intel processors used in PCs, have a word length of 32 bits and hence a data bus width of 32. The instruction width of the new Very Long Instruction Word (VLIW) processor (called IA-64 by Intel) is 128 bits and therefore the data bus width is 128 bits. The number of bits in the control bus depends on the signals required to coordinate input/output units as well as the main memory. It is normally around 16. The interconnection of CPU, memory and I/O units with buses is shown in Figure.

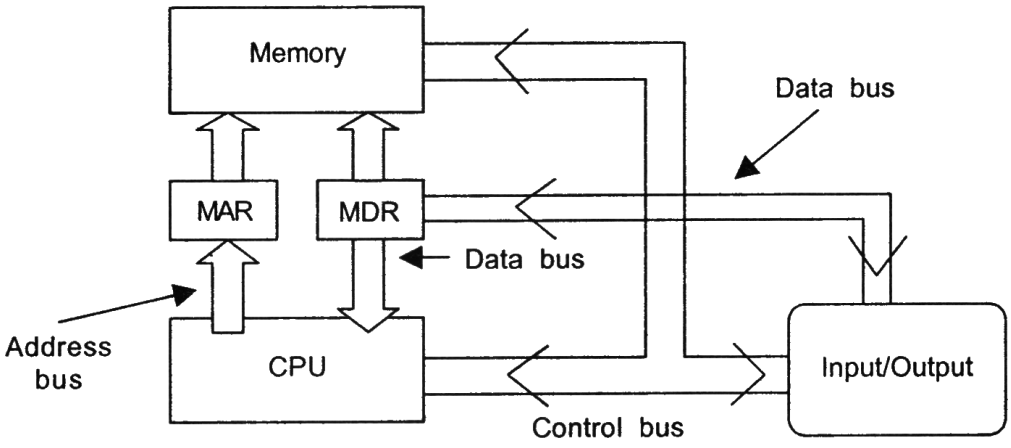


Fig.: Configuration of Buses connecting CPU with main memory and input/output units

The three buses, namely, data bus, address bus, and control bus emanate from the CPU chip and are used to connect the CPU to both memory and I/O units. This collection of buses is called a system bus. The structure of these buses, i.e., the number of wires, speed of transmission of data and length are normally standardized by an industry group. This standardization is essential to allow diverse manufacturers of various peripheral devices such as CDROM, VDU, keyboard to design devices which can be easily connected to a PC. This is a great boon to consumers as competitors can build peripherals at reasonable cost. Further, many new device manufacturers, such as say a digital video camera manufacturer can design and incorporate an interface in his device so that it can be plugged to a standard PC and data recorded in it downloaded to PC for editing, storage, etc.

The bus standards also evolve with time as PCs become more powerful. An early standard was ISA (Industry Standard Architecture) for 8 bit PCs of the first generation. It evolved into EISA (Extended ISA) which is a faster 32 bit bus. Another standard proposed by Intel is PCI (Peripheral Component Interconnect) bus which allows 32 and 64 bit implementations. It can be run at 33 MHz and one can connect to 16 peripheral devices. Advertisements for PCs mention the standard used by the particular PC manufacturer.

The CPU, Memory and integrated circuits necessary to connect I/O units to the CPU and main memory are all mounted on what is called a motherboard. Motherboards are assembled and sold by reputed vendors such as Intel. There are also many competitors who make motherboards which are bought by vendors who assemble PCs. The motherboard also has a ROM where a program called BIOS (Basic Input Output System) is stored to control all the peripheral devices connected to a computer.

A motherboard has a set of connection points called ports to connect units such as disk, VDU, keyboard, etc. Besides that, it has a set of parallel wires (bus) connected to a pluggable connector to attach I/O units such as hard disk, CDROM, etc. The motherboard is mounted in a case and constitutes a "PC box". Devices such as VDU, keyboard and mouse are outside this box. At the back of PC box or cabinet, sockets called ports are placed to connect peripherals as shown in Figure.

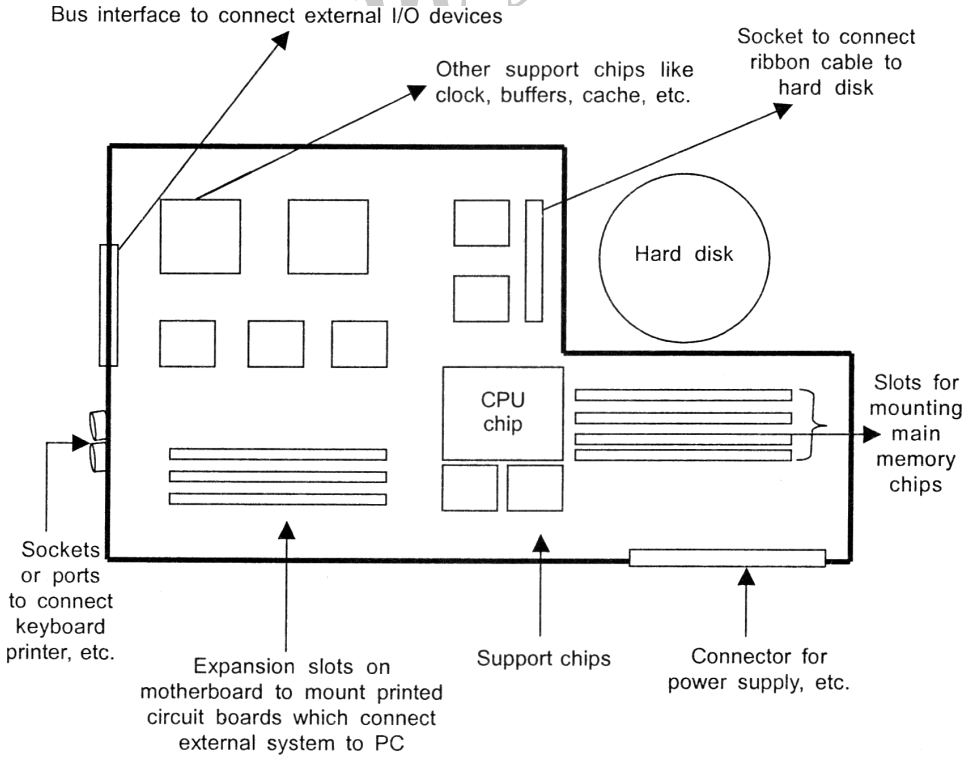


Fig.: Sketch of motherboard of a PG showing important components

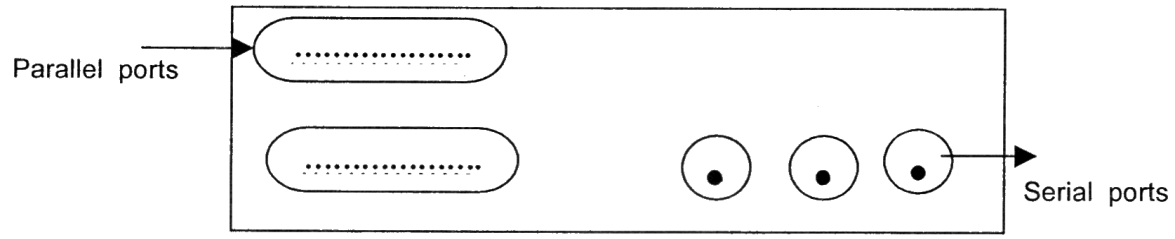


Fig.: Parallel and serial port at the back of PC cabinet

In a parallel port data on parallel lines coming from the motherboard are connected. They are transmitted to peripherals via a set of parallel wires (called ribbon cables). As all bits travel in parallel, these ports carry 16 to 32 bits simultaneously. They are thus faster compared to serial ports which transmit single bits serially, that is, one after another. Faster peripherals such as hard disk are connected to parallel ports. Serial ports which carry one bit at a time from the motherboard are connected to slower devices such as keyboard, printer, etc. A standard serial bus is known as Universal Serial Bus (USB) and is currently very popular. A device connected to PC via USB in turn has one or more USB ports. This allows more devices to be connected to the PC. This is called daisy chaining Figure.

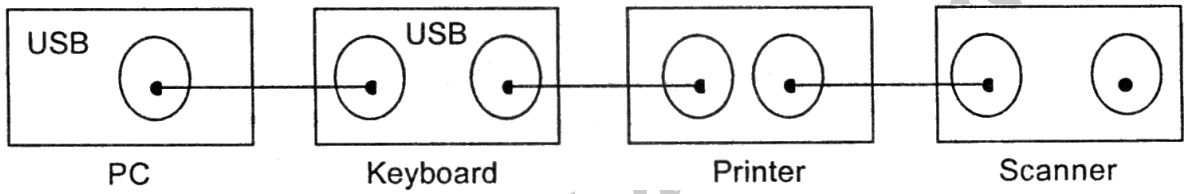


Fig.: Daisy Chaining Peripheral using USB port

The advantage of USB is that it is a thin wire which is easy to connect. It is not necessary to open a PC to connect new devices. Further, with USB standard a new peripheral can be added while PC is on and working. This is called hot plugging. Also when new peripherals are added the PC software automatically recognizes it without having to install new programs.

2.2.5 Embedded processors

Q30. Why we use embedded processors.

Ans : **(Aug.-21)**

So far we have discussed what are known as general purpose processors. These are used in PCs and other computers employed in day-to-day data processing jobs such as calculation of payrolls, word processing, bus reservation, etc. They are also used nowadays for processing images, audio and video. As we pointed out at the beginning of this chapter, special purpose or embedded processors are used for many other jobs such as washing machine control, steering and other controls in motor cars, and VCD operation. These processors have a much simpler structure and are designed to interpret and execute a small variety of instructions. They are also inexpensive as they are used in consumer goods which have to be sold at competitive prices.

There are two major categories of embedded processors. One of them is called microcontroller which is primarily used for controlling appliances such as washing machines. The other is called digital signal processor. Digital signal processors are used to process audio and video signals and are used in CD players, cell phones, digital cameras, etc. These processors are called embedded processors as they are integrated as a part of the system in which they are employed.

Q31. Draw and explain internal structure of a single chip microcontroller.

Ans : **(Aug.-21)**

Microcontrollers are programmed to cycle through a set of states based on the occurrence of some events. An example is an automatic washing machine. When clothes are put in a washing machine with necessary detergent powder, one can set water level based on the weight of clothes load. One can also set a wash time and spin time for drying. When the machine is turned on, a valve in the water inlet opens. A water level sensor senses the water level and when it reaches a specified level, the machine goes to wash cycle. Washing continues till the preset time is reached. It then gets into a rinse cycle which is usually a fixed time. When rinsing is over a valve opens and drains the water. When all the water is drained, fresh water is let in automatically under the microcontroller's command upto a specified level. Rinsing is done again for a preset time at which time the water outlet valve opens to drain the machine. When fully drained, the machine enters a spin drying cycle. This cycle ends when the preset time is reached. The machine now gives a beeping sound indicating end of wash. The actions which take place are summarized in Table.

Table: Washing Machine Control

Event	Action
Press start	Open inlet valve, fill tub
Tub full	Close inlet vale, start wash cycle
Wash time over	Open outlet valve
Tub empty	Close outlet valve, open inlet valve
Tub full	Close inlet valve, start rinse cycle
Rinse time over	Open outlet valve
Tub empty	Start spin cycle to dry clothes
Drying time over	Close outlet valve, activate beeper

Observe that the system follows a specific sequence determined by various events and by sensing the timer. A microcontroller is designed to support such sequential control applications.

The basic differences between a general microprocessor and a special purpose microcontroller are:

- Microcontrollers have a built-in ROM within the processor chip to store the control program for the specific application.
- They have a small RAM for storing data temporarily. The size is of the order of 128 bytes.
- The word size is usually 8 bits so that the limited ROM space can be used effectively.
- They have built-in counters and timers which can be set by users.
- Some microcontrollers have a small processor to perform logic operations on binary conditions (i.e., on-off).
- They have built-in input/output ports for easy interaction with devices external to the controller.

Very little external circuitry is needed for the microcontroller to effectively perform its function. The cost of a microcontroller is a fraction of the cost of a general purpose microprocessor.

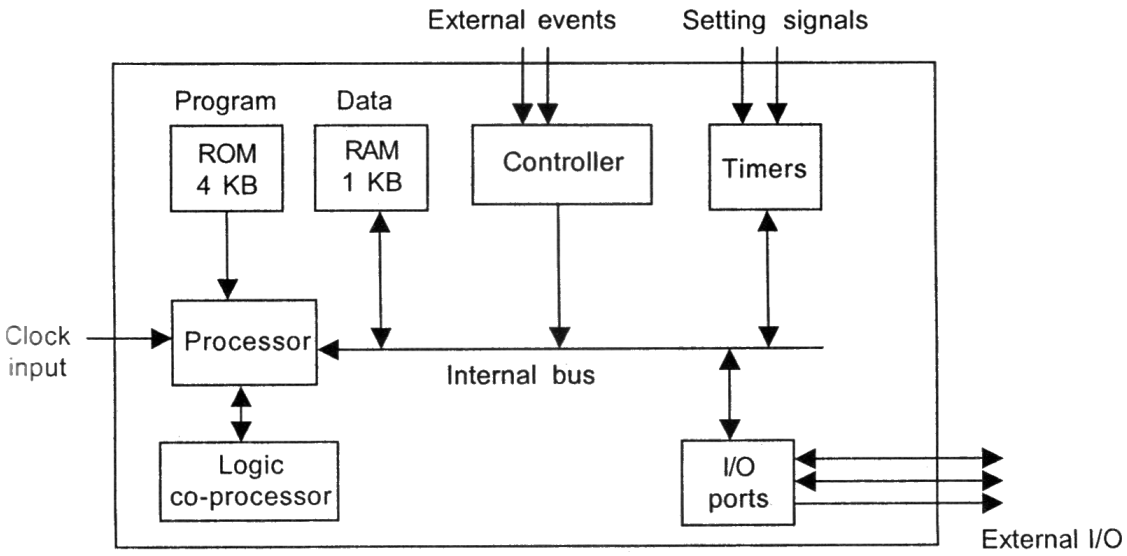


Fig.: Internal Structure of a Single Chip Microcontroller

Currently the most popular microcontroller is Intel's model 8051. The cheapest model has 4 KB ROM for programs and 128 bytes of RAM. The program is factory programmed for each specified application. Before burning the ROM, a prototype with EEPROM is used to test the system. Versions of microcontrollers which consume very little power are now available for use in portable systems.

Development systems with necessary software are available for various models of microcontrollers. Development systems are used to create bug tree application programs before microcontrollers are integrated into systems such as washing machines.

Q32. Draw and explain basic block diagram of the internal structure of a digital signal processors.

Ans :

Digital Signal Processors (DSP) are optimized to process real-time audio and video signals. By real-time we mean the time we measure with our watches. For example, cricket match shown on TV "live" is real-time whereas the replay shown later on is not. A real-time processor accepts input signals while it is being generated, for example, a telephone conversation. Digital signal processors are widely used in cost-sensitive consumer products such as hi-fi audio systems, TVs, etc., and thus their cost must be much lower than that of general purpose processors such as Pentium. Whereas general purpose processors cost around Rs. 5000, DSPs cost around Rs. 500.

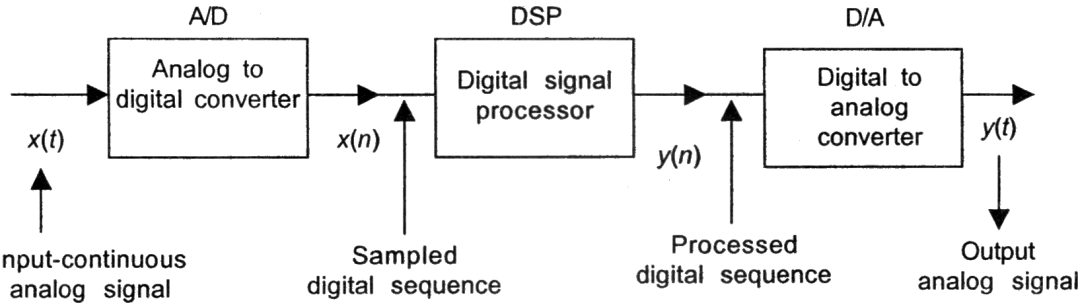


Fig.: Analog Input/Output to DSP

Most DSP applications for audio signal processing perform operations using formula of the type

$$y(n) = x(l)\ h(n-1) + x(2)h(n-2) + x(3)h(n-3) + \ldots + x(m)\ h(n-m)$$

where y(n) is the nth sample output, x(l), x(2), x(3), ..., etc., are input samples of x{t) (a function of time) at equal intervals, and h(n - 1), h(n - 2), ..., etc., are called weights whose values are adjusted based on the type of processing. Observe that we need to multiply and add. A unit called Multiply Accumulate Unit (MAC) is thus an integral part of DSPs. The arithmetic is to be done while the input data is streaming in and no input sample should be missed. Thus DSPs have fast arithmetic unit with two ports. One port continuously reads while the other port simultaneously outputs the processed stream of bits. DSPs normally have two different memories on chip-one for data and the other for program. There are two independent paths from the two memories to CPU so that an instruction can be fetched from the instruction memory while a result is being written in the data memory. To summarize the most important units of a DSP are:

- An A/D converter
- A D/A converter
- A Multiply Accumulate Unit
- A fast ALU which handles real-time arithmetic
- An on-chip data memory
- An on-chip program memory

A block diagram giving the internal structure of a DSP is given in Figure.

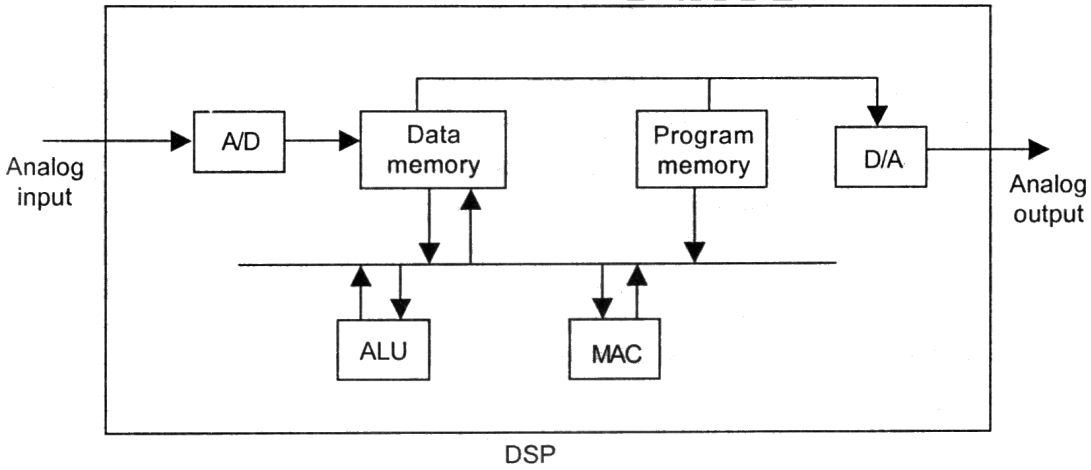


Fig.: Basic Block Diagram of the Internal Structure of a DSP

Observe the differences between this and general purpose processor structure. Video signals have 1000 times higher bandwidth. Thus the processing rate must be 1000 times faster. With better integrated circuit technology, real-time processing of video signals with DSP is also becoming feasible.

Short Question and Answers

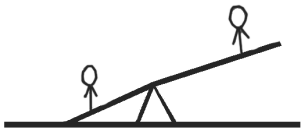
1. What is memory cell ? Explain with example.

Ans :

Memory Cell

Memories in computers are made using what we call memory cells. A variety of memory cells are used to fabricate memories. A common characteristic of all cells used in today s computers is that they can be in one of two stable states. By a stable state we mean that the cell remains in that state unless it is intentionally disturbed. A simple example of a system with two stable states is a seesaw you find in children's playground. It is shown in Figure. The seesaw will remain in state 1 as long as a child sits as shown. If a heavier child sits on the opposite end of the seesaw, it will go to stable state 2.

Stable State 1



Stable State 2

Fig.: A Seesaw in one of the Two Stable States

The other properties of a memory cell which are important in today's memories are:

1. Whether continuous supply of power is necessary for a cell to continue to remain in a stable state.
2. Whether a bit once written is permanently stored and cannot be altered by a user.
3. The time needed to write/read a bit in a cell.

A typical memory cell is shown in Figure.

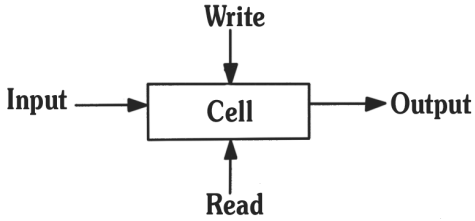


Fig.: A memory cell

2. What is the use of primary memory?

Ans :

Primary memory is also known as the computer system's main memory that communicates directly within the CPU, Auxiliary memory and the Cache memory. Main memory is used to kept programs or data when the processor is active to use them. When a program or data is activated to execute, the processor first loads instructions or programs from secondary memory into main memory, and then the processor starts execution. Accessing or executing of data from primary memory is faster because it has a cache or register memory that provides faster response, and it is located closer to the CPU. The primary memory is volatile, which means the data in memory can be lost if it is not saved when a power failure occurs. It is costlier than secondary memory, and the main memory capacity is limited as compared to secondary memory.

The primary memory is further divided into two parts:

i) RAM (Random Access Memory)

ii) ROM (Read Only Memory).

3. What is Cache memory?

Ans :

It is a small-sized chip-based computer memory that lies between the CPU and the main memory. It is a faster, high performance and temporary memory to enhance the performance of the CPU. It stores all the data and instructions that are often used by computer CPUs. It also reduces the access time of data from the main memory. It is faster than the main memory, and sometimes, it is also called CPU memory because it is very close to the CPU chip.

4. What are the differences between SRAM and DRAM.

Ans :

SRAM	DRAM
It is a Static Random-Access Memory.	It is a Dynamic Random Access Memory.
The access time of SRAM is slow.	The access time of DRAM is high.
It uses flip-flops to store each bit of information.	It uses a capacitor to store each bit of information.
It does not require periodic refreshing to preserve the information.	It requires periodically refreshing to preserve the information.
It uses in cache memory.	It is used in the main memory.
The cost of SRAM is expensive.	The cost of DRAM is less expensive.
It has a complex structure.	Its structure is simple.
It requires low power consumption.	It requires more power consumption.

5. Write any 4 advantages and disadvan-tages of RAM.

Ans :

Advantages of RAM

- It is a faster type of memory in a computer.
- It requires less power to operate.
- Program loads much faster
- More RAM increases the performance of a system and can multitask.
- Perform read and write operations.
- The processor can read information faster than a hard disc, floppy, USB, etc.

Disadvantages of RAM

- Less RAM reduces the speed and perfor-mance of a computer.
- Due to volatile, it requires electricity to preserve the data.
- It is expensive than ROM
- It is unreliable as compared to ROM
- The Size of RAM is limited.

6. State the differences between RAM and ROM.

Ans :

RAM	ROM
It is a Random-Access Memory.	It is a Read Only Memory.
Read and write operations can be performed.	Only Read operation can be performed.
Data can be lost in volatile memory when the power supply is turned off.	Data cannot be lost in non-volatile memory when the power supply is turned off.
It is a faster and expensive memory.	It is a slower and less expensive memory.
Storage data requires to be refreshed in RAM.	Storage data does not need to be refreshed in ROM.
The size of the chip is bigger than the ROM chip to store the data.	The size of the chip is smaller than the RAM chip to store the same amount of data.
Types of RAM: DRAM and SRAM	Types of ROM: MROM, PROM, EPROM, EEPROM

7. Features of Secondary Memory.

Ans :

- Its speed is slower than the primary/ main memory.
- Store data cannot be lost due to non-volatile nature.
- It can store large collections of different types, such as audio, video, pictures, text, software, etc.
- All the stored data in a secondary memory cannot be lost because it is a permanent storage area; even the power is turned off.
- It has various optical and magnetic memories to store data.

8. List out various types of CD's.

Ans :

Types of CDs

i) **CD-ROM (Compact Disc Read Only Memory):** It is mainly used for bulk size mass like audio CDs, software and computer games at the time of manufacture. Users can only read data, text, music, videos from the disc, but they cannot modify or burnt it.

ii) **CD-R (Compact Disc Recordable):** The type of Compact Disc used to write once by the user; after that, it cannot be modified or erased.

iii) **CD-RW (Compact Disc Rewritable):** It is a rewritable CD disc, often used to write or delete the stored data.

9. Differentiate between Primary and secondary memory.

Ans :

Primary Memory	Secondary Memory
It is also known as temporary memory.	It is also known as a permanent memory.
Data can be access directly by the processor or CPU.	Data cannot be accessed directly by the I/O processor or CPU.
Stored data can be a volatile or non-volatile memory.	The nature of secondary memory is always non-volatile.
It is more costly than secondary memory.	It is less costly than primary memory.
It is a faster memory.	It is a slower memory.
It has limited storage capacity.	It has a large storage capacity.
It required the power to retain the data in primary memory.	It does not require power to retain the data in secondary memory.
Examples of primary memory are RAM, ROM, Registers, EPROM, PROM and cache memory.	Examples of secondary memory are CD, DVD, HDD, magnetic tapes, flash disks, pen drive, etc.

10. What is archival Memory ?

Ans :

By archival memory we mean a storage device used to store data to be preserved. It is necessary to keep a duplicate copy of important data being used in an on-line application so that if there is a failure of the secondary memory we can use the copy to restore the data and continue work. We also saw that some of the data after they are used and not required for further on-line processing are removed from the on-line storage and a duplicate copy kept either for legal purposes or for further analysis. These duplicates are kept in what are known as archival storage units.

Choose the Correct Answer

1. Components that provide internal storage to the CPU are _____ [a]
   (a) Registers (b) Program Counters
   (c) Controllers (d) Internal chips
2. Saving data and instructions to make them readily available is the job of _____ [a]
   (a) Storage Unit (b) Cache Unit
   c) Input Unit (d) Output Unit
3. Which of the following is used to hold running program instructions? [a]
   (a) Primary Storage (b) Virtual Storage
   (c) Internal Storage (d) Minor Devices
4. Which of the following is non-volatile storage? [b]
   (a) Backup (b) Secondary
   (c) Primary (d) Cache
5. Which of the following are types of ROMs? [b]
   (a) SROM & DROM
   (b) PROM & EPROM
   (c) Only one type there is no further classification
   (d) PROM & EROM
6. A process is a _____ [b]
   (a) Single thread of execution (b) Program in the execution
   (c) Program in the memory (d) Task
7. The input and output operations are respectively similar to the operations. [c]
   (a) Read, read (b) Write, write
   (c) Read, write (d) write, read
8. The registers of the controller are _____ [b]
   (a) 16 bit (b) 32 bit
   (c) 64 bit (d) 128 bit
9. The fastest data access is provided using _____ [d]
   (a) Cache (b) DRAM's
   (c) SRAM's (d) Registers
10. Dot matrix is an example of _____ [c]
    (a) Line printers (b) Ink printers
    (c) Character printer (d) Of band printer

Fill in the blanks

1. A non-erasable disk that stores digitized audio information is _____
2. DRAM stands for _____
3. _____ is a non-volatile memory.
4. ROM stands for _____
5. 1 GB is equal to _____ mega bytes.
6. The _____ printers give very high quality output.
7. A _____ copies the text and pictures directly into the computer.
8. The physical parts of a computer are called _____.
9. _____ devices display the result which we get after processing.
10. _____ the high speed memory between the main memory and the CPU called.

ANSWESRS

1. CD
2. Dynamic random access memory
3. Secondary
4. Read only memory
5. 1024
6. Laser
7. Scanner
8. Hardware
9. Output
10. Cache memory

One Mark Question and Answers

1. What are the properties of a memory cell?

Ans :

i) It should have two stable states.

ii) While a cell is in a stable state, it should not consume any energy. Even if it does, it must be very small.

iii) It should be possible to switch between 0 and 1 states any number of times without losing the data.

iv) Each cell should occupy very little space.

v) The time taken to write/read must be very small.

vi) The data stored in a cell must not be lost with passage of time.

vii) The cost of each cell must be very small.

2. EPROM?

Ans :

EPROM (Erasable and Programmable Read Only Memory)

It is the type of read only memory in which stored data can be erased and re-program-med only once in the EPROM memory. It is a non-volatile memory chip that holds data when there is no power supply and can also store data for a minimum of 10 to 20 years. In EPROM, if we want to erase any stored data and re-programmed it, first, we need to pass the ultraviolet light for 40 minutes to erase the data; after that, the data is re-created in EPROM.

3. Write any 3 advantages of ROM.

Ans :

Advantages of ROM

i) It is a non-volatile memory in which stored information can be lost even power is turned off.

ii) It is static, so it does not require refreshing the content every time.

iii) Data can be stored permanently.

iv) It is easy to test and store large data as compared to RAM.

v) These cannot be changed accidently

vi) It is cheaper than RAM.

vii) It is simple and reliable as compared to RAM.

viii) It helps to start the computer and loads the OS.

4. What are the properties of an archival storage?

Ans :

i) The medium used for storage should be removable from the drive.

ii) It should be a writable memory.

iii) The size must be appropriate for the application - normally quite large - a few gigabytes.

iv) It should not be volatile - it should retain data stored in it for a considerable time.

5. Define storage unit.

Ans :

The information or set of guidelines are stored in the storage unit of the computer system. The storage unit provides the space to store the data or instruction of processed data. The information or data is saved or hold in computer memory or storage device. The data storage is the core function and fundamental of the computer components.

UNIT III

Computer Networks: Introduction, Local Area Network (LAN), Applications of LAN, Wide Area Network (WAN), Internet, Naming Computers Connected to Internet, Future of Internet Technology.

Input Output Devices: Introduction, Keyboard, Video Display Devices, Touch Screen Display, E-Ink Display, Printers, Audio Output.

Computer Software: Introduction, Operating System, Programming Languages, Classification of Programming Languages, Classification of Programming Languages Based on Applications

3.1 Computer Networks

3.1.1 Introduction

Q1. What is a computer network ? What are the basic hardware components required to set up a computer network?

Ans :

A computer network is a system in which multiple computers are connected to each other to share information and resources.

Characteristics of a Computer Network

- Share resources from one computer to another.
- Create files and store them in one computer, access those files from the other computer(s) connected over the network.
- Connect a printer, scanner, or a fax machine to one computer within the network and let other computers of the network use the machines available over the network.

Following is the list of hardware's required to set up a computer network.

i) Network Cables

ii) Distributors

iii) Routers

iv) Network Card

a) Internal Network Cards

b) External Network Cards

i) Network Cables: Network cables are used to connect computers. The most commonly used cable is Category 5 cable RJ-45.

ii) Distributors: A computer can be connected to another one via a serial port but if we need to connect many computers to produce a network, this serial connection will not work.

