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From the Pen of the Guide...

Presently, the subject of computers is highly important in competitive exams. Among competitive exam candidates, Dharmendra Kumar Yadav is a popular name as a guide and expert in the computer subject. He is a resident of village Kalyanpura (Uchhwala), located in the Shahpura tehsil of Jaipur. Thousands of competitive exam candidates have achieved success through his writings and guidance. He has obtained a technical education degree, B.Tech.

With best wishes!

Dharmendra Kumar Yadav

The birthplace of Mr. Satyaprakash Dadarwal is the village of Sanga ka Bas, Post Office - Dungari Kalan, Tehsil - K. Renwal, District - Jaipur. Mr. Dadarwal's educational qualifications are B.Tech. (Computer Science) and MCA. Mr. Dadarwal is an experienced, hardworking, and visionary educationist. Due to his deep theoretical and practical knowledge in the field of computers, he is highly regarded as an effective guide (mentor) for students. Under his guidance, many students have achieved remarkable success in their academic lives.

With best wishes!

Satya Prakash Dadarwal

Author Introduction

The author was born in Navalpura village, Shahpura Tehsil, Jaipur district of Rajasthan. Her educational qualification is Post-Graduation. Due to her interest in writing and technical knowledge, she has been engaged in writing for the past many years. Thousands of competitive exams have received guidance by studying the books written and compiled by her.

Manisha Yadav
Computer Expert

SYLLABUS
Computer Instructor :: Paper-II

(i) **Pedagogy**
(ii) **Mental Ability:** Decision making and Problem solving, Data Interpretation, Data Sufficiency, Logical Reasoning and Analytical Ability, Major developments in the field of Information Technology.
(iii) **Fundamentals of Computer:** Overview of the Computer System including input-output devices, pointing devices, and scanner. Representation of Data (Digital versus Analog, Number System - Decimal, Binary & Hexadecimal), Introduction to Data Processing, Concepts of files and its types.
(iv) **Data Processing:** Word Processing (MS-Word), Spread Sheet Software (MS Excel), Presentation Software (MS Power Point), DBMS Software (MS-Access).
(v) **Programming Fundamentals:** Introduction to C, C++, Java, DotNet, Artificial Intelligence (AI), Machine learning, Python and Block Chain, Principles and Programming Techniques, Introduction of Object Oriented Programming (OOPs) concepts, Introduction to "Integrated Development Environment" and its advantages.
(vi) **Data structures and Algorithms:** Algorithms for Problem Solving, Abstract data types, Arrays as data structures, linked list v/s array for storage, stack and stack operations, queues, binary trees, binary search trees, graphs and their representations, sorting and searching, symbol table. Data structure using ¢ & c++.
(vii) **Computer Organization and Operation System:** Basic Structure of Computers, Computer Arithmetic Operations, Central Processing Unit and Instructions, Memory Organization, I/O Organization, Operating Systems Overview, Process Management, Finding and processing files.
(viii) **Communication and Network Concepts:** Introduction to Computer Networks, Introduction: Networks layers/Models, Networking Devices, Fundamentals of Mobile Communication.
(ix) **Network Security:** Protecting Computer Systems from viruses & malicious attacks, Introduction to Firewalls and its utility, Backup & Restoring data, Networking (LAN & WAN), Security, Ethical Hacking.
(x) **Database Management System:** An Overview of the Database Management, Architecture of Database System, Relational Database Management System (RDBMS), Database Design, Manipulating Data, NoSQL Database Technologies, Selecting Right Database.
(xi) **System Analysis and Design:** Introduction, Requirement Gathering and Feasibility Analysis, Structured Analysis, Structured Design, Object-Oriented Modelling Using UML, Testing, System Implementation and Maintenance, Other Software Development Approaches.
(xii) **Internet of things and its application :** Introduction of Internet Technology and Protocol, LAN, MAN, WAN, Search Services/Engines, Introduction to online & offline messaging, World Wide Web Browsers, Web publishing, Basic knowledge HTML, XML and Scripts, Creation & maintenance of Websites, HTML interactivity Tools, Multimedia and Graphics, Voice Mail and Video Conferencing, Introduction to e-Commerce.

Content

2022 Basic Computer Instructor

18 June, 2022 (118-B)

1. Which type of research can be done to immediately solve the problems related to understanding difficult concepts of any subject in the class?
(A) Case Study (B) Action Research
(C) Interaction Analysis (D) Basic Research **[B]**

Explanation—Action Research is a process in the field of education used to find a solution to an **immediate or local problem** and to **improve the current working system**. The question talks about "immediately solving problems related to understanding difficult concepts", which is the main feature of action research. This type of research is usually done by **teachers or school administration themselves** so that they can bring necessary changes in their teaching methods and immediately remove the practical problems of the students. It is different from other research (like basic research) because its objective is not to create new principles, but to **bring improvement in a specific situation**. In this, the teacher identifies the problem, makes a plan for its solution, and immediately implements it in the class to see its result, which makes the **learning process of the students easier**.

2. To increase 'Critical Thinking' among students, which of the following methods is most effective?
(A) Project-based teaching-learning
(B) Lecture method
(C) Lecture-cum-demonstration method
(D) Inductive-deductive method **[D]**

Explanation—The inductive-deductive method is most effective for critical thinking because it requires students to analyze observations to form generalizations (inductive) and then apply those rules to new problems (deductive). This process moves students beyond rote memorization and forces them to actively evaluate logic, identify patterns, and test hypotheses. By engaging in this dual-process of inquiry, students develop the analytical skills necessary to think independently and critically.

3. You notice that there are two students in your class due to whom difficulty arises in class management. What step will you take?
(A) Stand them at the back of the class and punish them
(B) Give them small projects and observe them continuously
(C) Do not pay any attention to them
(D) Throw them out of the class **[B]**

Explanation—If students create obstacles in class management, then instead of punishing them, it is a better solution to keep them busy in positive tasks. By giving them **small projects or responsibilities and observing them continuously**, their energy will be directed in the right direction, and they will **play an active role in the learning process** instead of creating disruptions in the class.

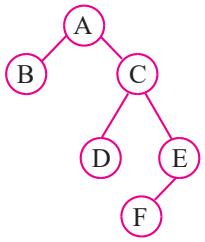
4. The application of "Essay-type Questions" is done to check which of the following?
(A) To make comparisons, to check the ability of a person
(B) Application of principles in a new situation
(C) For communication of ideas
(D) All of the above **[D]**

Explanation—'Essay-type Questions' are those questions in which the student has to write an answer in detail on a subject. These questions not only check the ability to remember information but also do the **Evaluation** of many aspects of the mental skills of the student.
First of all, these questions check the student's **'Ability to make comparison'**. When a student is asked to tell the difference or similarity between two different principles or events, they have to analyze them using their understanding. Secondly, it also checks how a student can **'Apply'** the learned **'Principles'** in **'New Situations'**. Merely memorizing formulas or rules is not enough, but using them in real problems is real learning.
The third important aspect is the **'Communication of Ideas'**. While writing an essay-type answer, the student has to gather their scattered thoughts and put them into words in a **'Logical'** and systematic manner, which reveals their expression ability.
Therefore, since essay-type questions are capable of checking all these three **'Abilities'**—making comparisons, applying principles, and expressing ideas effectively.

13. What will be the post-order traversal of a binary tree T, if the pre-order and in-order traversals of T are ABCDEF and BADCFE respectively?
(A) BDFECA (B) BCFDEA
(C) BFDECA (D) BEFDCA **[A]**

Explanation—Rule: Preorder: The first letter is the **Root**.
Inorder: The one on the left of the Root is **Left**, the one on the right is **Right**.
Step-by-Step Solution:
Step 1: Find the Root
Preorder: A B C D E F → **Root = A**
Inorder: B (Left) | **A** (Root) | **D C F E** (Right)
Postorder *will end with* **A**.
Step 2: Solve the Right Part (D C F E)

he next letter in **Preorder** is **C** → **Root = C**
Inorder में **D** (Left) | **C** (Root) | **F E** (Right)
Step 3: Solve the Remaining Part (F E)
The next letter in **Preorder** is **E** → **Root = E**
Inorder में **F** (Left) | **E** (Root)
Tree Structure (Visual):



Find Postorder (Left → Right → Root):
1. Left: **B**
2. Right: D → F → E → C (**D F E C**)
3. Root: **A**

Postorder: B D F E C A

14. Which of the following e-mail protocols is used to deliver messages from source to destination over the internet?
(A) SMTP (B) IMAP (C) POP (D) UDP **[A]**
Explanation—SMTP (Simple Mail Transfer Protocol) is used to **send emails**. It is the standard protocol for transferring email messages from a client to a server or from one server to another, whereas **POP** and **IMAP** are protocols used to receive emails.

15. Which of the following is a Sans Serif font?
(A) Arial (B) Times New Roman
(C) Courier (D) Gothic **[*]**
Explanation—Serif fonts are those that have small **decorative strokes or tails** at the ends of their letters. For example, **Times New Roman** and **Courier** are serif fonts, which look a bit traditional or classic. On the contrary, **Sans Serif** fonts are those that lack these decorative strokes. These fonts look completely **plain, modern, and clear**. **Arial** and **Gothic** are sans serif fonts because the edges of their letters are completely straight and without any decoration, making them very easy to read on digital screens.

16. Which of the following is not related to an animation format?
(A) Flic Format (FLI/FLC)
(B) MPEG (.mpg)
(C) Quick time (QT/Moov)
(D) Amiga (SGI) **[D]**
Explanation—Flic Format, **MPEG**, and **QuickTime** are popular animation and video file formats. Whereas **Amiga (SGI)** is mainly related to a computer hardware platform or image format (.sgi); it does not fall under the category of standard animation file formats.

17. Which of the following is not a proper file extension for an audio file?
(A) .wav (B) .mp3 (C) .mid (D) .rar **[D]**
Explanation—.rar is a **compressed archive** file format, used to reduce the size of files and bundle them. It is not an audio file extension. **.wav**, **.mp3**, and **.mid** are extensions for audio files.

18. Consider the following statements regarding Keys—
(I) A **Super key** is a combination of one or more attributes that **uniquely identifies** records in an RDBMS table.
(II) A **Candidate key** is a subset of a super key.
(III) All **Super keys** are candidate keys, but not all candidate keys are super keys.
(A) Only (I) is true
(B) Only (II) is true
(C) Both (I) and (III) are true
(D) Both (I) and (II) are true **[A]**
Explanation—A **Super Key** is a set of attributes that can **uniquely identify** every row (tuple) in a table.
A **Candidate Key** is a **minimal Super Key** (the smallest form of a Super Key). Therefore, every Candidate Key is a Super Key, but every Super Key (which has extra columns) cannot be a Candidate Key.

19. Which of the following is not a type of NoSQL?
(A) CouchDB (B) MongoDB
(C) HBase (D) QBase **[D]**
Explanation—CouchDB, **MongoDB**, and **HBase** are all **NoSQL databases** used to manage **Big Data**. Whereas there is no standard NoSQL database type named **QBase**.

20. Identify the most accurate statement regarding the application of XML—
(A) XML should be used to produce XML and HTML output.
(B) XML cannot specify or contain presentation information.
(C) XML is used to describe hierarchically organized information.
(D) XML transforms information between various e-business applications. **[C]**
Explanation—The main purpose of **XML (Extensible Markup Language)** is to **store and transport data**, not to display it. XML structures data as a **Tree**. It organizes data in the form of a **Tree Structure**. It has a **Root Element**, and inside it are **Child Elements**. This is called **Hierarchy**.
XML itself is a **Text Format**, not a software. **XML** does not perform **Conversion**; instead, programs or **Software** perform the conversion using **XML** data. **XML** is just a **Medium**.

21. What is used to maintain the physical view in RDBMS?
(A) Trigger (B) Pointer
(C) Clone object (D) None of these **[A]**
Explanation—In **RDBMS**, a **Trigger** is a **Stored Procedure** that automatically executes when a specific event (like **INSERT, UPDATE**) occurs on a table. It is used to maintain **Data Integrity** and manage data changes at the physical level (such as keeping **Materialized Views** updated) so that the **Physical View** of the database remains consistent.

22. What is the result of the prefix expression +, “, *, 3, 2, /, 8, 4, 1?
(A) 12 (B) 11 (C) 5 (D) 4 **[C]**

Explanation—Prefix Evaluation: +, “, *, 3, 2, /, 8, 4, 1
To solve a **Prefix Expression**, we scan from **Right to Left** —
1. Scan: 1, 4, 8, /
Operation: 8 / 4 = 2
New Expression: + - * 3 2 2 1 (Note: 1 remains as it is at the end)
2. Scan: 2, 2, 3, *
Operation: 3 * 2 = 6
New Expression: + - 6 2 1
3. Scan: 2, 6, -
Operation: 6 - 2 = 4
New Expression: + 4 1
4. Scan: 1, 4, +
Operation: 4 + 1 = 5
Final Result : 5

23. Which of the following statements contains an error?
(A) Select * from emp where empid = 10003;
(B) Select empid from emp where empid = 1006;
(C) Select empid from emp;
(D) Select empid where empid = 10009 and last name = ‘GELLER’; **[D]**
Explanation—Select empid where empid = 10009 and last name = ‘GELLER’;
Error: The **FROM clause** is missing in this statement. In **SQL**, after **SELECT**, it is mandatory to specify from which table the data is to be taken (**FROM table_name**). Additionally, if **last name** (with a space) is a column name, it must be enclosed in **Quotes or Brackets** (e.g., **“last name”**), or it should be written as **lastname**.

24. What is the information that gets converted in encryption called?
(A) Plain text (B) Parallel text
(C) Encrypted text (D) Decrypted text **[A]**
Explanation—Encryption is a process in which normal readable information is converted into a code format (**Cipher Text**) to keep it secure. The original information given as input in this process is called **Plain Text**. This plain text gets converted into **Encrypted Text**.

25. A Black Hole in a DFD is —
(A) A data store with no in bound flows
(B) A data store with only in bound flows
(C) A data store with more than one in bound flow
(D) None of these **[B]**
Explanation—In a **DFD (Data Flow Diagram)**, a **Black Hole** is a type of **Logical Error**. Consider it like a black hole in space – where everything goes in, but nothing comes out.
A **Black Hole** situation occurs when data comes inside (**Input**) a **Data Store** or **Process**, but no data goes out (**Output**) from there. While checking a DFD, three main errors occur —
Black Hole : Only Input, No Output.
Miracle : No Input, Only Output.
Gray Hole : Insufficient Input.

26. Which of the following is not a Software Process Model?
(A) Linear sequential model
(B) Prototype model
(C) The spiral model (D) COCOMO model **[D]**
Explanation—Linear Sequential, **Prototype**, and **Spiral** models are all **Software Process Models** that define the **Steps** to build a software.
However, **COCOMO (Constructive Cost Model)** is an **Estimation Model** used to estimate the **Cost** and **Effort** of a software project, not the process to build it.

27. Which of the following is not a valid Master View option in Microsoft PowerPoint 2016?
(A) Notes Master (B) Outline Master
(C) Slide Master (D) Handout Master **[B]**
Explanation—In PowerPoint, **Master View** is used to control the format of the entire presentation. It includes **Slide Master**, **Handout Master**, and **Notes Master**. However, there is no option like **Outline Master**. There is only an **Outline View** which comes under the normal View tab, not in the Master View.

28. In Excel 2016, what will you do to insert three columns between columns G and H?
(A) Select column G, right-click, and select insert three times
(B) Select **column H**, right-click, and select **insert three times**.
(C) Select **columns E, F, and G**, right-click, and select **insert three times**.
(D) Select **columns D, E, and F**, right-click, and select **insert three times**. **[B]**
Explanation—In **MS Excel**, when we insert a column, it is added to the **left** of the selected column. Therefore, to add a column between **G and H**, we must select the **H column**. By inserting three times, the **H column** will shift to the right, and **three new empty columns** will be created between G and H.

29. An IP Packet arrives with the first 8 bits as 01000010. Which of the following is correct?
(A) The number of hops this packet can travel is 2
(B) The total number of bytes in the header is 16 bytes
(C) The upper layer protocol is ICMP
(D) The receiver rejects the packet **[D]**
Explanation—The **first 8 bits** of an **IPv4 Packet** header represent two important pieces of information. The first 4 bits are for the **Version**, which is **0100** here (4 in binary), meaning it is the **IPv4 protocol**. The next 4 bits represent the **Internet Header Length (IHL)**, which is **0010** here (2 in binary). According to networking rules, to calculate the actual header length, the value of **IHL is multiplied by 4**, making the header length here only **8 bytes**.
Since according to **IPv4 standards**, the **minimum length** of any valid packet header must be at least **20 bytes**, this 8-byte packet is considered **invalid** or **malformed**. For this reason, the receiver or network device immediately **rejects** or **discards** the packet instead of processing it.

30. Which of the following is a combinational logic circuit that has 2^n input lines and a single output line?
(A) Multiplexer (B) Demultiplexer
(C) Encoder (D) Decoder **[A]**

Explanation—In digital electronics, **Combinational Logic Circuits** are those circuits whose output depends only on the current input. A **Multiplexer (MUX)**, often called a Many-to-One data selector, is a circuit that has many input lines but only a **single output line**. If it has 2^n input lines, then **n selection lines** are used to choose one of the inputs. Its main function is to select one of the many available input signals and send it to the output.

31. The commonly used protocol for web page transfer is—

(A) HTML (B) HTTP (C) WML (D) WTTP **[B]**

Explanation—HTTP (Hypertext Transfer Protocol) is the foundation of data communication on the internet. When you type a URL into a web browser, this protocol requests the **web page (HTML document)** from the web server and delivers it to your browser, allowing users to view the website.