The solution is to use a central body to which other computers, printers, scanners, etc. can be connected and then this body will manage or distribute network traffic.

iii) Router: A router is a type of device which acts as the central point among computers and other devices that are a part of the network. It is equipped with holes called ports. Computers and other devices are connected to a router using network cables. Now-a-days router comes in wireless modes using which computers can be connected without any physical cable.

iv) Network Card: Network card is a necessary component of a computer without which a computer cannot be connected over a network. It is also known as the network adapter or Network Interface Card (NIC). Most branded computers have network card pre-installed. Network cards are of two types: Internal and External Network Cards.

a) Internal Network Cards: Motherboard has a slot for internal network card where it is to be inserted. Internal network cards are of two types in which the first type uses Peripheral Component Interconnect (PCI) connection, while the second type uses Industry Standard Architecture (ISA). Network cables are required to provide network access.

b) External Network Cards: External network cards are of two types: Wireless and USB based. Wireless network card needs to be inserted into the motherboard, however no network cable is required to connect to the network.

v) Universal Serial Bus (USB)

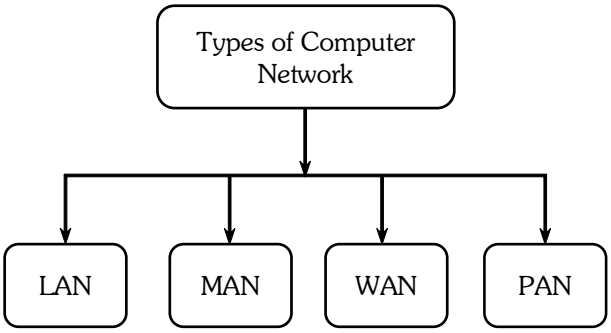
USB card is easy to use and connects via USB port. Computers automatically detect USB card and can install the drivers required to support the USB network card automatically.

Q2. List out various types of computer networks.

Ans : **(Imp.)**

A computer network is a group of computers linked to each other that enables the computer to communicate with another computer and share their resources, data, and applications.

A computer network can be categorized by their size. A computer network is mainly of four types:



i) LAN (Local Area Network)

ii) PAN (Personal Area Network)

iii) MAN (Metropolitan Area Network)

iv) WAN (Wide Area Network)

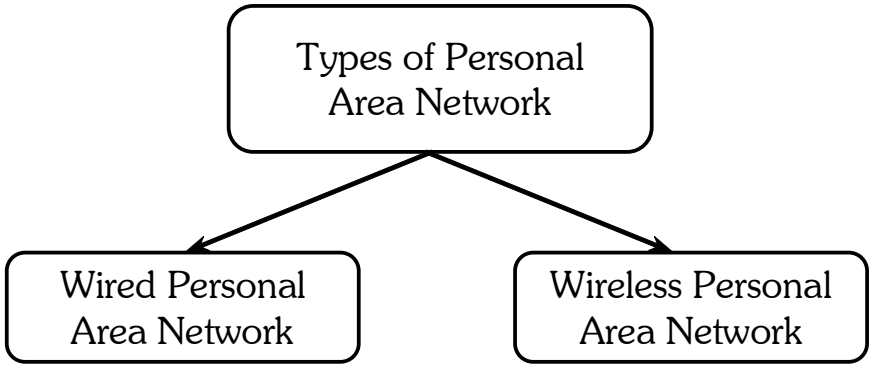
i) LAN (Local Area Network)

- Local Area Network is a group of computers connected to each other in a small area such as building, office.
- LAN is used for connecting two or more personal computers through a communication medium such as twisted pair, coaxial cable, etc.
- It is less costly as it is built with inexpensive hardware such as hubs, network adapters, and ethernet cables.
- The data is transferred at an extremely faster rate in Local Area Network.
- Local Area Network provides higher security.

ii) PAN (Personal Area Network)

- Personal Area Network is a network arranged within an individual person, typically within a range of 10 meters.
- Personal Area Network is used for connecting the computer devices of personal use is known as Personal Area Network.
- Thomas Zimmerman was the first research scientist to bring the idea of the Personal Area Network.
- Personal Area Network covers an area of 30 feet.
- Personal computer devices that are used to develop the personal area network are the laptop, mobile phones, media player and play stations.

There are two types of Personal Area Network:



- Wired Personal Area Network
- Wireless Personal Area Network

Wireless Personal Area Network: Wireless Personal Area Network is developed by simply using wireless technologies such as WiFi, Bluetooth. It is a low range network.

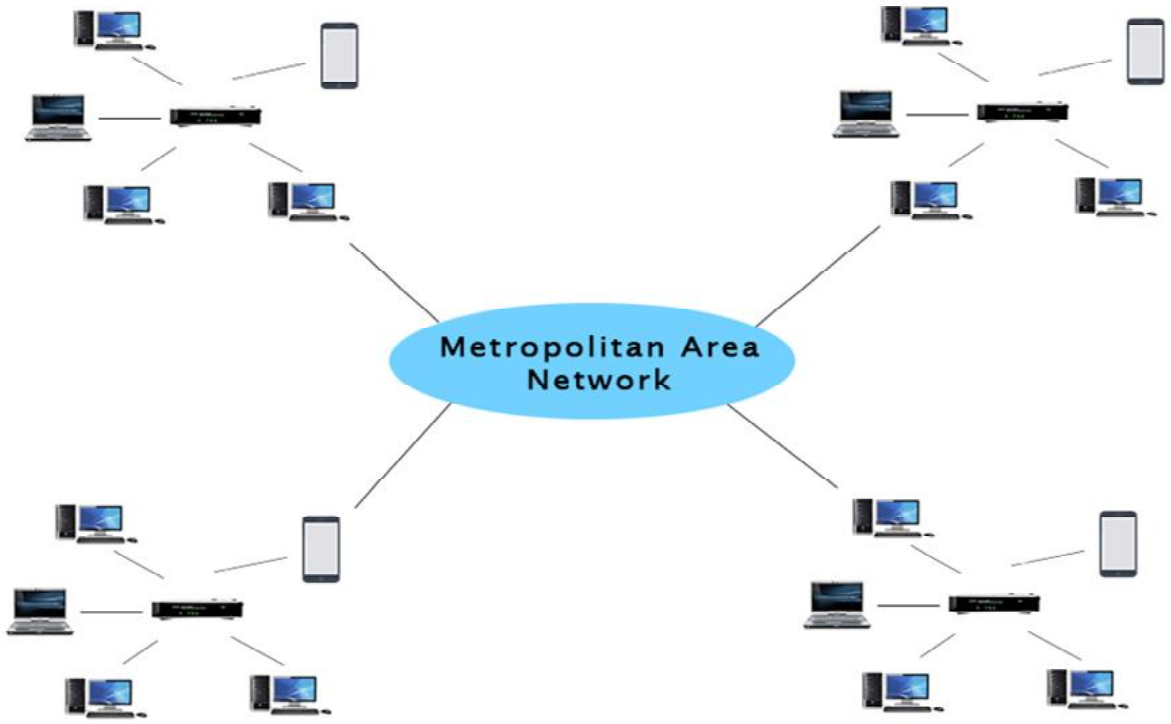
Wired Personal Area Network: Wired Personal Area Network is created by using the USB.

Examples of Personal Area Network

- **Body Area Network:** Body Area Network is a network that moves with a person. **For example**, a mobile network moves with a person. Suppose a person establishes a network connection and then creates a connection with another device to share the information.
- **Off-line Network:** An offline network can be created inside the home, so it is also known as a **home network**. A home network is designed to integrate the devices such as printers, computer, television but they are not connected to the internet.
- **Small Home Office:** It is used to connect a variety of devices to the internet and to a corporate network using a VPN

iii) MAN (Metropolitan Area Network)

- A metropolitan area network is a network that covers a larger geographic area by interconnecting a different LAN to form a larger network.
- Government agencies use MAN to connect to the citizens and private industries.
- In MAN, various LANs are connected to each other through a telephone exchange line.
- The most widely used protocols in MAN are RS-232, Frame Relay, ATM, ISDN, OC-3, ADSL, etc.
- It has a higher range than Local Area Network (LAN).

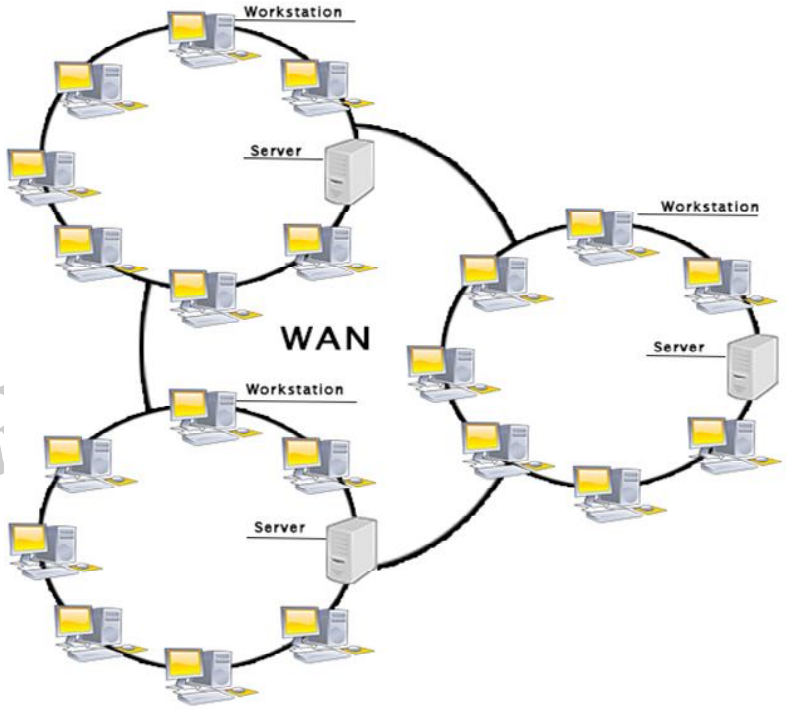


Uses of Metropolitan Area Network

- MAN is used in communication between the banks in a city.
- It can be used in an Airline Reservation.
- It can be used in a college within a city.
- It can also be used for communication in the military.

iv) WAN (Wide Area Network)

- A Wide Area Network is a network that extends over a large geographical area such as states or countries.
- A Wide Area Network is quite bigger network than the LAN.
- A Wide Area Network is not limited to a single location, but it spans over a large geographical area through a telephone line, fibre optic cable or satellite links.
- The internet is one of the biggest WAN in the world.
- A Wide Area Network is widely used in the field of Business, government, and education.



3.1.2 Local area Network

Q3. What is Local area network ?

Ans :

LAN is basically a Data Communication Network. In this type of Network, several computers and their peripherals like disc storage devices, printers are connected to a single high speed data line within a limited area. Local Area Network is usually a privately owned network. In LAN, data is divided and transmitted in the form of packets and regenerated back by the receiving computer.

Fig.1: Introduction to LAN

It provides high data rates extending from 10-100 Mbps and up. Latest LAN's can provide data rate up to 10 Gbps. The coverage area is less than 10 kms. Like any other Networks, LAN also requires Hardware and Software components. Hardware consists of transmission medium and connecting devices like Transceivers, Bridges, Switches, Repeaters etc. Software has Application Programs which includes protocols defined by IEEE Standard. Figure shows schematic diagram of Ethernet LAN.

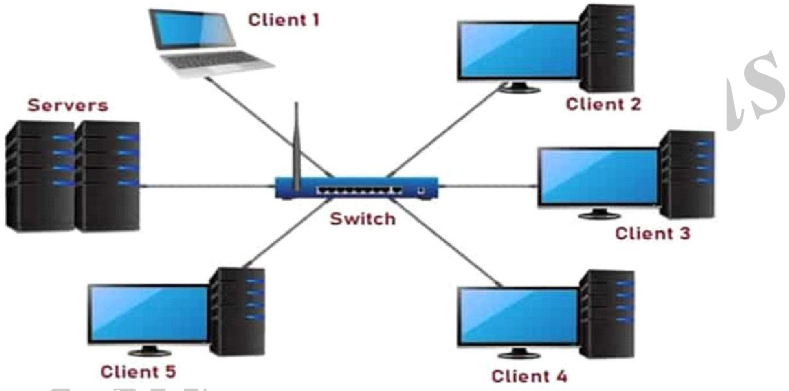


Fig. 2: Schematic Diagram of Ethernet Local Area Network

Types of Local Area Network (LAN)

LAN's can be implemented using:

i) Ethernet LAN (Wired connection)

ii) WLAN (Wireless)

i) Ethernet LAN (Wired connection)

Ethernet LAN uses Ethernet cables to connect the devices in a network. In this type of connection, the network installation is wired and the Switches and Routers are configured using the network settings. Standard Internet Protocol is set, that allows the internet to run on different devices within the network.

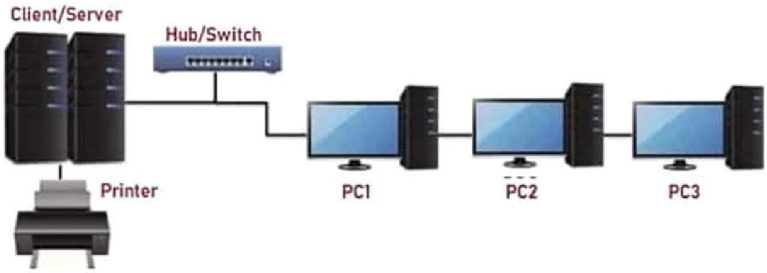


Fig. 3: Ethernet Local Area Network

ii) WLAN (Wireless Local Area Network)

WLAN uses Radio waves as the means of communication. It does not require cables to connect the devices. The advantage of WLAN over LAN is the increased security it offers. The users can access the internet without wired connection (wireless) if they are within the range of the Router. With the help of WLAN connection, many devices can be connected simultaneously, provided they all are within the range of the Router.

Fig.4: Wireless Local Area Network (WLAN)

LAN (Local Area Network) Topology

Topology is defined as the pattern of interconnection between the nodes of the network. The three basic topologies of LAN are:

i) Star Topology

ii) Ring Topology

iii) Bus Topology

i) Star Topology: In this network, all the nodes are connected to Central Node. The devices are not connected to each other and transmits the messages to the Central Node. The central node is responsible for transmitting the message to the required destination. It is the most widely used topology for LAN's.

ii) Ring Topology: In this network, the nodes are interconnected to make a closed loop. Each node communicates with the nodes on its either side with the help of Token (information passing). The nodes with Token are allowed to transmit data. This topology eliminates the connection of nodes with the central node i.e. there is no need of Network Server to control other devices.

iii) Bus Topology: In this network, all the nodes including computers and servers are connected to a single cable termed as Bus. This network is easier compared to other networks and is economical. Source node transmits a signal which is broadcast to all the other nodes via Bus cable. Though the message is broadcast, the intended recipient receives the signal. The recipient can accept the signal if its MAC Address or IP Address matches and data transmission occurs in a single direction.

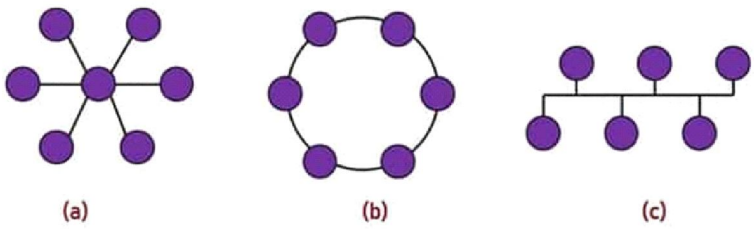


Fig. 5: (a) Star Topology (b) Ring Topology (c) Bus Topology

Q4. How does a LAN Works ?

Ans :

To understand how LAN works, consider Following figure which shows the 7- Layers of OSI Model. It is necessary to know the three lower levels of OSI Model i.e.

i) Physical Layer

ii) Data Link Layer

iii) Network Layer

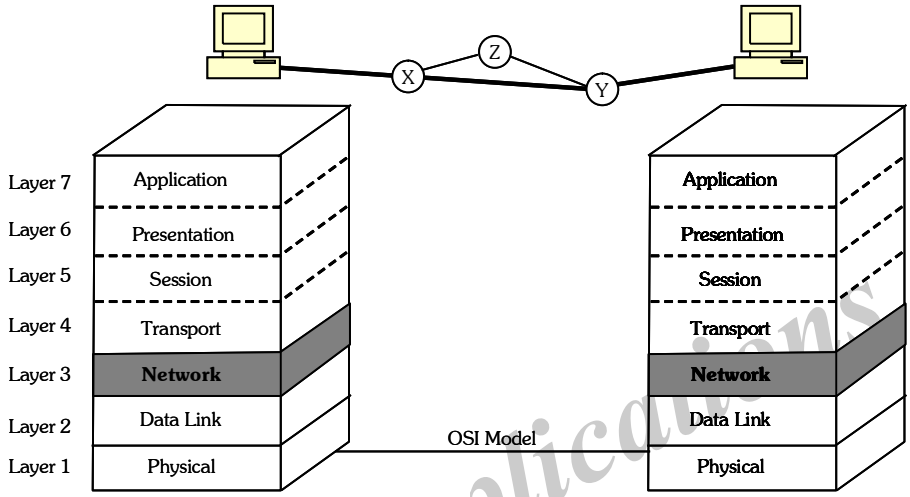


Fig. 6: Seven Layers of OSI Model

i) Physical Layer: The Physical Layer transmits raw data bits over communication lines. It deals with establishing physical circuit between devices. Physical Layer protocols and standards are responsible for type of modulation to be used for transmitting digital data over analog transmission lines. It accounts for the components of network like Multiplexers, Repeaters, Modems etc.

ii) Data Link Layer: The Data Link Layer is responsible for transferring data over the communication channel provided by the Physical Layer. This layer breaks the data into data frames, transmits the frames sequentially over the channel. Error detection and correction is done and the data is transmitted to Network Layer.

iii) Network Layer: The Network Layer helps in routing the data across the network from source node to receiving node. This Layer provides interface between a host and the network. Based on Topology used, routing of packets takes place to the receiving device where the conversion of data occurs and the original data is obtained.

3.1.3 Applications of LAN

Q5. Explain various applications of LAN.

Ans :

The applications include:

- LAN is used for school environment, offices, hospitals etc as it allows sharing of resources like sharing data, scanners, printing and internet.

- LAN serves users at home to access internet.
- LAN's are widely used in manufacturing industries where a central server coordinates the activities of other machines.
- High speed LANs are typically used to connect many slower networks together.

Q6. List out various advantages and disadvantages of LAN.

Ans :

Advantages of LAN (Local Area Network)

The advantages of LAN are:

- Provides high-bandwidth communication.
- Transmission medium is inexpensive.
- Bandwidth is utilized effectively.
- Maintenance is easy.

Disadvantages of LAN (Local Area Network)

The disadvantages of LAN are:

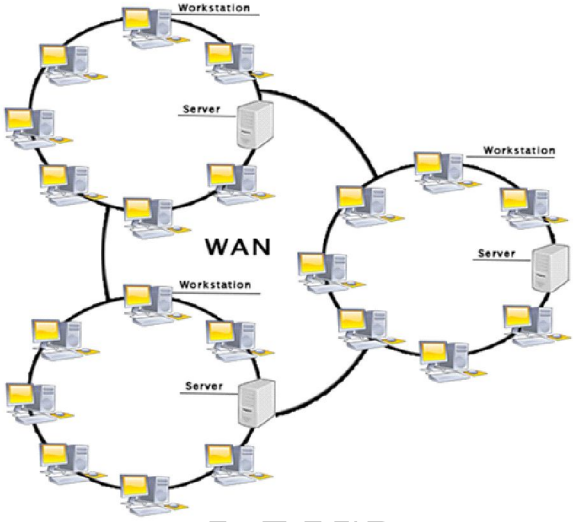
- Speed reduces as it includes sharing of resources.
- Less Secure.
- Requires skilled technicians to setup the network.
- Covers Limited area.

3.1.4 Wide area Network

Q7. What is WAN ? List out its advantages and disadvantages.

Ans : **(Imp.)**

- A Wide Area Network is a network that extends over a large geographical area such as states or countries.
- A Wide Area Network is quite bigger network than the LAN.
- A Wide Area Network is not limited to a single location, but it spans over a large geographical area through a telephone line, fibre optic cable or satellite links.
- The internet is one of the biggest WAN in the world.
- A Wide Area Network is widely used in the field of Business, government, and education.



Examples of Wide Area Network

- **Mobile Broadband:** A 4G network is widely used across a region or country.
- **Last mile:** A telecom company is used to provide the internet services to the customers in hundreds of cities by connecting their home with fiber.
- **Private network:** A bank provides a private network that connects the 44 offices. This network is made by using the telephone leased line provided by the telecom company.

Advantages of Wide Area Network

Following are the advantages of the Wide Area Network:

- **Geographical area:** A Wide Area Network provides a large geographical area. Suppose if the branch of our office is in a different city then we can connect with them through WAN. The internet provides a leased line through which we can connect with another branch.
- **Centralized data:** In case of WAN network, data is centralized. Therefore, we do not need to buy the emails, files or back up servers.
- **Get updated files:** Software companies work on the live server. Therefore, the programmers get the updated files within seconds.

- **Exchange messages:** In a WAN network, messages are transmitted fast. The web application like Facebook, Whatsapp, Skype allows you to communicate with friends.
- **Sharing of software and resources:** In WAN network, we can share the software and other resources like a hard drive, RAM.
- **Global business:** We can do the business over the internet globally.
- **High bandwidth:** If we use the leased lines for our company then this gives the high bandwidth. The high bandwidth increases the data transfer rate which in turn increases the productivity of our company.

Disadvantages of Wide Area Network

The following are the disadvantages of the Wide Area Network:

- **Security issue:** A WAN network has more security issues as compared to LAN and MAN network as all the technologies are combined together that creates the security problem.
- **Needs Firewall & antivirus software:** The data is transferred on the internet which can be changed or hacked by the hackers, so the firewall needs to be used. Some people can inject the virus in our system so antivirus is needed to protect from such a virus.
- **High Setup cost:** An installation cost of the WAN network is high as it involves the purchasing of routers, switches.
- **Troubleshooting problems:** It covers a large area so fixing the problem is difficult.

3.1.5 Internet

Q8. What is Internet ?

Ans :

The Internet is a global wide area network that connects computer systems across the world. It includes several high-bandwidth data lines that comprise the Internet "backbone." These lines are connected to major Internet hubs that distribute data to other locations, such as web servers and ISPs.

In order to connect to the Internet, you must have access to an Internet service provider (ISP), which acts the middleman between you and the Internet. Most ISPs offer broadband Internet access via a cable, DSL, or fiber connection. When you connect to the Internet using a public Wi-Fi signal, the Wi-Fi router is still connected to an ISP that provides Internet access. Even cellular data towers must connect to an Internet service provider to provide connected devices with access to the Internet.

The Internet provides different online services. Some examples include:

- **Web:** A collection of billions of webpages that you can view with a web browser
- **Email:** The most common method of sending and receiving messages online
- **Social media:** Websites and apps that allow people to share comments, photos, and videos
- **Online gaming:** Games that allow people to play with and against each other over the Internet
- **Software updates:** Operating system and application updates can typically downloaded from the Internet

In the early days of the Internet, most people connected to the Internet using a home computer and a dial-up modem. DSL and cable modems eventually provided users with "always-on" connections. Now mobile devices, such as tablets and smartphones, make it possible for people to be connected to the Internet at all times. The Internet of Things has turned common appliances and home systems into "smart" devices that can be monitored and controlled over the Internet. As the Internet continues to grow and evolve, you can expect it to become an even more integral part of daily life.

Q9. What is an IP address? How an IP address works?

Ans :

IP address stands for internet protocol address; it is an identifying number that is associated with a specific computer or computer network. When connected to the internet, the IP address allows the computers to send and receive information.

Key Takeaways

- An internet protocol (IP) address allows computers to send and receive information.
- There are four types of IP addresses: public, private, static, and dynamic.
- An IP address allows information to be sent and received by the correct parties, which means they can also be used to track down a user's physical location.

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An example of an IP address would be: 506.457.14.512

Q10. How can an individual in a home or organization be connected to the Internet ?

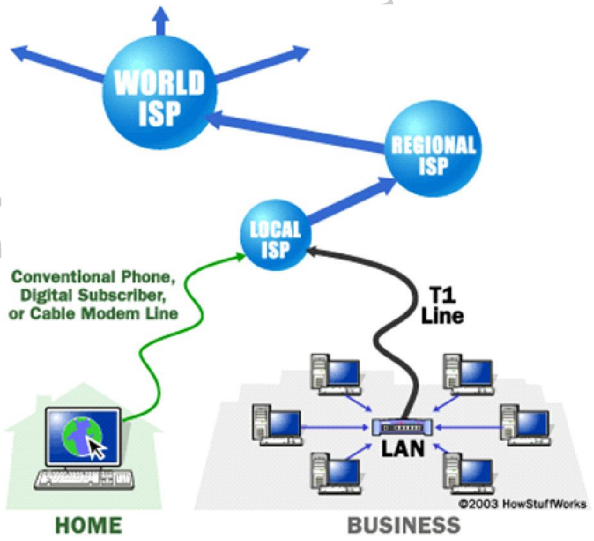
(OR)

What is internet service provider?

Ans :

The term internet service provider (ISP) refers to a company that provides access to the internet to both personal and business customers. ISPs make it possible for their customers to surf the web, shop online, conduct business, and connect with family and friends all for a fee. ISPs may also provide other services including email services, domain registration, web hosting, and browser packages. An ISP may also be referred to as an information service provider, a storage service provider, an internet service provider (INSP), or any combination of these three based on the services the company offers.

- An internet service provider (ISP) is a company that provides web access to both businesses and consumers.
- ISPs may also provide other services such as email services, domain registration, web hosting, and browser services.
- An ISP is considered to be an information service provider, storage service provider, internet network service provider (INSP), or a mix of all of them.
- Internet use has evolved from only those with university or government accounts having access to nearly everyone having access, whether it's paid or free.
- Access has gone from dial-up connections to high-speed broadband technology.



Understanding Internet Service Provider (ISP)

Internet service was originally limited to government agencies and specific university departments. The technology was developed to provide access to the general public through the World Wide Web in the late 1980s. Consumers were able to gain limited access through a few ISPs - America On Line (AOL) being one of the most recognized names at the time - that used dial-up connections using a phone line.

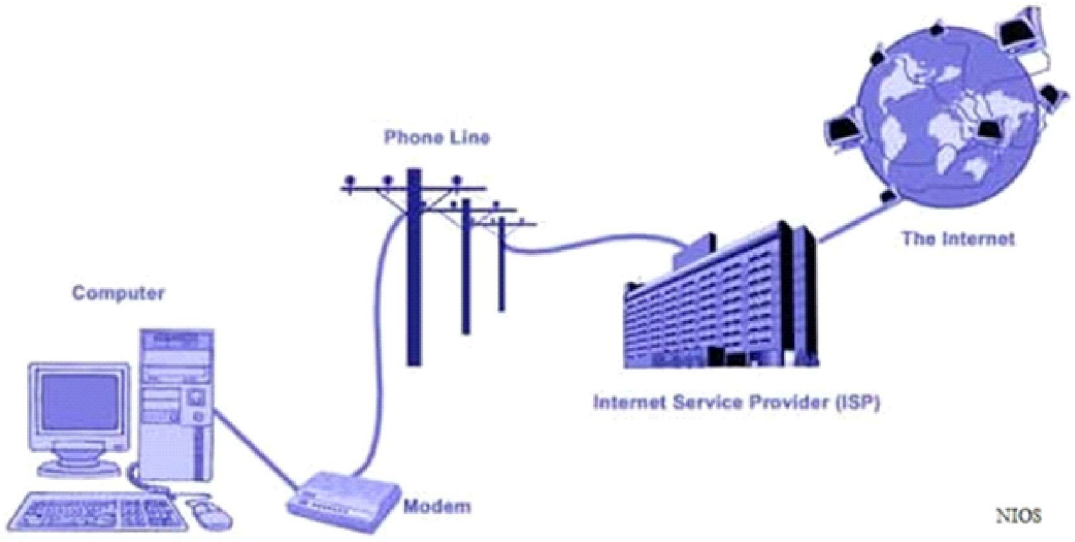
The number of ISPs increased to several thousand during the mid-1990s and the boom was on. As the options for connectivity increased and speeds moved away from slower dial-up connec-

tions, the internet economy was born. Providers developed more advanced technology, allowing customers high-speed access via broadband technology through cable and digital subscriber line (DSL) modems.

Behind all of this was a multi-layered web of connections. Local ISPs sold access to customers but paid larger ISPs for their own access. These larger ISPs, in turn, paid even larger ISPs for access. The trail leads to Tier 1 carriers that can reach every network access point without having to pay for access. These Tier 1 companies own the infrastructure in their region.

As noted above, internet service providers primarily provide their customers access to the internet—plain access providers that just handle the traffic between the individual and the internet as a whole. But there may also be other services bundled in depending on the customer's location and availability. Some of these services include:

- Email services
- Web hosting services
- Domain registration
- Browser and software packages



Q11. How data transmission is possible through internet ?

(OR)

What is IP Packet? Explain in detail.

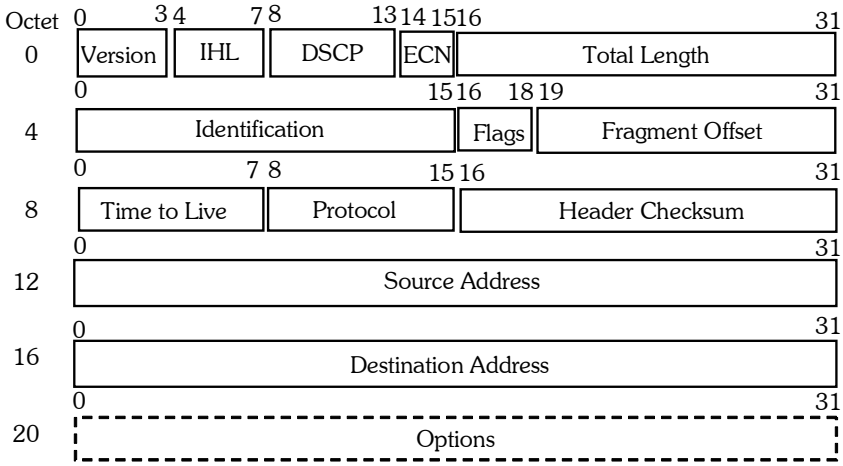
Ans:

On the massive network known as the Internet, computing devices send all kinds of messages to other computing devices. A message might be a tiny ping to check if another device is online or a message could be an entire webpage.

But there's a limit to how large a message can be, since there's a limit to how much data can be reasonably transmitted at once by the physical network connections between devices.

That's why many networking protocols split each message into multiple small **packets**. The Internet Protocol (IP) describes the structure of the packets that whizz around the Internet.

Each IP packet contains both a header (20 or 24 bytes long) and data (variable length). The header includes the IP addresses of the source and destination, plus other fields that help to route the packet. The data is the actual content, such as a string of letters or part of a webpage.



[Image: IP Header]

A diagram of an IP packet. The header is 24 bytes long and contains 15 fields, including 4 bytes for source IP address and 4 bytes for destination IP address. The payload is variable length.

You can think of IP packets like postal letters: the header is the envelope with all the routing information that's needed by the post office, and the payload is the letter that's read only by the recipient.

Diagram of an IP packet as a postal letter. An envelope is shown with "Source IP address" as the return address and "Destination IP address" as the mailing address. The envelope is then shown in an open state, with a letter that says "Data" poking out.

Just like the postal system routes postal letters around the world, the Internet Protocol routes IP packets around the Internet.

Q12. What is switching ?

Ans :

- When a user accesses the internet or another computer network outside their immediate location, messages are sent through the network of transmission media. This technique of transferring the information from one computer network to another network is known as switching.
- Switching in a computer network is achieved by using switches. A switch is a small hardware device which is used to join multiple computers together with one local area network (LAN).
- Network switches operate at layer 2 (Data link layer) in the OSI model.
- Switching is transparent to the user and does not require any configuration in the home network.
- Switches are used to forward the packets based on MAC addresses.
- A Switch is used to transfer the data only to the device that has been addressed. It verifies the destination address to route the packet appropriately.
- It is operated in full duplex mode.
- Packet collision is minimum as it directly communicates between source and destination.
- It does not broadcast the message as it works with limited bandwidth.