32. The correct statement(s) regarding WiFi and Wi-Max technology is/are—

(I) WiFi uses **radio waves** to create a wireless connection; WiMax uses **spectrum** to provide a connection.

(II) WiFi is defined under **IEEE 802.11x** standards, whereas WiMax is defined under **IEEE 803.16y** standards.

(III) WiMax covers a comparatively **larger area** than WiFi.

(A) Only (II) (B) Only (I) and (II)
(C) Only (I) and (III) (D) (I), (II), and (III) **[C]**

Explanation—WiFi is an abbreviation for **Wireless Fidelity**. WiFi creates **wireless high-speed internet** and network connections using **radio waves**. A **wireless adaptor** is required to create a hotspot.

Wi-Max is an abbreviation for **Wireless Interoperability for Microwave Access**. Wi-Max uses **spectrum** to provide a connection and handle a large inter-operable network. WiFi is specified by **IEEE 802.11x standards**, where x represents different WiFi versions. WiMax is specified by **IEEE 802.16y standards**, where y represents different Wi-Max versions. The **maximum range of WiFi is 100 meters**, and the **maximum range of Wi-Max is 90 kilometers**. Therefore, Wi-Max covers a larger area.

33. Which of the following are correct statements regarding XML?

(i) It is used only for displaying data.
(ii) XML can also be used as a database.
(iii) XPATH is used to store the IP address of the server.
(iv) XLL definition is used to specify links with other documents alongside XML.

(A) Only (i) and (ii)
(B) Only (i), (ii), and (iii)
(C) Only (ii), (iii), and (iv)
(D) Only (ii) and (iv) **[D]**

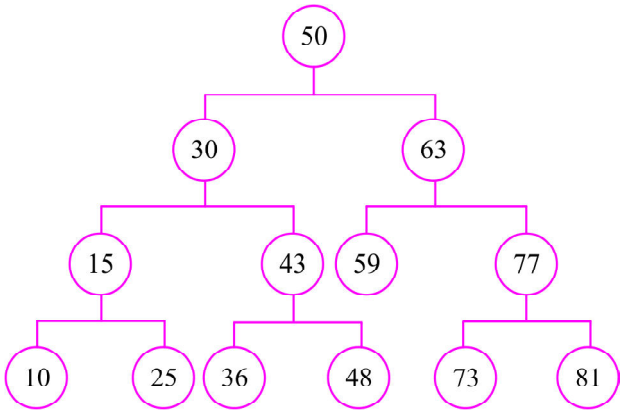
Explanation—Statement (i) is False: XML does not **display data** (this is the job of HTML); XML **stores and transports data**.

Statement (ii) is True: XML keeps data organized. Therefore, it can be used as a database.

Statement (iii) is Incorrect: The function of **XPath** is to **navigate** elements inside an XML file, not to store IP addresses.

Statement (iv) is Correct: XLL (XML Linking Language) is used to create **links** with other documents.

34. Consider the given Binary Search Tree. If the root node is deleted, what can be the new root—



(A) 43 or 48 (B) 63 or 81
(C) 48 or 59 (D) 30 or 63 **[C]**

Explanation—When we delete a node from a **Binary Search Tree (BST)** that has two children (like the Root node 50 here), there are two **standard** ways to replace it—

1. **Inorder Predecessor:** The **largest** element of the **Left Subtree**. Who is the **rightmost** in the Left Subtree (the part with 30)? -> **48**
2. **Inorder Successor:** The **smallest** element of the **Right Subtree**. Who is the **leftmost** in the Right Subtree (the part with 63)? -> **59**

35. What will be the prefix notation of the given equation?
(a+(b/c) * (d^e)-f)

(A) +-a*^/bcdef (B) -+a*b/c^def
(C) -+a*/bc^def (D) -+fa*/bc^de **[C]**

Explanation—Logic (Infix to Prefix Conversion):
(a + (b/c) * (d^e) - f)
Precedence Order:
1. Brackets ()
2. Exponent ^ (Right to Left)
3. Multiplication/Division * / (Left to Right)
4. Addition/Subtraction + - (Left to Right)

Step-by-Step Conversion:
1. Solve Brackets first:
(b/c) → /bc and (d^e) → ^de
Expression becomes: (a + /bc * ^de - f)
2. Multiplication *:
(/bc) * (^de) → */bc^de
Expression becomes: (a + */bc^de - f)
3. Addition +:
a + (*/bc^de) → +a*/bc^de Expression becomes: (+a*/bc^de - f)
4. Subtraction -:
(+a*/bc^de) - f → -+a*/bc^def
Final Prefix Expression: -+a*/bc^def

36. Consider the following stack implementation—

```
# define SIZE 11
Struct STACK
{
int arr [SIZE];
int top = -1;
}
```

What will be the maximum value of top that does not cause a stack overflow?

(A) 8 (B) 9 (C) 11 (D) 10 **[D]**

Explanation—In the code, **#define SIZE 11** is given. This means the size of the **array** for the stack is 11. **Indexing:** In C/C++, array indexing starts from **0**. If the Size is 11, the valid indexes will be: **0, 1, 2, ..., 10**. **Overflow** occurs when we try to move the Top index beyond **Size - 1**. The last (Maximum) element of the stack can be stored at index 10 (i.e., 11 - 1). Therefore, the **maximum value of top** can be **10**. If top becomes 11, it will go out of the array's bounds (**Overflow**).

37. In MS Excel, the output of =LCM(5, 7, 35) will be—

(A) 70 (B) 1225 (C) 12 (D) 35 **[D]**

Explanation—In **MS Excel**, any formula starts with an = sign. The **LCM (Least Common Multiple)** function in Excel calculates the least common multiple of the given numbers. The smallest multiple of the numbers 5, 7, and 35 that is divisible by all three is **35**.

38. In MS PowerPoint, we can run a slide show from the beginning by using the ... key and from the current slide by using the ... key.

(A) F5, F7 (B) F6, F8
(C) F7, Shift + F7 (D) F5, Shift + F5 **[D]**

Explanation—In PowerPoint, the keyboard shortcut **'F5'** is used to start the presentation from the very first slide. If you want the presentation to start from the slide you are currently working on, i.e., to start the presentation from the current slide, **'Shift + F5'** is used.

39. Which of the following is the most suitable view to rearrange slides in MS PowerPoint?

(A) Slide Sorter (B) Notes Page
(C) Normal (D) Slide Show **[A]**

Explanation—In **Slide Sorter View**, all the slides of the presentation appear together as small thumbnails. This makes it very easy and fast for the user to drag and drop the slides to **rearrange** their order.

40. In the context of memory cards, SD and MMC stand for—

(A) Secure Digital, Multimedia Card
(B) Secure Data, Memory Management Card
(C) Safe Data, Mega Memory Card
(D) Safe Digits, Multimedia Card **[A]**

Explanation—These both are standard names for **storage devices**. The full form of SD is **'Secure Digital'**, which is widely used in modern cameras and phones. The full form of MMC is **'Multimedia Card'**, which was the **predecessor** standard of the SD card. These are types of **flash memory cards**.

41. In MS Word, 'Gutter' is related to?

(A) Orientation (B) Page Size
(C) Margins (D) Equation **[C]**

Explanation—In MS Word, **'Gutter'** is related to **page setup and margins**. It is the extra blank space added to the **binding side** of the page during printing. Its main objective is to ensure that no text or content of the page gets hidden after binding. It is usually added to the left or top margin.

42. Fill in the blank in the context of MS Word—
'Create a ..... to name a specific point in a document.'

(A) Clip Art (B) Cross-Reference
(C) Hyperlink (D) Bookmark **[D]**

Explanation—In MS Word, **'Bookmark'** is a feature that provides the facility to mark a specific part, text, or location of a document by giving it a name. Just like we put a mark in a book, similarly, by using a bookmark in a digital document, a user can directly and instantly reach that specific location in the future.

43. Decorative text in an MS Word document is called—

(A) Bookmark (B) WordArt
(C) SmartArt (D) ClipArt **[B]**

Explanation— **'WordArt'** is a text-styling feature in MS Word. It is used to convert normal text in a document into **'decorative text'** by giving it special effects (like shadow, 3D effect, curved shape, outline, and various colours). It is often used to make **headings or main points** attractive.

44. Which of the following is not a system software?

(A) Programming Language Translators
(B) Utility Programs
(C) Database Software
(D) Operating System **[C]**

Explanation—System software is a group of programs that enables the computer system to function. System software is necessary for the **execution** of any program on a computer and for the operation of the computer. Examples: **Operating System, Programming Language, Language Translator, Device Driver**.

45. Which of the following is the largest unit of storage?

(A) Terabyte (B) Kilobyte
(C) Megabyte (D) Gigabyte **[A]**

Explanation—The increasing order of computer memory units is as follows: Bit < Byte < Kilobyte (KB) < Megabyte (MB) < Gigabyte (GB) < Terabyte (TB). Among the given options, 'Terabyte' (TB) is the largest unit. 1 Terabyte is approximately equal to 1024 Gigabytes.

46. Which of the following is not a first-generation computer?

(A) ENIAC (B) PDP-11
(C) UNIVAC-I (D) IBM-701 **[B]**

Explanation—PDP-11 is a minicomputer developed in the 1970s, whereas **ENIAC, UNIVAC-I, and IBM-701** are **first-generation computers**, in which **vacuum tubes** were used as the main electronic component.

47. Which of the following is used by the banking industry to manage cheques received in large quantities?

(A) Digitizer (B) MICR
(C) Barcode Reader (D) Captcha **[B]**

Explanation—MICR is used in the banking system and industries for reading cheques and for **fast processing**. In banks, some specific types of characters are printed on the cheque with **magnetic ink**; these are read by MICR.
The full name of MICR is **Magnetic Ink Character Reader/Recognition**.

48. If three threads are trying to share a single object at the same time, which condition will arise in this scenario?
(A) Time-Lapse (B) Critical Situation
(C) Race Condition (D) Depletion **[C]**

Explanation—In an operating system, a **'Race Condition'** arises when two or more **threads** or processes try to access and modify a **shared resource** at the same time. In this situation, the final result of the program depends on which thread completes its task first, which can lead to unpredictable results.

49. Minimal super keys in a relational database are called .....
(A) Primary Keys (B) Foreign Keys
(C) Candidate Keys (D) Reference Keys **[C]**

Explanation—In a **Relational Database**, a **Super Key** is the set that uniquely identifies rows.
A **Minimal Super Key** (from which if any attribute is removed, it loses its unique identification) is called a **Candidate Key**.
A **Primary Key** is also a **Candidate Key** which is selected by the **Database Administrator**, but the technical definition (**Minimal Super Key**) is for the **Candidate Key**.

50. In decision table left-lower quadrant is called—
(A) Condition entry (B) Condition stub
(C) Action entry (D) Action stub **[D]**

Explanation—A **Decision Table** is divided into four main **Quadrants** (parts)—
1. **Condition Stub (Top-Left):** All the **Conditions** are written here.
2. **Condition Entry (Top-Right):** The values of the conditions (**Y/N**) are filled here.
3. **Action Stub (Bottom-Left):** All the **Actions** to be taken upon fulfilling the conditions are written here.
4. **Action Entry (Bottom-Right):** It is marked here which **Action** to take and when.

51. In the context of information collection, in a ranking scale question, the respondent is asked—
(A) To choose one of the given answer options
(B) To rank the item list in order of utility
(C) To mark the level of satisfaction on a given scale
(D) To say yes or no **[B]**

Explanation—Ranking Scale is a method of survey and research. In this, the respondent is given a list of options or items and is asked to arrange them in a specific order (like **1 to 5**) based on their preference, choice, importance, or utility. This reveals which option the users give more importance to compared to others.

52. A relation in which every non-key attribute is fully functionally dependent on the primary key and which has no transitive dependency, is in—
(A) 5NF (B) 3NF (C) 4NF (D) BCNF **[B]**

Explanation—A **Relation** is in **3NF** when it is already in **2NF** (which means every **Non-key Attribute** is fully **Functionally Dependent** on the **Primary Key**). It should not have any **Transitive Dependency** (i.e., a **Non-key attribute** should not be dependent on another **Non-key attribute**).

53. Which is a measure of software complexity?
(A) Lines of Code (LOC)
(B) Number of Man Years
(C) Number of Function Points (FP)
(D) All of the above **[D]**

Explanation—Several **Metrics** are used to measure **Software Complexity**. **Lines of Code (LOC)** indicates the **Size** of the software, **Function Points (FP)** measures the **Business Functionality** of the system, and **Man Years** estimates the required **Effort** and **Time** for the project. Therefore, all of these are **Software Complexity Measures**.

54. Testing level is done in which of the following order?
(A) Unit, Integration, System, Acceptance
(B) It is based on the nature of the project
(C) Unit, Integration, Acceptance, System
(D) Unit, System, Integration, Acceptance **[A]**

Explanation—There is a standard **Hierarchy** (order) of **Software Testing**—
1. **Unit Testing:** First of all, the smallest parts (**Modules/Functions**) of the code are tested separately.
2. **Integration Testing:** Then these small **Modules** are combined together (by **Integrating**) to check whether they are working correctly together or not.
3. **System Testing:** After this, the entire software is tested as a **Complete System**.
4. **Acceptance Testing:** Finally, it is checked by the **Client/User** whether the software meets their needs or not, so that it can be **Accepted**.

55. Which testing focuses on heavily testing of one particular module?
(A) Gorilla testing (B) Fuzz testing
(C) Inter system testing (D) Breadth testing **[A]**

Explanation—Gorilla Testing is a type of **Manual Software Testing**. In this, a specific **Module** or **Functionality** is tested repeatedly and very deeply (**Heavily**) to ensure that it is **Robust** and not crashing.

56. The first step for a system study project is—
(A) Define system performance criteria
(B) Describe information needs
(C) Staff for study project
(D) Announce the study project **[B]**

Explanation—In the **System Development Life Cycle (SDLC)**, the first phase of any project is **Requirement Analysis** and **Problem Definition**. To start a project, it is mandatory to first identify and define the **User Requirements** and **Information Needs**.

57. Which of the following memory is used to minimize the processor-memory speed mismatch?
(A) UVEPROM (B) Flash Memory
(C) DVD (D) Cache Memory **[D]**
Explanation—In a computer, the speed of the **CPU** is much higher compared to the **Main Memory (RAM)**. To reduce or overcome this **Speed Mismatch**, the **CPU** and **Cache Memory** is placed between the CPU and RAM. It is a very **fast and expensive memory** that stores **frequently used data** so that the CPU does not have to wait for the data.

58. By which of the following methods a string will be created in Java?
I : String S = "Hello Java";
II : String S2 = New string ("Hello Java");
(A) Only I (B) Only II
(C) Both I and II (D) Neither I nor II **[A]**
Explanation—**Method I:** String S = "Hello Java"; is **valid**. This is the **String Literal** method. It is the absolutely correct syntax. Java stores it in the **String Constant Pool**.
Method II: String S2 = New string ("Hello Java"); is **Invalid** (Compilation Error).
There are two mistakes in the syntax here: The keyword new must always be in **small letters** (Java is case-sensitive).
The Class name should be String (**Capital 'S'**). Here, string (**small 's'**) is written.
The correct syntax is: String S2 = new String("Hello Java");

59. Which of the following are Line Printer and Page Printer respectively?
(A) Laser Printer, Dot-Matrix Printer
(B) Drum Printer, Band Printer
(C) Drum Printer, Laser Printer
(D) Laser Printer, Chain Printer **[C]**
Explanation—Printers are classified based on their **printing capacity**. A **Drum Printer** prints a complete line at a time, so it is a **Line Printer**. On the other hand, a **Laser Printer** processes data and prints a complete page at a time, so it is called a **Page Printer**. This option shows the correct classification.

60. On the relation EMPLOYEE having 'n' tuples, if the SQL command DELETE FROM EMPLOYEE is executed, then ..... will be removed from the EMPLOYEE relation.
(A) Zero tuple (B) Only the first tuple
(C) All 'n' tuples (D) Only the last tuple **[C]**
Explanation—In an SQL command, if we use the **WHERE condition** with **DELETE** (like DELETE FROM EMP WHERE ID=1), then only the selected Rows are deleted. In this question, DELETE FROM EMPLOYEE; is written, which has **no WHERE clause**. Therefore, executing the **DELETE command** without any condition removes all the Rows from the table. Since there were a total of **'n' tuples** in the table, all those **'n' tuples** will be deleted.

61. Which of the following is an appropriate pair of Schema Modification statements in SQL?
(A) DELETE, ALTER (B) DROP, UPDATE
(C) DROP, ALTER (D) DELETE, UPDATE **[C]**
Explanation—In SQL, **DDL (Data Definition Language)** commands change the structure (**Schema**) of the database.
Examples: CREATE, **ALTER**, **DROP**, **TRUNCATE** and **DML (Data Manipulation Language)** commands.

62. Select the true statement:
I. Binary search is faster than linear search.
II. Binary search cannot be applied to all the input lists on which linear search is applied.
(A) Only I (B) Only II
(C) Both I and II (D) Neither I nor II **[C]**
Explanation—The Time Complexity of **Binary Search** is **O(log n)**, whereas for **Linear Search** it is **O(n)**. For large lists, **log n** is much smaller than **n**, so **Binary Search** is much **faster**.
Linear Search can work on any list (**Sorted** or **Unsorted**). However, **Binary Search** can only be applied to a **Sorted List**. Therefore, **Binary Search** cannot be applied to those **Unsorted lists** on which **Linear Search** can be applied.