Switching concept is developed because of the following reasons:

- **Bandwidth:** It is defined as the maximum transfer rate of a cable. It is a very critical and expensive resource. Therefore, switching techniques are used for the effective utilization of the bandwidth of a network.
- **Collision:** Collision is the effect that occurs when more than one device transmits the message over the same physical media, and they collide with each other. To overcome this problem, switching technology is implemented so that packets do not collide with each other.

Advantages of Switching

- Switch increases the bandwidth of the network.
- It reduces the workload on individual PCs as it sends the information to only that device which has been addressed.
- It increases the overall performance of the network by reducing the traffic on the network.
- There will be less frame collision as switch creates the collision domain for each connection.

Disadvantages of Switching

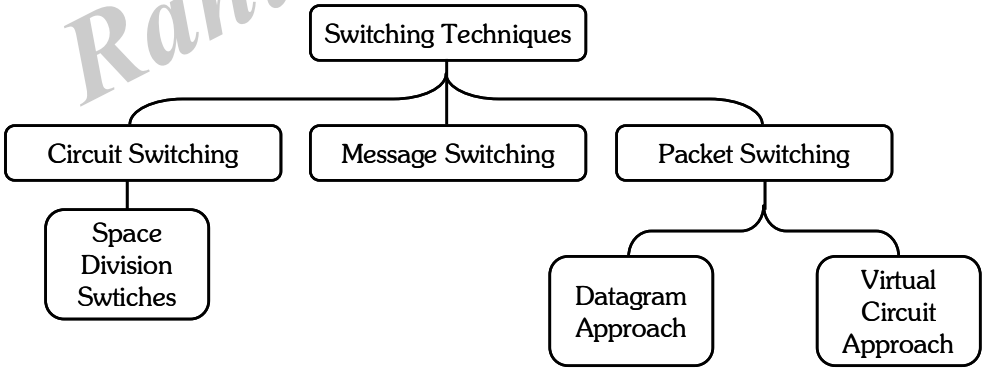
- A Switch is more expensive than network bridges.
- A Switch cannot determine the network connectivity issues easily.
- Proper designing and configuration of the switch are required to handle multicast packets.

Q13. Explain various switching techniques.

Ans : **(Dec.-21, Imp.)**

Switching technique is used to connect the systems for making one-to-one communication.

Classification of Switching Techniques



1. Circuit Switching

- Circuit switching is a switching technique that establishes a dedicated path between sender and receiver.
- In the Circuit Switching Technique, once the connection is established then the dedicated path will remain to exist until the connection is terminated.
- Circuit switching in a network operates in a similar way as the telephone works.
- A complete end-to-end path must exist before the communication takes place.

- In case of circuit switching technique, when any user wants to send the data, voice, video, a request signal is sent to the receiver then the receiver sends back the acknowledgment to ensure the availability of the dedicated path. After receiving the acknowledgment, dedicated path transfers the data.
- Circuit switching is used in public telephone network. It is used for voice transmission.
- Fixed data can be transferred at a time in circuit switching technology.

Communication through circuit switching has 3 phases

- Circuit establishment
- Data transfer
- Circuit Disconnect

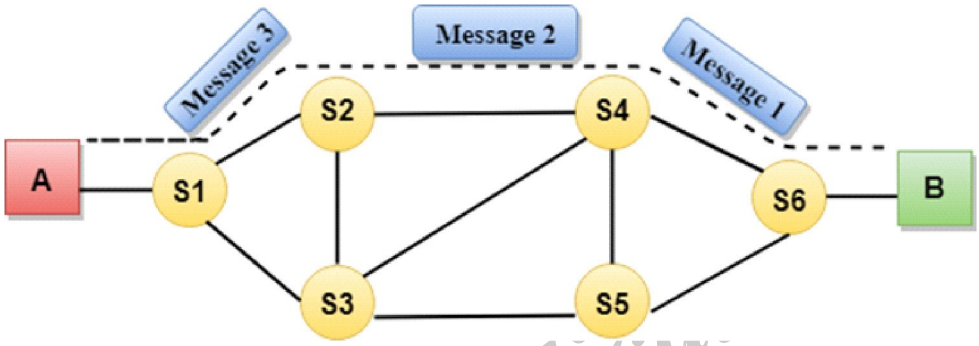


Fig.: Circuit Switching

Circuit Switching can use either of the two technologies

i) Space Division Switches

- Space Division Switching is a circuit switching technology in which a single transmission path is accomplished in a switch by using a physically separate set of crosspoints.
- Space Division Switching can be achieved by using crossbar switch. A crossbar switch is a metallic crosspoint or semiconductor gate that can be enabled or disabled by a control unit.
- The Crossbar switch is made by using the semiconductor. For example, Xilinx crossbar switch using FPGAs.
- Space Division Switching has high speed, high capacity, and nonblocking switches.

Space Division Switches can be categorized in two ways:

- Crossbar Switch
- Multistage Switch

a) Crossbar Switch: The Crossbar switch is a switch that has n input lines and n output lines. The crossbar switch has n^2 intersection points known as **crosspoints.**

a) Disadvantage of Crossbar switch

The number of crosspoints increases as the number of stations is increased. Therefore, it becomes very expensive for a large switch. The solution to this is to use a multistage switch.

b) Multistage Switch

- Multistage Switch is made by splitting the crossbar switch into the smaller units and then interconnecting them.
- It reduces the number of crosspoints.
- If one path fails, then there will be an availability of another path.

Advantages Of Circuit Switching:

- In the case of Circuit Switching technique, the communication channel is dedicated.
- It has fixed bandwidth.

Disadvantages Of Circuit Switching:

- Once the dedicated path is established, the only delay occurs in the speed of data transmission.
- It takes a long time to establish a connection approx 10 seconds during which no data can be transmitted.
- It is more expensive than other switching techniques as a dedicated path is required for each connection.
- It is inefficient to use because once the path is established and no data is transferred, then the capacity of the path is wasted.
- In this case, the connection is dedicated therefore no other data can be transferred even if the channel is free.

2. Message Switching

- Message Switching is a switching technique in which a message is transferred as a complete unit and routed through intermediate nodes at which it is stored and forwarded.
- In Message Switching technique, there is no establishment of a dedicated path between the sender and receiver.

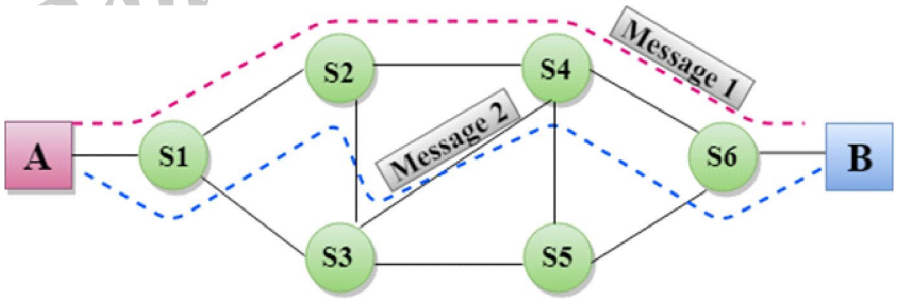


Fig.: Message Switching

- The destination address is appended to the message. Message Switching provides a dynamic routing as the message is routed through the intermediate nodes based on the information available in the message.
- Message switches are programmed in such a way so that they can provide the most efficient routes.
- Each and every node stores the entire message and then forward it to the next node. This type of network is known as store and forward network.
- Message switching treats each message as an independent entity.

Advantages of Message Switching

- Data channels are shared among the communicating devices that improve the efficiency of using available bandwidth.
- Traffic congestion can be reduced because the message is temporarily stored in the nodes.
- Message priority can be used to manage the network.
- The size of the message which is sent over the network can be varied. Therefore, it supports the data of unlimited size.

Disadvantages Of Message Switching

- The message switches must be equipped with sufficient storage to enable them to store the messages until the message is forwarded.
- The Long delay can occur due to the storing and forwarding facility provided by the message switching technique.

3. Packet Switching

- The packet switching is a switching technique in which the message is sent in one go, but it is divided into smaller pieces, and they are sent individually.
- The message splits into smaller pieces known as packets and packets are given a unique number to identify their order at the receiving end.
- Every packet contains some information in its headers such as source address, destination address and sequence number.
- Packets will travel across the network, taking the shortest path as possible.
- All the packets are reassembled at the receiving end in correct order.
- If any packet is missing or corrupted, then the message will be sent to resend the message.
- If the correct order of the packets is reached, then the acknowledgment message will be sent.

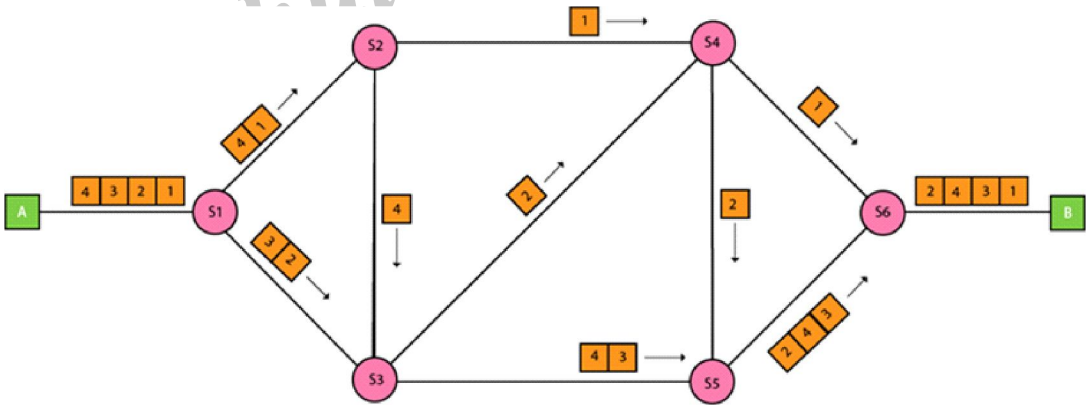


Fig.: Packet Switching

Approaches of Packet Switching

There are two approaches to Packet Switching:

i) Datagram Packet Switching

- It is a packet switching technology in which packet is known as a datagram, is considered as an independent entity. Each packet contains the information about the destination and switch uses this information to forward the packet to the correct destination.

- The packets are reassembled at the receiving end in correct order.
- In Datagram Packet Switching technique, the path is not fixed.
- Intermediate nodes take the routing decisions to forward the packets.
- Datagram Packet Switching is also known as connectionless switching.

ii) Virtual Circuit Switching

- Virtual Circuit Switching is also known as connection-oriented switching.
- In the case of Virtual circuit switching, a preplanned route is established before the messages are sent.
- Call request and call accept packets are used to establish the connection between sender and receiver.
- In this case, the path is fixed for the duration of a logical connection.

Let's understand the concept of virtual circuit switching through a diagram

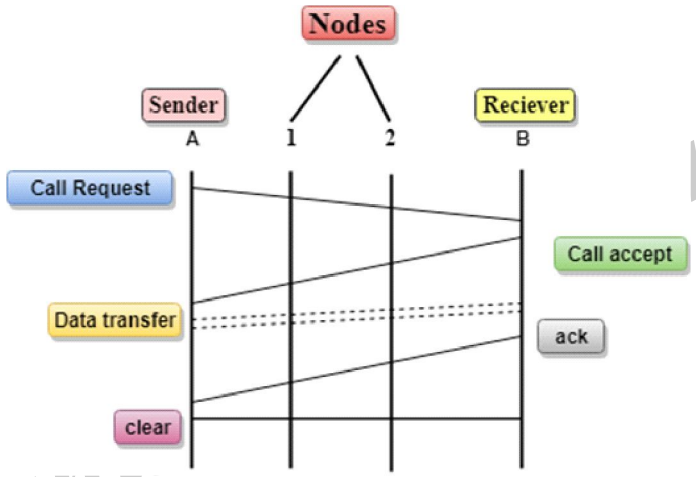


Fig.: Viral Circuit Switching

- In the above diagram, A and B are the sender and receiver respectively. 1 and 2 are the nodes.
- Call request and call accept packets are used to establish a connection between the sender and receiver.
- When a route is established, data will be transferred.
- After transmission of data, an acknowledgment signal is sent by the receiver that the message has been received.
- If the user wants to terminate the connection, a clear signal is sent for the termination.

Advantages of Packet Switching

- **Cost-effective:** In packet switching technique, switching devices do not require massive secondary storage to store the packets, so cost is minimized to some extent. Therefore, we can say that the packet switching technique is a cost-effective technique.
- **Reliable:** If any node is busy, then the packets can be rerouted. This ensures that the Packet Switching technique provides reliable communication.
- **Efficient:** Packet Switching is an efficient technique. It does not require any established path prior to the transmission, and many users can use the same communication channel simultaneously, hence makes use of available bandwidth very efficiently.

Disadvantages Of Packet Switching:

- Packet Switching technique cannot be implemented in those applications that require low delay and high-quality services.
- The protocols used in a packet switching technique are very complex and requires high implementation cost.
- If the network is overloaded or corrupted, then it requires retransmission of lost packets. It can also lead to the loss of critical informa-tion if errors are nor recovered.

3.1.6 Naming Computers connected to internet

Q14. What is the use of DNS?

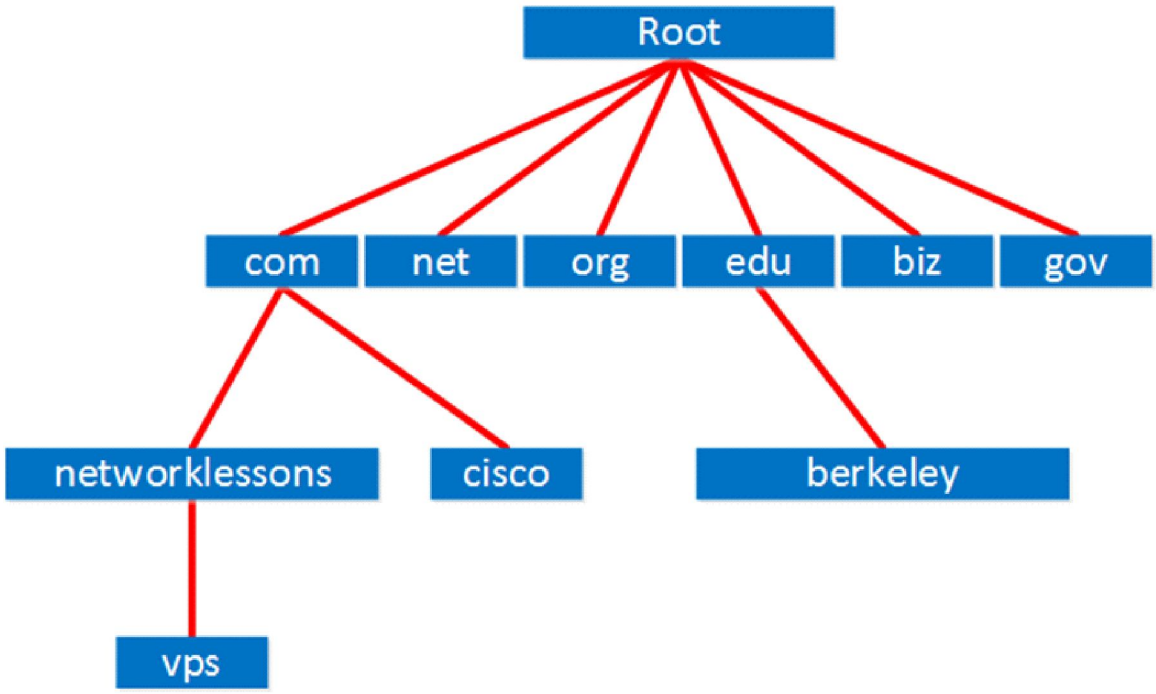
Ans :

DNS (Domain Name System) is a network protocol that we use to find the IP addresses of hostnames. Computers use IP addresses but for us humans, it's more convenient to use domain names and hostnames instead of IP addresses.

For example 144.16.79.48 is IP address. It is difficult for people to remember such a long sequence of digits Thus it is common practice to assign easy to remember names to computers connected to internet which is possible through DNS.

DNS is distributed and hierarchical, there are thousands of DNS servers, but none of them has a complete database with all hostnames / domain names and IP addresses. A DNS server might have information for certain domains but might have to query other DNS servers if it doesn't have an answer.

There are 13 root name servers that have information for the generic top level domains like com, net, org, biz, edu or country specific domains like uk, nl, de, be, au, ca, and such. Take a look at the image below:



At the top of the DNS hierarchy are 13 root name servers that contain name server information for the top level domain extensions. For example, a name server for .com will have information on networklessons.com, but it won't know anything about networklessons.org. It will have to query a name server that is responsible for the org domain extension to get an answer.

Below the top level domain extensions you will find the second level domains. Here's where you find the domain names like networklessons, Cisco, Microsoft, etc.

Further down the tree, you can find hostnames or subdomains. For example, vps.networklessons.com is the hostname of the VPS (virtual private server) that runs this website. An example of a subdomain is tools.cisco.com where vps.tools.cisco.com could be the hostname of a server in that subdomain.

Between each DNS "record" we use a period character (.) and officially we also have to use a period character for the root, but almost nobody writes or prints it. Take a look at the two examples below:

- vps.networklessons.com.
- vps.networklessons.com

Take a close look at those examples above; the first one has a trailing period character that indicates the root of the DNS hierarchy. Writing down a hostname with its complete domain name like we did above is called an FQDN (Fully Qualified Domain Name).

Here's a summary of what I just explained:

.	root of the DNS hierarchy
com	the com. top level domain
networklessons	the networklessons domain within .com
vps	the VPS hostname within domain network lessons.com

3.1.7 Future of Internet technology

Q15. What will be the future internet look like?

Ans :

Since its inception 25 years ago the internet has transformed all levels of business and society. Whether we're at work, or on our morning commute, or shopping for a new iPhone 6, we rely on the internet and the instantaneous access to information it brings us. Our daily routine is so structured by the internet that we scarcely stop to remember what life was like before the world wide web.

Internet information-sharing will be 'like electricity'

"information sharing over the Internet will be so effortlessly interwoven into daily life that it will become invisible, flowing like electricity, often through machine intermediaries." The Internet of Things/ Everything will be the biggest driver towards creating an internet that is 'like electricity.'

Internet as a form of enhanced Global Connectivity

Enhanced global connectivity will mean cheaper, faster, and more efficient ways to communicate and collaborate, irrespective of location. This will spawn new economies of scale in previously undeveloped communities. Practically everyone now has a smartphone. In the internet of the future, spinning up a startup or doing innovation will not be just for the privileged class. Anyone with a mobile signal or internet connection will be able to participate in the growing global economy.

Internet of Things, Artificial Intelligence and Big Data

"The Internet of Things, artificial intelligence, and big data will make people more aware of their world and their own behavior." Internet of Things and Big Data are closely intertwined innovations that will drive the internet of the future and continue to disrupt business and society on massive scales. One of the biggest buzz words in the digital technologies market right now is "smart machine." Smart machines are systems trained to employ artificial intelligence (AI) and machine learning algorithms to make decisions and solve problems without human intervention. Examples of these systems are increasingly evident: contextually aware devices (smartphones that use information to influence computer behavior), intelligent personal assistants (think Google Now and Apple's Siri), smart advisors (such as IBM Watson), advanced global industrial systems, and autonomous vehicles (driverless cars and Amazon's fleet of delivery drones called Air Prime).

Augmented Reality and Wearable Devices

"Augmented reality and wearable devices will be implemented to monitor and give quick feedback on daily life, especially tied to personal health." The future internet will become harnessed to our bodies and personas in ways never before imagined. Our eyes, ears, and other senses, as well as our arms and hands, will become extensions of our digital selves. Wearable technology coupled with augmented reality will give us new and exciting ways to access real-time data and interact with our environment.

Internet-enabled Revolutions in Education

The Digital Life report says that "An Internet-enabled revolution in education will spread more opportunities, with less money spent on real estate and teachers." This internet-enabled education revolution has already started and it's known as the Massive Open Online Course

3.2 Input Output Devices (Key Board, Visual Display Devices, Touchscreen Display E-Link Display, Printers, Audio Output)

Q16. List out various input devices of a computer.

Ans : **(Imp.)**

Input Devices

Input device enables the user to send data, information, or control signals to a computer. The Central Processing Unit (CPU) of a computer receives the input and processes it to produce the output.

- Keyboard
- Mouse
- Joy Stick
- Light pen
- Track Ball
- Scanner
- Graphic Tablet
- Microphone
- Magnetic Ink Card Reader (MICR)
- Optical Character Reader (OCR)

- Bar Code Reader
- Optical Mark Reader (OMR)
- Touch screen

Keyboard

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

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

The keys on the keyboard are as follows:

S.No.	Keys	Description
1.	Typing Keys	These keys include the letter keys (A-Z) and digit keys (09) which generally give the same layout as that of typewriters.
2.	Numeric Keypad	It is used to enter the numeric data or cursor movement. Generally, it consists of a set of 17 keys that are laid out in the same configuration used by most adding machines and calculators.
3.	Function Keys	The twelve function keys are present on the keyboard which are arranged in a row at the top of the keyboard. Each function key has a unique meaning and is used for some specific purpose.
4.	Control keys	These keys provide cursor and screen control. It includes four directional arrow keys. Control keys also include Home, End, Insert, Delete, Page Up, Page Down, Control(Ctrl), Alternate(Alt), Escape(Esc).
5.	Special Purpose	KeysKeyboard also contains some special purpose keys such as Enter, Shift, Caps Lock, Num Lock, Space bar, Tab, and Print Screen.

Mouse

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

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

Advantages

- Easy to use
- Not very expensive
- Moves the cursor faster than the arrow keys of the keyboard.

Joystick

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

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

Light Pen

Light pen is a pointing device similar to a pen. It is used to select a displayed menu item or draw pictures on the monitor screen. It consists of a photocell and an optical system placed in a small tube.

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

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 the ball, the pointer can be moved.

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

Scanner

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

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

Digitizer

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

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

Microphone

Microphone is an input device to input sound that is then stored in a digital form.

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

Magnetic Ink Card Reader (MICR)

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

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

Optical Character Reader (OCR)

OCR is an input device used to read a printed text.

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

Bar Code Readers

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

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

Optical Mark Reader (OMR)

OMR is a special type of optical scanner used to recognize the type of mark made by pen or pencil. It is used where one out of a few alternatives is to be selected and marked.

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

Touch Screen

It is the display screen of a device such as a smartphone, tablet, etc., that allows users to interact or provide inputs to the device by using their finger. Today, most of the electronic devices come with touchscreen as an alternative to a mouse for navigating a graphical user interface. For example, by touching, you can unlock your phone, open emails, open files, play videos, etc. Besides this, it is used in lots of devices such as Camera, Car GPS, Fitness machine, etc.

Q17. List and explain various output devices of a computer.

Ans :

Output Devices

The output device displays the result of the processing of raw data that is entered in the computer through an input device. There are a number of output devices that display output in different ways such as text, images, hard copies, and audio or video.

Some of the popular output devices are:

1. Monitor
   - CRT Monitor
   - LCD Monitor
   - LED Monitor
   - Plasma Monitor
2. Printer
   - Impact Printers
     - (A) Character Printers
       - i) Dot Matrix printers
       - ii) Daisy Wheel printers
     - (B) Line printers
       - i) Drum printers
       - ii) Chain printers
   - Non-impact printers
     - A) Laser printers
     - B) Inkjet printers
3. Projector

1) Monitor

The monitor is the display unit or screen of the computer. It is the main output device that displays the processed data or information as text, images, audio or video.

The types of monitors are given below.

i) CRT Monitor

CRT monitors are based on the cathode ray tubes. They are like vacuum tubes which produce images in the form of video signals. Cathode rays tube produces a beam of electrons through electron guns that strike on the inner phosphorescent surface of the screen to produce images on the screen. The monitor contains millions of phosphorus dots of red, green and blue color. These dots start to glow when struck by electron beams and this phenomenon is called cathodoluminescence.

The main components of a CRT monitor include the electron gun assembly, deflection plate assembly, fluorescent screen, glass envelope, and base. The front (outer surface) of the screen onto which images are produced is called the face plate. It is made up of fiber optics.

There are three electron beams that strike the screen: red, green, and blue. So, the colors which you see on the screen are the blends of red, blue and green lights. The magnetic field guides the beams of electrons. Although LCDs have replaced the CRT monitors, the CRT monitors are still used by graphics professionals because of their color quality.

ii) LCD Monitor

The LCD monitor is a flat panel screen that is compact and light-weight as compared to CRT monitors. It is based on liquid crystal display technology which is used in the screens of laptops, tablets, smart phones, etc. An LCD screen comprises two layers of polarized glass with a liquid crystal solution between them. When the light passes through the first layer, an electric current aligns the liquids crystals. The aligned liquid crystals allow a varying level of light to pass through the second layer to create images on the screen.

The LCD screen has a matrix of pixels that display the image on the screen. Old LCDs had passive-matrix screens in which individual pixels are controlled by sending a charge. A few electrical charges could be sent each second that made screens appear blurry when the images moved quickly on the screen.

Modern LCDs use active-matrix technology and contain thin film transistors (TFTs) with capacitors. This technology allows pixels to retain their charge. So, they don?t make screen blurry when images move fast on the screen as well as are more efficient than passive-matrix displays.

iii) LED monitor

The LED monitor is an improved version of an LCD monitor. It also has a flat panel display and uses liquid crystal display technology like the LCD monitors. The difference between them lies in the source of light to backlight the display. The LED monitor has many LED panels, and each panel has several LEDsto backlight the display, whereas the LCD monitors use cold cathode fluorescent light to backlight the display.Modern electronic devices such as mobile phones, LED TVs, laptop and computer screens, etc., use a LED display as it not only produces more brilliance and greater light intensity but also consumes less power.

iv) Plasma Monitor

The plasma monitor is also a flat panel display that is based on plasma display technology. It has small tiny cells between two glass panels. These cells contain mixtures of noble gases and a small amount of mercury. When voltage is applied, the gas in the cells turns into a plasma and emits ultraviolet light that creates images on the screen, i.e., the screen is illuminated by a tiny bit of plasma, a charged gas. Plasma displays are brighter than liquid crystal displays (LCD) and also offer a wide viewing angle than an LCD.

Plasma monitors provide high resolutions of up to 1920 X 1080, excellent contrast ratios, wide viewing angle, a high refresh rate and more. Thus, they offer a unique viewing experience while watching action movies, sports games, and more.

2. Printer

A printer produces hard copies of the processed data. It enables the user, to print images, text or any other information onto the paper.

Based on the printing mechanism, the printers are of two types: Impact Printers and Non-impact Printers.

Impact Printers: They are of two types:

A. Character Printers
   i. Dot Matrix printers
   ii. Daisy Wheel printers

B. Line printers
   i. Drum printers
   ii. Chain printers

Non-impact printers: They are of two types:

A. Laser printers

B. Inkjet printers

Impact Printer

The impact printer uses a hammer or print head to print the character or images onto the paper. The hammer or print head strikes or presses an ink ribbon against the paper to print characters and images.

Impact printers are further divided into two types.

A) Character Printers

B) Line printers

A) Character Printers

Character printer prints a single character at a time or with a single stroke of the print head or hammer. It does not print one line at a time. Dot Matrix printer and Daisy Wheel printer are character printers. Today, these printers are not in much use due to their low speed and because only the text can be printed. The character printers are of two types, which are as follows:

i) Dot Matrix Printer

Dot Matrix Printer is an impact printer. The characters and images printed by it are the patterns of dots. These patterns are produced by striking the ink soaked ribbon against the paper with a print head. The print head contains pins that produce a pattern of dots on the paper to form the individual characters. The print head of a 24 pin dot matrix contains more pins than a 9 pin dot matrix printer, so it produces more dots which results in better printing of characters. To produce color output, the black ribbon can be changed with color stripes. The speed of Dot Matrix printers is around 200-500 characters per second.

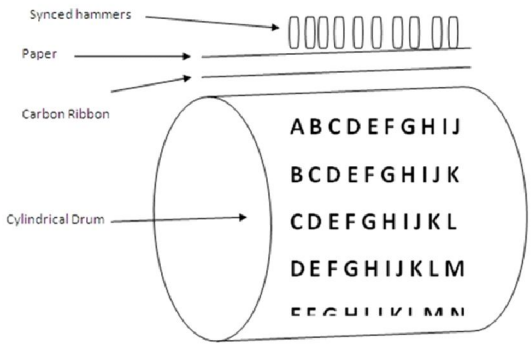
ii) Daisy Wheel Printer

Daisy Wheel Printer was invented by David S. Lee at Diablo Data Systems.It consists of a wheel or disk that has spokes or extensions and looks like a daisy, so it is named Daisy Wheel printer. At the end of extensions, molded metal characters are mounted. To print a character the printer rotates the wheel, and when the desired character is on the print location the hammer hits disk and the extension hits the ink ribbon against the paper to create the impression. It cannot be used to print graphics and is often noisy and slow, i.e., the speed is very low around 25-50 characters per second. Due to these drawbacks, these printers have become obsolete.

B) Line Printers

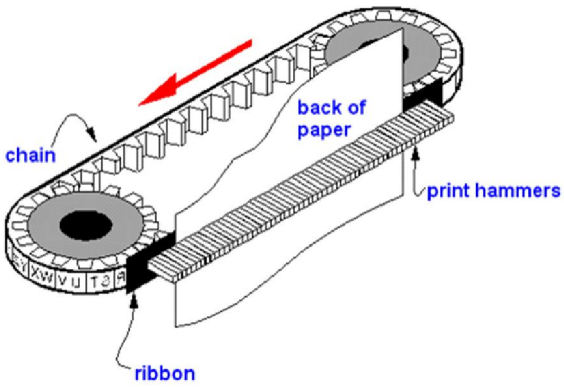
Line printer, which is also as a bar printer, prints one line at a time. It is a high-speed impact printer as it can print 500 to 3000 lines per minute. Drum printer and chain printer are examples of line printers.

i) Drum Printer



Drum printer is a line printer that is made of a rotating drum to print characters. The drum has circular bands of characters on its surface. It has a separate hammer for each band of characters. When you print, the drum rotates, and when the desired character comes under the hammer, the hammer strikes the ink ribbon against the paper to print characters. The drum rotates at a very high speed and characters are printed by activating the appropriate hammers. Although all the characters are not printed at a time, they are printed at a very high speed. Furthermore, it can print only a predefined style as it has a specific set of characters. These printers are known to be very noisy due to the use of hammering techniques.

ii) Chain Printer



Chain printer is a line printer that uses a rotating chain to print characters. The characters are embossed on the surface of the chain. The chain rotates horizontally around a set of hammers, for each print location one hammer is provided, i.e., the total number of hammers is equal to the total number of print positions.

The chain rotates at a very high speed and when the desired character comes at the print location, the corresponding hammer strikes the page against the ribbon and character on the chain. They can type 500 to 3000 lines per minute. They are also noisy due to the hammering action.