63. A linear array LA has Lower Bound LB and Upper Bound UB. Consider the following algorithm—
1. Repeat for K = LB to UB apply PROCESS to LA [K]
2. Exit
This algorithm ..... the array LA.
(A) Sorts (B) Searches
(C) Traverses (D) Merges **[C]**
Explanation—Here in an array (**LA**), **LB** means **Lower Bound** (starting index), and **UB** means **Upper Bound** (ending index).
Repeat for K = LB to UB => This means the loop starts from the first element of the array and moves forward one by one till the last element.
apply PROCESS to LA[K] => This means a **Visit/ Process** is being done on each **Element**.
In Data Structures, **Traversal** means to visit and process each **Element** exactly once.

64. In context with Relational Algebra, which of the following are Unary operators?
1. Select 2. Project
3. Union 4. Product
(A) Only 1 and 3 (B) Only 2 and 4
(C) Only 1 and 2 (D) All are Binary **[C]**
Explanation—Operations in **Relational Algebra** are divided into two types—
1. Unary Operators: They require only one **Relation (Table)** to operate. Examples— **Select (σ)**, **Project (π)**
2. Binary Operators: They require two **Relations (Tables)** to operate. Examples— **Union (U)**, **Product (×)**

65. Which of the following database objects does not physically exist?
(A) Base Table (B) Index
(C) View (D) None of these **[C]**

Explanation—In a **Database**, a **View** is a **Virtual Table**. It does not **physically exist** (meaning, it does not store data on the disk).
Base table: This is the actual table where data (**Rows/Columns**) is **physically stored** on the disk.
Index: This is a data structure (like **B-Tree**) used to speed up data retrieval, which is **physically stored** on the disk (it consumes space).

66. Which of the following is not a super key in a relational schema with attributes V, W, X, Y, Z and primary key VY?
(A) VXYZ (B) VWXZ
(C) VWXY (D) VWXYZ **[B]**
Explanation—Any Attribute Set that includes the **Primary Key** (or **Candidate Key**) is a **Super Key**.
Attributes: V, W, X, Y, Z
Primary Key: VY (This means any set containing both **V** and **Y** will be a **Super Key**).

67. Match the following—

List–I	List - II
(a) DDL	(i) LOCK TABLE
(b) DML	(ii) COMMIT
(c) TCL	(iii) Natural Difference
(d) Binary operation	(iv) REVOKE

(A) a-(ii), b-(i), c-(iii), d-(iv)
(B) a-(i), b-(ii), c-(iv), d-(iii)
(C) a-(iii), b-(ii), c-(i), d-(iv)
(D) a-(iv), b-(i), c-(ii), d-(iii) **[D]**
Explanation—TCL (Transaction Control Language): It includes commands that manage transactions, such as **COMMIT, ROLLBACK,** and **SAVEPOINT**.
In databases like Oracle, the **LOCK TABLE** command is placed in the **DML (Data Manipulation Language)** category because it controls data access.
In **Relational Algebra**, operations that require two operands are called **Binary Operations**. "**Difference**" (- Minus) is a **Binary operation**.
Technically, **REVOKE** is a **DCL (Data Control Language)** command, but it is also included under **DDL**.

68. In Tuple Relational Calculus $P_1 \rightarrow P_2$ is equal to—
(A) $\neg P_1 \vee P_2$ (B) $P_1 \vee P_2$
(C) $P_1 \wedge P_2$ (D) $P_1 \wedge \neg P_2$ **[A]**
Explanation—In Logic and **Tuple Relational Calculus**, the Expression $P_1 \Rightarrow P_2$ means: "If P_1 is true, then P_2 must be true".
$P_1 \Rightarrow P_2$ is False only when **P_1 is True** and **P_2 is False**. $\neg P_1 \vee P_2$ (**$\neg P_2$** is also False only when **P_1 is True** (so that $\neg P_1$ becomes False) and **P_2 is also False**.
Therefore, **$P_1 \rightarrow P_2$** is technically equivalent to **$\neg P_1 \vee P_2$**.

69. Which operations form the basic set of operations to manipulate relational data?
(A) Predicate Calculus (B) Relational Calculus
(C) Relational Algebra (D) None of these **[C]**
Explanation—Relational Algebra: It is a **Procedural Query Language**. It provides a set of operations that take one or more **Relations (Tables)** as Input and produce a new Relation as Output. It has **5 Basic Operations**: **Selection (σ), Projection (π), Union (U), Set Difference (–),** and **Cartesian Product (×)**.
Relational Calculus is a **Non-procedural language**. It is based on **Logic** and describes "**What to get**", but it does not describe "**How to get**" it.

70. A network layer firewall acts as a …….
(A) Frame filter (B) Packet filter
(C) Both (A) and (B) (D) None of these **[B]**
Explanation—A **Network Layer Firewall** works on the third layer of the OSI model (**Network Layer**). It inspects the headers of incoming and outgoing **data packets** (such as **IP address** and **Port number**) and either allows or blocks them based on defined rules. This process is known as '**Packet Filtering**'.

71. ……. is a malicious software that alters the regular functionality of an OS, takes full control of the target system, and acts as a system administrator on the victim's system.
(A) Spyware (B) Virus
(C) Rootkit (D) Trojan horse **[C]**
Explanation—A '**Rootkit**' is a highly dangerous **malicious software** designed to hide its presence within the system. It modifies the core components of the operating system (**Kernel**) so that antivirus software cannot detect it, granting the hacker full '**root**' or **administrator-level control** over the system.

72. Hacktivism is ……
(A) A process of breaking into a system, obtaining its information, and making it public.
(B) Gaining access to a system with the intention of fixing identified vulnerabilities.
(C) A testing technique to find the existing internet infrastructure and its flaws.
(D) The act of hacking a computer system motivated by a political or social purpose. **[D]**
Explanation—The word **Hacktivism** is made by combining **Hacking** and **Activism**. It means hacking websites or computer systems to promote or protest a political, social, or religious ideology. It is driven by ideology rather than personal gain.

73. Identify the oldest phone hacking technique used by hackers to make free calls —
(A) Spamming (B) Phreaking
(C) Cracking (D) Phishing **[B]**
Explanation—Phreaking is the oldest technique of hacking telecommunication systems, which is made by combining the words **Phone** and **Hacking**. In this technique, hackers manipulated the specific **Audio Frequencies** and tones used by the telephone network. By copying these tones, they controlled the telephone exchange and successfully confused the system into believing that the call had been paid for, allowing them to illegally make free long-distance calls. The use of devices like the **Blue Box** was very famous for this in the 1970s, which provided a free calling facility by taking advantage of the security flaws of telecommunication systems.

74. A RAM chip has a capacity of 1024 words of 8 bits (1k×8). The number of 2×4 decoders with an enable

line required to make a 16k×16 RAM from 1k×8 RAM is —
(A) 4 (B) 5 (C) 6 (D) 7 **[B]**

Explanation—
Step 1: Calculation of Requirements
Target RAM: 16k×16
Available Chip: 1k×8
This needs to be expanded in two ways:
Data bits: To make 16 bits from 8 bits. (This does not directly affect the number of decoders, it only increases the number of chips: 16/8 = **2 chips**)
Address/Words: To make 16k from 1k, we need 16k/1k = **16 rows**.
Step 2: Decoder Calculation
We have to make 16k memory from 1k. This means we have to control 16 different rows (16k/1k = 16).
Available Decoder: 2×4 (This gives 4 outputs)
Calculation:
Step 1: How many decoders are needed for 16 outputs? →16/4 = **4 decoders**.
Step 2: Now, how many decoders are needed to control these 4 decoders? → 4/4 = **1 decoder**.
Total: 4 + 1 = **5 decoders**

75. A small bootstrap loader program is located in —
(A) in Hard disk (B) in ROM
(C) in BIOS (D) None of these **[B]**

Explanation—Bootstrap Loader is the first program of the computer that runs first when the computer is switched on. Its main task is to load the Operating System from the Hard Disk into the Main Memory (**RAM**). Since the data in RAM gets erased when the computer is turned off, it is stored in the permanent memory **ROM**.

76. Which of the following is used in the process of Wi-Fi hacking?
(A) Aircrack – ng (B) Wireshark
(C) Norton (D) All of the above **[A]**

Explanation—Aircrack-ng is the most famous and powerful software tool kit for checking the security of wireless networks and hacking. It is used to capture network packets and crack Wi-Fi passwords like **WEP** or **WPA**. **Wireshark** is primarily a packet analyzer.

77. In ..... encoding scheme, every 24 bits become four 6-bit segments and are finally sent as 32 bits.
(A) 8 bit (B) binary
(C) base 64 (D) quoted – printable **[C]**

Explanation—Base64 Encoding is a technique primarily used to safely convert binary data (like photos, files, or attachments) into text format (**ASCII**). This process is specially used in emails (**MIME**) and data transfer protocols.
Working Process:
24-bit Group: First, 3 bytes of binary data are taken in the Base64 process. Since 1 byte = 8 bits, so 3 bytes = **24 bits**.
6-bit Division: These 24 bits are divided into 4 equal parts. Each part is of 6 bits (4 × 6 = **24**).
Mapping: A total of 64 different values (2^6 = **64**) can be formed from 6 bits. These 64 values are mapped with the printable characters of the Base64 Index Table (which includes A-Z, a-z, 0-9, '+' and '/').
32-bit Result: Since each 6-bit segment is now sent as an ASCII character and one ASCII character takes 8 bits in the system, a total of 4 characters combine to become **32 bits** (4 × 8).

78. In FTP, the three types of ... are stream, block, and compressed.
(A) File types (B) Data types
(C) Transmission modes (D) None of these **[C]**

Explanation—FTP is a protocol, whose full form is **File Transfer Protocol**. The methods of sending data in FTP are called **Transmission Modes**. These are of three types —
1. **Stream Mode—**Data is sent as a stream of bytes.
2. **Block Mode—**Data is divided into blocks.
3. **Compressed Mode—**Data is sent by compressing it.

79. Checksum is used for—
(A) Error Correction (B) Error Detection
(C) Both (A) and (B) (D) None of these **[B]**

Explanation—Checksum is an important technique to ensure data accuracy during **data transmission**, which is mainly used for **Error Detection**. It is a numerical value calculated based on the bits present in the data packet. While sending data, the sender calculates its checksum value, and upon receiving the data, the receiver also calculates its checksum value and compares the two. If the sender's and receiver's values do not match, it indicates that an error has occurred in the data during transmission or it has been altered. This technique can only detect errors; it cannot automatically perform **Error Correction**.

80. What will be the output list after completing the first pass of Bubble Sort on the input array 32, 51, 27, 85, 66, 23, 13, 57?
(A) 32, 27, 51, 66, 23, 13, 57, 85
(B) 32, 51, 27, 66, 23, 13, 57, 85
(C) 27, 33, 51, 23, 13, 57, 66, 85
(D) 23, 13, 27, 33, 51, 57, 66, 85 **[A]**

Explanation—In **Bubble Sort**, two adjacent elements are compared in every pass. If the first element is greater than the second, they are **swapped**. The main objective of the **First Pass** is to move the largest number to the very end.
Step-by-Step Execution (Pass 1):
Input Array: [32, 51, 27, 85, 66, 23, 13, 57]
Compare (32, 51): 32 < 51 **No Swap** => Array: 32, 51, 27, ...
Compare (51, 27): 51 > 27 **Swap** => Array: 32, 27, 51, 85, ...
Compare (51, 85): 51 < 85 **No Swap** => Array: 32, 27, 51, 85, 66, ...
Compare (85, 66): 85 > 66 **Swap** => Array: 32, 27, 51, 66, 85, 23, ...
Compare (85, 23): 85 > 23 **Swap** => Array: 32, 27, 51, 66, 23, 85, 13, ...
Compare (85, 13): 85 > 13 **Swap** => Array: 32, 27, 51, 66, 23, 13, 85, 57
Compare (85, 57): 85 > 57 **Swap** => Array: 32, 27, 51, 66, 23, 13, 57, 85

Final Result (After Pass 1): 32, 27, 51, 66, 23, 13, 57, 85

81. Choose the odd one out in the context of MS Excel—
(A) Portrait (B) Scenario Manager
(C) Goal Seek (D) Data Table **[A]**
Explanation—In **MS Excel**, **Portrait** is a type of **Page Orientation** that determines the direction of the page for printing. Whereas **Scenario Manager**, **Goal Seek**, and **Data Table**, all three are **What-If Analysis** tools that come under the Data tab. Therefore, **Portrait** is different from all these.

82. A special software that creates a job queue is called .....
(A) Linkage Editor (B) Interpreter
(C) Drive (D) Spooler **[D]**
Explanation—Spooler (Simultaneous Peripheral Operations On-Line) is an important system software that mainly performs the task of creating a **Job Queue**. When the **CPU** sends a very high-speed task to slow-speed peripheral devices like a printer, the spooler organizes those tasks in a temporary queue or buffer so that the CPU does not have to wait for the device to become free. This increases the efficiency of the **CPU** because after handing over its data to the spooler, it becomes **free** for other tasks. The spooler continues to process these tasks sequentially in the **background**, allowing the user to continue their other work on the computer without any interruption.

83. What are the forms of password cracking techniques?
(A) Syllable Attack (B) Brute Force Attack
(C) Hybrid Attack (D) All of the above **[D]**
Explanation—Hackers use various scientific and technical methods to crack the password of a system or account. The three methods given in the options are common techniques for password cracking:
1. **Brute Force Attack:** This is the simplest but most time-consuming technique. In this, software is used to try every possible combination of characters (letters, numbers, and symbols) until the correct password is found.
2. **Hybrid Attack:** As the name suggests, it is a combination of a 'Dictionary Attack' and a 'Brute Force' attack. In this, an attempt is often made to crack the password by adding a few numbers or special symbols to dictionary words (e.g., Password@123).
3. **Syllable Attack:** This technique is used to crack passwords that are made up of phonetic parts of words (syllables) or chunks of pronunciation. It is more advanced than a dictionary attack because it can also find words that are not in the dictionary but are pronounceable.

84. Find the incorrect statement—
(A) If a method is declared as **final**, then that method cannot be overridden in the subclass.
(B) **Finalize()** is a Java method, which is called by the **garbage collector thread** before removing an object from memory.
(C) If a class is declared as **final**, it cannot be inherited. If you do so, it will give a **compile-time error**.
(D) If we declare a variable as **final**, the value of the variable can be modified by the **final method**.**[D]**
Explanation—Final Variable: In Java, if a variable is declared as **final**, it means it has become a **Constant**. Once initialized, its **value cannot be changed** anywhere in the entire program.
Final Method: The **final method** is used solely to **prevent Overriding**. It has nothing to do with variable modification. A **final method cannot be overridden** in a Child Class.
The **finalize() method** is called by the **Garbage Collector** when an Object is being removed from Memory. A **final Class cannot be inherited** (extended). Doing so results in a **Compile-time error**.

85. How many states can a process have in an Operating System?
(A) 2 (B) 3 (C) 4 (D) 5 **[D]**
Explanation—In an Operating System, the **Lifecycle** of a process generally consists of **5 main States** —
1. **New** — When the process is being created.
2. **Ready** — Ready for execution.
3. **Running** — Being executed by the CPU.
4. **Waiting/Blocked** —Waiting for an event to occur.
5. **Terminated** — The process has finished.

86. An INT file in Windows 95 is a —
(A) Program file (B) Message file
(C) Text file (D) Link file **[C]**
Explanation—INT files are essentially in a **Text File format**. In these files, information is written in a specific structure (such as **[Sections], Key=Value**). Since these are text files, they can easily be opened, read, and edited in any basic Windows text editor like **Notepad**.

87. A counting semaphore is initialized to 8. Then 12 P (wait) operations and 7 V (signal) operations are completed on this semaphore. The resulting value of the semaphore will be —
(A) 4 (B) 3 (C) 5 (D) 1 **[B]**
Explanation—The value of a semaphore decreases with a **P (Wait) operation** and increases with a **V (Signal) operation**.
Calculation:
Initial Value = 8
Final Value = 8 – 12 (P operations) + 7 (V operations)
Final Value = 8 – 12 + 7 = 3।

88. Which of the following statement(s) is/are true regarding JAVA?
a. Constants that cannot be changed are declared using the 'static' keyword.
b. A class can inherit only one class which can implement multiple interfaces.
(A) Only a is correct
(B) Only b is correct
(C) Both (a) and (b) are correct
(D) Neither (a) nor (b) is correct **[B]**
Explanation—In Java, the **final keyword** is used to make a variable a **Constant**, not the static keyword. **Static** means the variable is at the **Class Level** (not Instance), but its value can be changed (unless it is final).

Java **does not support Multiple Inheritance** for Classes. Therefore, a child class can inherit **only one Parent Class** using the **extends** keyword. However, Java allows multiplicity for Interfaces. A class can **implement Multiple Interfaces**.

89. Which agent is associated with happy and unhappy states in Artificial Intelligence (AI)?
(A) Simple Reflex Agent (B) Model-Based Agent
(C) Learning Agent (D) Utility-Based Agent **[D]**

Explanation—Happy vs Unhappy State: This Agent uses a **Utility Function**, which assigns a Number (Score) to any State.
If the **Utility Score is High**, it means the State is favorable, technically known as a **"Happy State"**. If the **Utility Score is Low**, it is called an **"Unhappy State"**.
Goal-based agent: It operates only in **"Yes/No"** terms (whether the Goal is achieved or not). It has no measure of "happiness".
Utility-based agent: It evaluates which path or decision will give it **Maximum Happiness (Maximum Utility)**.
Example: In GPS Navigation:
- **Goal** (Goal-based) = Finding the path.
- **Utility** (Utility-based) = Finding the shortest, fastest, and traffic-free path (so that the User is **"Happy"**).