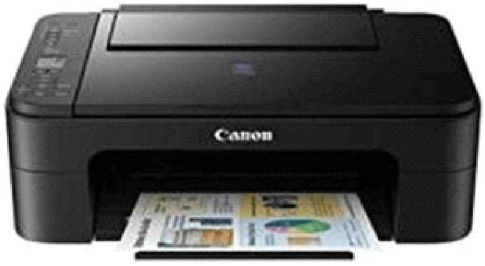
Non-Impact Printer

Non-impact printers don't print characters or images by striking a print head or hammer on the ink ribbon placed against the paper. They print characters and images without direct physical contact between the paper and the printing machinery. These printers can print a complete page at a time, so they are also known as page printers. The common types of non-impact printers are Laser printer and Inkjet printer:

i) Laser Printer

A laser printer is a non-impact printer that uses a laser beam to print the characters. The laser beam hits the drum, which is a photoreceptor and draws the image on the drum by altering electrical charges on the drum. The drum then rolls in toner, and the charged image on the drum picks the toner. The toner is then printed on the paper using heat and pressure. Once the document is printed, the drum loses the electric charge, and the remaining toner is collected. The laser printers use powdered toner for printing instead of liquid ink and produce quality print objects with a resolution of 600 dots per inch (dpi) or more.

ii) Inkjet Printer



The inkjet printer is a non-impact printer that prints images and characters by spraying fine, ionized drops of ink. The print head has tiny nozzles to spray the ink. The printer head moves back and forth and sprays ionized drops of ink on the paper, which is fed through the printer. These drops pass through an electric field that guides the ink onto the paper to print correct images and characters.

An inkjet printer has cartridges that contain ink. Modern inkjet printers are color printers that have four cartridges containing different colors: Cyan, Magenta, Yellow, and Black. It is capable of printing high-quality images with different colors. It can produce print objects with a resolution of at least 300 dots per inch (dpi).

3) Projector

A projector is an output device that enables the user to project the output onto a large surface such as a big screen or wall. It can be connected to a computer and similar devices to project their output onto a screen. It uses light and lenses to produce magnified texts, images, and videos. So, it is an ideal output device to give presentations or to teach a large number of people.

Modern projects (digital projectors) come with multiple input sources such as HDMI ports for newer equipment and VGA ports that support older devices. Some projectors are designed to support

Wi-Fi and Bluetooth as well. They can be fixed onto the ceiling, placed on a stand, and more and are frequently used for classroom teaching, giving presentations, home cinemas, etc.

A digital projector can be of two types:

Liquid Crystal Display (LCD) digital projector

This type of digital projectors are very popular as they are lightweight and provide crisp output. An LCD projector uses transmissive technology to produce output. It allows the light source, which is a standard lamp, to pass through the three colored liquid crystal light panels. Some colors pass through the panels and some are blocked by the panels and thus images are on the screen.

Digital Light Processing (DLP) digital projector

It has a set of tiny mirrors, a separate mirror for each pixel of the image and thus provide high-quality images. These projectors are mostly used in theatres as they fulfill the requirement of high-quality video output.

Audio Output

The term "audio output device" refers to any device that attaches to a computer for the purpose of playing sound, such as music or speech. The term can also refer to a computer sound card.

Speakers

Speakers are the most common type of audio output device. On laptops and other mobile computing devices, speakers are usually built in. External speakers can attach to a computer using a variety of audio plugs, or they can attach using a USB connection. Some external speakers require a separate energy supply, and must be plugged into the wall or a power strip.

Headphones

Headphones are another type of audio output device. Variations on the headphone concept include ear buds, which fit inside the ear, and headsets, which include both headphones and a microphone.

3.3 Computer Software

3.3.1 Introduction to operating system

Q18. What is operating system? What are the functions of operating system?

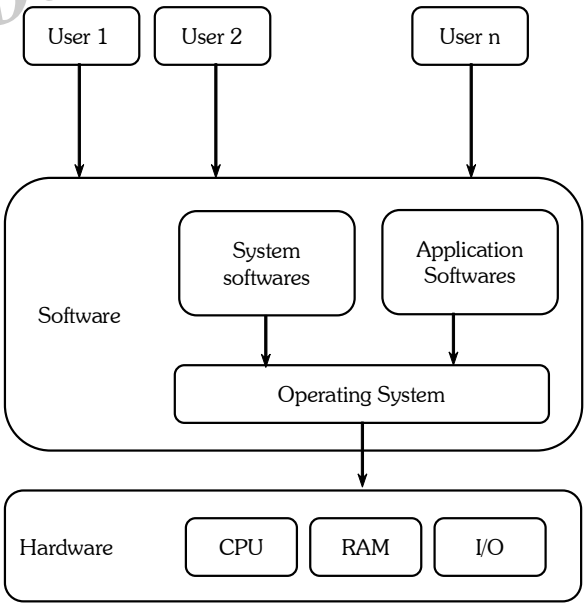
Ans : **(Imp.)**

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

Some popular Operating Systems include Linux Operating System, Windows Operating System, VMS, OS/400, AIX, z/OS, etc.

Definition

An operating system is a program that acts as an interface between the user and the computer hardware and controls the execution of all kinds of programs.



Following are some of important functions of an operating System.

- Memory Management
- Processor Management
- Device Management

- File Management
- Security
- Control over system performance
- Job accounting
- Error detecting aids
- Coordination between other software and users

Memory Management

Memory management refers to management of Primary Memory or Main Memory. Main memory is a large array of words or bytes where each word or byte has its own address.

Main memory provides a fast storage that can be accessed directly by the CPU. For a program to be executed, it must in the main memory. An Operating System does the following activities for memory management:

- Keeps tracks of primary memory, i.e., what part of it are in use by whom, what part are not in use.
- In multiprogramming, the OS decides which process will get memory when and how much.
- Allocates the memory when a process requests it to do so.
- De-allocates the memory when a process no longer needs it or has been terminated.

Processor Management

In multiprogramming environment, the OS decides which process gets the processor when and for how much time. This function is called process scheduling. An Operating System does the following activities for processor management:

- Keeps tracks of processor and status of process. The program responsible for this task is known as traffic controller.
- Allocates the processor (CPU) to a process.
- De-allocates processor when a process is no longer required.

Device Management

An Operating System manages device communication via their respective drivers. It does the following activities for device management:

- Keeps tracks of all devices. Program responsible for this task is known as the I/O controller.
- Decides which process gets the device when and for how much time.
- Allocates the device in the efficient way.
- De-allocates devices.

File Management

A file system is normally organized into directories for easy navigation and usage. These directories may contain files and other directions.

An Operating System does the following activities for file management:

- Keeps track of information, location, uses, status etc. The collective facilities are often known as file system.
- Decides who gets the resources.
- Allocates the resources.
- De-allocates the resources.

Other Important Activities

Following are some of the important activities that an Operating System performs:

- **Security:** By means of password and similar other techniques, it prevents unauthorized access to programs and data.
- **Control over system performance:** Recording delays between request for a service and response from the system.
- **Job accounting**: Keeping track of time and resources used by various jobs and users.
- **Error detecting aids:** Production of dumps, traces, error messages, and other debugging and error detecting aids.
- **Coordination between other softwares and users**: Coordination and assignment of compilers, interpreters, assemblers and other software to the various users of the computer systems.

Q19. Explain various types of operating system.

Ans :

Operating systems are there from the very first computer generation and they keep evolving with time. In this chapter, we will discuss some of the important types of operating systems which are most commonly used.

i) Batch Operating System

The users of a batch operating system do not interact with the computer directly. Each user prepares his job on an off-line device like punch cards and submits it to the computer operator. To speed up processing, jobs with similar needs are batched together and run as a group. The programmers leave their programs with the operator and the operator then sorts the programs with similar requirements into batches.

The problems with Batch Systems are as follows:

- Lack of interaction between the user and the job.
- CPU is often idle, because the speed of the mechanical I/O devices is slower than the CPU.
- Difficult to provide the desired priority.

ii) Time-sharing Operating Systems

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

The main difference between Multiprogrammed Batch Systems and Time-Sharing Systems is that in case of Multiprogrammed batch systems, the objective is to maximize processor use, whereas in Time-Sharing Systems, the objective is to minimize response time.

Multiple jobs are executed by the CPU by switching between them, but the switches occur so frequently. Thus, the user can receive an immediate response. For example, in a transaction processing, the processor executes each user program in a short burst or quantum of computation. That is, if n users are present, then each user can get a time quantum. When the user submits the command, the response time is in few seconds at most.

The operating system uses CPU scheduling and multiprogramming to provide each user with a small portion of a time. Computer systems that were designed primarily as batch systems have been modified to time-sharing systems.

Advantages of Timesharing operating systems are as follows:

- Provides the advantage of quick response.
- Avoids duplication of software.
- Reduces CPU idle time.

Disadvantages of Time-sharing operating systems are as follows:

- Problem of reliability.
- Question of security and integrity of user programs and data.
- Problem of data communication.

iii) Distributed Operating System

Distributed systems use multiple central processors to serve multiple real-time applications and multiple users. Data processing jobs are distributed among the processors accordingly.

The processors communicate with one another through various communication lines (such as high-speed buses or telephone lines). These are referred as loosely coupled systems or distributed systems. Processors in a distributed system may vary in size and function. These processors are referred as sites, nodes, computers, and so on.

The advantages of distributed systems are as follows:

- With resource sharing facility, a user at one site may be able to use the resources available at another.
- Speedup the exchange of data with one another via electronic mail.
- If one site fails in a distributed system, the remaining sites can potentially continue operating.

- Better service to the customers.
- Reduction of the load on the host computer.
- Reduction of delays in data processing.

iv) Network Operating System

A Network Operating System runs on a server and provides the server the capability to manage data, users, groups, security, applications, and other networking functions. The primary purpose of the network operating system is to allow shared file and printer access among multiple computers in a network, typically a local area network (LAN), a private network or to other networks.

Examples of network operating systems include Microsoft Windows Server 2003, Microsoft Windows Server 2008, UNIX, Linux, Mac OS X, Novell NetWare, and BSD.

The advantages of network operating systems are as follows:

- Centralized servers are highly stable.
- Security is server managed.
- Upgrades to new technologies and hardware can be easily integrated into the system.
- Remote access to servers is possible from different locations and types of systems.

The disadvantages of network operating systems are as follows:

- High cost of buying and running a server.
- Dependency on a central location for most operations.
- Regular maintenance and updates are required.

v) Real Time operating System

A real-time system is defined as a data processing system in which the time interval required to process and respond to inputs is so small that it controls the environment. The time taken by the system to respond to an input and display of required updated information is termed as the response time. So in this method, the response time is very less as compared to online processing.

Real-time systems are used when there are rigid time requirements on the operation of a processor or the flow of data and real-time systems can be used as a control device in a dedicated application. A real-time operating system must have well-defined, fixed time constraints, otherwise the system will fail. For example, Scientific experiments, medical imaging systems, industrial control systems, weapon systems, robots, air traffic control systems, etc.

There are two types of real-time operating systems.

Hard real-time systems

Hard real-time systems guarantee that critical tasks complete on time. In hard real-time systems, secondary storage is limited or missing and the data is stored in ROM. In these systems, virtual memory is almost never found.

Soft real-time systems

Soft real-time systems are less restrictive. A critical real-time task gets priority over other tasks and retains the priority until it completes. Soft real-time systems have limited utility than hard real-time systems. For example, multimedia, virtual reality, Advanced Scientific Projects like undersea exploration and planetary rovers, etc.

3.3.2 Programming Languages

Q20. Why do we need programming languages?

Ans :

Computer programming languages allow us to give instructions to a computer in a language the computer understands. Just as many human-based languages exist, there are an array of computer programming languages that programmers can use to communicate with a computer. The portion of the language that a computer can understand is called a "binary." Translating programming language into binary is known as "compiling." Each language, from C Language to Python, has its own distinct features, though many times there are commonalities between programming languages.

There are basically two types of computer programming languages given below:

1. Low level language
2. High level language

Low Level Languages

The programming languages that are very close to machine code (0s and 1s) are called low-level programming languages.

The program instructions written in these languages are in binary form.

The examples of low-level languages are:

- machine language
- assembly language

High Level Languages

The programming languages that are close to human languages (example like English languages) are called the high-level languages.

The examples of high-level languages are:

- Fortran
- COBOL
- Basic
- Pascal
- C
- C++
- Java

3.3.3 Classification of programming languages

Q21. Explain various types of programming languages.

Ans : **(Imp.)**

There are basically two types of computer programming languages given below:

1. Low level language
2. High level language

1. Low Level Languages

The programming languages that are very close to machine code (0s and 1s) are called low-level programming languages.

The program instructions written in these languages are in binary form.

The examples of low-level languages are:

- machine language
- assembly language

(i) Machine Language

The instructions in binary form, which can be directly understood by the computer (CPU) without translating them, is called a machine language or machine code.

Machine language is also known as first generation of programming language. Machine language is the fundamental language of the computer and the program instructions in this language is in the binary form (that is 0's and 1's).

This language is different for different computers.

It is not easy to learn the machine language.

ii) Assembly Language

It is another low-level programming language because the program instructions written in this language are close to machine language.

Assembly language is also known as second generation of programming language.

With assembly language, a programmer writes instructions using symbolic instruction code instead of binary codes.

Symbolic codes are meaningful abbreviations such as SUB is used for substation operation, MUL for multiply operation and so on. Therefore this language is also called the low-level symbolic language.

The set of program instructions written in assembly language are also called as mnemonic code.

Assembly language provides facilities for controlling the hardware.

2. High Level Languages

The programming languages that are close to human languages (example like English languages) are called the high-level languages.

The examples of high-level languages are:

- Fortran
- COBOL
- Basic
- Pascal
- C
- C++
- Java

The high level languages are similar to English language. The program instructions are written using English words, for example print, input etc. But each high level language has its own rule and grammar for writing program instructions. These rules are called syntax of the language.

The program written in high level language must be translated to machine code before to run it. Each high level language has its own translator program.

The high level programming languages are further divided into:

i) Procedural languages

ii) Non procedural languages

iii) Object oriented programming languages

i) Procedural Language

Procedural languages are also known as third generation languages (3GLs). In a procedural language, a program is designed using procedures.

A procedure is a sequence of instructions having a unique name. The instructions of the procedure are executed with the reference of its name.

In procedural programming languages, the program instructions are written in a sequence or in a specific order in which they must be executed to solve a specific problem. It means that the order of program instructions is very important.

Some popular procedural languages are described below:

- **FORTRAN** it stands for formula translation. It was developed in 1957 for IBM computers. It was the first earliest high level programming language used to introduce the concept of modular programming. It has been revised many times. Its commonly used version is FORTRAN 77
- **COBOL:** it stands for common business oriented language. It was developed in 1959. This high-level language was specially developed for business and commercial applications. It was suitable for handling large amount of data such as:
  - To prepare payroll
  - To process credit and debit account
  - To control inventory system and many other business applications
- **Pascal:** This programming language is named in the honour of Blaise Pascal, a mathematician and scientist who invented the first mechanical calculator. Structured programming language and is popular in computer science development in 1971. It is suitable for scientific field.
- **ADA:** It is developed in 1980 and is named in the honour of Lady Augusta ADA. She was the first computer programmer. The high level structure language Pascal was used as a model for the development of ADA language. This language is mainly used for defence purposes such as for controlling military weapons like missiles etc.
- **C language:** Dennis Ritchie and Brian Karnighan developed it in 1972 at Bell Laboratories. It is a high level language but it can also support assembly language codes (low level codes). It is because, C language is also referred to as middle level language. The program written in C can be compiled and run on any type of computer. In other words programs written in C language are portable. C language is a structured programming language. The main feature of C language is that, it uses a large number of built-in functions to perform various tasks. The user can also creates its own functions.

ii) Non Procedural Languages

Non procedural programming languages are also known as fourth generation languages. In non

procedural programming languages, the order of program instructions is not important. The importance is given only to, what is to be done.

With a non procedural language, the user/ programmer writes English like instructions to retrieve data from databases. These languages are easier to use than procedural languages. These languages provide the user-friendly program development tools to write instructions. The programmers have not to spend much time for coding the program.

The most important non procedural languages and tools are discussed below:

- **SQL:** It stands for structured query language. It is very popular database access language and is specially used to access and to manipulate the data of databases. The word query represents that this language is used to make queries (or enquiries) to perform various operations on data of database. However, SQL can also be used to create tables, add data, delete data, update data of database tables etc.
- **RPG:** It stands for report program generator. This language was introduced by IBM to generate business reports. Typically, RPG is used for application development on IBM midrange computers, such as AS/400.

iii) Object Oriented Programming Languages

The object oriented programming concept was introduced in the late 1960s, but now it has become the most popular approach to develop software.

In object oriented programming, the software is developed by using a set of interfacing object. An object is a component of program that has a set of modules and data structure. The modules are also called methods and are used to access the data from the object. The modern technique to design the program is object oriented approach. It is a very easy approach, in which program designed by using objects. Once an object for any program designed, it can be re-used in any other program.

Now-a-days, most popular and commonly used object oriented programming (OOPs) languages are C++ and Java.

Q22. List out advantages and disadvantages of Machine language?

Ans :

Advantage of Machine Language

The only advantage of machine language is that the program of machine language runs very fast because no translation program is required for the CPU.

Disadvantage of Machine Language

Here are some of the main disadvantages of machine languages:

i) Machine Dependent

The internal design of every computer is different from every other type of computer, machine language also differs from one computer to another. Hence, after becoming proficient in the machine language of one type of computer, if a company decides to change to another type, then its programmer will have to learn a new machine language and would have to rewrite all existing program.

ii) Difficult to Modify

It is difficult to correct or modify this language. Checking machine instructions to locate errors is very difficult and time consuming.

iii) Difficult to Program

A computer executes machine language program directly and efficiently, it is difficult to program in machine language. A machine language programming must be knowledgeable about the hardware structure of the computer.

Q23. List out various advantages and disadvantages of assembly language.

Ans :

Advantage of Assembly Language

Here are some of the main advantages of using assembly language:

i) Easy to understand and use

Due to the use of mnemonic instead of numeric op-codes and symbolic names for data location instead of numeric addresses, it is much

easier to understand and use in contrast with machine language.

ii) Easier to locate and correct errors

The programmers need not to keep track of storage location of the data and instruction, fewer errors are made while writing programs in assembly language and those that are made, are easier to find and correct.

iii) Easy to modify

Assembly language are easier to understand, it is easier to locate, correct and modify instruction of an assembly language program.

iv) Efficiency of machine language

An assembly language program will be just as long as the resulting machine language program. Hence, leaving out the translation time required by the assembler, the actual execution time for an assembly language program and its equivalent machine language program.

Disadvantage of Assembly Languages

And here are some of the main disadvantages of using assembly language:

i) Machine dependent

Each instructions of assembly language program is translated into exactly one machine language instruction, an assembly language programs are dependent on machine language.

ii) Knowledge of hardware required

Assembly languages are machine dependent, an assembly language programmer must have a good knowledge of characteristics and logical structure of his/her computer to write a good assembly language computer code.

iii) Machine level coding

Assembly language instruction is substituted for one machine language instruction. Hence like machine language programs, write assembly language program is also time consuming and difficult.

Q24. What are the advantages and limitations of High level language.

Ans :

Advantages of High Level Languages

There are several advantages of high level programming languages. The most important advantages are:

i) Easy to learn

The high level languages are very easy to learn than low level languages. The statements written for the program are similar to English-like statements.

ii) Easy to understand

The program written in high level language by one programmer can easily be understood by another because the program instructions are similar to the English language.

iii) Easy to write program

In high level language, a new program can easily be written in a very short time. The larger and complicated software can be developed in few days or months.

iv) Easy to detect and remove errors

The errors in a program can be easily detected and removed. mostly the errors are occurred during the compilation of new program.

v) Built-in library functions

Each high level language provides a large number of built-in functions or procedures that can be used to perform specific task during designing of new programs. In this way, a large amount of time of programmer is saved.

vi) Machine Independence

Program written in high level language is machine independent. It means that a program written in one type of computer can be executed on another type of computer.

Limitations of High Level Language

There are two main limitation of high level languages are:

i) Low efficiency

A program written in high level languages has lower efficiency than one written in a machine/ assembly language to do the same job. That is, program written in high level languages result in multiple machine language instruction that may not be optimize, taking more time to execute and requiring more memory space.

ii) Less flexibility

High level languages are less flexible than assembly languages because they do not normally have instructions or mechanism to control a computer's CPU, memory and register.

Q25. What are language processors?

Ans :

Language Processors

Assembly language is machine dependent yet mnemonics that are being used to represent instructions in it are not directly understandable by machine and high Level language is machine independent. A computer understands instructions in machine code, i.e. in the form of 0s and 1s. It is a tedious task to write a computer program directly in machine code. The programs are written mostly in high level languages like Java, C++, Python etc. and are called **source code**. These source code cannot be executed directly by the computer and must be converted into machine language to be executed. Hence, a special translator system software is used to translate the program written in high-level language into machine code is called **Language Processor** and the program after translated into machine code (object program / object code).

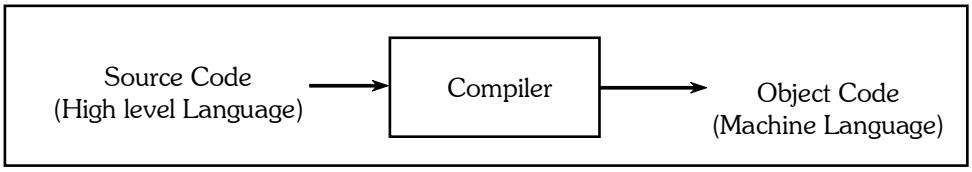
The language processors can be any of the following three types:

1. Compiler

The language processor that reads the complete source program written in high level language as a whole in one go and translates it into an equivalent program in machine language is called as a Compiler.

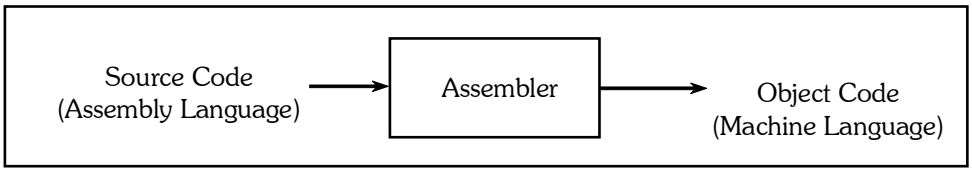
Example: C, C++, C#, Java

In a compiler, the source code is translated to object code successfully if it is free of errors. The compiler specifies the errors at the end of compilation with line numbers when there are any errors in the source code. The errors must be removed before the compiler can successfully recompile the source code again.



2. Assembler

The Assembler is used to translate the program written in Assembly language into machine code. The source program is a input of assembler that contains assembly language instructions. The output generated by assembler is the object code or machine code understandable by the computer.



3. Interpreter

The translation of single statement of source program into machine code is done by language processor and executes it immediately before moving on to the next line is called an interpreter. If there is an error in the statement, the interpreter terminates its translating process at that statement and displays an error message. The interpreter moves on to the next line for execution only after removal of the error. An Interpreter directly executes instructions written in a programming or scripting language without previously converting them to an object code or machine code.

Example: Perl, Python and Matlab.

Q26. What are the differences between compiler and interpreter?

Ans :

Compiler	Interpreter
A compiler is a program which coverts the entire source code of a programming language into executable machine code for a CPU.	Interpreter takes a source program and runs it line by line, translating each line as it comes to it.
Compiler takes large amount of time to analyze the entire source code but the overall execution time of the program is comparatively faster.	Interpreter takes less amount of time to analyze the source code but the overall execution time of the program is slower.
Compiler generates the error message only after scanning the whole program, so debugging is comparatively hard as the error can be present any where in the program.	Its Debugging is easier as it continues translating the program until the error is met
Generates intermediate object code.	No intermediate object code is generated.
Examples: C, C++, Java	Examples: Python, Perl

3.3.4 Classification of programming languages based on applications

Q27. Explain various programming languages based on applications.

Ans :

Classification of Programming Languages Based on Applications

Another method of classifying computer languages is by applications. The major applications of computers are in the following areas:

(i) Business data processing: Where large files are to be processed. COBOL has been the dominant language in this area. We have seen, however, the emergence of spread sheet based "languages" for answering "what if' type questions. Languages known as 4GLs (Fourth Generation Languages) are also used, which provide query languages to access data from data bases and manipulate them. 4 GLs also have special features like "fill in the blanks" to obtain answers to queries and elegant form generation.

(ii) Scientific applications: Require numeric intensive computing, such as those used to solve problems in science and engineering. Fortran 90 is the dominant language in this area. C is making inroads. Recently, Fortran 95 standard has been published, which incorporates features to write Fortran programs for parallel computers.

(iii) System programs: Such as those used to write compilers and operating systems. In this area, C and, more recently C++ dominate. A language known as Ada was specially designed to write programs for these applications but did not become popular.

(iv) Scripting programs: Another class of applications is to combine "program components" to build large programs. Examples of these are: commands to back up files at specified times, sending replies automatically to e-mail messages and invoking certain processes automatically when some conditions are satisfied. Languages have been developed to specify such tasks and sequence them to execute automatically. In Unix operating system, the user command language is called the shell, and command programs are known as shell scripts. This class of languages are called scripting languages. One such language is called PERL (Practical Extraction and Report Language). Visual Basic is used to develop graphical user interfaces.

(v) Artificial Intelligence (AI): Applications are characterized by algorithms which search large data bases for specific patterns. Typical examples are chess playing programs which generate many potential moves and search for the best move within a given time, using heuristic rules. LISP and Prolog are preferred languages in this area.

(vi) Publishing: Has become an important application of computers. Languages for word processing have proliferated which have special formatting commands, print commands, etc. LATEX is a popular language used to typeset material with complicated mathematical equations. The LATEX translator produces a program in the Postscript page description language for printing the material using a laser printer.

The area of programming languages is dynamic. As more sophisticated hardware systems appear in the market new computer applications emerge, which spawn new languages for such applications.

Another trend is the continuous increase in complexity of applications as hardware becomes more sophisticated and cheaper. The increase in size of programs needs new methods of tackling complexity while keeping the cost of program development low and ensuring correctness of program. This leads to many innovations.

Short Question and Answers

1. Define computer network? What are the characteristics of a computer network?

Ans :

A computer network is a system in which multiple computers are connected to each other to share information and resources.

Characteristics of a Computer Network

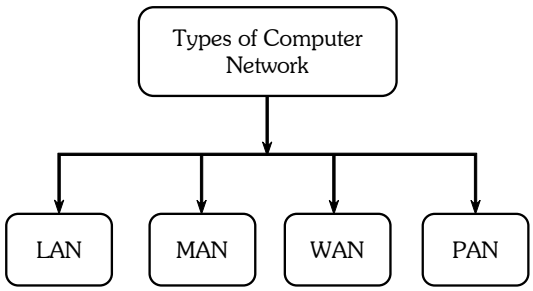
- Share resources from one computer to another.
- Create files and store them in one computer, access those files from the other computer(s) connected over the network.
- Connect a printer, scanner, or a fax machine to one computer within the network and let other computers of the network use the machines available over the network.

2. List out various types of computer networks.

Ans :

A computer network is a group of computers linked to each other that enables the computer to communicate with another computer and share their resources, data, and applications.

A computer network can be categorized by their size. A computer network is mainly of four types:



i) LAN (Local Area Network)
ii) PAN (Personal Area Network)
iii) MAN (Metropolitan Area Network)
iv) WAN (Wide Area Network)

3. What is LAN?

Ans :

- Local Area Network is a group of computers connected to each other in a small area such as building, office.
- LAN is used for connecting two or more personal computers through a communication medium such as twisted pair, coaxial cable, etc.
- It is less costly as it is built with inexpensive hardware such as hubs, network adapters, and ethernet cables.
- The data is transferred at an extremely faster rate in Local Area Network.
- Local Area Network provides higher security.

4. What is WAN?

Ans :

- A Wide Area Network is a network that extends over a large geographical area such as states or countries.
- A Wide Area Network is quite bigger network than the LAN.
- A Wide Area Network is not limited to a single location, but it spans over a large geographical area through a telephone line, fibre optic cable or satellite links.

- The internet is one of the biggest WAN in the world.
- A Wide Area Network is widely used in the field of Business, government, and education.

5. Explain various applications of LAN.

Ans :

The applications include:

- LAN is used for school environment, offices, hospitals etc as it allows sharing of resources like sharing data, scanners, printing and internet.
- LAN serves users at home to access internet.
- LAN's are widely used in manufacturing industries where a central server coordinates the activities of other machines.
- High speed LANs are typically used to connect many slower networks together.

6. What are the Disadvantages of LAN.

Ans :

The disadvantages of LAN are:

- Speed reduces as it includes sharing of resources.
- Less Secure.
- Requires skilled technicians to setup the network.
- Covers Limited area.

7 . What are the Advantages of WAN?

Ans :

Following are the advantages of the Wide Area Network:

- **Geographical area:** A Wide Area Network provides a large geographical area. Suppose if the branch of our office is in a different city then we can connect with them through WAN. The internet provides a leased line through which we can connect with another branch.
- **Centralized data:** In case of WAN network, data is centralized. Therefore, we do not need to buy the emails, files or back up servers.
- **Get updated files:** Software companies work on the live server. Therefore, the programmers get the updated files within seconds.
- **Exchange messages:** In a WAN network, messages are transmitted fast. The web application like Facebook, Whatsapp, Skype allows you to communicate with friends.
- **Sharing of software and resources:** In WAN network, we can share the software and other resources like a hard drive, RAM.
- **Global business:** We can do the business over the internet globally.
- **High bandwidth:** If we use the leased lines for our company then this gives the high bandwidth. The high bandwidth increases the data transfer rate which in turn increases the productivity of our company.

8. What is internet service provider?

Ans :

The term internet service provider (ISP) refers to a company that provides access to the internet to both personal and business customers. ISPs make it possible for their customers to surf the web, shop online, conduct business, and connect with family and friends all for a fee. ISPs may also provide other services including email services, domain registration, web hosting, and browser packages. An ISP may also be referred to as an information service provider, a storage service provider, an internet service provider (INSP), or any combination of these three based on the services the company offers.

- An internet service provider (ISP) is a company that provides web access to both businesses and consumers.
- ISPs may also provide other services such as email services, domain registration, web hosting, and browser services.
- An ISP is considered to be an information service provider, storage service provider, internet network service provider (INSP), or a mix of all of them.

- Internet use has evolved from only those with university or government accounts having access to nearly everyone having access, whether it's paid or free.
- Access has gone from dial-up connections to high-speed broadband technology.

9. Explain packet swtiching.

Ans :

- The packet switching is a switching technique in which the message is sent in one go, but it is divided into smaller pieces, and they are sent individually.
- The message splits into smaller pieces known as packets and packets are given a unique number to identify their order at the receiving end.
- Every packet contains some information in its headers such as source address, destination address and sequence number.
- Packets will travel across the network, taking the shortest path as possible.
- All the packets are reassembled at the receiving end in correct order.
- If any packet is missing or corrupted, then the message will be sent to resend the message.
- If the correct order of the packets is reached, then the acknowledgment message will be sent.

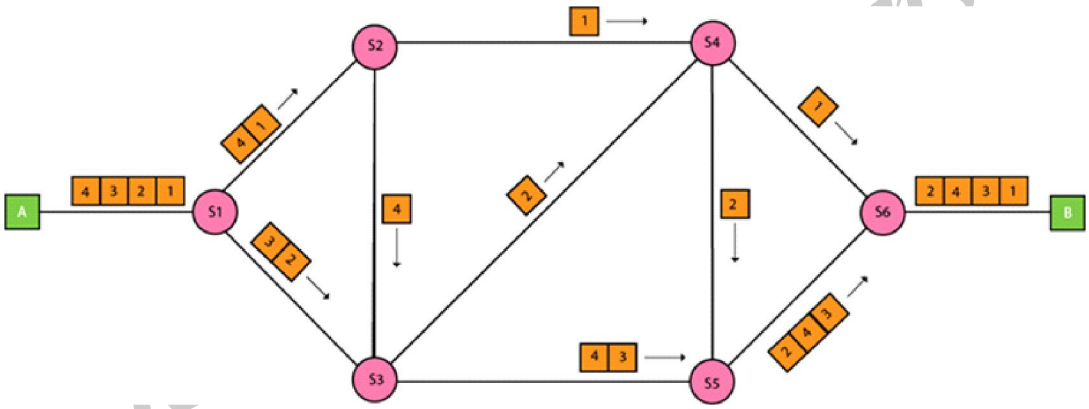


Fig.: Packet Switching

10. List out various functions of operating system.

Ans :

Following are some of important functions of an operating System.

- Memory Management
- Processor Management
- Device Management
- File Management
- Security
- Control over system performance
- Job accounting
- Error detecting aids
- Coordination between other software and users

11. Expalin about Assembly Language.

Ans :

It is another low-level programming language because the program instructions written in this language are close to machine language.

Assembly language is also known as second generation of programming language.

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Symbolic codes are meaningful abbreviations such as SUB is used for substation operation, MUL for multiply operation and so on. Therefore this language is also called the low-level symbolic language.

The set of program instructions written in assembly language are also called as mnemonic code.

Assembly language provides facilities for controlling the hardware.

12. What are the disadvantage of Machine Language.

Ans :

Here are some of the main disadvantages of machine languages:

i) Machine Dependent

The internal design of every computer is different from every other type of computer, machine language also differs from one computer to another. Hence, after becoming proficient in the machine language of one type of computer, if a company decides to change to another type, then its programmer will have to learn a new machine language and would have to rewrite all existing program.

ii) Difficult to Modify

It is difficult to correct or modify this language. Checking machine instructions to locate errors is very difficult and time consuming.

iii) Difficult to Program

A computer executes machine language program directly and efficiently, it is difficult to program in machine language. A machine language programming must be knowledgeable about the hardware structure of the computer.

13. List out the advntages of high level language.

Ans :

There are several advantages of high level programming languages. The most important advantages are:

i) Easy to learn

The high level languages are very easy to learn than low level languages. The statements written for the program are similar to English-like statements.

ii) Easy to understand

The program written in high level language by one programmer can easily be understood by another because the program instructions are similar to the English language.

iii) Easy to write program

In high level language, a new program can easily be written in a very short time. The larger and complicated software can be developed in few days or months.

iv) Easy to detect and remove errors

The errors in a program can be easily detected and removed. mostly the errors are occurred during the compilation of new program.

v) Built-in library functions

Each high level language provides a large number of built-in functions or procedures that can be used to perform specific task during designing of new programs. In this way, a large amount of time of programmer is saved.

vi) Machine Independence

Program written in high level language is machine independent. It means that a program written in one type of computer can be executed on another type of computer.

14. What are the differences between compiler and interpreter?

Ans :

Compiler	Interpreter
A compiler is a program which coverts the entire source code of a programming language into executable machine code for a CPU.	Interpreter takes a source program and runs it line by line, translating each line as it comes to it.
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Compiler generates the error message only after scanning the whole program, so debugging is comparatively hard as the error can be present any where in the program.	Its Debugging is easier as it continues translating the program until the error is met
Generates intermediate object code.	No intermediate object code is generated.
Examples: C, C++, Java	Examples: Python, Perl

Choose the Correct Answer

1. A collection of hyperlinked documents on the internet forms the ?.? [a]
   (a) World Wide Web (WWW) (b) E-mail system
   (c) Mailing list (d) Hypertext markup language
2. Location of a resource on the internet is given by its? [b]
   (a) Protocol (b) URL
   (c) E-mail address (d) ICQ
3. The term HTTP stands for? [c]
   (a) Hyper terminal tracing program (b) Hypertext tracing protocol
   (c) Hypertext transfer protocol (d) Hypertext transfer program
4. Which software prevents the external access to a system? [a]
   (a) Firewall (b) Gateway
   (c) Router (d) Virus checker
5. The term WAN stands for? [c]
   (a) Wide Area Net (b) Wide Access Network
   (c) Wide Area Network (d) Wide Access Net
6. What is internet? [b]
   (a) A single network (b) A vast collection of different networks
   (c) Interconnection of local area networks (d) Interconnection of wide area networks
7. To join the internet, the computer has to be connected to a _____ [c]
   (a) Internet architecture board (b) Internet society
   (c) Internet service provider (d) Different computer
8. Internet works on _____ [a]
   (a) Packet switching
   (b) Circuit switching
   (c) both packet switching and circuit switching
   (d) data switching
9. The _____ pen is a small input device used to select and display objects on a screen. [c]
   (a) Ink (b) Magnetic
   (c) Light (d) None of the above

10. _____ keys are present on the top row of the keyboard. [a]

(a) Function (b) Type writer

(c) Numeric (c) Navigation

11. Which of the following is not an operating system? [c]

(a) Windows (b) Linux

(c) Oracle (d) DOS

12. Which of the following is a single-user operating system? [c]

(a) Windows (b) MAC

(c) Ms-Dos (d) None of these

13. which of the following is not application software? [a]

(a) Windows 7 (b) WordPad

(c) Photoshop (d) MS-excel

Fill in the blanks

1. Operating system is a _____ software.
2. Linux is a _____ operating system.
3. The size of virtual memory is based on _____ bus.
4. Computer as by its hardware design, can only understand _____ language.
5. A program that can execute high-level language programs called _____
6. _____ was the first high -level language developed by John Backus at IBM in 1956.
7. C is known as _____ Language.
8. _____ converts an assembly language program into machine language.
9. _____ converts a high-level language program line by line into a machine language.
10. Errors in a computer program are referred to as _____

ANSWESRS

1. System
2. Open source
3. Address
4. Machine
5. Interpretter
6. Fortran
7. High level programming
8. Assembler
9. Compiler
10. Bugs

One Mark Question and Answers

1. What is Internet ?

Ans :

The Internet is a global wide area network that connects computer systems across the world. It includes several high-bandwidth data lines that comprise the Internet "backbone." These lines are connected to major Internet hubs that distribute data to other locations, such as web servers and ISPs.

2. Define IP address?

Ans :

IP address stands for internet protocol address; it is an identifying number that is associated with a specific computer or computer network. When connected to the internet, the IP address allows the computers to send and receive information.

3. List out any 2 advantages and disadvantages of switching.

Ans :

Advantages of Switching

- Switch increases the bandwidth of the network.
- It reduces the workload on individual PCs as it sends the information to only that device which has been addressed.
- It increases the overall performance of the network by reducing the traffic on the network.
- There will be less frame collision as switch creates the collision domain for each connection.

Disadvantages of Switching

- A Switch is more expensive than network bridges.
- A Switch cannot determine the network connectivity issues easily.
- Proper designing and configuration of the switch are required to handle multicast packets.

4. What is the use of DNS?

Ans :

DNS (Domain Name System) is a network protocol that we use to find the IP addresses of hostnames. Computers use IP addresses but for us humans, it's more convenient to use domain names and hostnames instead of IP addresses.

For example 144.16.79.48 is IP address. It is difficult for people to remember such a long sequence of digits Thus it is common practice to assign easy to remember names to computers connected to internet which is possible through DNS.

5. Define Operating System.

Ans :

An operating system is a program that acts as an interface between the user and the computer hardware and controls the execution of all kinds of programs.

6. Define Compiler.

Ans :

The language processor that reads the complete source program written in high level language as a whole in one go and translates it into an equivalent program in machine language is called as a Compiler.

UNIT IV

The Software Problem: Cost, Schedule, and Quality, Scale and Change

Software Processes: Process and Project, Component Software Processes, Software Development Process Models

Programming Principles and Guidelines: Structured Programming, Information Hiding, Some Programming Practices, Coding Standards

4.1 The Software Problem

Q1. Define Software Engineering.

Ans :

The term is made of two words, software and engineering.

Software

Software is more than just a program code. A program is an executable code, which serves some computational purpose. Software is considered to be collection of executable programming code, associated libraries and documentations. Software, when made for a specific requirement is called software product.

Engineering

Engineering on the other hand, is all about developing products, using well-defined, scientific principles and methods.

Software engineering

Software engineering is an engineering branch associated with development of software product using well-defined scientific principles, methods and procedures. The outcome of software engineering is an efficient and reliable software product.

Q2. Identify the functions playing a vital role in producing softwares with a caselet.

Ans :

Ask any student who has had some programming experience the following question:

You are given a problem for which you have to build a software system that most students feel will be approximately 10,000 lines of code. If you are working full time on it, how long will it take you to build this system.

The answer of students is generally 1 to 3 months. And, given the programming expertise of the students, there is a good chance that they will be able to build the software and demo it to the professor within 2 months. With 2 months as the completion time, the productivity of the student will be 5000 lines of code (LOC) per person-month.

Now let us take an alternative scenario—we act as clients and pose the same problem to a company that is in the business of developing software for clients. Though there is no standard productivity figure and it varies a lot, it is fair to say a productivity figure of 1000 LOC per person-month is quite respectable (though it can be as low as 100 LOC per person-month for embedded systems). With this productivity, a team of professionals in a software organization will take 10 person-months to build this software system.

Difference in productivity in the two scenarios. Why is it that the same students who can produce software at a productivity of a few thousand LOC per month while in college end up producing only about a thousand LOC per month when working in a company.

The answer, of course, is that two different things are being built in the two scenarios. In the first, a student system is being built which is primarily meant for demonstration purposes, and is not expected to be used later. Because it is not to be used, nothing of significance depends on the software and the presence of bugs and lack of quality is not a major concern. Neither are the other quality issues like usability, maintainability, portability etc.

On the other hand, an industrial-strength software system is built to solve some problem of a client and is used by the client's organization for operating some part of business, and a malfunction of such a system can have huge impact in terms of financial or business loss, inconvenience to users, or loss of property and life. Consequently, the software system needs to be of high quality with respect to properties like reliability, usability, portability, etc. This need for high quality and to satisfy the the end users has a major impact on the way software is developed and its cost. The rule of thumb Brooks gives suggests that the industrial-strength software may cost about 10 times the student software. The software industry is largely interested in developing industrial-strength software, and the area of software engineering focuses on how to build such systems. That is, the problem domain for software engineering is industrial strength software.

- That quality, cost, and schedule are the main forces that drive a (industrial strength) software project.
- How cost and productivity are defined and measured for such a project, and how quality of software is characterized and measured.
- That large scale and change are important attributes of the problem domain and solution approaches have to handle them.

4.1.1 Cost , Schedule and Quality

Q3. Explain how cost, schedule and quality playing important role in producing software's.

Ans :

Though the need for high quality distinguishes industrial strength software from others, cost and schedule are other major driving forces for such software. In the industrial-strength software domain, there are three basic forces at play - cost, schedule, and quality. The software should be produced at reasonable cost, in a reasonable time, and should be of good quality. These three parameters often drive and define a software project.

Industrial-strength software is very expensive primarily due to the fact that software development is extremely labour intensive. To get an idea of the costs involved, let us consider the current state of practice in the industry. Lines of code (LOC) or thousands of lines of code (KLOC) delivered is by far the most commonly used measure of software size in the industry. As the main cost of producing software is the manpower employed, the cost of developing software is generally measured in terms of person-months of effort spent in development. And productivity is frequently measured in the industry in terms of LOC (or KLOC) per person-month.

Schedule is another important factor in many projects. Business trends are dictating that the time to market of a product should be reduced; that is, the cycle time from concept to delivery should be small. For software this means that it needs to be developed faster, and within the specified time. Unfortunately, the history of software is full of cases where projects have been substantially late.

Besides cost and schedule, the other major factor driving software engineering is quality. Today, quality is one of the main mantras, and business strategies are designed around it. Unfortunately, a large number of instances have occurred regarding the unreliability of software - the software often does not do what it is supposed to do or does something it is not supposed to do. Clearly, developing high-quality software is another fundamental goal of software engineering.

Q4. What are the different attributes of software quality?

Ans :

The international standard on software product quality suggests that software quality comprises six main attributes

Functionality

The capability to provide functions which meet stated and implied needs when the software is used.

Reliability

The capability to provide failure-free service.

Usability

The capability to be understood, learned, and used.

Efficiency

The capability to provide appropriate performance relative to the amount of resources used.

Maintainability

The capability to be modified for purposes of making corrections, improvements, or adaptation.

Portability

The capability to be adapted for different specified environments without applying actions or means other than those provided for this purpose in the product.

Q5. What are the various software engineering problems ? Explain.

(OR)

Discuss various software engineering problems.

Ans : **(Imp.)**

Software engineering is the systematic approach to the development, operation, maintenance, and retirement of software. There are few fundamental problems that software engineering faces.

The Problem of Scale

A fundamental problem of software engineering is the problem of scale; development of a very large system requires a very different set of methods compared to developing a small system. In other words, the methods that are used for developing small systems generally do not scale up to large systems. A different set of methods has to be used for developing large software. Any large project involves the use of technology and project management.

For software projects, by technology we mean the methods, procedures, and tools that are used. In small projects, informal methods for development and management can be used. However, for large projects, both have to be much more formal.

While dealing with a small software project, the technology requirement is low and the project management requirement is also low. However, when the scale changes to large systems, to solve such problems properly, it is essential that we move in both directions-the methods used for development need to be more formal, and the project management for the development project also needs to be more formal.

Cost, Schedule and Quality

The cost of developing a system is the cost of the resources used for the system, which, in the case of software, are the manpower, hardware, software, and the other support resources. Generally, the manpower component is predominant, as software development is largely labor-intensive and the cost of the computing systems is now quite low.

Hence, the cost of software project is measured in terms of person-months, i.e. the cost is considered to be the total number of person-months spent in the project. Schedule is an important factor in many projects. Business trends are dictating that the time to market of a product should be reduced; that is, the cycle time from concept to delivery should be small. Any business with such a requirement will also require that the cycle time for building a software needed by the business be small.

One of the major factors driving any production discipline is quality. We can view quality of a software product as having three dimensions:

- Product operation
- Product Transition
- Product Revision

The Problem of Consistency

Though high quality, low cost and small cycle time are the primary objectives of any project, for an organization there is another goal: consistency. An organization involved in software development does not just want low cost and high quality for a project, but it wants these consistently.

4.1.2 Scale and Change

Q6. Explain how scale and change are driving forces of software development ?

(OR)

Explain the driving forces of software development.

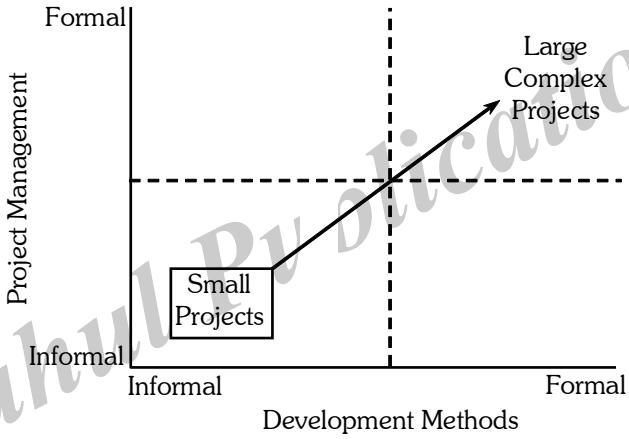
Ans : **(Imp.)**

Though cost, schedule, and quality are the main driving forces for a project in our problem domain (of industry strength software), there are some other characteristics of the problem domain that also influence the solution approaches employed. We focus on two such characteristics

- Scale
- Change

Scale

- Most industrial-strength software systems tend to be large and complex, requiring tens of thousands of lines of code. Sizes of some of the well-known software products are given in An example will illustrate this point. Consider the problem of counting people in a room versus taking a census of a country. Both are essentially counting problems. But the methods used for counting people in a room will just not work when taking a census. A different set of methods will have to be used for conducting a census, and the census problem will require considerably more management, organization, and validation, in addition to counting.
- Similarly, methods that one can use to develop programs of a few hundred lines cannot be expected to work when software of a few hundred thousand lines needs to be developed. A different set of methods must be used for developing large software.
- Any software project involves the use of engineering and project management. In small projects, informal methods for development and management can be used. However, for large projects, both have to be much more rigorous, as illustrated in Following figure In other words, to successfully execute a project, a proper method for engineering the system has to be employed and the project has to be tightly managed to make sure that cost, schedule, and quality are under control. Large scale is a key characteristic of the problem domain and the solution approaches should employ tools and techniques that have the ability to build large software systems.



Change

- Change is another characteristic of the problem domain which the approaches for development must handle. As the complete set of requirements for the system is generally not known (often cannot be known at the start of the project) or stated, as development proceeds and time passes, additional requirements are identified, which need to be incorporated in the software being developed. This need for changes requires that methods for development embrace change and accommodate it efficiently. Change requests can be quite disruptive to a project, and if not handled properly, can consume up to 30 to 40% of the develop-ment cost
- As discussed above, software has to be changed even after it has been deployed. Though traditionally changes in software during maintenance have been distinguished from changes that occur while the development is taking place, these lines are blurring, as fundamentally the changes in both of these scenarios are similar existing source code needs to be changed due to some changes in the requirements or due to some defects that need to be removed.
- Overall, as the world changes faster, software has to change faster, even while under development. Changes in requirements are therefore a characteristic of the problem domain. In today's world, approaches that cannot accept and accommodate change are of little use they can solve only those few problems that are change resistant.

4.2 Software Process

Q7. Explain software process

Ans : **(Dec.-21)**

The process that deals with the technical and management issues of software development is called a software process. A software development project must have at least development activities and project management activities. The fundamental objectives of a process are the same as that of software engineering (after all, the process is the main vehicle of satisfying the software engineering objectives), viz. optimality and scalability.

Optimality means that the process should be able to produce high-quality software at low cost, and scalability means that it should also be applicable for large software projects. To achieve these objectives, a process should have some properties. Predictability of a process determines how accurately the outcome of following a process in a project can be predicted before the project is completed. Predictability can be considered a fundamental property of any process, In fact, if a process is not predictable, it is of limited use.

One of the important objectives of the development project should be to produce software that is easy to maintain. And the process should be such that it ensures this maintainability. Testing consumes the most resources during development. Underestimating the testing effort often causes the planners to allocate insufficient resources for testing, which, in turn, results in unreliable software or schedule slippage.

The goal of the process should not be to reduce the effort of design and coding, but to reduce the cost of maintenance. Both testing and maintenance depend heavily on the design and coding of software, and these costs can be considerably reduced if the software is designed and coded to make testing and maintenance easier. Hence, during the early phases of the development process the prime issues should be "can it be easily tested" and "can it be easily modified". Errors can occur at any stage during development.

However error detection and correction should be a continuous process that is done throughout software development. Detecting errors soon after they have been introduced is clearly an objective that should be supported by the process. A process is also not a static entity.

As the productivity (and hence the cost of a project) and quality are determined largely by the process to satisfy the engineering objectives of quality improvement and cost reduction, the software process must be improved. Having process improvement as a basic goal of the software process implies that the software process used is such that is supports its improvement.

4.2.1 Process and Project

Q8. What is a software process model?

Ans :

Software Processes is a coherent set of activities for specifying, designing, implementing and testing software systems. A software process model is an abstract representation of a process that presents a description of a process from some particular perspective. There are many different software processes but all involve:

- **Specification:** Defining what the system should do;
- **Design and implementation:** Defining the organization of the system and implementing the system;
- **Validation:** Checking that it does what the customer wants;
- **Evolution:** Changing the system in response to changing customer needs.

Q9. What are the differences between project and process?

Ans :

Nature	Process	Project
Objective	A "process" has an objective that is typically defined around the on going operation of the process. For example, "provide ongoing maintenance for GM vehicles"	A "project" has an objective or outcome to be accomplished and the project ends when that objective is accomplished. That objective might be broadly -defined and might change or be further elaborated as the project is in progress. For example, "find a replacement ignition switch that will solve the problem with GM vehicles".
Time Duration	A "process" is generally ongoing and doesn't normally have an end.	A "project" has a beginning and an end (although the beginning and end may not be well-defined when the project starts and the end might be a long time in the future).
Process Orientation	A "process" is a repetitive sequence of tasks and the tasks are known at the outset since it is repetitive.	The sequence of tasks in a "project" is not normally repetitive and may not be known at the outset of the project.

4.2.2 Component software process

Q10. Explain software process in detail.

Ans :

A process is the sequence of steps executed to achieve a goal. Since many different goals may have to be satisfied while developing software, multiple processes are needed. Many of these do not concern software engineering, though they do impact software development. These could be considered nonsoftware process. Business processes, social processes, and training processes are all examples of processes that come under this. These processes also affect the software development activity but are beyond the purview of software engineering.

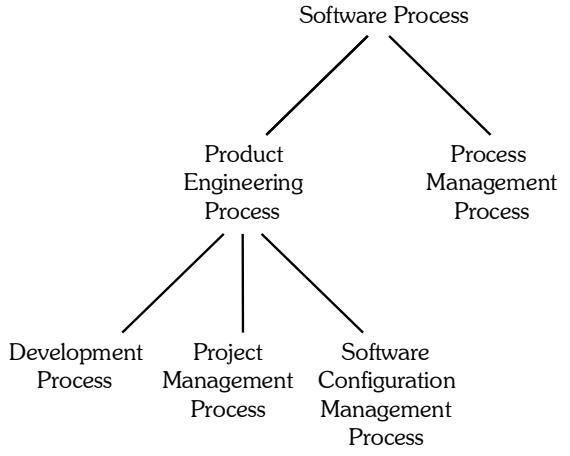
The processes that deal with the technical and management issues of software development are collectively called the software process. As a software project will have to engineer a solution and properly manage the project, there are clearly two major components in a software process-a development process and a project management process. The development process specifies all the engineering activities that need to be performed, whereas the management process specifies how to plan and control these activities so that cost, schedule, quality, and other objectives are met. Effective development and project management processes are the key to achieving the objectives of delivering the desired software satisfying the user needs, while ensuring high productivity and quality.

During the project many products are produced which are typically composed of many items (for example, the final source code may be composed of many source files). These items keep evolving as the project proceeds, creating many versions on the way. As development processes generally do not focus on evolution and changes, to handle them another process called software configuration control process is often used. The objective of this component process is to primarily deal with managing change, so that the integrity of the products is not violated despite changes.

These three constituent processes focus on the projects and the products and can be considered as comprising the product engineering processes, as their main objective is to produce the desired product. If the software process can be viewed as a static entity, then these three component processes will suffice. However, a software process itself is a dynamic entity, as it must change to adapt to our increased understanding about software development and availability of newer technologies and tools. Due to this, a process to manage the software process is needed.

The basic objective of the process management process is to improve the software process. By improvement, we mean that the capability of the process to produce quality goods at low cost is improved. For this, the current software process is studied, frequently by studying the projects that have been done using the process.

The whole process of understanding the current process, analyzing its properties, determining how to improve, and then affecting the improvement is dealt with by the process management process. The relationship between these major component processes is shown in following Figure. These component processes are distinct not only in the type of activities performed in them, but typically also in the people who perform the activities specified by the process. In a typical project, development activities are performed by programmers, designers, testers, etc.; the project management process activities are performed by the project management; configuration control process activities are performed by a group generally called the configuration controller; and the process management process activities are performed by the software engineering process group (SEPG).



4.2.3 Software development process Models

Q11. Define software process model. List out various types of software process models.

Ans :

Software Processes is a coherent set of activities for specifying, designing, implementing and testing software systems. A software process model is an abstract representation of a process that presents a description of a process from some particular perspective. There are many different software processes but all involve:

- **Specification:** Defining what the system should do;
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- **Evolution:** Changing the system in response to changing customer needs.

Types of Software Process Model

Software processes, methodologies and frameworks range from specific prescriptive steps that can be used directly by an organization in day-to-day work, to flexible frameworks that an organization uses to generate a custom set of steps tailored to the needs of a specific project or group. In some cases a "sponsor" or "maintenance" organization distributes an official set of documents that describe the process.

Software Process and Software Development Lifecycle Model

One of the basic notions of the software development process is SDLC models which stands for Software Development Life Cycle models. There are many development life cycle models that have been developed in order to achieve different required objectives. The models specify the various stages of the process and the order in which they are carried out. The most used, popular and important SDLC models are given below:

- Waterfall model
- V model
- Incremental model
- RAD model
- Agile model
- Iterative model
- Spiral model
- Prototype model

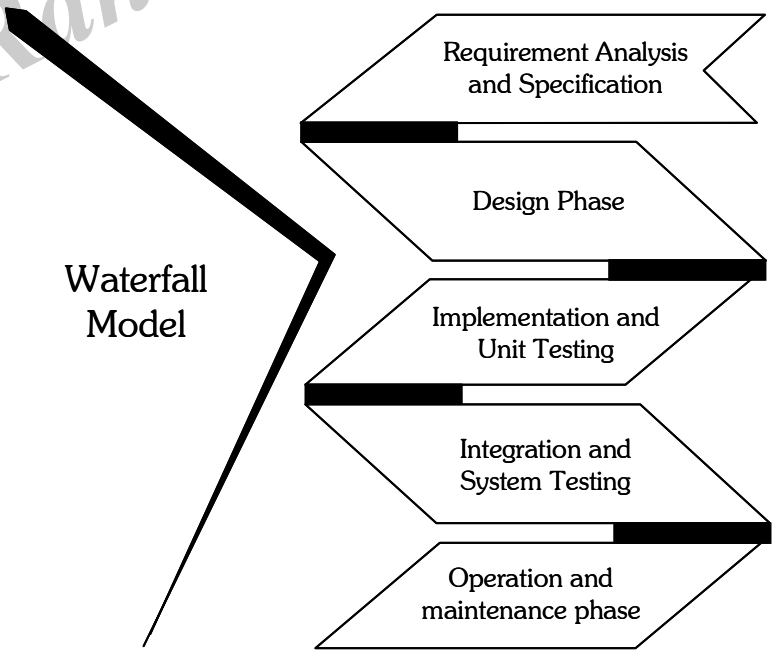
Q12. Explain the Waterfall Model.

Ans : **(Dec.-21)**

Waterfall model

Winston Royce introduced the Waterfall Model in 1970. This model has five phases: Requirements analysis and specification, design, implementation, and unit testing, integration and system testing, and operation and maintenance. The steps always follow in this order and do not overlap. The developer must complete every phase before the next phase begins. This model is named "Waterfall Model", because its diagrammatic representation resembles a cascade of waterfalls.

1. **Requirements analysis and specification phase:** The aim of this phase is to understand the exact requirements of the customer and to document them properly. Both the customer and the software developer work together so as to document all the functions, performance, and interfacing requirement of the software. It describes the "what" of the system to be produced and not "how."In this phase, a large document called Software Requirement Specification (SRS) document is created which contained a detailed description of what the system will do in the common language.



2. **Design Phase:** This phase aims to transform the requirements gathered in the SRS into a suitable form which permits further coding in a programming language. It defines the overall software architecture together with high level and detailed design. All this work is documented as a Software Design Document (SDD).

3. **Implementation and unit testing:** During this phase, design is implemented. If the SDD is complete, the implementation or coding phase proceeds smoothly, because all the information needed by software developers is contained in the SDD.

   During testing, the code is thoroughly examined and modified. Small modules are tested in isolation initially. After that these modules are tested by writing some overhead code to check the interaction between these modules and the flow of intermediate output.

4. **Integration and System Testing:** This phase is highly crucial as the quality of the end product is determined by the effective-ness of the testing carried out. The better output will lead to satisfied customers, lower maintenance costs, and accurate results. Unit testing determines the efficiency of individual modules. However, in this phase, the modules are tested for their interactions with each other and with the system.

5. **Operation and maintenance phase:** Maintenance is the task performed by every user once the software has been delivered to the customer, installed, and operational.

Advantages of Waterfall Model

- This model is simple to implement also the number of resources that are required for it is minimal.
- The requirements are simple and explicitly declared; they remain unchanged during the entire project development.
- The start and end points for each phase is fixed, which makes it easy to cover progress.
- The release date for the complete product, as well as its final cost, can be determined before development.
- It gives easy to control and clarity for the customer due to a strict reporting system.

Disadvantages of Waterfall Model

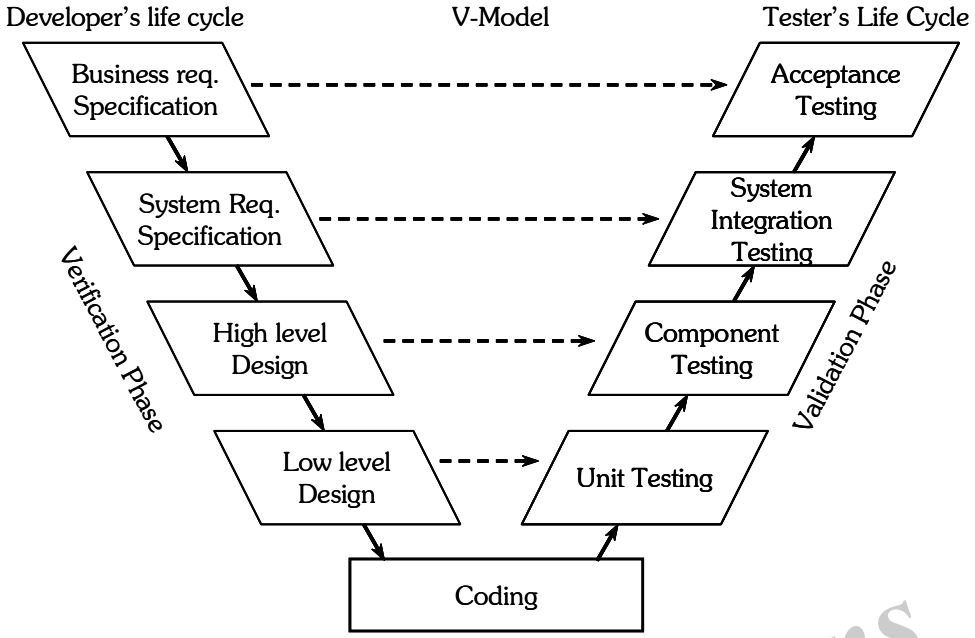
- In this model, the risk factor is higher, so this model is not suitable for more significant and complex projects.
- This model cannot accept the changes in requirements during development.
- It becomes tough to go back to the phase. For example, if the application has now shifted to the coding phase, and there is a change in requirement, It becomes tough to go back and change it.
- Since the testing done at a later stage, it does not allow identifying the challenges and risks in the earlier phase, so the risk reduction strategy is difficult to prepare.

Q13. Explain the V-Model.

Ans :

V-Model

V-Model also referred to as the Verification and Validation Model. In this, each phase of SDLC must complete before the next phase starts. It follows a sequential design process same as the waterfall model. Testing of the device is planned in parallel with a corresponding stage of development.



Verification

It involves a static analysis method (review) done without executing code. It is the process of evaluation of the product development process to find whether specified requirements meet.

Validation

It involves dynamic analysis method (functional, non-functional), testing is done by executing code. Validation is the process to classify the software after the completion of the development process to determine whether the software meets the customer expectations and requirements.

So V-Model contains Verification phases on one side of the Validation phases on the other side. Verification and Validation process is joined by coding phase in V-shape. Thus it is known as V-Model.