90. In SQL, ... is an aggregate function.
(A) SELECT (B) CREATE
(C) AVG (D) MODIFY **[C]**

Explanation—In SQL, an **Aggregate Function** is a function that takes **Multiple Values** (an entire column or group) as Input and returns a **Single Value** after performing a calculation.
AVG (Average): It is an **Aggregate Function**. It is used to calculate the average value of a Numeric Column. Additionally, **SUM(), COUNT(), MAX(), and MIN()** are also primary Aggregate Functions.
SELECT: It is a **Command/Statement** to retrieve data, not a function.
CREATE: It is a **DDL (Data Definition Language)** command used to create a Table or Database.
MODIFY: It is often used with the **ALTER TABLE** command is used with to change the definition of the Column, it is not an Aggregate Function.

91. ptrdata is a pointer to a datatype. The expression *ptrdata++ is evaluated as follows (C++)—
(A) *(ptrdata++)
(B) (*ptrdata)++
(C) *(ptrdata) ++
(D) Depends on the compiler **[*]**

Explanation—expression = *ptrdata++
In C/C++, the **Precedence of Postfix Increment (++) is High** compared to the **Dereference Operator (*)**. Therefore, the compiler treats it like ***(ptrdata++)**.
***(ptrdata++):** This is the correct grouping according to the rule of precedence. It increments the Pointer but returns the value of the old location and ***(ptrdata)++** will also perform the same work.
(*ptrdata)++: This means first extract the Value and then increment that Value (not the Pointer). This is different from *ptrdata++.

92. Assume that p and q are non-zero positive integers, the following program segment will perform—

```
While (p!= 0)
{
If (p>q)
        p=p-q;
else
        q=q-p;
printf("%d",p);
```

(A) Will subtract the smaller number from the larger number
(B) Will calculate the GCD of the given numbers
(C) Will calculate the LCM of the given numbers
(D) Loop will run infinite times **[D]**

Explanation—Suppose we take the value of **p as 3** and the value of **q as 2** in the program, now we execute the program.
Since **3 > 2**, the if condition will run (p = 3, q = 2)
p = p - q ⇒ p = 3 - 2 = 1 (p = 1, q = 2)
Next **1 > 2 (p > q)** then the condition becomes false, so else will execute
q = q - p ⇒ q = 2 - 1 = 1 (p = 1, q = 1)
Next **1 > 1 (p > q)** then the condition becomes false, so else will execute
q = q - p ⇒ q = 1 - 1 = 0 (p = 1, q = 0)
Next **1 > 0** then the condition became true, so the if statement will execute
p = p - q ⇒ p = 1 - 0 = 1 (p = 1, q = 0)
Now **p = 1, q = 0** will always continue, therefore the loop will run for an **infinite time**.

93. The command to open the Snipping tool menu to take a screenshot of only a part of your screen is—
(A) Window key + Ctrl + S
(B) Window key + Shift + S
(C) Window key + Alt + X
(D) Ctrl + Shift + K **[B]**

Explanation—In **Windows 10 and 11**, the shortcut key **Windows key + Shift + S** is used to quickly capture a specific part of the screen (**Screen Snipping**). This opens the snipping toolbar from which you can take a rectangular, free-form, or full-screen screenshot.

94. Find x = ?
If $(356)_8 = (x)_{16}$
(A) EE (B) EA (C) 7E (D) A8 **[A]**

Explanation—$(356)_8 = (?)_{16}$
We will write the **Binary of the given Octal number**—
011101110
Now Pairs of 4-4 will be made:
0$\underline{1110}$ $\underline{1110}$
E E
$= (EE)_{16}$

95. Which statement(s) is/are correct about Exception handling?
i. There can be a try block without a catch block but the reverse is not possible.
ii. There can be any number of catch blocks for a single try block.
iii. The object in which the error occurred must be created of its specified class, otherwise a runtime error will occur.

iv. To execute any code with every run of the program, the code is written in the finally block.

(A) i, ii and iv (B) Only ii
(C) Only iii (D) Only ii and iv **[A]**

Explanation—

1. **Statement i (True):** A try block can exist without a catch block (if a finally block is present with it). However, a catch block can never be written alone without a try block.
2. **Statement ii (True):** There is no Limit on the number of catch blocks for a try block. We can use multiple catch blocks to handle different Exceptions.
3. **Statement iv (True):** The code of the finally block always Executes in the program, whether an Exception occurs or not. It is often used for **Resource cleanup** (like File closing, Database connection closing).

Statement iii (False): When an Exception occurs, the Runtime Environment automatically creates an Exception Object, it is not mandatory for the user to create it.

Therefore, **statements i, ii, and iv are correct**.

96. Which one state is not included in the virus life cycle?

(A) Dormant (B) Execution
(C) Start (D) Triggering **[C]**

Explanation—There are mainly four **phases** in the **life cycle of a computer virus**. A virus enters the system and completes its work through these steps. The four main steps of the virus life cycle are as follows—

1. **Dormant Phase :** In this step, the virus is present in the system, but it remains idle. It waits for a specific event, date, or keystroke so that it can become active.
2. **Propagation Phase :** In this phase, the virus starts making its copies. It spreads throughout the system by copying itself to other programs, files, or parts of the disk.
3. **Triggering Phase :** When the specific event occurs that the virus was waiting for (such as a particular date or opening a file), the virus leaves its dormant state and becomes active. This is called triggering.
4. **Execution Phase :** This is the final phase where the virus performs its actual work (payload), such as deleting files, displaying messages, or damaging the system.

97. Which of the following statement(s) is/are incorrect regarding abstract classes?

i. A subclass of an abstract class that does not provide the implementation of the abstract class method is also abstract.
ii. Constructors and static methods cannot be declared in an abstract class.
iii. Sometimes we can directly create an object.
iv. A method must always be redefined in a subclass of an abstract class.

(A) i and ii (B) ii and iii
(C) ii and iv (D) i, ii and iv **[*]**

Explanation—

1. **Statement (i) Correct:**
   If a subclass does not implement all the abstract methods of its abstract parent class, then it is mandatory to declare that subclass as abstract.
2. **Statement (ii) Incorrect:**
   An abstract class can have both constructors and static methods. The constructor is used by the child class for initialization.
3. **Statement (iii) Incorrect:**
   We can never instantiate (create an object of) an abstract class directly.
4. **Statement (iv) Incorrect:**
   It is only necessary to override or implement abstract methods. If there is a concrete method (which has a body) in the parent class, it is not necessary to redefine it in the subclass; it is inherited directly.

According to **OOPS/JAVA concepts**, statements (ii), (iii), and (iv) are incorrect.

98. What are the different types of real data types (floating point data types) in 'C'?

(A) float, long double
(B) long double, short int
(C) float, double, long double
(D) short int, double long int, float **[C]**

Explanation—In the C language, real data types (numbers with decimals) are called floating-point data types. They have 3 main types—
1. **float** (Single precision) 2. **double** (Double precision)
3. **long double** (Extended precision)
short int is an integer data type.

99. What is the result after executing the following code, if 'a' is 10, 'b' is 5, and 'c' is 10?

```
if ((a>b)&&(a<=c))
        a=a+1;
else
        c=c+1;
```

(A) a = 10, c = 10 (B) a = 11, c = 10
(C) a = 10, c = 11 (D) a = 11, c = 11 **[B]**

Explanation—Initial Values: a = 10, b = 5, c = 10
Condition Check: ((a > b) && (a <= c))
a > b (10 > 5) → **True**
a <= c (10 <= 10) → **True**
Since it is a logical AND operator, the if block will execute when both conditions are true.
a = a + 1 → 10 + 1 = **11**
The else block will be skipped, so the value of c will not change.
Result: a = 11, c = 10

100. Which of the following declarations is incorrect in the Python language?

(A) xyzp = 5,000,000
(B) xyzp = 5000 6000 7000 8000
(C) x, y, z, p = 5000, 6000, 7000, 8000
(D) x_y_z_p = 5,000,000 **[B]**

Explanation—While assigning a value to a variable in the Python language, we cannot give spaces between the values. By writing xyzp = 5000 6000 7000 8000, the Python interpreter gets confused about whether it is a single value or different ones. Therefore, it will give a Syntax Error (Invalid Syntax). The correct way would be: xyzp = [5000, 6000, 7000, 8000] (List) or xyzp = (5000, 6000, 7000, 8000) (Tuple).

UNIT-I : FUNDAMENTALS OF COMPUTER

1 Overview of the Computer System including I/O Devices, Pointing Devices & Scanner

Working of Input-Output

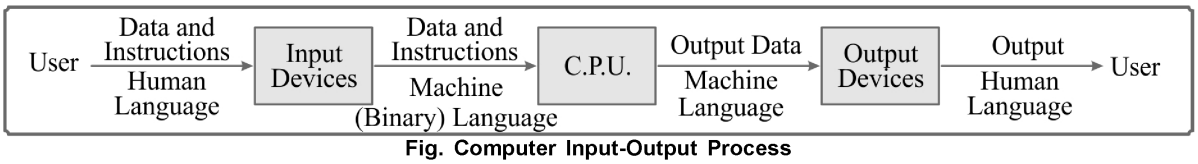


Fig. Computer Input-Output Process

- In the Input-Process-Output working process, the user gives input to the computer. The computer processes the input and gives the output to the user.
- The IPO cycle is divided into three steps: Input, Process, and Output
- Input and Output devices are used to establish contact between the user and the computer.

Input Devices

- A computer is a machine that does not understand human language; it only understands machine language or binary language.
- The user gives data, information, and instructions to the computer in human language, which is also called a High-Level Language.
- Before giving input to the computer, it is necessary to change the data and instructions from human language into machine or binary language.
- Devices that change the data and instructions given by the user in human language (High-Level Language) into a language that the computer can understand (machine or binary language) are called Input Devices.

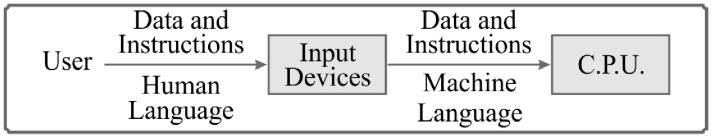


Fig. Input Device Working

- The devices through which data and instructions are entered into the computer are called Input Devices.
- Input Devices accept data and instructions, change them into binary or machine form, and make them usable for the computer.
- The data that is input into any computer can be in the format of text, sound, picture, video, etc.
- Input devices are used to enter/record/type/submit data and to capture information and commands in the computer.
- The main devices used for giving input to a computer are—**Key-Board, Mouse, Scanner, Trackball, Joystick, Lightpen, Stylus, Touch screen, Touchpad, Digital Camera, Video Camera, Web Camera, Digitizer, Biometric Sensor Machine, Microphone, Voice or Speech Recognition System, Kimball Tag Reader, BCR, MICR, OMR, OCR, SCR, QR Reader etc.**

Keyboard

- **The keyboard is the most commonly used input device for data entry** in a computer.
- The keyboard was invented in 1868 by **Christopher Latham Sholes**.

✧ The keyboard is called the **Primary Input Device** or the **Standard Input Device** of the computer.

- The keyboard works on the principle of **CUI (Character User Interface)**, just like a typewriter.
- The keyboard is connected to the CPU through the **PS2 (Plug Station 2) port**. Nowadays, keyboards are also connected to the computer through a **USB (Universal Serial Bus) port** or wirelessly (Bluetooth/RF).
- Radio waves are used in the wireless keyboards that are currently in use.
- The keyboard is also called a **QWERTY** board.

capable of providing high-quality colour output. An electronic gun is used in a C.R.T.

2. **F.P.D. Monitor**—The full form of F.P.D. is **Flat Panel Display** monitor. F.P.D. monitors are based on new technology. **Flat Panel Displays are thin, very flat, lightweight, and consume less power.** F.P.D. monitors are mainly used in Laptops. **L.C.D., L.E.D., and G.D.P. are types of Flat Panel Displays.**

❖ **L.C.D. (Liquid Crystal Display) Monitor**—In an L.C.D., a liquid is filled between two layers. A display is obtained by applying voltage to this liquid. **L.C.D. is used in Computer Monitors, Laptops, Tablets, Smart Phones, etc. L.C.D. consumes very little power.**

❖ **L.E.D. (Light Emitting Diode)**—This monitor works on **OLED (Organic Light Emitting Diode)** technology. An LED is a semiconductor device that emits light when current or electricity passes through it. **The resolution and refresh rate of an L.E.D. are better.**

❖ **G.P.D.—Gas Plasma Display** is also a type of F.P.D.

❖ **Based on the colours displayed, monitors are of 3 types—**

1. **Monochrome Monitor—**This monitor displays output in a single colour.
2. **Gray-Scale Monitor—**This monitor displays output in black and white colours.
3. **Colour Monitor—**It displays output in red, green, and blue colours.
   It is also called an **RGB (Red, Green, Blue) monitor.**

Display Quality Factors

❖ **Pixel**—The picture displayed on a monitor screen is made up of many small dots. **These dots are called pixels.**

❖ A **pixel** is the smallest resolvable part of a picture. The number of pixels that a display screen can accommodate is called **resolution**.

❖ **Resolution—**The product of the horizontal and vertical pixels displayed on a monitor's screen is called resolution. In other words, the number of dots or pixels present per unit area on the screen is called resolution.

✧ **Resolution tells us the number of dots or pixels in an image.**

✧ **Standard resolution is 1920 × 1080 or 1024 × 768.**

✧ **Resolution is measured in DPI (Dots Per Inch) or PPI (Pixels Per Inch).**

✧ **The higher the resolution, the closer the pixels will be, and the clearer the picture will be.**

❖ Image resolution is the number of prints displayed per unit of printed length in an image. The resolution of an image is increased by the **Upsampling** process. The upsampling process increases the resolution and depth of the map.

❖ **Dot Pitch—**The distance between two pixels is called dot pitch. **Dot pitch is measured in millimeters (mm).**

✧ **The lower the dot pitch, the clearer the picture will be displayed.**

✧ Dot pitch is also called phosphor pitch, line pitch, or stripe pitch.

Important Note :-

✧ **Number of dots in Picture $\propto$ Pixel $\propto$ Resolution $\propto \frac{1}{\text{dot pitch}}$**

❖ **The more pixels on a monitor's screen, the higher the resolution, and the clearer/sharper the picture will be.**

❖ **The lesser the distance between pixels, the higher the resolution, and the clearer the picture will be.**

❖ **Refresh Rate—**The rate at which the picture on the screen is refreshed is called the refresh rate. **A monitor's refresh rate is measured in Hertz (Hz).**
Note: If the refresh rate is less than 25 Hz, the images will flicker. A higher refresh rate improves the monitor's quality.

❖ **Aspect Ratio—**The ratio of a monitor screen's width to its height is called the Aspect Ratio. The relationship between the vertical length and the horizontal length of a monitor is called the aspect ratio. **Most monitors have an Aspect Ratio of 16:9.**

❖ **Response Time—**The time taken by a pixel to change from one color to another is called response time. **The lower a monitor's response time, the better output it will provide.**
Note: HD (High Definition), VGA, etc., indicate the quality of the display.

❖ **Bit Mapping—**The technique used to display text and pictures together on a monitor screen is called Bit Mapping.

❖ **Interlacing—**Interlacing describes how a picture displayed on a monitor is created. In this, the picture is created by scanning a line with its opposite line.

29. Which button is used to delete one character to the left of the cursor's current position?
(A) Space (B) Backspace
(C) Delete (D) Shift

30. Match Column A (Input Devices) with Column B (Characteristics / Principle):
Column A
1. OMR 2. OCR
3. MICR 4. Barcode Reader
5. Digitizer

Column B
1. Converts Hand-drawn images into digital form
2. Optical Reflection Principle
3. Magnetic Ink Recognition
4. Detects Marked bubbles
5. Converts Printed text into digital text

Choose the correct option—
(A) 1-D, 2-E, 3-C, 4-B, 5-A
(B) 1-B, 2-C, 3-A, 4-D, 5-E
(C) 1-A, 2-D, 3-C, 4-E, 5-B
(D) 1-D, 2-A, 3-E, 4-C, 5-B

31. Which key is used to capitalize all letters without using the Shift Key for every letter?
(A) Control (B) Space
(C) Caps Lock (D) Delete

32. Which button of the keyboard is used to copy the screen?
(A) Esc (B) Delete
(C) Print Screen (D) Enter

33. The function of Shift+Delete is—
(A) To remove a File/Folder/Icon permanently from memory
(B) To remove a File/Folder/Icon temporarily from memory
(C) To store a File/Folder/Icon permanently in the Recycle Bin
(D) None of the above

34. Which of the following is a toggle key?
(A) Caps Lock (B) Num Lock
(C) Scroll Lock (D) All of above

35. Which is the longest key on the keyboard?
(A) Home (B) Enter
(C) Spacebar (D) Shift

36. Which of the following buttons is used to turn on the numeric keypad?
(A) Caps Lock (B) Num Lock
(C) Scroll Lock (D) Shift

37. The number of buttons in a numeric keypad is—
(A) 12 (B) 15 (C) 17 (D) 20

38. Who invented the Input Device Computer Mouse and when?
(A) Douglas Engelbart, 1964
(B) William English, 1971
(C) O'Neal Cooper, 1952
(D) Robert Zawacki, 1964

39. Match Column A (Printers) with Column B (Technology Used):

Column A	Column B
1. Laser Printer	1. Piezoelectric or Thermal Bubble Technology
2. Inkjet Printer	2. Impact Printing
3. Dot Matrix Printer	3. Electro-photographic Process
4. Thermal Printer	4. Additive Manufacturing
5. 3D Printer	5. Heat Sensitive Paper

Choose the correct option—
(A) 1-C, 2-A, 3-B, 4-E, 5-D
(B) 1-A, 2-D, 3-E, 4-B, 5-C
(C) 1-D, 2-C, 3-A, 4-E, 5-B
(D) 1-B, 2-E, 3-C, 4-D, 5-A

40. The term Spooling is mainly used in the context of?
(A) Online gaming (B) Printing systems
(C) RAM management (D) Disk fragmentation

41. Which of these is a Point-and-Draw device?
(A) Mouse (B) Scanner
(C) CD-ROM (D) Keyboard

42. Which of the following is a pointing device?
(A) Mouse (B) Trackball
(C) Joystick (D) All of above

43. Helps in accessing the properties of an object—
(A) Monitor (B) Mouse
(C) Printer (D) Plotter

44. Used to move the page or picture displayed on the screen top-bottom—
(A) Scroll Button (B) Triple Click
(C) Both A & B (D) Double Click

45. An image is made up of which of the following?
(A) Pels (B) Pixels
(C) Dots (D) All of these

46. Used to select a file, folder, or icon—
(A) Double Click (B) Left Click/Single Click
(C) Right Click (D) None of these

47. The mouse is left-clicked ... to select a word.
(A) Once (B) Twice
(C) Thrice (D) Four times

48. Performs the function of dragging and dropping a file, folder, or icon on the screen—
(A) Mouse (B) Printer
(C) Scanner (D) Web camera

Answer Sheet

29.(B)	**30.**(A)	**31.**(C)	**32.**(C)	**33.**(A)	**34.**(D)	**35.**(C)	**36.**(B)	**37.**(C)	**38.**(A)
39.(A)	**40.**(B)	**41.**(A)	**42.**(D)	**43.**(B)	**44.**(A)	**45.**(D)	**46.**(B)	**47.**(B)	**48.**(A)

162. Select the odd one out from the given options—
(A) Laser Jet Printer (B) Touchpad
(C) Light Pen (D) Scanner

163. A printer that prints each character by representing a configuration of dots is called—
(A) Laser Printer (B) Dot Matrix Printer
(C) Drum Printer (D) Ink Jet Printer

164. Which of the following is 'not' an input device?
(A) MICR (B) OMR
(C) Trackball (D) Speaker

165. Which input device is used to enter Motion data into a computer or other electronic devices?
(A) Trackball
(B) Magnetic Ink Character Recognition
(C) Barcode Reader
(D) Light Pen

166. ... is an input device used to save a person's voice in the computer.
(A) Speaker (B) Scanner
(C) Microphone (D) Joystick

167. Which of the following is not a pointing input device—
(A) Trackball (B) Joystick
(C) Digitizing Tablet (D) Scanner

168. The resolution of a printer is measured in ...
(A) Dots Per Inch (B) Data Per Inch
(C) Dots Per Second (D) Dots Per Character

169. Which of the following is a hard copy output device?
(A) Monitor
(B) Laser Printer
(C) Visual Display Terminal
(D) Projector

170. Which hardware is required in the system for Graphics Multimedia Component?
(A) Scanner (B) Visual Display Unit
(C) Printer and Plotter (D) All of the above

171. The number of pixels that a display screen can accommodate is called which of the following?
(A) Dot Pitch (B) Resolution
(C) Aspect Ratio (D) Size

172. Which of the following devices can be used to enter handwritten signatures?
(A) Graphics Tablet (B) Plotter
(C) Joystick (D) Mouse

173. The statement 'The pen moves along both axes' is true for which plotter?
(A) Microgrip Plotter (B) Flatbed Plotter
(C) Electrostatic Plotter (D) Inkjet Plotter

174. What is a Dumb Terminal?
(A) An embedded microprocessor
(B) Independent processing capability
(C) A keyboard and screen
(D) Extensive memory

175. ... is a sound-to-electricity transducer or sensor and is used to convert sound signals into electrical signals.
(A) Microphone (B) Printer
(C) Voice Recorder (D) Plotter

176. Which of the following keys is used to activate the Extended Selection Mode on a keyboard?
(A) F4 (B) F7 (C) F3 (D) F8

177. To expand the selection of text, which of the following keys can be held down while clicking anywhere on the sentence?
(A) Shift (B) Ctrl (C) Alt (D) Esc

178. Which is the wildcard character for matching any number of characters?
(A) Hyphen Sign (B) Ampersand Sign
(C) Asterisk Sign (D) Dollar Sign

179. What do Non-Impact Printers use for printing?
(A) Chemical, thermal or electrical signals
(B) Ink
(C) Ink or inked ribbon
(D) All of the above

180. ... can be used to convert the Bitmap Image of characters into editable text.
(A) OCR (B) OMR (C) MICR (D) OSR

181. State True or False—
1. **Laser printers have lower DPI compared to Dot-matrix printers.**
2. **The printout taken by a printer is called softcopy.**

(A) 1-False, 2-True (B) 1-True, 2-False
(C) 1-True, 2-True (D) 1-False, 2-False

182. Which device is mandatory for Video Conferencing among the given options?
(A) Printer (B) Scanner
(C) Webcam (D) Mouse

183. Which of the following functions is performed by a Microphone?
(A) Draw lines or figures on a computer screen
(B) Reads bar codes and converts them into electric pulses
(C) Detects alphanumeric characters printed or written on a paper
(D) Convert human speech into electric signals

184. Which of the following is a type of Dot Matrix Printer?
(A) Line Printer (B) Serial Printer
(C) Laser Printer (D) Plotter

Answer Sheet

162.(A)	**163.**(B)	**164.**(D)	**165.**(A)	**166.**(C)	**167.**(D)	**168.**(A)	**169.**(B)	**170.**(B)	**171.**(B)
172.(A)	**173.**(B)	**174.**(C)	**175.**(A)	**176.**(D)	**177.**(A)	**178.**(C)	**179.**(A)	**180.**(A)	**181.**(D)
182.(C)	**183.**(D)	**184.**(B)							

2 Representation of Data (Digital v/s Analog)

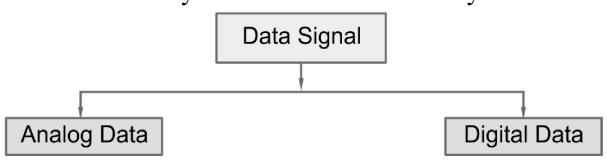
Representation of Data (Digital vs Analog)

Data

- Information like **Text, Symbol, Image, Number, Audio, Video**, etc., which is **Processed** or **Stored** by various **Electronic devices** like **mobile phones, Laptops, tablets**, is called **data**.
- **Data** can be divided according to processing as follows:
  - **Numeric Data** — Data which is in the form of **Numbers**, meaning data that can be expressed as mathematical digits, is called **Numeric Data**. Example: A person's mobile number, a person's salary, etc.
    Example — **2200, 9876543210**
  - **Non-Numeric Data** — Data which is expressed in the form of **Alphabets**. This data is not in digits but in the form of letters, words, etc.
    Example — **Kartik, Manisha (Person's Name) Delhi, Jaipur (Place Name)**

Data Representation

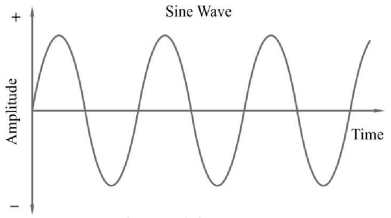
- **Data Representation** is made of two words: **Data** and **Representation**. The word **Data** means **digital** or **Electronic information** and **Representation** means to show. Therefore, the literal meaning of **Data Representation** is to show data in **digital form**.
- The method used to **Store** and **Process** data in an **Electronic device** is called **Data Representation**. Meaning, the form in which all types of digital information are shown inside an **Electronic machine** is called **Data Representation**.
- Basically, data is processed or stored in two forms:
  1. **Analog**
  2. **Digital**
- A **detailed description** of these two types of data is given in this chapter.
- **Data** is mainly **Classified** in two ways:



Analog Data

- **Analog** means **Continuous data** or **Signal**.
- **Analog Signals** are in the form of a **Continuous Wave Form** which keeps changing.
- **Analog data** has values that change **Smoothly**. **Analog data** contains **continuous signals**; its data format shows **continuity**. In this, **audio, video, voice, image**, etc., are **transmitted**. **Analog data** accepts **continuous value** and shows **Continue value**.
- **Analog data** is used to measure physical quantities like **Temperature, Pressure, Sound, Voltage**, etc.
- The presence of a **Full Pattern** in a **Signal** is called a **cycle**.

Note:



Sine wave is used in **Analog System**.

1. An **Analog clock** which shows **smoothly moving time**.
2. **Sound wave** is also an example of **analog data**. In a **Sound wave**, **air pressure continuously** changes easily. Devices like **Microphone, Headphones, Loud Speaker, Sensor (Temperature, pressure)** etc., are used as **Analog devices** for the **transmission** of **Analog data**.

- **The Major Characteristics of Analog Signal are as follows—**
  - Analog Signal works on continuous data.
  - The accuracy of Analog Signal is less compared to Digital Signal.
  - Analog Signal is useful to measure physical values.
  - The output obtained from Analog Signal is like a Curve, Line, or Graph.
  - Analog Signal represents all possible Infinite Values.

3 Representation of Data

Number System : Decimal, Binary & Hexadecimal

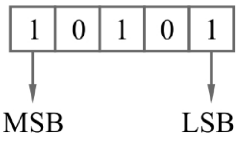
Number System

- Computers use digits 0 and 1 to understand any data or information.
- All data and instructions given to the computer by the user get converted into these two digits (0 and 1), which is called **Data Representation**.

Type of Number System

Binary Number System

- There are only two digits in the **Binary Number System**, which are 0 and 1.
- **Binary Number System** is also called the dual-base number system.
- The **Base Value** of the **Binary Number System** is **2**.
  Note :- Numbers are identified by the **Base Value** to determine which number system a number belongs to.
- Example of Binary Number—**$(1011101)_2$**
  Note :-
  In any **Binary Number System**, the last digit (Right Side) is called the **Least Significant Bit (LSB)** and the first digit (left digit) is called the **Most Significant Bit (MSB)**.



Octal Number System

- Due to the greater length of binary numbers, it sometimes becomes difficult to use them.
- **Octal Number System** is used as an alternative to the **Binary Number System**, which requires fewer digits.
- A total of **eight digits** are used in the Octal System. Which are from **0 to 7** (0, 1, 2, 3, 4, 5, 6, 7).
- The **Base Value** of the **Octal Number System** is **8**.
  Example of Octal Number—$(137)_8$

Octal Number	Binary Number
0	000
1	001
2	010
3	011
4	100
5	101
6	110
7	111

Decimal Number System

- There are a total of **ten digits (10 Numbers)** in the **Decimal Number System** which are from **0 to 9** (0, 1, 2, 3, 4, 5, 6, 7, 8, 9).
- The **Base Value** of the **Decimal Number System** is **10**.

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

- Example of Decimal Number—**$(165)_{10}$**

Hexa Decimal Number System

- In this type of number system, the number of digits is **16**. Which consists of digits from **0 to 9** and letters from **A to F** (0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F).
- **Here A=10, B=11, C=12, D=13, E=14, F=15**
- The Base Value of the Hexadecimal Number System is 16. Binary, Octal, Decimal and Hexadecimal numbers are expressed as follows:

Interchange of Number System

Convert Binary Numbers to Decimal Numbers $()_2 = (?)_{10}$

The method to convert binary digits to decimal digits is as follows:

1. Write all binary digits separately.
2. Write the binary base value, i.e., **2**, below all binary digits.
3. Write exponents 0, 1, 2, 3, 4... on **Base Value 2** from the **Right side**.
4. Solve it after writing the exponent on the base value.
   Note:—If the exponent on any number is 0, its result is 1. Example: $56^\circ \Rightarrow 1$
5. After solving the base value with the exponent, multiply the obtained result by the binary digits written above them.
6. Add the results obtained after multiplication.

Example-1 : $(110101)_2 = (?)_{10}$

1	1	0	1	0	1	
2^5	2^4	2^3	2^2	2^1	2^0	(Binary base value with exponent)
32	16	8	4	2	1	(Result obtained after solving base value with exponent)
1×32	1×16	0×8	1×4	0×2	1×1	(Multiply with binary digits written above)
32 +	16 +	0 +	4 +	0 +	1	(Sum of the results obtained after multiplication)

= 53

$(110101)_2 = (53)_{10}$ meaning Binary digit 110101 is equal to Decimal digit 53.

Example-2 : $(1110110)_2 = (?)_{10}$

1	1	1	0	1	1	0
2^6	2^5	2^4	2^3	2^2	2^1	2^0
64	32	16	8	4	2	1
1×64	1×32	1×16	0×8	1×4	1×2	0×1
64 +	32 +	16 +	0 +	4 +	2 +	0

= 118

$(1110110)_2 = (118)_{10}$ meaning Binary digit 1110110 is equal to Decimal digit 118.

Example-3 : $(111001101)_2 = (?)_{10}$

1	1	1	0	0	1	1	0	1
2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
256	128	64	32	16	8	4	2	1
1×256 +	1×128 +	1×64 +	0×32 +	0×16 +	1×8 +	1×4 +	0×2 +	1×1
256 +	128 +	64 +	0 +	0 +	8 +	4 +	0 +	1

= 461

$(111001101)_2 = (461)_{10}$ meaning Binary digit 111001101 is equal to Decimal digit 461.

Short Method to Convert Binary Digits to Decimal Digits

1. Write all binary digits separately.
2. Starting from the right side, write the series of the following numbers **1, 2, 4, 8, 16, 32, 64...** respectively under all binary digits.

68. What will be the binary number equivalent to decimal number 413?
(A) 100111111 (B) 11011011
(C) 110011101 (D) 111001001

69. An electronic logic gate whose output is 0 when all inputs are 1—
(A) NOR (B) NAND
(C) OR (D) NOT

Previous Year Competitive Exam Questions

1. Binary file contains machine readable characters in _____ and _____ format.
[Raj. Informatic Assistant (IA) 21.01.2024]
(A) 1, 0
(B) Alphabets and Numbers
(C) Special characters and Numbers
(D) Alphabets and Special characters

2. Which of these is not a logical operator?
[Raj. Informatic Assistant (IA) 21.01.2024]
(A) Check (B) AND (C) OR (D) NOT

3. The right most bit of the Binary numbers is _____.
[Raj. Informatic Assistant (IA) 21.01.2024]
(A) LBB (B) LSB (C) MBB (D) MSB

4. On dividing binary digit ... by 11, the output is 10. Identify the correct option.
[Raj. Informatic Assistant (IA) 21.01.2024]
(A) 111 (B) 011 (C) 110 (D) 101

5. Repeated division by 2 method is used to convert from _____ to _____.
[Raj. Informatic Assistant (IA) 21.01.2024]
(A) Decimal, Binary (B) Binary, Decimal
(C) Decimal, Decimal (D) Binary, Binary

6. Find X = ? If $(356)_8 = (X)_{16}$
[Raj. Basic Computer Inst. 18.06.2022]
(A) EE (B) EA (C) 7E (D) A8

7. Hexadecimal number is a mixture of—
[Raj. Senior Computer Inst. 19.06.2022]
(A) Octal or Decimal Numbers
(B) Binary or Octal numbers
(C) Letter or Decimal digits
(D) Binary or Decimal Numbers

8. How many symbols does the Hexadecimal system use? [Raj. Informatic Assistant (IA) 2018]
(A) 6 (B) 10 (C) 16 (D) 60

9. To convert Decimal to Octal, we do—
[Raj. Informatic Assistant (IA) 2018]
(A) Divide decimal number by 8
(B) Multiply decimal number by 8
(C) Divide decimal number by 16
(D) Multiply decimal number by 16

10. Subtract $(1056)_{16}$ from $(A427)_{16}$ using Hexadecimal method— [Raj. Informatic Assistant (IA) 2018]
(A) $(A3B1)_{16}$ (B) $(9331)_{16}$
(C) $(3711)_{16}$ (D) $(93D1)_{16}$

11. 2's complement of $(1000)_2$ is .....
[Raj. Informatic Assistant (IA) 2018]
(A) 0001 (B) 0101
(C) 0111 (D) 1000

12. Convert the following decimal number into 8-bit binary—
$(187)_{10}$ [Raj. HM 2018]
(A) 10111011_2 (B) 11011101_2
(C) 10111101_2 (D) 10111100_2

13. Represent the following binary number in Octal—
$(010111100)_2$ [Raj. HM 2018]
(A) 172_8 (B) 272_8
(C) 174_8 (D) 274_8

14. The result of binary subtraction (100–011) is—
[Raj. HM 2018]
(A) –111 (B) 111
(C) 011 (D) 001

15. B.C.D. Code of decimal number 9 is—
[ACF & FRO 2018]
(A) 1010 (B) 1001
(C) 1111 (D) 1110

16. Decimal number 617 is equal to Hexadecimal—
[ACF & FRO 2018]
(A) 269 (B) 2CC (C) 18F (D) 399

17. What is the base of the Octal number system?
[Raj. Informatic Assistant (IA) 2014]
(A) 2 (B) 8 (C) 10 (D) 16

Answer Sheet

68.(C)	**69.**(B)		**1.**(A)	**2.**(A)	**3.**(B)	**4.**(C)	**5.**(A)	**6.**(A)	**7.**(C)
8.(C)	**9.**(A)	**10.**(D)	**11.**(D)	**12.**(A)	**13.**(D)	**14.**(D)	**15.**(B)	**16.**(A)	**17.**(B)

4 Introduction to Data Processing

- **Data Processing** is made up of two words—
  1. Data
  2. Processing
- **Data** generally refers to a group of **Information** and **Processing** refers to the work done to achieve a **Special Result**.
- **Data Processing** can be understood as follows—

Data

- **Data** is a set of characters which is **Collected & Store** for a special task.
- **Collection of unorganized facts and figures is Data.** Text, number, audio, video, document, etc. present in a computer is data. It means data is a type of **Raw material** for any process.
- **Symbol and Numeric Information** entered in the computer is called Data. Note:—**A group of Data is called Record.**
- **Raw data** used in the process of data processing is structured and unstructured data obtained from various sources. For example – Excel, File, Text File, Video clip, database file etc.
- **Data** is mainly classified as follows—
  1. **Numeric Data**—In this, only **mathematical digits** are used. For example – **Salary, Mobile Number**.
  2. **Alphabetic Data**—In this, only **characters (A–Z)** are used. Example – **Name**.
  3. **Alphanumeric Data**—It contains letters, numbers and **special symbols**. For example – **Address, A-12, Sector-14**.
  4. **Audio/Video/Image Data**—**Multimedia data** comes under this.