There are the various phases of Verification Phase of V-model:

1. **Business requirement analysis:** This is the first step where product requirements understood from the customer's side. This phase contains detailed communication to understand customer's expectations and exact requirements.
2. **System Design:** In this stage system engineers analyze and interpret the business of the proposed system by studying the user requirements document.
3. **Architecture Design:** The baseline in selecting the architecture is that it should understand all which typically consists of the list of modules, brief functionality of each module, their interface relationships, dependencies, database tables, architecture diagrams, technology detail, etc. The integration testing model is carried out in a particular phase.
4. **Module Design:** In the module design phase, the system breaks down into small modules. The detailed design of the modules is specified, which is known as Low-Level Design
5. **Coding Phase:** After designing, the coding phase is started. Based on the requirements, a suitable programming language is decided. There are some guidelines and standards for coding. Before checking in the repository, the final build is optimized for better performance, and the code goes through many code reviews to check the performance.

There are the various phases of Validation Phase of V-model:

1. **Unit Testing:** In the V-Model, Unit Test Plans (UTPs) are developed during the module design phase. These UTPs are executed to eliminate errors at code level or unit level. A unit is the smallest entity which can independently exist, e.g., a program module. Unit testing verifies that the smallest entity can function correctly when isolated from the rest of the codes/ units.
2. **Integration Testing:** Integration Test Plans are developed during the Architectural Design Phase. These tests verify that groups created and tested independently can coexist and communicate among themselves.
3. **System Testing:** System Tests Plans are developed during System Design Phase. Unlike Unit and Integration Test Plans, System Tests Plans are composed by the client?s business team. System Test ensures that expectations from an application developer are met.
4. **Acceptance Testing:** Acceptance testing is related to the business requirement analysis part. It includes testing the software product in user atmosphere. Acceptance tests reveal the compatibility problems with the different systems, which is available within the user atmosphere. It conjointly discovers the non-functional problems like load and performance defects within the real user atmosphere.

When to use V-Model

- When the requirement is well defined and not ambiguous.
- The V-shaped model should be used for small to medium-sized projects where requirements are clearly defined and fixed.
- The V-shaped model should be chosen when sample technical resources are available with essential technical expertise.

Advantage (Pros) of V-Model

1. Easy to Understand.
2. Testing Methods like planning, test designing happens well before coding.
3. This saves a lot of time. Hence a higher chance of success over the waterfall model.
4. Avoids the downward flow of the defects.
5. Works well for small plans where requirements are easily understood.

Disadvantage (Cons) of V-Model

1. Very rigid and least flexible.
2. Not a good for a complex project.
3. Software is developed during the implemen-tation stage, so no early prototypes of the software are produced.
4. If any changes happen in the midway, then the test documents along with the required documents, has to be updated.

Q14. Explain the incremental Model.

Ans : **(Aug.-21)**

Incremental Model

Incremental Model is a process of software development where requirements divided into multiple standalone modules of the software development cycle. In this model, each module goes through the requirements, design, implementation and testing phases. Every subsequent release of the module adds function to the previous release. The process continues until the complete system achieved.

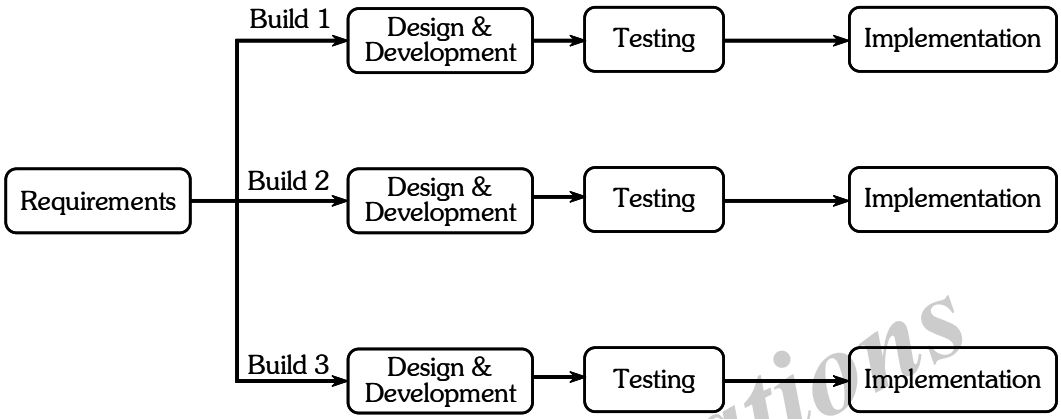


Fig.: Incremental Model

The various phases of incremental model are as follows:

1. **Requirement analysis:** In the first phase of the incremental model, the product analysis expertise identifies the requirements. And the system functional requirements are understood by the requirement analysis team. To develop the software under the incremental model, this phase performs a crucial role.
2. **Design & Development:** In this phase of the Incremental model of SDLC, the design of the system functionality and the development method are finished with success. When software develops new practicality, the incremental model uses style and development phase.
3. **Testing:** In the incremental model, the testing phase checks the performance of each existing function as well as additional functionality. In the testing phase, the various methods are used to test the behavior of each task.
4. **Implementation:** Implementation phase enables the coding phase of the development system. It involves the final coding that design in the designing and development phase and tests the functionality in the testing phase. After completion of this phase, the number of the product working is enhanced and upgraded up to the final system product

When to use incremental model

- When the requirements are superior.
- A project has a lengthy development schedule.
- When Software team are not very well skilled or trained.
- When the customer demands a quick release of the product.
- You can develop prioritized requirements first.

Advantage of Incremental Model

- Errors are easy to be recognized.
- Easier to test and debug
- More flexible.
- Simple to manage risk because it handled during its iteration.
- The Client gets important functionality early.

Disadvantage of Incremental Model

- Need for good planning
- Total Cost is high.
- Well defined module interfaces are needed.

Q15. What is RAD model? State its advantages and disadvantages.

Ans : **(Imp.)**

RAD (Rapid Application Development) Model

RAD is a linear sequential software develop-ment process model that emphasizes a concise development cycle using an element based construction approach. If the requirements are well understood and described, and the project scope is a constraint, the RAD process enables a develop-ment team to create a fully functional system within a concise time period.

RAD (Rapid Application Development) is a concept that products can be developed faster and of higher quality through:

- Gathering requirements using workshops or focus groups
- Prototyping and early, reiterative user testing of designs
- The re-use of software components
- A rigidly paced schedule that refers design improvements to the next product version
- Less formality in reviews and other team communication

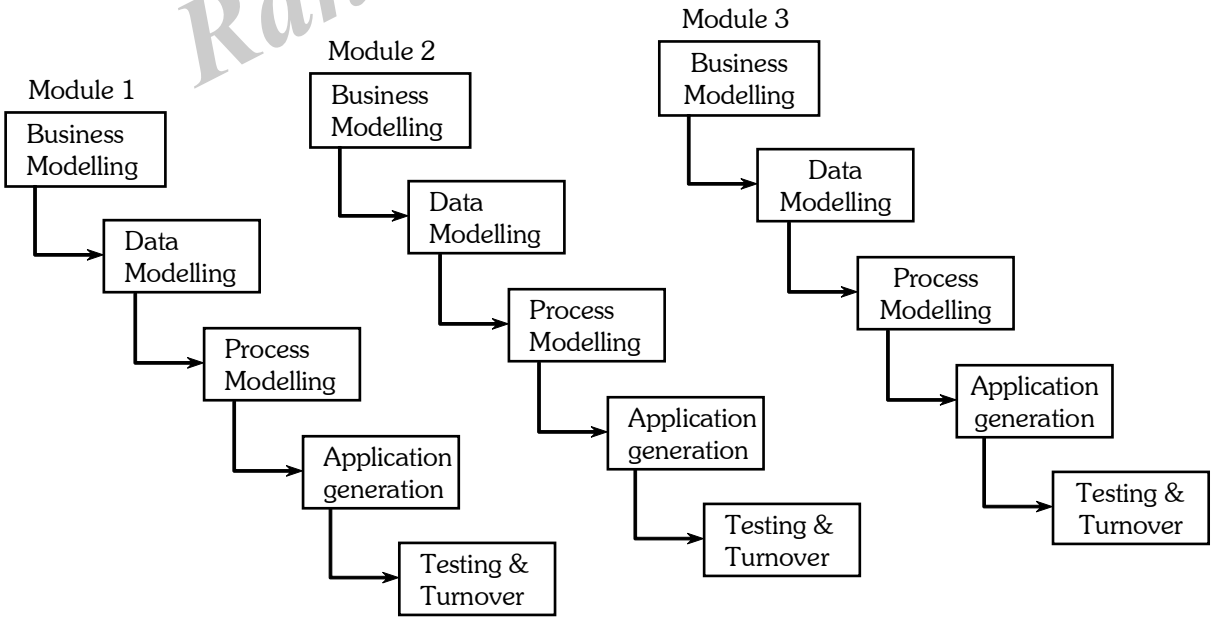


Fig.: RAD Model

The various phases of RAD are as follows:

1. **Business Modelling:** The information flow among business functions is defined by answering questions like what data drives the business process, what data is generated, who generates it, where does the information go, who process it and so on.
2. **Data Modelling:** The data collected from business modeling is refined into a set of data objects (entities) that are needed to support the business. The attributes (character of each entity) are identified, and the relation between these data objects (entities) is defined.
3. **Process Modelling:** The information object defined in the data modeling phase are transformed to achieve the data flow necessary to implement a business function. Processing descriptions are created for adding, modifying, deleting, or retrieving a data object.
4. **Application Generation:** Automated tools are used to facilitate construction of the software; even they use the 4th GL techniques.
5. **Testing & Turnover:** Many of the programming components have already been tested since RAD emphasis reuse. This reduces the overall testing time. But the new part must be tested, and all interfaces must be fully exercised.

When to use RAD Model

- When the system should need to create the project that modularizes in a short span time (2-3 months).
- When the requirements are well-known.
- When the technical risk is limited.
- When there's a necessity to make a system, which modularized in 2-3 months of period.
- It should be used only if the budget allows the use of automatic code generating tools.

Advantage of RAD Model

- This model is flexible for change.
- In this model, changes are adoptable.
- Each phase in RAD brings highest priority functionality to the customer.
- It reduced development time.
- It increases the reusability of features.

Disadvantage of RAD Model

- It required highly skilled designers.
- All application is not compatible with RAD.
- For smaller projects, we cannot use the RAD model.
- On the high technical risk, it's not suitable.
- Required user involvement.

Q16. Explain the spiral Model.

Ans :

Spiral Model

The spiral model, initially proposed by Boehm, is an evolutionary software process model that couples the iterative feature of prototyping with the controlled and systematic aspects of the linear sequential model. It implements the potential for rapid development of new versions of the software. Using the spiral model, the software is developed in a series of incremental releases. During the early iterations, the additional release may be a paper model or prototype. During later iterations, more and more complete versions of the engineered system are produced.

The Spiral Model is shown in figure.

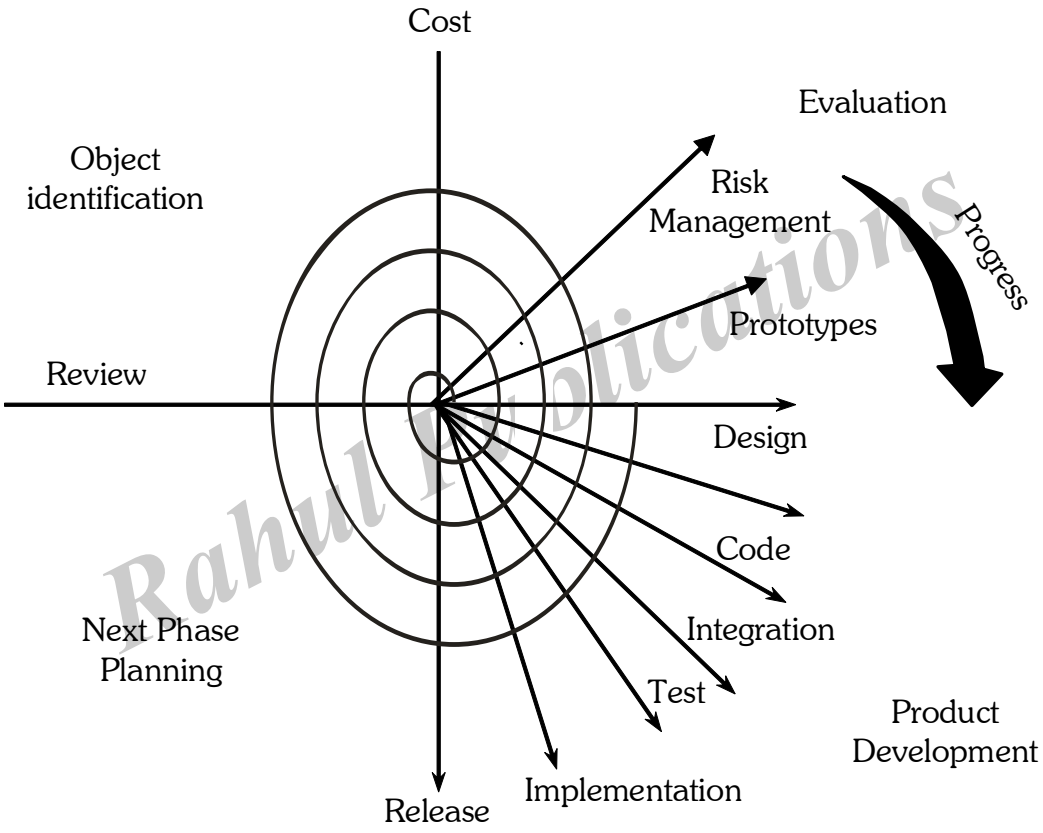


Fig.: Spiral Model

Each cycle in the spiral is divided into four parts

i) **Objective setting:** Each cycle in the spiral starts with the identification of purpose for that cycle, the various alternatives that are possible for achieving the targets, and the constraints that exists.

ii) **Risk Assessment and reduction:** The next phase in the cycle is to calculate these various alternatives based on the goals and constraints. The focus of evaluation in this stage is located on the risk perception for the project.

iii) **Development and validation:** The next phase is to develop strategies that resolve uncertainties and risks. This process may include activities such as benchmarking, simulation, and prototyping.

iv) Planning: Finally, the next step is planned. The project is reviewed, and a choice made whether to continue with a further period of the spiral. If it is determined to keep, plans are drawn up for the next step of the project.

The development phase depends on the remaining risks. For example, if performance or user-interface risks are treated more essential than the program development risks, the next phase may be an evolutionary development that includes developing a more detailed prototype for solving the risks.

The **risk-driven** feature of the spiral model allows it to accommodate any mixture of a specification-oriented, prototype-oriented, simulation-oriented, or another type of approach. An essential element of the model is that each period of the spiral is completed by a review that includes all the products developed during that cycle, including plans for the next cycle. The spiral model works for development as well as enhancement projects.

When to use Spiral Model

- When deliverance is required to be frequent.
- When the project is large
- When requirements are unclear and complex
- When changes may require at any time
- Large and high budget projects

Advantages

- High amount of risk analysis
- Useful for large and mission-critical projects.

Disadvantages

- Can be a costly model to use.
- Risk analysis needed highly particular expertise
- Doesn't work well for smaller projects.

Q17. List out the phases of Agile Model.

Ans :

Agile Model

The meaning of Agile is swift or versatile." Agile **process model**" refers to a software development approach based on iterative development. Agile methods break tasks into smaller iterations, or parts do not directly involve long term planning. The project scope and requirements are laid down at the beginning of the development process. Plans regarding the number of iterations, the duration and the scope of each iteration are clearly defined in advance.

Each iteration is considered as a short time "frame" in the Agile process model, which typically lasts from one to four weeks. The division of the entire project into smaller parts helps to minimize the project risk and to reduce the overall project delivery time requirements. Each iteration involves a team working through a full software development life cycle including planning, requirements analysis, design, coding, and testing before a working product is demonstrated to the client.

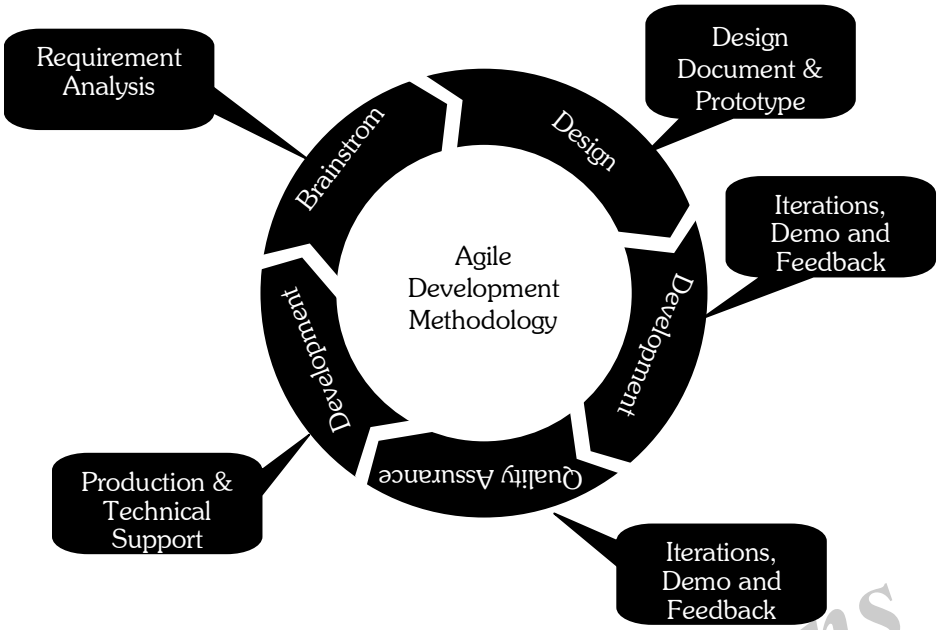


Fig.: Agile Model

Phases of Agile Model

Following are the phases in the Agile model are as follows:

1. Requirements gathering
2. Design the requirements
3. Construction/ iteration
4. Testing/ Quality assurance
5. Deployment
6. Feedback

1. **Requirements gathering:** In this phase, you must define the requirements. You should explain business opportunities and plan the time and effort needed to build the project. Based on this information, you can evaluate technical and economic feasibility.
2. **Design the requirements:** When you have identified the project, work with stakeholders to define requirements. You can use the user flow diagram or the high-level UML diagram to show the work of new features and show how it will apply to your existing system.
3. **Construction/ iteration:** When the team defines the requirements, the work begins. Designers and developers start working on their project, which aims to deploy a working product. The product will undergo various stages of improvement, so it includes simple, minimal functionality.
4. **Testing:** In this phase, the Quality Assurance team examines the product's performance and looks for the bug.
5. **Deployment:** In this phase, the team issues a product for the user's work environment.
6. **Feedback:** After releasing the product, the last step is feedback. In this, the team receives feedback about the product and works through the feedback.

Advantage (Pros) of Agile Method:

1. Frequent Delivery
2. Face-to-Face Communication with clients.
3. Efficient design and fulfils the business requirement.
4. Anytime changes are acceptable.
5. It reduces total development time.

Disadvantages (Cons) of Agile Model:

1. Due to the shortage of formal documents, it creates confusion and crucial decisions taken throughout various phases can be misinterpreted at any time by different team members.
2. Due to the lack of proper documentation, once the project completes and the developers allotted to another project, maintenance of the finished project can become a difficulty.

Q18. What is iterative Model? State it's advantages and disadvantages.

Ans : **(Imp.)**

Iterative Model

In this Model, you can start with some of the software specifications and develop the first version of the software. After the first version if there is a need to change the software, then a new version of the software is created with a new iteration. Every release of the Iterative Model finishes in an exact and fixed period that is called iteration.

The Iterative Model allows the accessing earlier phases, in which the variations made respectively. The final output of the project renewed at the end of the Software Development Life Cycle (SDLC) process.

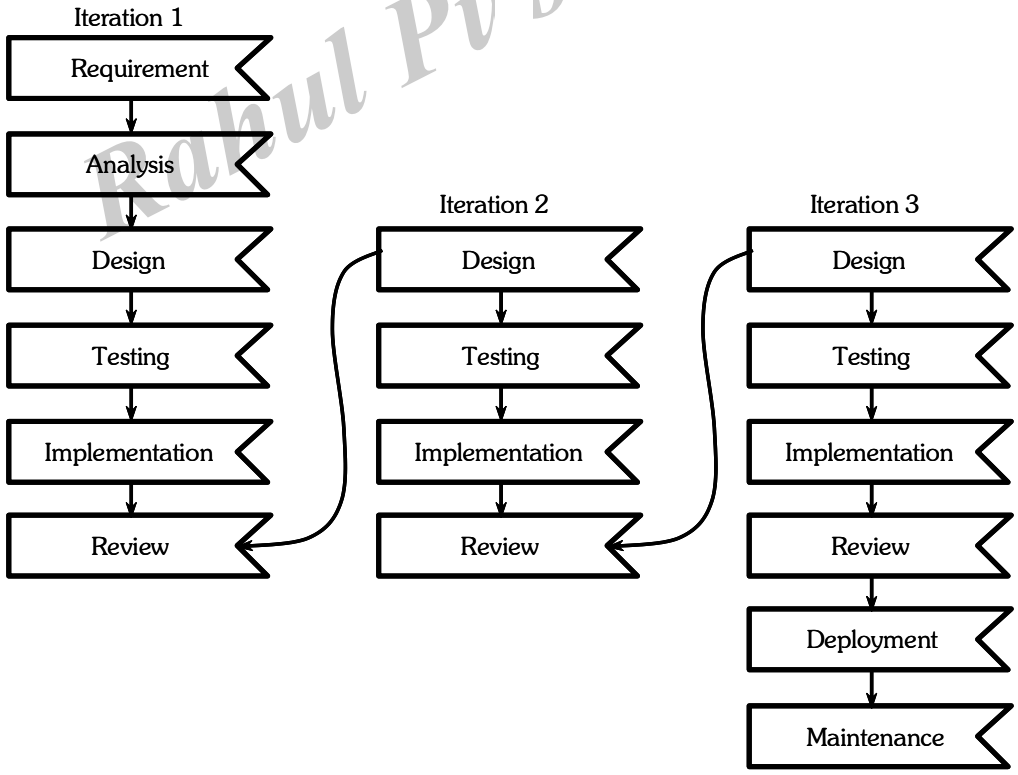


Fig.: Iterative Model

The various phases of Iterative model are as follows:

1. **Requirement gathering & analysis:** In this phase, requirements are gathered from customers and check by an analyst whether requirements will fulfil or not. Analyst checks that need will achieve within budget or not. After all of this, the software team skips to the next phase.
2. **Design:** In the design phase, team design the software by the different diagrams like Data Flow diagram, activity diagram, class diagram, state transition diagram, etc.
3. **Implementation:** In the implementation, requirements are written in the coding language and transformed into computer programmes which are called Software.
4. **Testing:** After completing the coding phase, software testing starts using different test methods. There are many test methods, but the most common are white box, black box, and grey box test methods.
5. **Deployment:** After completing all the phases, software is deployed to its work environment.
6. **Review:** In this phase, after the product deployment, review phase is performed to check the behaviour and validity of the developed product. And if there are any error found then the process starts again from the requirement gathering.
7. **Maintenance:** In the maintenance phase, after deployment of the software in the working environment there may be some bugs, some errors or new updates are required. Maintenance involves debugging and new addition options.

Advantage (Pros) of Iterative Model

1. Testing and debugging during smaller iteration is easy.
2. A Parallel development can plan.
3. It is easily acceptable to ever-changing needs of the project.
4. Risks are identified and resolved during iteration.
5. Limited time spent on documentation and extra time on designing.

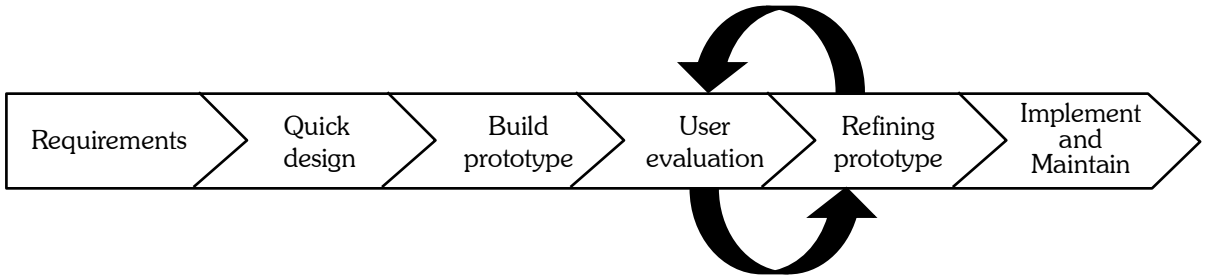
Disadvantage (Cons) of Iterative Model

1. It is not suitable for smaller projects.
2. More Resources may be required.
3. Design can be changed again and again because of imperfect requirements.
4. Requirement changes can cause over budget.
5. Project completion date not confirmed because of changing requirements.

Q19. What is the prototype model? Explain.

Ans :

Prototyping Model is a software development model in which prototype is built, tested, and reworked until an acceptable prototype is achieved. It also creates base to produce the final system or software. It works best in scenarios where the project's requirements are not known in detail. It is an iterative, trial and error method which takes place between developer and client.



Prototyping Model has following six SDLC phases as follow:

Step 1: Requirements gathering and analysis

A prototyping model starts with requirement analysis. In this phase, the requirements of the system are defined in detail. During the process, the users of the system are interviewed to know what is their expectation from the system.

Step 2: Quick design

The second phase is a preliminary design or a quick design. In this stage, a simple design of the system is created. However, it is not a complete design. It gives a brief idea of the system to the user. The quick design helps in developing the prototype.

Step 3: Build a Prototype

In this phase, an actual prototype is designed based on the information gathered from quick design. It is a small working model of the required system.

Step 4: Initial user evaluation

In this stage, the proposed system is presented to the client for an initial evaluation. It helps to find out the strength and weakness of the working model. Comment and suggestion are collected from the customer and provided to the developer.

Step 5: Refining prototype

If the user is not happy with the current prototype, you need to refine the prototype according to the user's feedback and suggestions.

This phase will not over until all the requirements specified by the user are met. Once the user is satisfied with the developed prototype, a final system is developed based on the approved final prototype.

Step 6: Implement Product and Maintain

Once the final system is developed based on the final prototype, it is thoroughly tested and deployed to production. The system undergoes routine maintenance for minimizing downtime and prevent large-scale failures.

Q20. Write any two advantages and disadvantages of time boxing model.

Ans :

In time boxing model, development is done iteratively as in the iterative enhancement model. However, in time boxing model, each iteration is done in a timebox of fixed duration. The functionality to be developed is adjusted to fit the duration of the timebox. Moreover, each timebox is divided into a sequence of fixed stages where each stage performs a clearly defined task (analysis, implementation, and deploy) that can be done independently. This model also requires that the time duration of each stage is approximately equal so that pipelining concept is employed to have the reduction in development time and product releases.

There is a dedicated team for each stage so that the work can be done in pipelining. Thus, stages should be chosen in such a way that each stage perform some logical unit of work that becomes the input for next stage.

In addition to the advantages of iterative model, time boxing model has some other advantages too. Various advantages and disadvantages associated with timeboxing model are listed in Table.

Advantages	Disadvantages
➢ Speeds up the development process and shortens the delivery time	➢ Project management becomes more complex.
➢ Well suited to develop projects with a number of features in short time period.	➢ Not suited to projects in which entire development work cannot be divided into multiple iterations of almost, equal duration.

Q21. Explain phases of Rational Unified process model.

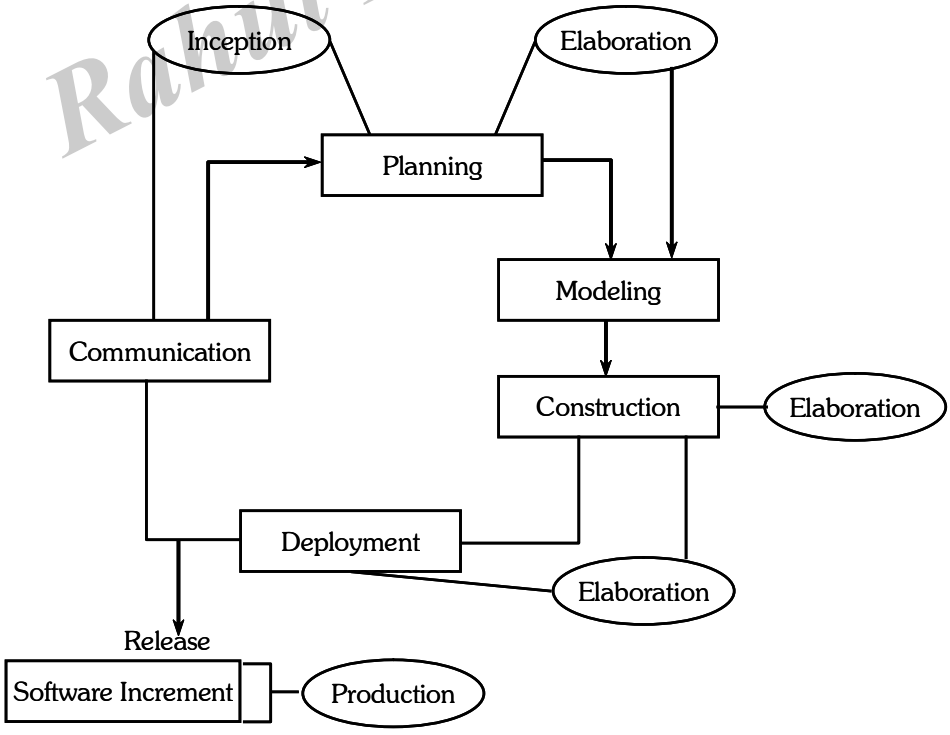
Ans :

Rational Unified Process (RUP) is a software development process for object-oriented models. It is also known as the Unified Process Model. It is created by Rational corporation and is designed and documented using UML (Unified Modeling Language). This process is included in IBM Rational Method Composer (RMC) product. IBM (International Business Machine Corporation) allows us to customize, design, and personalize the unified process.

RUP is proposed by Ivar Jacobson, Grady Bootch, and James Rambaugh. Some characteristics of RUP include use-case driven, Iterative (repetition of the process), and Incremental (increase in value) by nature, delivered online using web technology, can be customized or tailored in modular and electronic form, etc. RUP reduces unexpected development costs and prevents wastage of resources.

Phases of RUP

There are total five phases of life cycle of RUP:



1. Inception

- Communication and planning are main.
- Identifies Scope of the project using use-case model allowing managers to estimate costs and time required.
- Customers requirements are identified and then it becomes easy to make a plan of the project.
- Project plan, Project goal, risks, use-case model, Project description, are made.
- Project is checked against the milestone criteria and if it couldn't pass these criteria then project can be either cancelled or redesigned.

2. Elaboration

- Planning and modeling are main.
- Detailed evaluation, development plan is carried out and diminish the risks.
- Revise or redefine use-case model (approx. 80%), business case, risks.
- Again, checked against milestone criteria and if it couldn't pass these criteria then again project can be cancelled or redesigned.
- Executable architecture baseline.

3. Construction

- Project is developed and completed.
- System or source code is created and then testing is done.
- Coding takes place.

4. Transition

- Final project is released to public.
- Transit the project from development into production.
- Update project documentation.
- Beta testing is conducted.
- Defects are removed from project based on feedback from public.

5. Production

- Final phase of the model.
- Project is maintained and updated accordingly.