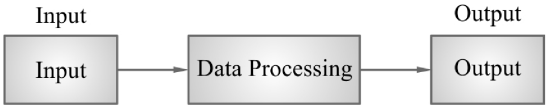
Processing

- Under computing, when any **Task** is performed, the process from the beginning to the end of that task is called **Processing**.
- **Processing** includes all the **Steps** from the start of a work to its completion.
- Any **Raw data** converts into **Information** after processing.

Data Processing

- **Data Processing** is a process through which data is **analyzed (Analysis)** and made useful.

- The process of converting **Raw data** or unorganized data into meaningful data or organized data is called **Data Processing**. It means storing data and converting it into **Meaningful Information**.
- **Data** is changed into meaningful data by the process of data processing. Meaningful data is called **Information**.
- **Data Processing** is a process used in the computer, under which the user can check **Raw data** and extract useful information for their work.
- Before the invention of the Computer, the **Compilation, Collection, Resources** and output of Data to achieve a fixed goal was done by **Manual method**, which was called Data Processing.
- In the process of **Data Processing**, data has to pass through **various steps**.
- The process of data processing starts with **Raw data**. After data processing, **useful information** is obtained from the Image, Chart, or Graph received from Raw data.
- The Data which is input first in the process of data processing is called **Raw data**. After inputting, Raw data is processed by the **CPU** and converted into **Information**. In this process, Raw data is called **Input** and Information is called **Output**.
- There are mainly three actions in this type of process—
  (A) Input Data
  (B) Data Processing
  (C) Output Data



- The process of **data processing** includes collecting data, computer functionality, and calculation work of the computer.
- When **Technology** developed, the **Computer** started being used for these tasks and **Data** began to be sent via electronic medium; this is called **Electronic Data Processing (EDP)**.
- **Lyons Electronic Office** developed the first **Business Computer** in the **UK** in **1951**. At that time, **Data**

5 Concept of Files & Its Types

- **In every computer system, data (like text, audio, video, etc.) is stored in the format of Files.**
- **File system is used to Store & Arrange data in a computer system.**
- A file used in a computer system is a **collection of data or information**, which is identified by a **File Name and Icon**.
- A file is a **group of Related Informations** which remains Stored in **Secondary Storage Media** like Optical disc, Magnetic tape, Magnetic disk.
- A file is a **Sequence of bits, bytes, lines and Records**, whose Meaning is determined by the user. **Each digital group of Data is called a file.**
- **Bit → Byte → Field → Record → File → Database**
- **The smallest unit of memory that Stores user's data through the operating system is called a File.**
- A file is a **block of memory** in which data is stored in a determined sequence.
- **Pictures, audio, video, applications, desktop icons**, etc. present in the computer are also kept in the category of **File**.
- **Information Stored in a File is non-volatile**, meaning **Information remains stored even upon Power loss**. File is used to Store any Information for a **Long time**.
- **Data cannot be Stored in a computer until the Data is Stored in a file.**
- A File can store all types of data like **text, image, audio, video, picture** etc.
- **File is used to keep data arranged correctly in the computer system.**

File Name

- Any data or information in the computer is stored in the form of a file. **The name given to identify these files is called a File name.**
- **The name given by the User while Storing a file in the computer is called File Name.**
- File name is used to **Uniquely identify** a stored file in a computer system.
- **There are mainly two parts in a file name given to a file—**
  1. **Name**—This is the **Basename** of the file which is given by the user.
  2. **Extension**—The extension of a file tells the **type of that file**, indicating which **format** the file is in.
- File extension is also given automatically by the system. For example—**Anudeshak.doc** is a file name in which **Anudeshak** is the name of the file and **doc** is the extension which tells that the type of file is a **document file**.
- **Any file can be easily accessed in the computer system by File name.**
- **File name starts in alphanumeric (character and number) format.** Like—**Jaipur.docx** starts with a character. In **123.docx**, 123 is a filename which starts in numeric format.
- **The filename of a file used by Window operating system can be of maximum 255 characters which includes spaces, Multiple periods and numbers.**
- In Windows operating system, when a file is saved with a **long file name**, then an **8.3 file name** is also saved in **Background compatibility**.
- This runs automatically in the Background of the system in which the file name is saved in **8 characters** and the file extension in **3 characters**.
- **8.3 filename < 8 character for filename >, < 3 character for extension >**
- When a user saves a file with a long file name, this **8.3 name is automatically assigned by the operating system**, in which the first six letters are of the long file name, followed by a **tilde** and a **sequential number**.

  Note—
  1. **Character Count limitation while giving File Name to any file can be different because it depends on various file systems.** For example—In **Older MS-DOS FAT File system**, while naming a file, there are maximum **8 characters for Base file name** and **3 Characters for extension** and including **dot separator** there are total **12 characters**. This is generally called **8.3 file name**.
  2. **Windows FAT** and **NTFS File systems** do not have **8.3 File names** because it is possible to give them a **long file name**. However, these file systems also support the **8.3 version**.

File Naming Rule

- Different file systems have different rules for naming

UNIT-II : DATA PROCESSING

1 Microsoft Word

Microsoft Office

- The full name of M.S. Office is **Microsoft Office**.
- **Microsoft Office is an Application Software**, created by the Microsoft company.
- **Microsoft is a software development company, founded on April 4, 1975, by Bill Gates and Paul Allen.**
- The **headquarters of Microsoft is in Redmond, Washington (America).**
- Microsoft Office is also known as **MS Office**.
- The **first version of Microsoft Office was created in 1989 for the Macintosh operating system.**
- In **November 1990, Microsoft created the first Microsoft Office 1.0 version for the Windows Operating System.**
- Various versions of Microsoft Office such as **Microsoft Office 4.0, 4.3, 1995, 1997, 2000, 2003, 2007, 2010, 2013, 2016, 2019, 2021, and 2024** have been released by Microsoft.

✧ Applications similar to Microsoft Office are LibreOffice, Kingsoft Office, NeoOffice, OpenOffice, OnlyOffice, FreeOffice, etc.

- **Microsoft Office 2024 is the latest edition of MS Office.**
- Nowadays, MS Office is also available on Android phones, iPhones, etc., under the name **WPS Office**. The full form of **WPS is Writer, Presentation, Spreadsheet.**
- The main programs or application software used in Microsoft Office are as follows—
  1. **Microsoft Word** - For creating **text documents**. For example—To write a letter for an office or a school.
  2. **Microsoft Excel** - For **mathematical and statistical calculations**. For example—To record details of ledgers/income-expenditure in an office.
  3. **Microsoft PowerPoint** - For creating **slides to give presentations**. For example—To present data, activities, and achievements of an office/ company through graphs and presentations.
  4. **Microsoft Access** - For creating **Database applications**. For example—To maintain the details of people working in an office/ organization, a program is needed that works based on data to manage the database.

Note:-

1. These small application software used in Microsoft Office are collectively called an **Office Suite**.
2. **FrontPage is also a part of MS Office.**

- Other programs in Microsoft Office include **Microsoft Office Tools, OneNote, InfoPath Designer, InfoPath Filler, Outlook, SharePoint Workspace,** etc.

Note:—MS-Outlook, used for e-mail client service, is also a part of MS Office. It allows the user to open multiple e-mail accounts in one place on their computer without a browser.

Office 365

- Users use Word, Excel, PowerPoint, etc., in M.S. Office offline. This means that while using them, it is not necessary for the user's computer to be connected to the internet, and these files are saved in the computer's local storage. Sharing these files is not easy, and they cannot be edited when the user is not on their own computer system. Office 365 was introduced to solve these problems.
- **Office 365 is a web-based Cloud Computing Service developed by Microsoft.**
- **Office 365 is an online advanced version of Microsoft Office**, which includes various application software like Word, Excel, PowerPoint, OneDrive, and Outlook. The user can work on this software.
- The work done in **Office 365 is web-based.** Internet is necessary to use it, and the work done will be saved on the server.
- The work done in Office 365 is not saved on your computer's hard disk but on the **cloud/server**. The advantage of this is that the user can open and edit the data online from any computer, anywhere.
- **Office 365 cannot be used without the internet.**
- Saving a file on the cloud allows **more than one user to edit it at the same time.**
- If any application in **MS-Office** gets an update, **Office 365** will also be updated. It includes different types of updates like security updates and tools updates. For example, if a new version of **MS Word**, like **MS**

Word 2024, is launched, then this **Word 2024** will also be available in **Office 365**, and the user will be able to use it.

Microsoft Word Introduction

- **Microsoft Word** is an application software of the word processor type.
- **Word Processor**—A word processor is a program or software that processes or works on words.
- In word processing, software like **MS Word, Notepad, WordPad, PageMaker, Word Star, OpenOffice Writer, WordPerfect, SoftWord, Akshar**, etc., are used.
- Currently, the most widely used word processor is **MS Word** because other processors like **WordStar** and **Akshar** have fewer features.
- **Microsoft Word** is a word processing program of **Microsoft Office**, and its latest version is **2024**.
- Tasks performed in **MS Word** include: changing the colour, size, and shape of typed words; drawing a line under words (**Underline**); making words dark (**Bold**); making words slanted (*Italic*); aligning the first and last characters of different lines; centering characters on the page; correcting spelling and grammar mistakes; putting a border around the page; arranging lines in alphabetical order; adding a header and footer to every page; and inserting various types of pictures/graphs.
- **MS Word**, a part of **MS Office**, is similar to **Notepad**. Both **MS Word** and **Notepad** are text editors used to create, open, and edit text files. **Notepad** does not provide the feature of text formatting, whereas **MS Word** does.

Word File Extension

- An extension tells us about the type or format of a file/document. This means the extension gives information on whether the file is a pdf, image, word file, excel spreadsheet, etc.

✧ A file created in **Microsoft Word** is called a **Document file**.
✧ The file extension for **Microsoft Word** is **.Doc/.Docx**.

- **.Doc** is the extension used for **Microsoft Word versions 1997, 2000, and 2003**. The **.Docx** extension is used for versions **2007, 2010, 2013, 2016, 2019, 2021, and 2024**.
- The extension for a **Template File** is **.Dot** in **Microsoft Word 2000 and 2003**, and **.Dotx** in **Microsoft Word 2010, 2013, 2016, 2019, 2021, and 2024**.
- The extension of a **Macro File** is **.Docm**.

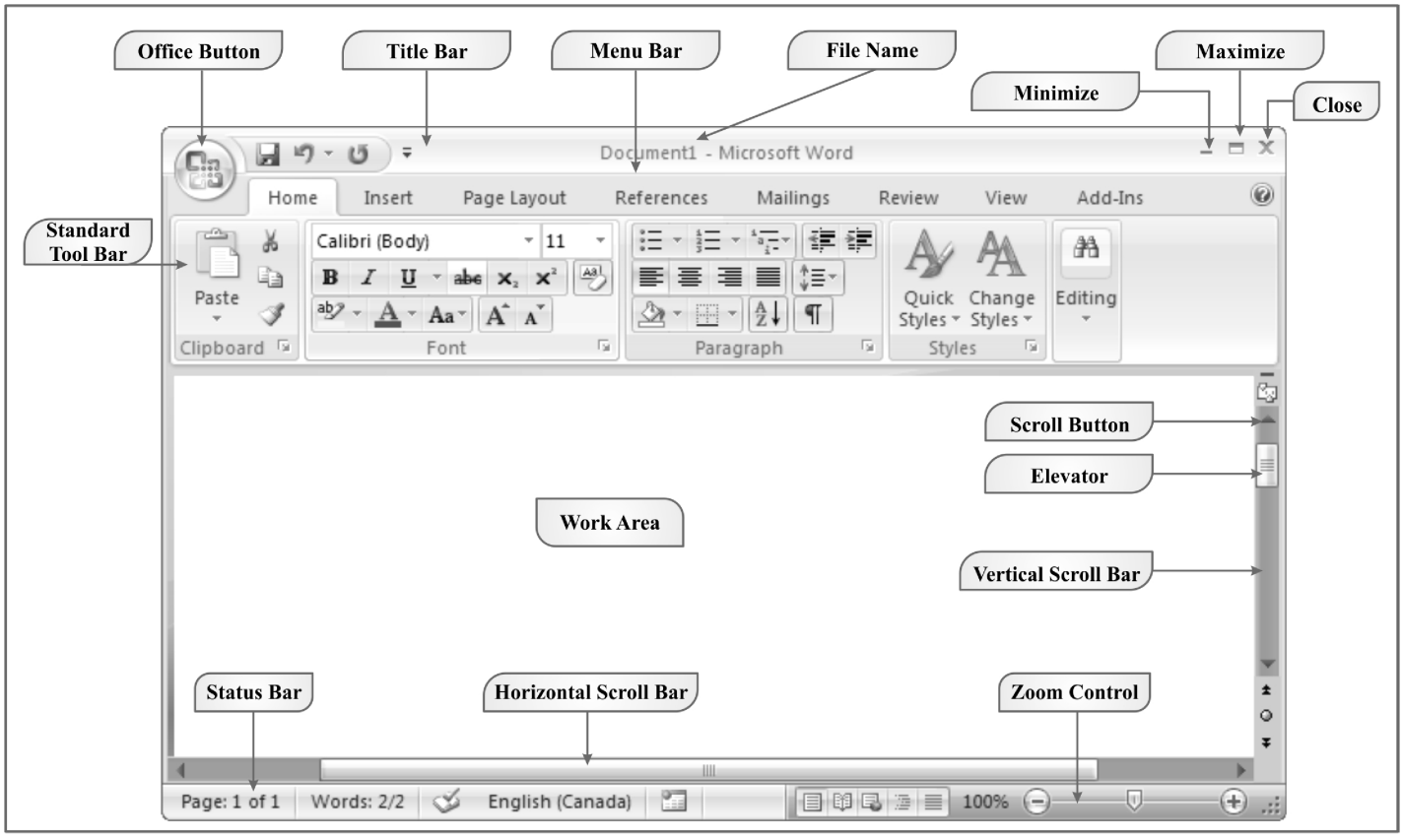


Fig. : Microsoft Word Window

Steps to Open Microsoft Word in a Computer–

1. **Opening through the Run Command—**
   Open the Run box using **Window + R** and type **Winword/Winword.exe**.
   Note—The commands used to open any program in a computer system through the Run Box are called **Run Commands**.

✧ The **Run command for Microsoft Word** is **Winword/Winword.exe**.

197. What is the shortcut key for Double Line Spacing?
(A) Ctrl + 1 (B) Ctrl + 2
(C) Ctrl + 5 (D) Shift + 2

198. Select the appropriate application for the various shortcut keys used in MS Word—

	Set-I	Set-II
(a)	Alt + Ctrl + D	(i) Endnote
(b)	Alt + Ctrl + C	(ii) Copyright Symbol
(c)	Ctrl + Shift + C	(iii) Format Painter
(d)	Shift + F3	(iv) Change Case

(A) a-i, b-ii, c-iii, d-iv (B) a-i, b-iv, c-ii, d-iii
(C) a-iv, b-i, c-iii, d-ii (D) a-i, b-ii, c-iii, d-iv

199. In a sentence, to underline only the words while leaving the spaces between them, you can press ... in MS Word.
(A) Shift+W (B) Ctrl+U
(C) Ctrl+Shift+W (D) Ctrl+Shift+U

200. In Microsoft Word 2016, what is not included in the Word Count?
(A) Page (B) Character (no spaces)
(C) Character (with spaces) (D) Sentences

201. Which of the following is not a valid menu item in MS-Word 2019?
(A) View (B) Mailings (C) Home (D) Data

202. In MS Word 2016, which of the following key combinations can be pressed to insert a page break?
(A) Ctrl+F1 (B) Shift+Enter
(C) Shift+F1 (D) Ctrl+Enter

203. In MS-Word, which of the following keyboard shortcuts is used to remove a paragraph indent?
(A) CTRL + SHIFT + M (B) CTRL + T
(C) CTRL + SHIFT + T (D) CTRL + Q

204. In MS-Word, which of the following keyboard shortcuts is used to display the Object dialogue box for inserting a file object in the document?
(A) ALT+N, J, J (B) CTRL + SHIFT + C
(C) CTRL + SHIFT + V (D) CTRL + H

205. In MS-Word, which of the following keyboard shortcuts is used to select text and graphics from the current position to the top of the screen?
(A) Shift + Page up
(B) Ctrl + Shift + Left arrow key
(C) Ctrl + Shift + Right arrow key
(D) Ctrl + A

206. In MS-Word, which of the following keyboard shortcuts is used for the preview page when zooming in?
(A) Arrow keys (B) Ctrl + Home
(C) Ctrl + I (D) Ctrl + P

207. In MS-Word 365, which of the following menus includes the 'Reuse Files' option?
(A) Insert (B) Draw
(C) Design (D) Layout

208. In MS-Word, which of the following shortcut keys is used to adjust the Zoom Magnification?
(A) Alt + W + Q (B) Ctrl + Z
(C) Ctrl + Alt + S (D) Alt + Shift + C

209. In an MS-Word document, ... can be used to set a predefined format of size, color, etc., on text.
(A) Smart Art (B) Styles
(C) Ribbon (D) Word Art

210. In MS Word 2016, in which type of mode used for editing English language text, typing new characters will replace any existing characters to the right side of the insertion point?
(A) Over Insert Mode
(B) Insert Mode
(C) Retype Mode
(D) Overtype Mode

211. What is the mandatory condition for the 'AutoSave' feature to work in Office 365 (Microsoft 365)?
(A) The file must be saved on the local hard drive (C: drive).
(B) The file does not need to be in .docx format.
(C) The file must be saved on OneDrive.
(D) It works even when the internet connection is off.

Previous Year Competitive Exam Questions

Questions asked by Rajasthan Public Service Commission (RPSC) and Rajasthan Staff Selection Board (RSSB)

1. Which of the following shortcut keys is used for Print Preview in MS Word? [Raj. Livestock Assistant 13.06.2025]
(A) Shift+F2 (B) Ctrl+F1
(C) Ctrl+F5 (D) Ctrl+F2

2. Which of the following keys do you use to check spelling in MS Word? [CET 10+2 Level, 24.10.24 (IInd Shift)]
(A) F9 (B) F7 (C) F5 (D) F2

3. What is the shortcut key for centre alignment of a line or text in MS Office software? [CET 10+2 Level, 24.10.24 (IInd Shift)]]
(A) Ctrl + X (B) Ctrl + Alt + S
(C) Ctrl + W (D) Ctrl + E

4. Which of the following is the Open command in MS Office? [CET 10+2 Level, 23.10.24 (IInd Shift)]
(A) Tab + O (B) Ctrl + O
(C) Alt + O (D) Shift + O

Answer Sheet

197.(B)	**198.**(B)	**199.**(C)	**200.**(D)	**201.**(D)	**202.**(D)	**203.**(A)	**204.**(A)	**205.**(A)	**206.**(D)
207.(A)	**208.**(A)	**209.**(B)	**210.**(D)	**211.**(C)		**1.**(D)	**2.**(B)	**3.**(D)	**4.**(B)

5. Which of the following views shows margins and Rulers? [CET 10+2 Level, 23.10.24 (Ist Shift)]
(A) Review (B) Page Setup
(C) Normal (D) Page Layout

6. Which of the following keys is used to check grammar and spelling in MS Word? [CET 10+2 Level, 23.10.24 (Ist Shift)]
(A) F9 (B) F3 (C) F5 (D) F7

7. In Microsoft Word, which of the following provides information about the current document? [CET 10+2 Level, 22.10.24 (IInd Shift)]
(A) Standard Toolbar (B) Tab Stop
(C) Status Bar (D) View Buttons

8. Which of the following is the shortcut command for Print in M.S. Office? [CET 10+2 Level, 22.10.24 (Ist Shift)]
(A) Alt + P (B) Shift + P
(C) Ctrl + P (D) Alt + Ctrl + P

9. Which of the following is not a character formatting word processing tool? [CET 10+2 Level, 22.10.24 (Ist Shift)]
(A) Font Color (B) Alignment
(C) Underline (D) Effect

10. Which of the following is not a paragraph alignment option in MS Word? [CET Gr. Level, 28.09.24 (IInd Shift)]
(A) Former Alignment (B) Left Alignment
(C) Right Alignment (D) Justify

11. With the help of which of the following can we create the same letter for multiple recipients in MS-Word? [Hostel Superintendent Exam, 28.08.2024]
(A) Template (B) E-mail
(C) Mail Merge (D) Macros

12. Which of the following is not a font style? [Hostel Superintendent Exam, 28.08.2024]
(A) Regular (B) Superscript
(C) Italics (D) Bold

13. What is the shortcut key combination to open the Font dialog box in MS Word? [Raj. Sanganak-03.03.2024]
(A) Ctrl + Shift + F (B) Ctrl + Shift + G
(C) Ctrl + Shift + L (D) Ctrl + Shift + V

14. What does the F12 key open in MS Word? [Raj. Sanganak-03.03.2024]
(A) Save As dialog box
(B) Open dialog box
(C) Save dialog box
(D) Close dialog box

15. What is the shortcut key combination to create a folder? [Raj. Sanganak-03.03.2024]
(A) F2 (B) Ctrl + C
(C) Ctrl + Shift + N (D) Ctrl

16. Which of the following is used to check for synonyms in MS Word? [Raj. Jr. Accountant–11.02.2024]
(A) Spell checking (B) Auto check
(C) What if (D) Thesaurus

17. What are the benefits of the Mail Merge feature in MS Word?
1. It saves a lot of time and effort.
2. It is used to outline the document.
3. It can keep the details of all the recipients.
4. It makes the document more attractive.
Choose the most appropriate option from the options given below: [Raj. Jr. Accountant-11.02.2024]
(A) Only 1 (B) Only 2 or 3
(C) Only 1 or 3 (D) Only 1 or 4

18. In a Word document, Simrat has to display a list of online sites, which is to be later used by a student to prepare a research paper on the topic 'Impact of Social Media on Student Behavior'. Which feature of Word is suitable for preparing this list? [Raj. Information Assistant-21.01.2024]
(A) Linking (B) Bullets
(C) Numbering (D) Graph

19. Which button is used to create a multi-column document? [Raj. CET 10+2, 11.02.2023]
(A) Break column (B) Multi column
(C) Column (D) Set column

20. In Microsoft Word 2016, the Borders option is in the ... menu— [Raj. CET 10+2, 11.02.2023]
(A) Font style (B) Font size
(C) Font alignment (D) Font art

21. Portrait and Landscape are options for.....— [Raj. CET 10+2, 11.02.2023]
(A) Insert (B) View (C) Review (D) Design

22. The shortcut key to save a document in MS Word is... [Raj. CET 10+2, 05.02.2023]
(A) of paper size (B) of page orientation
(C) of page layout (D) of page size (size)

23. The shortcut key to save a document in MS Word is— [Raj. CET 10+2, 05.02.2023]
(A) Ctrl+O (B) Ctrl+S (C) Ctrl+F (D) Ctrl+P

24. What is the minimum and maximum font size available in the font size toolbar of the formatting toolbar? [Raj. CET 10+2, 04.02.2023; Junior Instructor (COPA) 24.03.2019]
(A) 6 and 68 (B) 8 and 68
(C) 6 and 72 (D) 8 and 72

Answer Sheet

5.(D)	**6.**(D)	**7.**(C)	**8.**(C)	**9.**(B)	**10.**(A)	**11.**(C)	**12.**(B)	**13.**(A)	**14.**(A)
15.(C)	**16.**(D)	**17.**(C)	**18.**(A)	**19.**(C)	**20.**(A)	**21.**(D)	**22.**(B)	**23.**(B)	**24.**(D)

2 Microsoft Excel

Microsoft Excel : Introduction

- Microsoft Excel is a part of the **Microsoft Office Package** and is an **electronic spreadsheet program**.
- A spreadsheet program is used for the **analysis of statistical data, mathematical calculations, creating budgets, making accounting worksheets, and for keeping records of financial transactions.**

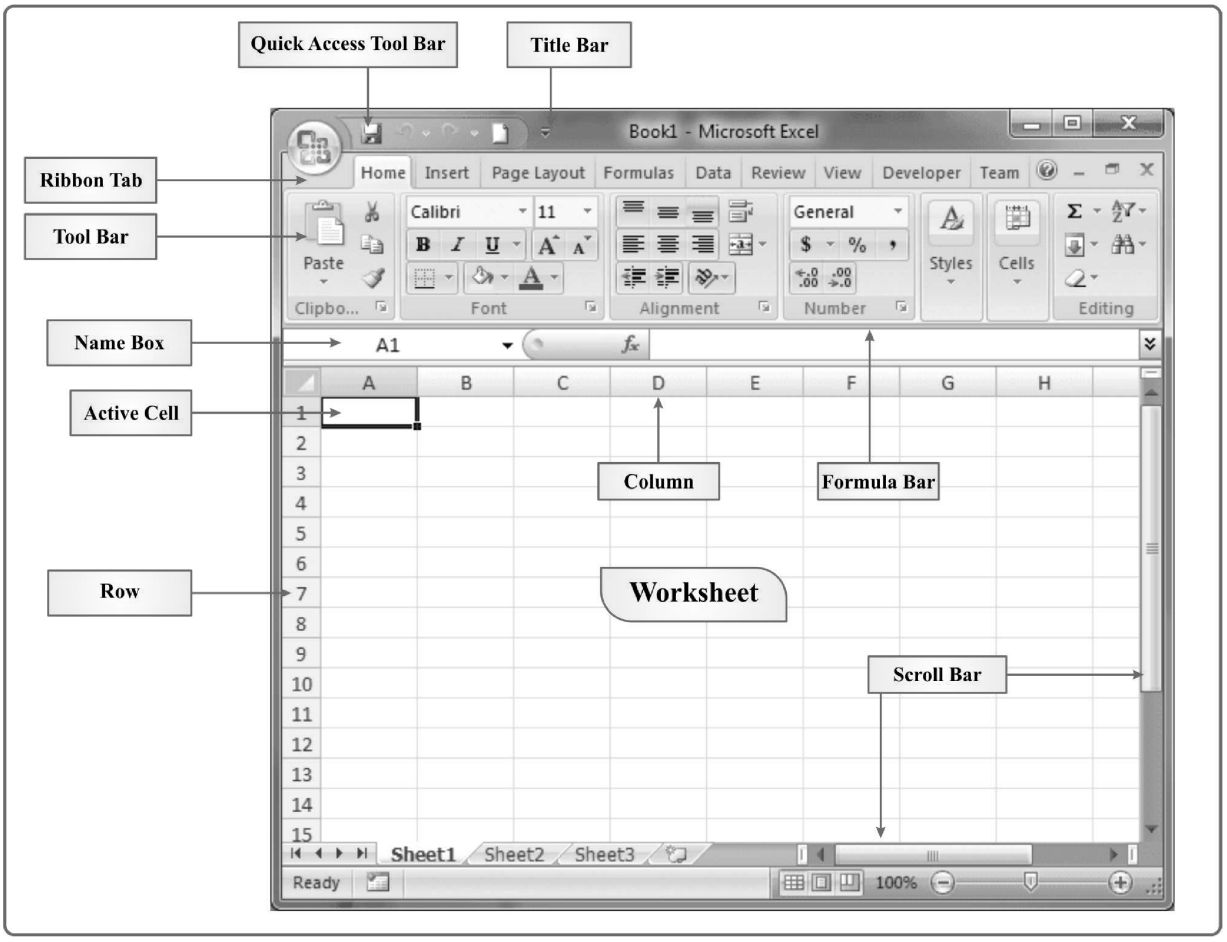


Fig. : MS Excel Window

- **The first electronic spreadsheet program is VisiCalc.**
- MS Excel is used for statistical calculations and creating charts, as well as for analyzing data and organizing data and information.
- Using MS Excel, account-related tasks and large calculations can be easily performed.
- There are many other spreadsheet programs similar to Excel, such as—**Lotus 123, LibreOffice, Google Sheets, iWork Numbers, Lotus Symphony, VisiCalc,** etc.
- The format or **Extension** of an Excel file is **.xls /.xlsx**. The extension for the Excel 2003 version is **.xls**, and for versions from 2007 to 2024, the extension is **.xlsx**.
- The extension of a **Template File** in MS Excel is **.xltx.**
- लोटस में बनी फाईल का एक्सटेंशन 123 होता है।
- एक्सेल का रन कमाण्ड **Excel/Excel.exe** होता है।

Workbook & Worksheet

- "In Excel, the **intersection point of a Row** and **Column** is called a **Cell**.

226. Match the following.

Set-1	Set-2
I. Active cell	(a) Left align
II. First cell	(b) Currently selected cell
III. Text	(c) Right align
IV. Numbers	(d) A1

(A) I-d, II-b, III-c, VI-a (B) I-b, II-d, III-c, VI-a
(C) I-b, II-d, III-a, VI-c (D) I-d, II-b, III-a, VI-c

227. Which is true regarding Pivot Table used in MS Excel?
(A) Pivot Table is an interactive way to summarize large amounts of data quickly.
(B) It can analyze numerical data in detail.
(C) It is used to answer unexpected questions about your data.
(D) All of the above

228. In EXCEL 2016, a cell range is represented by using the ... symbol.
(A) Comma (B) Colon
(C) Semicolon (D) Forward Slash

229. Data visualization programs like Business Intelligence software use ... tool for data summarization.
(A) Function (B) Macro
(C) Chart (D) Pivot Table

230. In Microsoft Excel, which of the following combinations is used to select the data of a table column?
(A) Ctrl + C (B) Ctrl + Arrow key
(C) Ctrl + S (D) Ctrl + Spacebar

231. Which of the following shortcut keys is used to insert Macros in Microsoft Excel?
(A) Alt + F12 (B) Alt + F5
(C) Ctrl+F5 (D) Alt + F8

232. On what do we click to move from one worksheet to another in an MS Excel workbook?
(A) On Active cell (B) On Sheet tab
(C) On Scroll bar (D) On Tab button

233. Through which feature of MS Excel can Excel dynamically calculate results from data?
(A) Diagram (B) Chart
(C) Table (D) Formula & Function

234. The shortcut key to insert Auto Sum function automatically in Microsoft Excel 2016 is ...
(A) Ctrl ++ (B) Alt ++
(C) Alt + = (D) Alt + S

Previous Year Competitive Exam Questions

Questions asked by Rajasthan Public Service Commission (RPSC) and Rajasthan Staff Selection Board (RSSB)

1. Which type of cell data is generally not found in a spreadsheet? [Raj. Patwar (S-I) 17.08.2025]
(A) Numeric Value (B) Date and Time
(C) User Authentication (D) Label and Formula

2. Which of the following is not a mathematical function of Spreadsheet/MS Excel? [Raj. Patwar (S-I) 17.08.2025]
(A) TODAY() (B) ROUND
(C) COUNTA() (D) SUMIF()

3. Which of the following is not a type of spreadsheet program? [CET 10+2 Level, 24.10.24 (IInd Shift)]
(A) Google Sheet (B) Rose Symphony
(C) Zoho Sheet (D) Microsoft Excel

4. With what does a valid formula start in Excel? [CET 10+2 Level, 24.10.24 (Ist Shift)] [CET Gr. Level, 28.09.24 (Ist Shift)]
(A) + (B) = (C) # (D) @

5. In which referencing does the cell reference not change while copying the formula? [CET 10+2 Level, 24.10.24 (Ist Shift)]
(A) Cell Referencing
(B) Absolute Referencing
(C) Relative Referencing
(D) Mixed Referencing

6. ... shortcut key hides the selected column in Excel. [CET 10+2 Level, 23.10.24 (IInd Shift)]
(A) Shift + F10 (B) Alt + H
(C) F2 (D) Ctrl + 0 (Zero)

7. 'Pivot Table' is a feature of which of the following software? [CET 10+2 Level, 23.10.24 (IInd Shift)]
(A) Microsoft Excel (B) Microsoft Word
(C) Microsoft Access (D) Microsoft PowerPoint

8. Which of the following is most suitable for the name of an Excel sheet? [CET 10+2 Level, 23.10.24 (IInd Shift)]
(A) Minimum 1 character, Maximum 21 characters
(B) Minimum 1 character, Maximum 31 characters
(C) Minimum 2 characters, Maximum 19 characters
(D) Minimum 2 characters, Maximum 27 characters

9. Which of the following commands in Excel will take you to the previous sheet of your workbook? [CET 10+2 Level, 23.10.24 (IInd Shift)]
(A) Ctrl + Shift + Page Up (B) Alt + Page Up
(C) Ctrl + Page Up (D) Tab + Page Up

10. Which of the following is a method to arrange data in ascending or descending order in a spreadsheet? [CET 10+2 Level, 23.10.24 (Ist Shift)]
(A) Filter (B) Sorting
(C) Auto Sum (D) Logical Operator

Answer Sheet

226.(C)	**227.**(D)	**228.**(B)	**229.**(D)	**230.**(D)	**231.**(D)	**232.**(B)	**233.**(D)	**234.**(C)	
1.(C)	**2.**(A)	**3.**(B)	**4.**(B)	**5.**(B)	**6.**(D)	**7.**(A)	**8.**(B)	**9.**(C)	**10.**(B)

3 Microsoft Power Point

Microsoft Power Point : Introduction

Fig. : Microsoft Power Point Window

- Microsoft Power Point is a part of the **Microsoft Office Package**, which is made by the **Microsoft Company**.
- Microsoft Power Point is an **Application Software** used for making **Presentations**.
- Microsoft Power Point is a complete **Presentation Graphics Program**.
- The **Run Command** of Microsoft Power Point is **'Powerpnt'**.
- The **File Format/Extension** of Microsoft Power Point is **.ppt/.pptx**.
  - ✧ Extension up to **Power Point 2003** – **.ppt**
  - ✧ Extension after **Power Point 2003** – **.pptx**

✧ The file created in Microsoft Power Point is called a **Presentation**.