4.3 Programming Principles and Guidelines

Q22. What major practices helps a programmer to write higher quality code?

(OR)

List the practices that can help a programer write high quality code.

Ans :

The main task before a programmer is to write readable code with few bugs in it. An additional goal is to write code quickly. Writing solid code is a skill that can only be acquired by practice. However, based on experience, some general rules and guidelines can be given for the programmer. Good programming (producing correct and simple programs) is a practice independent of the target programming language, although well-structured programming languages make the programmer's job simpler.

Following are the concepts and practices that can help a programmer write higher-quality code that is also easier to understand.

1. Structured programming
2. Information hiding
3. Some programming practices
4. Coding standards.

4.3.1 Structured programming

Q23. What is structure programming? and Explain it's advantages and disadvantages.

Ans :

Structured Programming Approach, as the word suggests, can be defined as a programming approach in which the program is made as a single structure. It means that the code will execute the instruction by instruction one after the other. It doesn't support the possibility of jumping from one instruction to some other with the help of any statement like GOTO, etc. Therefore, the instructions in this approach will be executed in a serial and structured manner. The languages that support Structured programming approach are:

- C
- C++
- Java
- C#

..etc

The structured program mainly consists of three types of elements:

- Selection Statements
- Sequence Statements
- Iteration Statements

The structured program consists of well structured and separated modules. But the entry and exit in a Structured program is a single-time event. It means that the program uses single-entry and single-exit elements. Therefore a structured program is well maintained, neat and clean program. This is the reason why the Structured Programming Approach is well accepted in the programming world.

Advantages of Structured Programming Approach

1. Easier to read and understand
2. User Friendly
3. Easier to Maintain
4. Mainly problem based instead of being machine based
5. Development is easier as it requires less effort and time
6. Easier to Debug
7. Machine-Independent, mostly.

Disadvantages of Structured Programming Approach

1. Since it is Machine-Independent, So it takes time to convert into machine code.
2. The converted machine code is not the same as for assembly language.
3. The program depends upon changeable factors like data-types. Therefore it needs to be updated with the need on the go.
4. Usually the development in this approach takes longer time as it is language-dependent. Whereas in the case of assembly language, the development takes lesser time as it is fixed for the machine.

4.3.2 Information Hiding

Q24. What is information hiding ?

Ans : **(Aug.-21)**

Information hiding focuses on hiding the non-essential details of functions and code in a program so that they are inaccessible to other components of the software. A software developer applies information hiding in software design and coding to hide unnecessary details from the rest of the program. The objective of information hiding is to minimize complexities among different modules of the software. Note that complexities arise when one program or module in software is dependent on several other programs and modules.

Information hiding is implemented with the help of interfaces. An interface is a medium of interaction for software components that are using the properties of the software modules containing data. The implementation of interfaces depends on the syntax and process. Examples of interface include constants, data types, types of procedures, and so on. Interfaces protect other parts of programs when a software design is changed.

Generally, the interfaces act as a foundation to modular programming (top-down programming) and object-oriented programming. In object-oriented programming, interface of an object comprises a set of methods, which are used to interact with the objects of the software programs. Using information hiding, a single program is divided into several modules. These modules are independent of each other and can be used interchangeably in other software programs.

To understand the concept of information hiding, let us consider an example of a program written for 'car'. The program can be organized in several ways. One is to arrange modules without using information hiding. In this case, the modules

can be created as 'front part', 'middle part', and 'rear part'. On the other hand, creating modules using information hiding includes specifying names of modules such as 'engine' and 'steering'.

On comparison, it is found that modules created without using information hiding affect other modules. This is because when a module is modified, it affects the data, which does not require modification. However, if modules are created using information hiding, then modules are concerned only with specific segments of the program and not the whole program or other parts of the program. In our example, this statement means that the module 'engine' does not have any affect on the module 'steering'.

4.3.3 Programming practices

Q25. Discuss how program practices helps to make code easier?

Ans :

We discuss here a few rules that have been found to make code easier to read as well as avoid some of the errors.

Control Constructs

As discussed earlier, it is desirable that as much as possible single-entry, single-exit constructs be used. It is also desirable to use a few standard control constructs rather than using a wide variety of constructs, just because they are available in the language.

Gotos

Gotos should be used sparingly and in a disciplined manner. Only when the alternative to using gotos is more complex should the gotos be used. In any case, alternatives must be thought of before finally using a goto. If a goto must be used, forward transfers (or a jump to a later statement) is more acceptable than a backward jump.

Information Hiding

As discussed earlier, information hiding should be supported where possible. Only the access functions for the data structures should be made visible while hiding the data structure behind these functions

User-Defined Types

Modern languages allow users to define types like the enumerated type. When such facilities are available, they should be exploited where applicable. For example, when working with dates, a type can be defined for the day of the week. Using such a type makes the program much clearer than defining codes for each day and then working with codes.

Nesting

If nesting of if-then-else constructs becomes too deep, then the logic become harder to understand. In case of deeply nested if-then-elses, it is often difficult to determine the if statement to which a particular else clause is associated. Where possible, deep nesting should be avoided, even if it means a little inefficiency.

Module Size

We discussed this issue during system design. A programmer should carefully examine any function with too many statements (say more than 100). Large modules often will not be functionally cohesive. There can be no hard-and-fast rule about module sizes; the guiding principle should be cohesion and coupling.

Module Interface

A module with a complex interface should be carefully examined. As a rule of thumb, any module whose interface has more than five parameters should be carefully examined and broken into multiple modules with a simpler interface if possible.

Side Effects

When a module is invoked, it sometimes has side effects of modifying the program state beyond the modification of parameters listed in the module interface definition, for example, modifying global variables. Such side effects should be avoided where possible, and if a module has side effects, they should be properly documented.

Robustness

A program is robust if it does something planned even for exceptional conditions. A program might encounter exceptional conditions in such forms as incorrect input, the incorrect value of some

variable, and overflow. If such situations do arise, the program should not just "crash" or "core dump"; it should produce some meaningful message and exit gracefully.

Switch Case with Default

If there is no default case in a "switch" statement, the behavior can be unpredictable if that case arises at some point of time which was not predictable at development stage. Such a practice can result in a bug like NULL dereference, memory leak, as well as other types of serious bugs. It is a good practice to always include a default case.

Give Importance to Exceptions

Most programmers tend to give less attention to the possible exceptional cases and tend to work with the main flow of events, control, and data. Though the main work is done in the main path, it is the exceptional paths that often cause software systems to fail. To make a software system more reliable, a programmer should consider all possibilities and write suitable exception handlers to prevent failures or loss when such situation occurs.

4.3.4 Coding standards

Q26. What are the common aspects of coding standards?

Ans : **(Imp.)**

Writing codes without conventions and standards can easily become messy and unmaintainable for a large codebase. When working as a team, it is crucial to set rules and guidelines that each member on the development team must follow to ensure that the product is reliable and consistently maintained. In order to write well-structured and clean code, developers need to get aligned with the standards and conventions used in their teams. This eases the understanding of the code for any developers who gets on the codebase.

Good quality code requires consistent effort and a great focus from the developers' team to meet the quality goal. Without conventions, it can be difficult for developers to understand the codebase and it can increase the development time as well as the complexity of the project structure.

Coding standards

Coding standards are collections of rules and guidelines that determine the programming style, procedures, and methods for a programming language.

Importance of coding conventions

Without the coding conventions, every individual in a team will settle their coding styles. It will not be easy to maintain and debug the code in the near future.

Benefits of coding standards

- Easy team integration
- Increased code quality efficiency and easy for maintaining
- Reduce code complexity
- Reduce development cost

Drawbacks of not having proper coding conventions for a team

Without predefined conditions that all team member should follow can result in the following:

- Reduced engineers motivation
- Increased development time
- Complex codebase structure

Common Aspects of Coding Standard

- **Naming Conventions:** The naming convention is how your packages, classes methods, variables, etc. should be named. (eg. camelCase, PascalCase or snake_case)
- **File and folder Naming and Organization:** This is how your file and folder should be named and structured.
- **Formatting and Indentation:** The code should be written in a standardized format and indentation.
- **Commenting and Documenting:** This makes it easy for the reviewer of your code to better understand codes methods and declarations.
- **Classes and Functions:** This specifies how classes and functions should behave.
- **Testing:** This specifies which approach and tools should be used to test the codes.

Short Question and Answers

1. What are the different attributes of software quality?

Ans :

The international standard on software product quality suggests that software quality comprises six main attributes

Functionality

The capability to provide functions which meet stated and implied needs when the software is used.

Reliability

The capability to provide failure-free service.

Usability

The capability to be understood, learned, and used.

Efficiency

The capability to provide appropriate performance relative to the amount of resources used.

Maintainability

The capability to be modified for purposes of making corrections, improvements, or adaptation.

Portability

The capability to be adapted for different specified environments without applying actions or means other than those provided for this purpose in the product.

2. Discuss various software engineering problems.

Ans :

Software engineering is the systematic approach to the development, operation, maintenance, and retirement of software. There are few fundamental problems that software engineering faces.

The Problem of Scale

A fundamental problem of software engineering is the problem of scale; development of a very large system requires a very different set of methods compared to developing a small system. In other words, the methods that are used for developing small systems generally do not scale up to large systems. A different set of methods has to be used for developing large software. Any large project involves the use of technology and project management.

For software projects, by technology we mean the methods, procedures, and tools that are used. In small projects, informal methods for development and management can be used. However, for large projects, both have to be much more formal.

While dealing with a small software project, the technology requirement is low and the project management requirement is also low. However, when the scale changes to large systems, to solve such problems properly, it is essential that we move in both directions-the methods used for development need to be more formal, and the project management for the development project also needs to be more formal.

Cost, Schedule and Quality

The cost of developing a system is the cost of the resources used for the system, which, in the case of software, are the manpower, hardware, software, and the other support resources. Generally, the manpower component is predominant, as software development is largely labor-intensive and the cost of the computing systems is now quite low.

Hence, the cost of software project is measured in terms of person-months, i.e. the cost is considered to be the total number of person-months spent in the project. Schedule is an important factor in many projects. Business trends are dictating that the time to market of a product should be reduced; that is, the cycle time from concept to delivery should be small. Any business with such a requirement will also require that the cycle time for building a software needed by the business be small.

One of the major factors driving any production discipline is quality. We can view quality of a software product as having three dimensions:

- Product operation
- Product Transition
- Product Revision

The Problem of Consistency

Though high quality, low cost and small cycle time are the primary objectives of any project, for an organization there is another goal: consistency. An organization involved in software development does not just want low cost and high quality for a project, but it wants these consistently.

3. What are the differences between project and process?

Ans :

Nature	Process	Project
Objective	A "process" has an objective that is typically defined around the on going operation of the process. For example, "provide ongoing maintenance for GM vehicles"	A "project" has an objective or outcome to be accomplished and the project ends when that objective is accomplished. That objective might be broadly -defined and might change or be further elaborated as the project is in progress. For example, "find a replacement ignition switch that will solve the problem with GM vehicles".
Time Duration	A "process" is generally ongoing and doesn't normally have an end.	A "project" has a beginning and an end (although the beginning and end may not be well-defined when the project starts and the end might be a long time in the future).
Process Orientation	A "process" is a repetitive sequence of tasks and the tasks are known at the outset since it is repetitive.	The sequence of tasks in a "project" is not normally repetitive and may not be known at the outset of the project.

4. Define software process model.

Ans :

Software Processes is a coherent set of activities for specifying, designing, implementing and testing software systems. A software process model is an abstract representation of a process that presents a description of a process from some particular pers-pective. There are many different software processes but all involve:

- **Specification:** Defining what the system should do;
- **Design and implementation:** Defining the organization of the system and implementing the system;
- **Validation:** Checking that it does what the customer wants;
- **Evolution:** Changing the system in response to changing customer needs.

5. List out advantages and disadvantags of waterfall Model.

Ans :

Advantages of Waterfall Model

- This model is simple to implement also the number of resources that are required for it is minimal.
- The requirements are simple and explicitly declared; they remain unchanged during the entire project development.

- The start and end points for each phase is fixed, which makes it easy to cover progress.
- The release date for the complete product, as well as its final cost, can be determined before development.
- It gives easy to control and clarity for the customer due to a strict reporting system.

Disadvantages of Waterfall Model

- In this model, the risk factor is higher, so this model is not suitable for more significant and complex projects.
- This model cannot accept the changes in requirements during development.
- It becomes tough to go back to the phase. For example, if the application has now shifted to the coding phase, and there is a change in requirement, It becomes tough to go back and change it.
- Since the testing done at a later stage, it does not allow identifying the challenges and risks in the earlier phase, so the risk reduction strategy is difficult to prepare.

6. What are the advantages and disadvantages of RAD Model?

Ans :

Advantage of RAD Model

- This model is flexible for change.
- In this model, changes are adoptable.
- Each phase in RAD brings highest priority functionality to the customer.
- It reduced development time.
- It increases the reusability of features.

Disadvantage of RAD Model

- It required highly skilled designers.
- All application is not compatible with RAD.
- For smaller projects, we cannot use the RAD model.
- On the high technical risk, it's not suitable.
- Required user involvement.

7. List the practices that can help a programer write high quality code.

Ans :

The main task before a programmer is to write readable code with few bugs in it. An additional goal is to write code quickly. Writing solid code is a skill that can only be acquired by practice. However, based on experience, some general rules and guidelines can be given for the programmer. Good programming (producing correct and simple programs) is a practice independent of the target programming language, although well-structured programming languages make the programmer's job simpler.

Following are the concepts and practices that can help a programmer write higher-quality code that is also easier to understand.

i) Structured programming
ii) Information hiding
iii) Some programming practices
iv) Coding standards.

8. Write any 3 advantages, disadvantages of structured programming.

Ans :

Advantages of Structured Programming Approach

1. Easier to read and understand
2. User Friendly
3. Easier to Maintain
4. Mainly problem based instead of being machine based
5. Development is easier as it requires less effort and time
6. Easier to Debug
7. Machine-Independent, mostly.

Disadvantages of Structured Programming Approach

1. Since it is Machine-Independent, So it takes time to convert into machine code.
2. The converted machine code is not the same as for assembly language.
3. The program depends upon changeable factors like data-types. Therefore it needs to be updated with the need on the go.

9. What is information hiding ?

Ans :

Information hiding focuses on hiding the non-essential details of functions and code in a program so that they are inaccessible to other components of the software. A software developer applies information hiding in software design and coding to hide unnecessary details from the rest of the program. The objective of information hiding is to minimize complexities among different modules of the software. Note that complexities arise when one program or module in software is dependent on several other programs and modules.

Information hiding is implemented with the help of interfaces. An interface is a medium of interaction for software components that are using the properties of the software modules containing data. The implementation of interfaces depends on the syntax and process. Examples of interface include constants, data types, types of procedures, and so on. Interfaces protect other parts of programs when a software design is changed.

10. What are the common aspects of coding standards.

Ans :

- **Naming Conventions:** The naming convention is how your packages, classes methods, variables, etc. should be named. (eg. camelCase, PascalCase or snake_case)
- **File and folder Naming and Organization:** This is how your file and folder should be named and structured.
- **Formatting and Indentation:** The code should be written in a standardized format and indentation.
- **Commenting and Documenting:** This makes it easy for the reviewer of your code to better understand codes methods and declarations.
- **Classes and Functions:** This specifies how classes and functions should behave.
- **Testing:** This specifies which approach and tools should be used to test the codes.

Choose the Correct Answer

1. Which of the items listed below is not one of the software engineering layers? [b]
   (a) Process (b) Manufacturing
   (c) Methods (d) Tools
2. Which of these are 5 generic software engineering frame work activities ? [a]
   (a) Communication, planning, modeling, construction, deployment
   (b) Communication, planning, modeling, deployment, construction
   (c) Planning, communication, modeling, construction, deployment
   (d) Communication, planning,construction, deployment, modeling
3. Waterfall model of software development is [a]
   (a) A reasonable approach when requirements are well organized.
   (b) A good approach when a working problem is required quickly.
   (c) The best approach to use for projects with large development teams.
   (d) None of the above
4. The increment model of a software development is [b]
   (a) A reasonable approach when requirements are well organized.
   (b) A good approach when a working core product is required quickly.
   (c) The best approach to use for projects with large development teams.
   (d) None of the above
5. A Prototype model of software development is [b]
   (a) A reasonable approach when requirements are well organized.
   (b) A good approach when a working problem is required quickly.
   (c) The best approach to use for projects with large development teams.
   (d) None of the above
6. Software engineers collaborate with customers to define which of the following [d]
   (a) Customer visible usage scenarios (b) Important software features
   (c) System input and outputs (d) All of the above
7. Which of the following is an attribute of software quality [d]
   (a) Functionality, reliability (b) Usability, portability
   (c) Efficiency, maintainability (d) All of the above

8. _____ and _____ are driving forces of software development. [a]

(a) Scale, change (b) Cost, schedule

(c) Cost, quality (d) Transition and consistency.

9. Quality of a software having _____ dimensions. [b]

(a) 2 (b) 3

(c) 4 (d) 5

10. V-Model is used, when _____ [b]

(a) Easy to understand (b) When requirements are not ambiguous

(c) Complex problems (d) All of the above.

Fill in the blanks

1. A _____ is generally on going and doesn't normally have an end.
2. SDLC stands for _____
3. RAD stands for _____
4. Each cycle in the spiral model is divided into _____ parts.
5. Agile model contains _____ phases
6. The structure program mainly contains selection, sequence and _____ statements
7. _____ focuses on hiding the non-essential details in program
8. _____ and _____ are driving forces of software development
9. _____ and _____ are common aspects of coding standards.
10. _____ is an engineering branch associated with development of software products using well defined principles.

ANSWESRS

1. Process
2. Software development lifecycle
3. Rapid application development
4. 4
5. 6
6. Iteration
7. Information hiding
8. Scale, change
9. Naming conventions, classes and functions
10. Software engineering

One Mark Question and Answers

1. Define software engineering.

Ans :

Software engineering is an engineering branch associated with development of software product using well-defined scientific principles, methods and procedures. The outcome of software engineering is an efficient and reliable software product.

2. When to use spiral model.

Ans :

- When deliverance is required to be frequent.
- When the project is large.
- When requirements are unclear and complex.
- When changes may require at any time.
- Large and high budget projects.

3. Phases of Agile Model

Ans :

Following are the phases in the Agile model are as follows:

i) Requirements gathering
ii) Design the requirements
iii) Construction/ iteration
iv) Testing/ Quality assurance
v) Deployment
vi) Feedback

4. List out various advantages and disadvantages of time boxing model.

Ans :

Advantages	Disadvantages
➢ Speeds up the development process and shortens the delivery time	➢ Project management becomes more complex.
➢ Well suited to develop projects with a number of features in short time period.	➢ Not suited to projects in which entire development work cannot be divided into multiple iterations of almost, equal duration.

5. What are the benfits of coding standards.

Ans :

- Easy team integration
- Increased code quality efficiency and easy for maintaining
- Reduce code complexity
- Reduce development cost

FACULTY OF SCIENCE

B.Sc. I-Year I-Semester Examination

Model Paper - I

DATA SCIENCE

Fundamentals of Information Technology

Time: 3 Hours | Max. Marks: 80

SECTION – A (8 × 4 = 32 Marks)

(Short Answer Type)

Note: Answer any EIGHT questions. All questions carry equal marks.

1. Define data and Information. **(Unit-I, SQA - 1)**
2. What is data processing ? **(Unit-I, SQA - 2)**
3. What is data processing cycle? **(Unit-I, SQA - 3)**
4. What is the use of primary memory. **(Unit-II, SQA - 2)**
5. Features of Secondary Memory. **(Unit-II, SQA - 7)**
6. Differentiate between Primary and secondary memory. **(Unit-II, SQA - 9)**
7. Define computer network? What are the characteristics of a computer network. **(Unit-III, SQA - 1)**
8. What is internet service provider? **(Unit-III, SQA - 8)**
9. List out various functions of operating system. **(Unit-III, SQA - 10)**
10. Define software process model. **(Unit-IV, SQA - 4)**
11. List out advantages and disadvantags of waterfall Model. **(Unit-IV, SQA - 5)**
12. What are the advantages and disadvantages of RAD Model? **(Unit-IV, SQA - 6)**

SECTION – B (4 × 12 = 48 Marks)

(Essay Answer Type)

Note: Attempt ALL questions. All questions carry equal marks.

13. a) Briefly explain general components connected to desktop computer. **(Unit-I, Q.No. 9)**

(OR)

b) Explain the representation of characters in computer **(Unit-I, Q.No. 18)**

14. a) Draw and explain block diagram of memory which stores 4096, 8-bit words. **(Unit-II, Q.No. 8)**

(OR)

b) Draw and explain configuration of buses connecting CPU with main memory and I/O Units. **(Unit-II, Q.No. 29)**

15. a) List and explain various output devices of a computer. **(Unit-III, Q.No. 17)**

(OR)

b) List out various types of computer networks. **(Unit-III, Q.No. 2)**

16. a) What is structure programming? and Explain it's advantages and disadvantages. **(Unit-IV, Q.No. 23)**

(OR)

b) What are the common aspects of coding standards? **(Unit-IV, Q.No. 26)**

FACULTY OF SCIENCE

B.Sc. I-Year I-Semester Examination

Model Paper - II

DATA SCIENCE

Fundamentals of Information Technology

Time: 3 Hours Max. Marks: 80

SECTION – A (8 × 4 = 32 Marks)
(Short Answer Type)
Note: Answer any EIGHT questions. All questions carry equal marks.

1. What is the use of control unit? **(Unit-I, SQA - 4)**
2. What is the use of ALU? **(Unit-I, SQA - 5)**
3. What is data acquistion. **(Unit-I, SQA - 6)**
4. What is Cache memory? **(Unit-II, SQA - 3)**
5. What are the differences between SRAM and DRAM. **(Unit-II, SQA - 4)**
6. Explain in detail ROM. Discuss various types of ROM's. **(Unit-II, Q.No. 10)**
7. What are the disadvantage of Machine Language. **(Unit-III, SQA - 12)**
8. List out any 2 advantages and disadvantages of switching. **(Unit-III, VSQA - 3)**
9. What is an IP address? How an IP address works? **(Unit-III, Q.No. 9)**
10. What are the different attributes of software quality? **(Unit-IV, SQA - 1)**
11. Discuss various software engineering problems. **(Unit-IV, SQA - 2)**
12. What are the differences between project and process? **(Unit-IV, SQA - 3)**

SECTION – B (4 × 12 = 48 Marks)
(Essay Answer Type)
Note: Attempt ALL questions. All questions carry equal marks.

13. a) Explain the steps in data processing cycle? **(Unit-I, Q.No. 6)**

(OR)

b) What is data acquisition? Explain with an example. **(Unit-I, Q.No. 10)**

14. a) Explain in detail about CDROM. **(Unit-II, Q.No. 21)**

(OR)

b) Draw and explain internal structure of a single chip microcontroller. **(Unit-II, Q.No. 31)**

15. a) Explain various types of programming languages. **(Unit-III, Q.No. 21)**

(OR)

b) List out various input devices of a computer. **(Unit-III, Q.No. 16)**

16. a) Explain how scale and change are driv-ing forces of software development ? **(Unit-IV, Q.No. 6)**

(OR)

b) What is RAD model? State its advantages and disadvantages. **(Unit-IV, Q.No. 15)**

FACULTY OF SCIENCE

B.Sc. I-Year I-Semester Examination

Model Paper - III

DATA SCIENCE

Fundamentals of Information Technology

Time: 3 Hours Max. Marks: 80

SECTION – A (8 × 4 = 32 Marks)

(Short Answer Type)

Note: Answer any EIGHT questions. All questions carry equal marks.

1. Conver D6C1 into Decimals. **(Unit-I, SQA - 7)**
2. Find the binary equivalent of $(23)_{10}$. **(Unit-I, SQA - 8)**
3. Find the binary equivalent of 0.8125. **(Unit-I, SQA - 9)**
4. What is memory cell ? Explain with example. **(Unit-II, SQA - 1)**
5. State the differences between RAM and ROM. **(Unit-II, SQA - 6)**
6. List out various types of CD's. **(Unit-II, SQA - 8)**
7. Explain packet swtiching. **(Unit-III, SQA - 9)**
8. Expalin about Assembly Language. **(Unit-III, SQA - 11)**
9. What are the differences between compiler and interpreter? **(Unit-III, SQA - 14)**
10. List the practices that can help a programer write high quality code. **(Unit-IV, SQA - 7)**
11. Write any 3 advantages, disadvantages of structured programming. **(Unit-IV, SQA - 8)**
12. What is information hiding ? **(Unit-IV, SQA - 9)**

SECTION – B (4 × 12 = 48 Marks)

(Essay Answer Type)

Note: Attempt ALL questions. All questions carry equal marks.

13. a) Explain various types of data. **(Unit-I, Q.No. 3)**

(OR)

b) Explain decimal to binary conversion with examples. **(Unit-I, Q.No. 17)**

14. a) Explain the classification of memory. **(Unit-II, Q.No. 4)**

(OR)

b) Draw and explain block diagram of CPU. **(Unit-II, Q.No. 25)**

15. a) Explain various switching techniques. **(Unit-III, Q.No. 13)**

(OR)

b) i) What is operating system? What are the functions of operating system? **(Unit-III, Q.No. 18)**

ii) Explain various types of operating system. **(Unit-III, Q.No. 19)**

16. a) What is the prototype model ? Explain. **(Unit-IV, Q.No. 5)**

(OR)

b) Explain the V-Model. **(Unit-IV, Q.No. 13)**

FACULTY OF SCIENCE

B.Sc. I - Semester (CBCS) Examination

November / December - 2021

DATA SCIENCE

Paper - I: Fundamental of Information Technology

Time : 2 Hours] **[Max. Marks : 80**

PART - A (5 × 4 = 20 Marks)

[Short Answer Type]

Note : Answer any five questions.

ANSWERS

1. Explain the limitations of computers.

Ans :

(i) No. IQ

A computer cannot act on situations that are not fed or programmed into them. They have zero IQ(Intelligent Quotient). These outputs are completely dependent on the user's input. That is they produce wrong output if the wrong input is provided instead of correcting it.

(ii) Lack of Decision Making

A computer cannot decide on its own. For each operation that the computer performs it is fed with an algorithm to take perform different processes for each situation. However, if it faces a problem that is not fed into the system, the computer is not ready for it. It either gets corrupt or does not respond.

(iii) Lack of Common Sense

A computer might be an automated machine still, it requires human assistance. It works only when it is provided with some input. For example, you have to do calculations for your math homework. You will have to feed each sum to get the output. The computer cannot read the whole homework and provide results.

2. What is data Acquisition? Explain in detail. **(Unit-I, Q.No. 10)**

3. What is hand scanner? What are its applications?

Ans :

A handheld scanner is an electronic device used for scanning physical documents into digital formats. This can thereby be digitally stored, edited, transferred or emailed within the digital network.

To capture barcodes, specific reading devices are required to access the information behind the codes for further data processing. The handheld scanner can read barcodes and detect the code pattern with either red or infrared light.

The handheld scanner consists of an actual reading unit and downstream decoding unit. The decoding unit is integrated into the reading unit in almost all device types, and they are mostly used in retail, logistics and industry.

4. Write the storage cell importance. **(Unit-II, Q.No. 2)**

5. What is the difference between a data path and control path in CPU architecture?

Ans :

Data path: Memory, registers, adders, ALU, and communication buses. Each step (fetch, decode, execute, save result) requires communication (data transfer) paths between memory, registers and ALU.

Control path : Data path for each step is set up by control signals that set up dataflow directions on communication buses and select ALU and memory functions. Control signals are generated by a control unit consisting of one or more finite state machines.

6. Explain the concept of hot plugging.

Ans :

Hot plugging is the addition of a component to a running computer system without significant interruption to the operation of the system. Hot plugging a device does not require a restart of the system. This is especially useful for systems that must always stay running, such as a server.

Common examples of hot-pluggable devices include hard disk drives (HDDs) or solid-state drives (SSDs) which can be added to a storage system; or USB (Universal Serial Bus) devices, mice, keyboards or printers that can be added to a personal computer.

Hot plugging is not the same as hot swapping a component into a running computer system. Hot swapping involves the replacement of a component. Hot plugging is the addition or removal of a component that serves to expand the system.

7. What is client-server computing? Why it is deployed?

Ans :

In client server computing, the clients requests a resource and the server provides that resource. A server may serve multiple clients at the same time while a client is in contact with only one server. Both the client and server usually communicate via a computer network but sometimes they may reside in the same system.

8. What is packet switching? Write about problems with packet switching. **(Unit-III, Q.No. 13)**

9. What is flat panel display?

Ans :

A flat panel display is a television, monitor or other display appliance that uses a thin panel design instead of a traditional cathode ray tube (CRT) design. These screens are much lighter and thinner, and can be much more portable than traditional televisions and monitors. They also have higher resolution than older models.

10. What are the main differences between a student software and an industrial software?

Ans :

A student system is being built which is primarily meant for demonstration purposes, and is not expected to be used later. Because it is not to be used, nothing of significance depends on the software and the presence of bugs and lack of quality is not a major concern. Neither are the other quality issues like usability, maintainability, portability etc.

On the other hand, an industrial-strength software system is built to solve some problem of a client and is used by the client's organization for operating some part of business, and a malfunction of such a system can have huge impact in terms of financial or business loss, inconvenience to users, or loss of property and life. Consequently, the software system needs to be of high quality with respect to properties like reliability, usability, portability, etc.

11. Explain about timebox processing model. **(Unit-IV, Q.No. 20)**

12. What is refactoring? Explain advantages and disadvantages of it.

Ans :

Programming software is a lengthy process that can involve multiple developers. Written source code is often revised, changed, and expanded during this work. As a result of time pressure or outdated practices, inelegant sections can accumulate in the source code. These are known as code smells. These weak spots that accrue over time endanger the usability and compatibility of the program. To prevent this gradual erosion and deterioration of the software, refactoring is necessary.

In principle, refactoring is similar to editing a book. The practice of editing does not create a completely new book, but instead a more understandable text. Just like various approaches exist in editing such as cutting, reformulating, deleting, and restructuring, code refactoring likewise encompasses a number of methods like encapsulation, reformatting, or extraction in order to optimize a code without changing its function.

This process is much more cost-effective than preparing an entirely new code structure. Especially in iterative and incremental software development, as well as agile software development, refactoring plays a major role, since programmers frequently need to alter software in these cyclical models. In this context, refactoring is a fixed step in the workflow.

PART - B (3 × 20 = 60 Marks)

[Essay Answer Type]

Note : Answer any three questions.

13 What is a motherboard? What parts of a computer are accommodated in a motherboard explain in detail its functions.

Ans :

The motherboard serves as a single platform to connect all of the parts of a computer together. It connects the CPU, memory, hard drives, optical drives, video card, sound card, and other ports and expansion cards directly or via cables. It can be considered as the backbone of a computer.

Functions

- Motherboard varies greatly in supporting various types of components.
- Motherboard supports a single type of CPU and few types of memories.
- Video cards, hard disks, sound cards have to be compatible with the motherboard to function properly.
- Motherboards, cases, and power supplies must be compatible to work properly together.

14 Write an algorithm to find whether a given number is even or odd. Obtain a flowchart for this algorithm.

Ans :

Step 1: Start

Step 2: Read a number to N

Step 3: Divide the number by 2 and store the remainder in R.

Step 4: If R = O Then go to Step 6

Step 5: Print "N is odd" go to step 7

Step 6: Print "N is even"

Step 7: Stop

15 What do you understand by DRAM? What types of storage cells are used in a DRAM explain? Also discuss the importance of DRAM. **(Unit-II, Q.No. 5)**

16 What are the three board classes of CPU architecture? What are their differences? **(Unit-II, Q.No. 25)**

17. What are the advantages of laser printer as compare to an inkjet printer? What are disadvantages explain in detail?

Ans :

Advantages

- Long life
- Low cost
- Fast printing speed
- Good for photo printing
- Long-term non-printing effect will not change
- Will not cause damage to the human body
- Suitable for mass printing, low cost
- Environmentally friendly
- The machine is relatively stable
- Suitable for small prints
- Low quality requirements for paper

Disadvantages

- High initial investment cost
- Slower print speed
- Color toner cartridge are expensive
- Need to print regularly, otherwise the nozzle will be easy to block
- Toner is harmful to humans

- High quality requirements for paper
- Will cause environmental pollution and release ozone
- Late maintenance is more troublesome

18. What is a text to speech system? How does it work? What are its applications?

Ans :

Text-to-speech systems, also known as TTS, were first developed to aid the visually impaired by offering a computer-generated spoken voice that would "read" text to the user.

Text-to-speech tools are often used with optical character recognition (OCR). OCR is a technology that scans printed material into a computer or handheld unit and converts it to digital text. There are also portable OCR devices available. These are called reading pens, and they can scan and read back text. Most digital devices include apps that read digital books.

While text to speech has benefits for all users, some specific groups benefit more than others.

People with learning disabilities who have difficulty reading large amounts of text due to dyslexia or other problems really benefit from TTS, offering them an easier option for experiencing website content.

19. Describe software process and its characteristics in detail. **(Unit-IV, Q.No. 7)**

20. Explain software development process using waterfall model. **(Unit-IV, Q.No. 12)**

FACULTY OF SCIENCE

B.Sc. I - Semester (CBCS) Examination

August - 2021

DATA SCIENCE

Paper - I: Fundamental of Information Technology

Time : 2 Hours] **[Max. Marks : 80**

PART - A (5 × 4 = 20 Marks)

[Short Answer Type]

Note : Answer any five questions.

ANSWERS

1. What is computer? Why is it known as data processor? **(Unit-I, Q.No.7, 4)**
2. What is ISCII code? How it differs from ASCII explain? **(Unit-I, Q.No.18)**
3. What is flash memory? State its applications.

Ans :

The Flash Memory technology has evolved into the preferred storage media for a variety of consumer and industrial devices.

I. In Consumer Devices, Flash Memory Is Widely Used In:

(i) Notebook computers

(ii) Digital cameras

(iii) Personal Digital Assistants (PDAs)

(iv) Cell phones

(v) Global Positioning Systems (GPS)

(vi) Electronic musical instruments

II. Solid-state music players such as

(i) Television set-top boxes

(ii) MP3 players

(iii) Pagers

(iv) Personal computers

III. In Industrial Devices, Flash Memory Is Widely Used In:

(i) Security systems

(ii) Military systems

(iii) Embedded computers

(iv) Solid-state disk drives

(v) Networking and communication products

(vi) Wireless communication devices

(vii) Retail management products (e.g., handheld scanners)

(viii) Medical products

4. What is a DVD? What is its typical capacity explain? **(Unit-II, Q.No.16 (4th point)**

5. Explain CPU specifications. **(Unit-II, Q.No.28)**

6. What is Motherboard? What does it contain?

Ans :

The motherboard is the main circuit board of your computer and is also known as the mainboard or logic board. If you ever open your computer, the biggest piece of silicon you see is the motherboard. Attached to the motherboard, you'll find the CPU, ROM, memory RAM expansion slots, PCI slots, and USB ports. It also includes controllers for devices like the hard drive, DVD drive, keyboard, and mouse. Basically, the motherboard is what makes everything in your computer work together

7. Explain functions of a NIC.

Ans :

A network interface card (NIC) is a hardware component without which a computer cannot be connected over a network. It is a circuit board installed in a computer that provides a dedicated network connection to the computer. It is also called network interface controller, network adapter or LAN adapter.

Functions

- NIC allows both wired and wireless communications.
- NIC allows communications between computers connected via local area network (LAN) as well as communications over large-scale network through Internet Protocol (IP).
- NIC is both a physical layer and a data link layer device, i.e. it provides the necessary hardware circuitry so that the physical layer processes and some data link layer processes can run on it.

8. What is a firewall? Why it is needed in computer network?

Ans :

A firewall can be defined as a special type of network security device or a software program that monitors and filters incoming and outgoing network traffic based on a defined set of security rules. It acts as a barrier between internal private networks and external sources (such as the public Internet).

The primary purpose of a firewall is to allow non-threatening traffic and prevent malicious or unwanted data traffic for protecting the computer from viruses and attacks. A firewall is a cyber security tool that filters network traffic and helps users block malicious software from accessing the Internet in infected computers.

9. Write about file fragmentation.

Ans :

File fragmentation is a term that describes a group of files that are scattered throughout a hard drive platter instead of one continuous location. Fragmentation is caused when information is deleted from a hard drive and small gaps are left behind to be filled by new data. As new data is saved to the computer, it is placed in these gaps. If the gaps are too small, the remainder of what needs to be saved is stored in other available gaps.

10. Write about different software quality attribute. **(Unit-IV, Q.No.4)**

11. How refactoring works to improve existing code explain?

Ans :

(i) To Improve The Performance of The Application

An application that doesn't have unnecessary classes, functions, variables, methods, or any other mess, runs faster and smoother. Performance of an application increases if the code is recently refreshed or updated. Your application generates quick responses and users no longer complain about the slower performance. This leads to a better customer experience.

(ii) To Reduce the Technical Debt

The cost of any software is not finalized when you launch the first version of it. Your software may stop responding after a couple of months if you don't make regular updates in it. You may end up with the technical debt and to reduce this debt you need to refactor the code all the time.

12. Explain about agile process **(Unit-IV, Q.No.17)**

PART - B (3 × 20 = 60 Marks)

[Essay Answer Type]

Note : Answer any three questions.

13. Draw a block diagram to illustrate the basic organization of a computer system

and explain the functions of various unit. **(Unit-I, Q.No.7)**

14. (a) Find decimal equivalent for (i) 1011001 101 (ii) AEF 6BC

(i) 1011001 101

Ans :

To convert binary number 1011001.101, we convert its integral and fractional part individually and then add them to get the equivalent decimal number, as below:

In integral part of binary number, multiply ones place with 2^0, tens place with 2^1, hundreds place with 2^2 and so on from right to left.

In the fractional part of binary number, multiply tenths place by 2^-1, hundredths place by 2^-2 and so on from left to right

Add them all together you got from step 1 & step 2 to get decimal equivalent of 1011001.101.

Using the above steps, we first convert the integral part 1011001 to decimal number

(Don't forget that we start from ones place to so on...)

Decimal equivalent of "1" = 1 × 2 ^ 0 = 1

Decimal equivalent of "0" = 0 × 2 ^ 1 = 0

Decimal equivalent of "0" = 0 × 2 ^ 2 = 0

Decimal equivalent of "1" = 1 × 2 ^ 3 = 8

Decimal equivalent of "1" = 1 × 2 ^ 4 = 16

Decimal equivalent of "0" = 0 × 2 ^ 5 = 0

Decimal equivalent of "1" = 1 × 2 ^ 6 = 64

Decimal equivalent of "1011001" = 640168001

1011001 = 89

Now we will convert the fractional part 0.101 to decimal form (Don't forget that we start from tenths palce to so on..):

Decimal equivalent of "1" = 1 × 2 ^ -1 = 0.5

Decimal equivalent of "0" = 0 × 2 ^ -2 = 0

Decimal equivalent of "1" = 1 × 2 ^ -3 = 0.125

Decimal equivalent of "0.101" = 0.500.125

0.101 = 0.625

The binary number 1011001.101 converted to decimal is therefore equal to:

$= 1011001.101_2$

$= 89_{10} + 0.625_{10}$

$= 89.625_{10}$

(ii) AEF 6BC

Ans :

Start from one's place in AEF6BC : multiply ones place with 16 ^ 0, tens place with 16 ^ 1, hundreds place with 16 ^ 2 and so on from right to left

Add all the product we got from step 1 to get the decimal equivalent of AEF6BC.

Using the above steps, here is the work involved in the solution for converting AEF6BC to decimal number (Don't forget that we start from ones place to so on...)

Decimal equivalent of "C" = (C) 12 × 16 ^ 0 = 12

Decimal equivalent of "B" = (B) 11 × 16 ^ 1 = 176

Decimal equivalent of "6" = 6 × 16 ^ 2 = 1536

Decimal equivalent of "F" = (F) 15 × 16 ^ 3 = 61440

Decimal equivalent of "E" = (E) 14 × 16 ^ 4 = 917504

Decimal equivalent of "A" = (A) 10 × 16 ^ 5 = 10485760

Decimal equivalent of "AEF6BC" = 10485760917504614401536176 12

AEF6BC = 11466428

(b) Find binary equivalent for (i) 25.625 (ii) 362.89

(i) 25.625

Ans :

To convert decimal number 25.625, we convert its integer and fraction part individually and then add them to get the equivalent binary number, as below:

To convert integer 25 to binary, follow these steps:

Divide 25 by 2 keeping notice of the quotient and the remainder. Continue dividing the quotient by 2 until you get a quotient of zero.

Then just write out the remainders in the reverse order to get the equivalent binary number.

25 / 2 = 12 with remainder 1

12 / 2 = 6 with remainder 0

6 / 2 = 3 with remainder 0

3 / 2 = 1 with remainder 1

1 / 2 = 0 with remainder 1

Here is the answer to 25 decimal to binary number:

11001

For converting decimal fraction 0.625 to binary number, follow these steps:

Multiply 0.625 by 2 keeping notice of the resulting integer and fractional part. Continue multiplying by 2 until you get a resulting fractional part equal to zero (we calcuclate upto ten digits).

Then just write out the integer parts from the results of each multiplication to get equivalent binary number.

$0.625 \times 2 = 1 + 0.25$

$0.25 \times 2 = 0 + 0.5$

$0.5 \times 2 = 1 + 0$

Here is the answer to 0.625 decimal to binary number:

0.101

Therefore, decimal number 25.625 converted to binary is equal:

11001.101

(ii) 362.89

Ans :

To convert decimal number 362.89, we convert its integer and fraction part individually and then add them to get the equivalent binary number, as below:

To convert integer 362 to binary, follow these steps:

Divide 362 by 2 keeping notice of the quotient and the remainder. Continue dividing the quotient by 2 until you get a quotient of zero.

Then just write out the remainders in the reverse order to get the equivalent binary number.

362 / 2 = 181 with remainder 0

181 / 2 = 90 with remainder 1

90 / 2 = 45 with remainder 0

45 / 2 = 22 with remainder 1

22 / 2 = 11 with remainder 0

11 / 2 = 5 with remainder 1

5 / 2 = 2 with remainder 1

2 / 2 = 1 with remainder 0

1 / 2 = 0 with remainder 1

Here is the answer to 362 decimal to binary number:

101101010

For converting decimal fraction 0.89 to binary number, follow these steps:

Multiply 0.89 by 2 keeping notice of the resulting integer and fractional part. Continue multiplying by 2 until you get a resulting fractional part equal to zero (we calculate upto ten digits).

Then just write out the integer parts from the results of each multiplication to get equivalent binary number.

$0.89 \times 2 = 1 + 0.78$

$0.78 \times 2 = 1 + 0.56$

$0.56 \times 2 = 1 + 0.12$

$0.12 \times 2 = 0 + 0.24$

$0.24 \times 2 = 0 + 0.48$

$0.48 \times 2 = 0 + 0.96$

$0.96 \times 2 = 1 + 0.92$

$0.92 \times 2 = 1 + 0.84$

$0.84 \times 2 = 1 + 0.68000000000001$

$0.68000000000001 \times 2 = 1 + 0.36000000000001$

Here is the answer to 0.89 decimal to binary number:

0.1110001111

Therefore, decimal number 362.89 converted to binary is equal:

101101010.1110001111

15. What is blu-ray disc? How is it differentiation DVD? What is typical capacity of binary disc? **(Unit-II, Q.No.16)**

16. Explain the types of embedded processor used in embedded systems. **(Unit-II, Q.No.30, 31)**

17. What is E-ink? Explain the principle operations of E-ink.

Ans :

E Ink (electronic ink) is a brand of electronic paper (e-paper) display technology commercialized by the E Ink Corporation, which was co-founded in 1997 by MIT undergraduates JD Albert and Barrett Comiskey, MIT Media Lab professor Joseph Jacobson, Jerome Rubin and Russ Wilcox

E Ink is made into a film and then integrated into electronic displays, enabling novel applications in phones, watches, magazines, wearables and e-readers, etc.[20][21][22][23]

The Motorola F3 was the first mobile phone to employ E Ink technology in its display to take advantage of the material's ultra-low power consumption. In addition, the Samsung Alias 2 uses this technology in its keypad in order to allow varying reader orientations.

The October 2008 limited edition North American issue of Esquire was the first magazine cover to integrate E Ink. This cover featured flashing text. It was manufactured in Shanghai and was shipped refrigerated to the United States for binding. The E Ink was powered by a 90-day integrated battery supply

18. What is UDP? What are the difference between TCP and UDP?

Ans :

In computer networking, the User Datagram Protocol (UDP) is one of the core members of the Internet protocol suite. With UDP, computer applications can send messages, in this case referred to as datagrams, to other hosts on an Internet Protocol (IP) network. Prior communications are not required in order to set up communication channels or data paths.

UDP uses a simple connectionless communication model with a minimum of protocol mechanisms. UDP provides checksums for data integrity, and port numbers for addressing different functions at the source and destination of the datagram. It has no handshaking dialogues, and thus exposes the user's program to any unreliability of the underlying network; there is no guarantee of delivery, ordering, or duplicate protection. If error-correction facilities are needed at the network interface level, an application may instead use Transmission Control Protocol (TCP) or Stream Control Transmission Protocol (SCTP) which are designed for this purpose

S.No	TCP	S.No.	UDP
1)	Keeps track of lost packets.Makes sure that lost packets are re-sent.	1)	Doesn't keep track of lost packets
2)	Adds sequence numbers to packets and reorders any packets that arrive in the wrong order.	2)	Doesn't care about packet arrival order
3)	Slower, because of all added additional functionality.	3)	Faster , because it lacks any extra features
4)	Requires more computer resources, because the OS needs to keep track	4)	Requires less computer resources

	of ongoing communication sessions and manage them on a much deeper level.		
5)	Examples of programs and services that use TCP : - HTTP - HTTPS - FTP - Many computer games	5)	Examples of programs and services that use UDP : - DNS - IP telephony - DHCP - Many computer games

19. Explain about incremental model detail. **(Unit-IV, Q.No.14)**

20. What is information hiding? Explain how coding standards help to improve readability. **(Unit-IV, Q.No.24)**

FACULTY OF SCIENCE

B.Sc. I - Semester (CBCS) Examination

March - 2022

DATA SCIENCE

Paper - I: Fundamental of Information Technology

Time : 3 Hours] **[Max. Marks : 80**

PART - A (8 × 4 = 32 Marks)

Note : Answer any eight questions.

ANSWERS

1. What is word processor? Out out the functions provided by word processor.

Ans :

Word processor, computer program used to write and revise documents, compose the layout of the text, and preview on a computer monitor how the printed copy will appear. The last capability is known as "what you see is what you get."

2. Differentiate between Internal and external representation of data.

Ans :

The last slide hinted at an important concept: the difference between the internal representation and the external representation of data.

- The internal representation is what the program uses. It should be easy to manipulate, e.g., compare values.
- The external representation is for the human user - it should be easy to read and understand.

3. What is CLUT compression method? Discuss about the principle used in it.

Ans :

Any color correction can be expressed as a Color Look Up Table or CLUT (some times written as "Color LUT"). This a 3D dimensional table where all colors are represented in color space. For each color in the color lookup table there is a destination color value that corresponds to what the particular color becomes when it is corrected using the CLUT. These tables are by nature 3-dimensional (Red Green and Blue) and therefore special file formats are used to store them. Hald CLUTs however have been converted to a 2D space and since tables store colors the CLUT can be be saved as a image, in any non destructive image format.

4. What is a Blu-Ray disk. How is different from DVD.

Ans :

The Blu-ray Disc (BD), often known simply as Blu-ray, is a digital optical disc storage format. It is designed to supersede the DVD format, and capable of storing several hours of high-definition video (HDTV 720p and 1080p). The main application of Blu-ray is as a medium for video material such as feature films and for the physical distribution of video games for the PlayStation 3, PlayStation 4, PlayStation 5, Xbox One, and Xbox Series X. The name "Blu-ray" refers to the blue laser (which is actually a violet laser) used to read the disc, which allows information to be stored at a greater density than is possible with the longer-wavelength red laser used for DVDs.

S.No.	Parameter	DVD	Blue-Ray Disc
1.	Storage Capacity	• Single layer DVDs (DVD-5s) can store about 4.7 G.D. • Double layer DVD's (DVD-9s) can store about 8.7 GB.	• Single layer Blu-Ray discs store approximately 25 GB. • Double layer Blu-ray discs can store about 50 GB.
2.	Laser Technology	• Use a red laser of lonter wave-length i.e., 650 nm wave length to read DVD discs. • Red lasers are wider in diameter and thus the reading is comparatively less precise.	• Use a blue laser of shorter wave-length i.e., 405 nm to read the stored information. • Blue lasers are two and a half times smaller in diameter than red lasers and thus allows for closer and more precise reading of information.
3.	Disc Construction	• Grooves on its underside are to be made wide enough to accommodate the laeger wave-length. (resulting in lesser storage)	• Grooves on a Blu-ray disc are much thinner and closer together because the blue laser used to read the disc has a shorter wavelength. (resulting in almost 5 times more grooves and immense storage)
4.	Scratch Resistance	• It has a protective layer (0.6mm) to resist scratching.	• It has a physically thinner (0.1 mm) layer, but with a hard coating that makes it more scratch resistant.
5.	Image Resolution	• Standards definition resolution of 480p • Enhanced definition resolution of 520p	• High definitiion resolution of 1080p
6.	Data Transfer Rate	• Data 11.08 Mbps • Audio/Video 10.08 Mbps	• Data 36.0 Mbps • Audio/Video 54.0 Mbps
7.	Video Resolution	• 720 × 480 (480i / 480p-US)	• 1920 × 1080 (1080p)
8.	Audio Codecs	• Linear PCM • Dolby Digital • DTS	• Linear PCM • Dolby Digital • DTS Digital Surround • Dolby Digital Plus • Dolby TrueHD • DTS-HD
9.	Video Codecs	• MPEG-2	• MPEG-2 • MPEG-4 AC • SMPTE VC-1

5. What is ROM? Where are SRAMs used and why. **(Unit-II, Q.No. 5, 10)**

6. Why is a CPU required in a computer. List out the funding of CPU. **(Unit-II, Q.No. 25)**

7. What is DNS. Why it is needed?

Ans :

The Domain Name System (DNS) is the phonebook of the Internet. Humans access information online through domain names, like nytimes.com or espn.com. Web browsers interact through Internet Protocol (IP) addresses. DNS translates domain names to IP addresses so browsers can load Internet resources.

Each device connected to the Internet has a unique IP address which other machines use to find the device. DNS servers eliminate the need for humans to memorize IP addresses such as 192.168.1.1 (in IPv4), or more complex newer alphanumeric IP addresses such as 2400:cb00:2048:1::c629:d7a2 (in IPv6).

8. What is ink jet printer? How does it work? **(Unit-III, Q.No. 17)**

9. What is BIOS? List out its functions.

Ans :

BIOS (basic input/output system) is the program a computer's microprocessor uses to start the computer system after it is powered on. It also manages data flow between the computer's operating system (OS) and attached devices, such as the hard disk, video adapter, keyboard, mouse and printer.

Functions

BIOS identifies, configures, tests and connects computer hardware to the OS immediately after a computer is turned on. The combination of these steps is called the boot process.

These tasks are each carried out by BIOS' four main functions:

(i) Power-on self-test (POST): This tests the hardware of the computer before loading the OS.

(ii) Bootstrap loader: This locates the OS.

(iii) Software/drivers: This locates the software and drivers that interface with the OS once running.

Complementary metal-oxide semiconductor (CMOS) setup: This is a configuration program that enable users to alter hardware and system settings. CMOS is the name of BIOS' non-volatile memory

10. Discuss about project management processor.

Ans :

Project management is one of the critical processes of any project. This is due to the fact that project management is the core process that connects all other project activities and processes together.

When it comes to the activities of project management, there are plenty. However, these plenty of project management activities can be categorized into five main processes.

Let's have a look at the five main project management processes in detail.

(i) Project Initiation: Project initiation is the starting point of any project. In this process, all the activities related to winning a project takes place. Usually, the main activity of this phase is the pre-sale.

During the pre-sale period, the service provider proves the eligibility and ability of completing the project to the client and eventually wins the business. Then, it is the detailed requirements gathering which comes next.

During the requirements gathering activity, all the client requirements are gathered and analysed for implementation. In this activity, negotiations may take place to change certain requirements or remove certain requirements altogether.

Usually, project initiation process ends with requirements sign-off.

(ii) Project Planning: Project planning is one of the main project management processes. If the project management team gets this step wrong, there could be heavy negative consequences during the next phases of the project.

Therefore, the project management team will have to pay detailed attention to this process of the project.

In this process, the project plan is derived in order to address the project requirements such as, requirements scope, budget and timelines. Once the project plan is derived, then the project schedule is developed.

Depending on the budget and the schedule, the resources are then allocated to the project. This phase is the most important phase when it comes to project cost and effort.

(iii) Project Execution: After all paperwork is done, in this phase, the project management executes the project in order to achieve project objectives.

When it comes to execution, each member of the team carries out their own assignments within the given deadline for each activity. The detailed project schedule will be used for tracking the project progress.

During the project execution, there are many reporting activities to be done. The senior management of the company will require daily or weekly status updates on the project progress.

In addition to that, the client may also want to track the progress of the project. During the project execution, it is a must to track the effort and cost of the project in order to determine whether the project is progressing in the right direction or not.

In addition to reporting, there are multiple deliveries to be made during the project execution. Usually, project deliveries are not onetime deliveries made at the end of the project. Instead, the deliveries are scattered through out the project execution period and delivered upon agreed timelines.

(iv) Control and Validation: During the project life cycle, the project activities should be thoroughly controlled and validated. The controlling can be mainly done by adhering to the initial protocols such as project plan, quality assurance test plan and communication plan for the project.

Sometimes, there can be instances that are not covered by such protocols. In such cases, the project manager should use adequate and necessary measurements in order to control such situations.

Validation is a supporting activity that runs from first day to the last day of a project. Each and every activity and delivery should have its own validation criteria in order to verify the successful outcome or the successful completion.

When it comes to project deliveries and requirements, a separate team called 'quality assurance team' will assist the project team for validation and verification functions.

(v) **Closeout and Evaluation:** Once all the project requirements are achieved, it is time to hand over the implemented system and closeout the project. If the project deliveries are in par with the acceptance criteria defined by the client, the project will be duly accepted and paid by the customer.

Once the project closeout takes place, it is time to evaluate the entire project. In this evaluation, the mistakes made by the project team will be identified and will take necessary steps to avoid them in the future projects.

During the project evaluation process, the service provider may notice that they haven't gained the expected margins for the project and may have exceeded the timelines planned at the beginning.

11. What is the relationship between a process modal and process specification. **(Unit-IV, Q.No. 7)**

12. Discuss naming conventions in Celling Standards? **(Unit-IV, Q.No. 24)**

PART - B (4 × 12 = 48 Marks)

Note : Answer any four questions.

13. Write an algorithm and flowchart to find whether the given number is prime or not.

Ans :

Step 1: Start

Step 2: Initialize variables num,flag=1, j=2

Step 3: Read num from user

Step 4: If num<=1 // Any number less than 1 is not a prime number

Display "num is not a prime number"

Goto step 7

Step 5: Repeat the steps until j<[(n/2)+1]

5.1 If remainder of number divide j equals to 0,

Set flag=0

Goto step 6

5.2 j=j+1

Step 6: If flag==0,

Display num+" is not prime number"

Else

Display num+" n is prime number"

Step 7: Stop

14. What is an Error detecting code? How does it can be detected? **(Unit-I, Q.No. 9)**

15. Discuss about functionality of the following

(i) RAM **(Unit-II, Q.No. 4)**

(ii) ROM **(Unit-II, Q.No. 10)**

(iii) Semi-Conductor storage systems.

Ans :

Semiconductor memory is a digital electronic semiconductor device used for digital data storage, such as computer memory. It typically refers to MOS memory, where data is stored within metal–oxide–semiconductor (MOS) memory cells on a silicon integrated circuit memory chip. There are numerous different types using different semiconductor technologies. The two main types of random-access memory (RAM) are static RAM (SRAM), which uses several MOS transistors per memory cell, and dynamic RAM (DRAM), which uses a MOS transistor and a MOS capacitor per cell. Non-volatile memory (such as EPROM, EEPROM and flash memory) uses floating-gate memory cells, which consist of a single floating-gate MOS transistor per cell.

16. What is a CISC processor? What are differences between RISC and CISC processors?

Ans :

CISC stands for Complex Instruction Set Computer. It comprises a complex instruction set. It incorporates a variable-length instruction format. Instructions that require register operands can take only two bytes.

The instructions that require two memory addresses can take five bytes to include the complete instruction code. Thus, CISC has a variable-length encoding of instructions and the execution of instructions may take a varying number of clock cycles. The CISC processor provides direct manipulation of operands that are in memory.

The task of a compiler is to generate a sequence of machine instructions for each high-level language statement. The task is simplified if there are machine instructions that implement the statements directly. The essential goal of a CISC architecture is to attempt to support a single machine instruction for each statement that is written in a high-level language.

Example: An ADD instruction will use index addressing to specify one operand in memory and direct addressing to specify the second operand in memory. This instruction would use another memory location to store the result. Thus, this instruction would use three memory references for execution.

Many CISC architectures read the inputs and write their outputs in the memory system instead of a register file. As CISC architecture takes a large number of addressing modes, more hardware logic is required to implement them. This reduces the computation speed.

The CISC architecture attempts to provide a single machine instruction for the statements that are written in a high-level language.

Features of CICS Processor

There are various features of CISC Processor that are as follows -

- A large number of instructions-typically from 100 to 250 instructions
- Some instructions that perform specialized tasks and are used infrequently.
- A large variety of addressing modes-typically from 5 to 20 different modes.
- It can variable-length instruction formats.
- It is used for instructions that manipulate operands in memory

S.No.	CISC	S.No.	RISC
1.	CISC architecture gives more importance to hardware	1.	RISC architecture gives more importance to Software.
2.	Complex instructions.	2.	Reduced instructions.
3.	It access memory directly.	3.	It requires registers.
4.	Coding in CISC processor is simple.	4.	Coding in RISC processor requires more number of lines.
5.	As it consists of complex instructions, it take multiple cycles to execute.	5.	It consists of simple instructions that take single cycle to execute.
6.	Complexity lies in microprogram.	6.	Complexity lies in compiler.

17. Define Ethernet? Draw Ethernet message format and also explain how functions?

Ans :

Ethernet is a type of communication protocol that is created at Xerox PARC in 1973 by Robert Metcalfe and others, which connects computers on a network over a wired connection. It is a widely used LAN protocol, which is also known as Alto Aloha Network. It connects computers within the local area network and wide area network. Numerous devices like printers and laptops can be connected by LAN and WAN within buildings, homes, and even small neighborhoods.

On the process of defining the Ethernet frame format, we have collected some ore-requisite definitions of associated elements which are mandatory to know.

We all know that from time to time enhancements are comings in any technology, in networking these enhancements are known as standards. The Ethernet frame rate talks of 802.3 standards, which are an essential OSI compliant and helps in defining the physical and MAC layer.

An Ethernet frame consists of 3 main division's.

They are as follows:

- Ethernet header (it consist of Preamble, SFD, Destination, Source, and Type)
- Encapsulated data (it consist of Data & Pad)
- Ethernet trailer (it consist of FCS)

Preamble	SFD	Destination Address	Source Address	Length	Data	CRC
7 Bytes	1 Byte	4 Bytes	6 Bytes	2 Bytes	46 - 1500 Bytes	4 Bytes

- Preamble being the first section and is 7 bytes long which is a combination of strings. These bytes are store within themselves alternate patterns of 1's and 0's. During the communication these preamble bytes play a crucial role, they make identify the receiving end (or devices) of initiation of Ethernet frame. It happens to lock the incoming bit stream as the receiving device get to know with these '10101010' as Ethernet frame.

- SFD aka start frame delimiter and is a 1 byte long section which contains string of 1 byte. The SFD byte holds similar byte structure as to preamble but the last bit becomes 1 instead of 0 (for preamble). It is the role of SFD byte to make aware the receiving device about the destination MAC address for the Ethernet frame. SFD – 10101011
- Destination holds the MAC address of the destination device and is a 6 byte long structure. Generally a MAC address is 6 byte of 48 byte. It is the role of destination MAC address to make aware the receiving device determine whether or not the incoming frame is for it or not. If the message is not for any device it will discard the frame.
- Source is again a 6 byte long and contains the MAC address of the source device. It performs the identification of source device by receiving device.
- Type or length field is a 2 byte long and stores the protocol information about the network layer. This 2 byte or 16 bit long filed holds value between 0 to 65534. Also it is important to note that there are two variants under the IP protocols – IPv4 & IPv6, if the type filed holds a value of ox800 then it belongs to IPv4 and if it has 0x86dd then it is a IPv6 protocol.
- Data is a place where actual data are placed, these are also known as Payloads, the Ethernet frame is designed in such a way that both the IP header and data will be used. The maximum byte size can be upto 1500 and minimum 46 bytes. This range of packing (i.e. 46 to 1500) decides the data capacity in one packet. If data is less than minimum (i.e. 46) than padding is added otherwise for more than maximum limit, extra data is packed.
- FCS aka frame check sequence or CRC (cyclic redundancy check) is a 4 byte long field, which checks whether the received frame is attached or not. This section generates a 4 byte long outcome which is placed in the FCS field. Once these are received by the destination devices, they take the same fields form the frame and runs through them with same algorithms.

18. Define operating system? Explain the functions of an Operating System?

Ans :

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

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

Functions

(i) Security: The operating system uses password protection to protect user data and similar other techniques. it also prevents unauthorized access to programs and user data.

(ii) Control over system performance: Monitors overall system health to help improve performance. records the response time between service requests and system response to having a complete view of the system health. This can help improve performance by providing important information needed to troubleshoot problems.

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

(iv) Error detecting aids: The operating system constantly monitors the system to detect errors and avoid the malfunctioning of a computer system.

(v) **Coordination between other software and users:** Operating systems also coordinate and assign interpreters, compilers, assemblers, and other software to the various users of the computer systems.

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

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

(vii) **Processor Management:** In a multi-programming environment, the OS decides the order in which processes have access to the processor, and how much processing time each process has. This function of OS is called process scheduling. An Operating System performs the following activities for processor management.

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

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

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

19. Explain any TWO software development process models with a neat diagram.

(Unit-IV, Q.No. 12, 13)

20. Define information hiding and coding standards? Explain how it helps to improve the reliability?

(Unit-IV, Q.No. 24, 26)