- **Presentation File** is also called **PPT**.
- The **By Default** name of a file created in Power Point is **Presentation1**.

✧ A **Presentation** is made up of many **Slides**.

- All the slides of a presentation on a specific topic are kept in one file, which is called a **Presentation File**.
- In Power Point, the **By Default Slide Orientation** is **Landscape**.
- The **Shortcut Key Ctrl+M** is used to take a **New Slide** in a Presentation.
- All **Information** in Power Point is displayed only on the **Slide**.
- **Text, picture, shape, audio, video, animation** etc. can be inserted in every slide of the **Presentation**.
- File formats like **.JPEG, .MPEG, .MP3, .JPG, .MP4, .WAV, .GIF, .BMP, .PNG, .GIV, .MID** etc. are

4 DBMS Software (MS Access)

DBMS Software

Database Management System

- The full name of **DBMS** is **Database Management System**.
- **DBMS** is a group of **Programs** in which **Users** can **create**, **delete** and **maintain** the database. It works to create an **interface** between the **user** and the **Database**. It contains many **commands**, through which the **user** can easily work in the **Database**.
- **Database Management System** is a **Software Program** used to **Manipulate**, **Edit**, **Update**, **Share Digital Data**, and delete old data to store new data.
- A group of **Inter-linked records** is called a **Database**.
- It also provides functionality like **Data Security**, **Backup**, **Easy accessibility**, etc.
- Generally used **Database software** are **SQL**, **MySQL**, **PgSQL**, **SQL Server** and **Oracle**, etc.

Microsoft Access

- **MS Access** is a **well known database system** created by **Microsoft Corporation**.
- **MS Access** is known as **Office Access** or **Microsoft access**.
- **Microsoft company** released the **First Version** of **MS Access** on **13 November 1992**. Before this, two **Databases**, **Borland** and **FoxPro**, were available in the market.
- It is a **DBMS (Database Management System)** using which a **User** can **Create** and **Manage** a **Database**.
- A collection of complete information shown about a subject matter is called a **database**.
- We can also prepare a **Report** from the **Database** present in **M.S. Access**.
- No **Programming Language** is required to **create** and **Manage** a **Database** in **MS Access**. It works on **GUI (Graphical User Interface)** and **Software Development Tool**.
- **MS Access** can be used as both **Front_end** and **Back_end**. Users use it as a **Front-end** using **GUI**, and it is used as a **Back-end** through **Visual Basic** and **ASP.NET**.
- **MS Access** can be used to prepare **Students' Data** in **School** and **College**.
- With the help of **Microsoft Access**, we **create** (**Table**, **Forms**, **Query**, and **Report**) and **manipulate** the database.
- In **Microsoft Office Access 2010**, you can **create** the database on the **web** and **Publish** it on a **SharePoint site**, so that the **database** can be used in a **web browser**.
- The **database extension** of **Microsoft Access 2003** is **.mdb (Mounted Database)** and the extension for **2007, 2010, 2013, 2016, 2019, 2021** is **.accdb (Access database)**.
- **Microsoft Access** is used by **data architects** and **software developers** to make **application software**. Its main uses are as follows—
- **Manage accounts and bills**
- **To store the data in a tabular manner and make it available as per the requirement of the user.**
- **Use Access to compare data and make relationships among them.**
- The first **Version 1.0** of **MS Access** was used to make small **Databases**.

Components of MS Access

- **Table**—A cell is formed by the **Intersection** of a **row** and **column** in a **table**. A **table** is a group of many **cells**. In this, every **record** is a **row** and every **field** is a **column**.
- **Queries**—The command given to find data satisfying certain conditions from a table or database is called a query. Queries include filtering, calculating, sorting, and updating. The information or record received in response to a query is called a **Dynaset**.
- There are mainly five types of queries in MS Access—
  - **(i) Select Query**—Select query is used to find or choose data according to a given condition.
  - **(ii) Parameter Query**—In a parameter query, some parameters are given first, and based on those given parameters, this query searches the data.
  - **(iii) Cross Tab**—This query is used to get the conclusion of information in columns and rows.
  - **(iv) Action Query**—Work has to be done under given conditions through this, such as changing or deleting records upon the fulfillment of certain conditions.

25. Data types used in MS Access can be—
(A) Number (B) Currency
(C) Memo (D) All of the above

26. The default data type in MS Access is—
(A) Number (B) Text
(C) Currency (D) Yes/No

27. Match the various types of Data Types used in MS Access with their Field Size—

Data type	Field Size
(a) Number	(i) 8 Byte
(b) Currency	(ii) 4 Byte
(c) Text	(iii) 1, 2, 4 or 8 Byte
(d) Auto Number	(iv) 0-255 Character

(A) a-i, b-ii, c-iii, d-iv (B) a-iii, b-i, c-iv, d-ii
(C) a-iv, b-iii, c-ii, d-i (D) None of these

28. In the context of MS Access, field-length is—
(A) Number of characters deleted from the field
(B) Maximum number of characters that can be stored in the field
(C) Area of the field
(D) Perimeter of the field

29. From Microsoft Access 2010 you can...
(A) Use the database in a web browser
(B) Create the database on the web
(C) Publish on SharePoint site
(D) All of the above

30. The way to start Microsoft Access is—
(A) Double click on M.S. access shortcut
(B) Start→All Programs→MS Office→MS Access
(C) Both A and B
(D) None of the above

31. Which of the following is not a Microsoft Access related tab—
(A) Home (B) Create
(C) Database tool (D) Hyperlink

32. The group found in the Home tab of Microsoft Access is—
(A) Report (B) Sort and Filter
(C) Form (D) Export

33. Tools related to manipulating the database are available in—
(A) Database Tool (B) Create
(C) External Data Tab (D) Home

34. Tools related to value import and export in the database are available in—
(A) External Data Tab (B) Database Tool
(C) Create Tab (D) Home Tab

35. Components of the database are—
(A) Form (B) Query
(C) Object (D) All of the above

36. Which of the following is not a component of the database—
(A) Table (B) Query
(C) Form (D) Tuple

37. Database View in MS Access is—
(A) Design View (B) Datasheet View
(C) Rule View (D) Both A & B

38. The by default name of New Table in MS Access is—
(A) New Table (B) Table New
(C) Table 1 (D) Start Table

39. Which is not a type of Form in MS Access—
(A) Tabular Form (B) Columnar Form
(C) Justified Form (D) Usual Form

40. By Query in MS Access—
(A) Data is viewed in different ways.
(B) To change, analyze data.
(C) As source of record for report.
(D) All of the above

41. Create Tab of MS Access is used—
(A) To Create Table (B) To Create Query
(C) To Create Form (D) All of the above

Previous Year Competitive Exam Questions

1. Data is stored in a software so that information related to various files can be available in the search method. Which of the following is the most important feature of the software that helps in sorting data? Choose the appropriate option. [Raj. Information Assistant Exam 21.05.2024]
(A) Access, Query (B) Word, Find
(C) PowerPoint (D) Access, Find

2. In MS Access, images can be set to …… data type. [Raj. IA Exam. 2018]
(A) Long (B) Ole
(C) Hyperlink (D) Memo

3. The basic elements of a form are called : [Raj. IA Exam. 2018]
(A) objects (B) table
(C) record (D) controls

4. To make a database password protected in MS Access : [Raj. IA Exam. 2018]
(A) Insert → Security → Set database password
(B) Tools → Security → Set database password
(C) View → Security → Set database password
(D) Data → Security → Set database password

5. MS-Access database is saved as extension. [Raj. IA Exam. 2018]
(A) .msa (B) .dbm (C) .mdb (D) .mss

6. MS Access can be used— [UPPCL 2018]
(A) To Create general Database.
(B) To prepare Data of Students in a School, College.
(C) For executing the Process of Database Manipulation
(D) All of the above

Answer Sheet

25.(D)	**26.**(B)	**27.**(B)	**28.**(B)	**29.**(D)	**30.**(C)	**31.**(D)	**32.**(B)	**33.**(A)	**34.**(A)
35.(D)	**36.**(D)	**37.**(D)	**38.**(C)	**39.**(D)	**40.**(D)	**41.**(D)			
				1.(A)	**2.**(B)	**3.**(D)	**4.**(B)	**5.**(C)	**6.**(D)

UNIT-III : PROGRAMMING FUNDAMENTAL

1 Introduction to C Language

❖ **Program** — A group of instructions to complete a specific task is called a **program**.

❖ **Programming** — Changing the solution of a problem into a language understandable by the computer is called **Programming**.

❖ Mainly, there are two types of computer programming languages—
1. Low level language
2. High level language

1. **Low Level Language—Language** which is close to **machine code (0's and 1's)** is called **low level language**. Its programs are written in **binary form**. These are of the following types—

✧ **Machine Language**—Its **instructions** are in **binary form** and are read **directly** by the computer. These are **machine dependent**, **difficult to modify**, and **difficult to write programs** in.

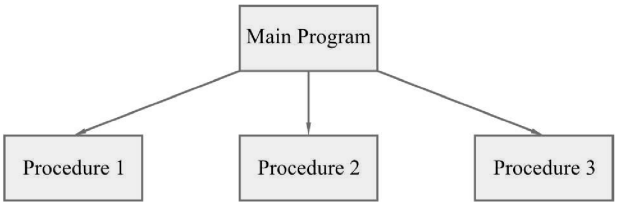
✧ **Assembly Language**—This is a **low level symbolic language**. The set of its programs is called **mnemonic code**. It remains **machine dependent**.

2. **High level language—**Its **programs** are written in **English language** which is **easy to understand**, **modify** and **write**. It is **machine independent**.

Examples of this—
Fortran, COBOL, Basic, Pascal, C, C++, Java
It is divided into two parts—
(i) Procedural Language
(ii) Object Oriented Programming Language

(i) **Procedure Oriented Programming : (POP) Language** has a **Collection of Functions**. In this type of process, a **main program** is divided into small **Functions or procedures**. These functions contain **statements** for the **operation**.

❖ When the **main program executes**, it executes the **procedure/function one by one** and in the end, the **Main program** gives the **final output**.



❖ **C, Pascal, Cobol**, etc. are examples of **POP** type language.

❖ **Non-procedural language**—In this type of **language**, the **user** only specifies "What to do" and not "How to do". It is also called **application** or **functional language**. Its examples are—**SQL, PROLOG** (This was the **first logical language** which was taken into much use), **LISP (List processing)**.

❖ **Procedural language—Codes** of the program which are written in a **sequence**. In this, the **user** specifies "What to do" and "How to do" (**Step by Step**). Example – **FORTRAN, COBOL, ALGOL, BASIC, C AND Pascal**.

(ii) OOPs (Object-Oriented Programming):

❖ **OOPS** is a **Collection of objects** and a **Set of objects** in which the **program** is divided into **objects**. Where **object** is a **collection** of **data-member, function member** which are logically related to each other as a **set**, which is called a **class**.

❖ In languages based on **Object**, **Programs** are based on **Class and Object**.

❖ In **POP**, when many **Functions** come in a program, the possibility of **Error** in the program's **output increases**. To solve this problem, **OOPs language** is used.

❖ If the **processor, function or Sub-program** of an **OOP** program and the **data** useful for them are together, then it will become **simple** to use them.

❖ In **OOPs**, a **class** is made for every work. The **main function** of a **Class** is to fulfill a **special purpose**. **Class** is a **set of instruction** and this **class** is represented by the **object**.

❖ **Modular programming language** is an **approach** in which a **big problem** is solved by dividing it into **small sub-problems**. These **sub-problems** are called **modules**, which makes its use **easy** and the **solution** of these **modules** can be used again if needed.

1. **Scientific Programming Language**—This **language** is mainly used for **scientific works** like—**FORTRAN, ALGOL**, etc.

2. **Commercial Programming Language**—This language is used in business-related works. It is used to keep **accounts, stock, daily journals**, etc. For example—**PL1, COBOL, dBase**, etc.

3. **Special Purpose Programming Language**—This language is used in different works with different

the user converts them **manually**.

There are two types of **Type Casting** in **C language**—

(i) Implicit Type Casting

(ii) Explicit Type Casting

Implicit Type Casting

❖ In **Implicit type cast**, the user does not need any operator for **Type Casting**. **Implicit Type Casting** is done **automatically** by the compiler. Users also call this **Type Casting** as **'Type Conversion'**.

In **Implicit Type Casting**, when we convert a variable from **Lower type** to **Higher type**, there is no **data loss**. But when the user **Type Casts** a **higher type** variable to a **lower type**, there is a risk of **Data Loss**. Therefore, whenever we do **Implicit type casting**, we only **Type Cast** the variable from **lower type** to **higher type**, so there is no risk of any **data loss**.

Example—

```
float a = 5 ; // int 5 became float automatically.
```

Explicit Type Casting

❖ **Explicit Type Casting** is a **user-defined Type Casting** because the user forcibly does this **type cast**. **Explicit Type Casting** is not done **automatically** by the compiler. In this, the **"(type_name)" operator** is used for **Type Casting**.

Example—

```
float z = (float) 5/2; // Forced by applying (float).
```

Operator

❖ **Operators** are special types of **Symbols**. They tell which **Operation** needs to be performed on the **Data**.

❖ The **Data** on which the **Operation** is performed are called **Operands**.

❖ **Expressions** are created with the help of **Variables**, **Constants**, and **Operators**.

❖ In **C language**, **operators** are divided into the following classes—

(i) **Unary operators**—Those **Operators** which require only **one operand**.

(ii) **Binary operators**—Those **operators** which require **two operands**.

(iii) **Ternary operators**—There are very few **Operators** in this class. These **Operators** require **three Operands**.

❖ The **operators** used in **C language** are divided into the following categories—

1. Arithmetic operators
2. Relational operators
3. Logical operators
4. Conditional operators
5. Increment & Decrement operators
6. Assignment operators
7. Bitwise operators

1. Arithmetic operators

❖ **Arithmetic operators** are used to perform **numerical calculations**.

❖ The following **operators** are used in **C language**—

Operator	Meaning
+	Addition
–	Subtraction
*	Multiplication
/	Division
%	Remainder **[Modulo division]**

❖ **Example:** If a = 12 and b = 5, then

a + b = 17

a % b = 2 (**Remainder**)

Note:— In **Modulo division (%)**, the **Sign** of the result is always like the first **operand**.

Example: – 12 % 5 = – 2

2. Relational operators

❖ **Relational operator** is used to compare two **values**.

❖ These **operators** need two **operands**.

❖ If the comparison relation is correct (**true**), then the **return value** will be **1** and if wrong (**false**), the **return value** will be **0**.

❖ The **operands** being compared must be of the same type.

❖ Following are the **Relational operators** used in **C language**.

Operator	Meaning
<	Less than
>	Greater than
< =	Less than or equal to
> =	Greater than or equal to
! =	Not equal to
= =	equal to

Example – If the **value** of a, b and c is 2, 3 and 5 respectively, then

Relation Expression	Result	Value
a < b	true	1
(a + b) < = C	true	1
a = = b	false	0
b ! = 5	true	1

3. Logical operators

❖ In this, **operands** can be **logical** or **Relational expressions** too. The result of **Logical expressions** comes in **True (1)** or **false (0)**.

Logical operators are as follows—

Operator	Meaning
&&	Logical AND
||	Logical OR
!	Logical NOT

5. Which of the following format specifiers can be used to read floating type values in C programming? [Senior Computer Instructor 19.06.2022]
(A) % e (B) % f
(C) % g (D) All options are correct

6. Assume that p and q are non-zero positive integers, the following program segment will display—
```
While (p!= 0)
{
If (p>q)
p=p-q;
else
q=q-p;
printf("%d",p);
```
[Basic Computer Instructor Exam 18.06.2022]
(A) Will subtract smaller number from larger number
(B) Will calculate GCD of given numbers
(C) Will calculate LCM of given numbers
(D) Loop will run infinitely

7. What are the various types of real data types (floating point data types) in 'C'? [Basic Computer Instructor Exam 18.06.2022]
(A) float, long double
(B) long double, short int
(C) float, double, long double
(D) short int, double long int, float

8. What is the result after the execution of the following code, if 'a' is 10, 'b' is 5 and 'c' is 10?
```
if ((a>b)&&(a<=c))
a=a+1;
else
c=c+1;
```
[Basic Computer Instructor Exam 18.06.2022]
(A) a = 10, c = 10 (B) a = 11, c = 10
(C) a = 10, c = 11 (D) a = 11, c = 11

9. Which structure allows the program to make a choice between two alternate paths depending upon the condition? [Raj. IA Exam 2018]
(A) Sequence (B) Selection
(C) Iteration (D) Logic

10. Which is not a data type of C? [Raj. IA Exam 2018]
(A) float (B) int
(C) char (D) class

11. The following two C language statements are equivalent to, n = * &q. These statements are—
```
p = &q;
n = *p;
```
which are further equivalent to, [Raj. IA Exam 2018]
(A) n = p (B) p = q
(C) n = p* q (D) n = q

12. ... error arises due to incorrect use of syntax. [Raj. IA Exam 2018]
(A) Compile time error (B) Linking error
(C) Run time error (D) Input error

13. COBOL and Pascal are examples of ... programming languages. [Raj. IA Exam 2018]
(A) Object oriented (B) Scripting
(C) Structured (D) Object based

14. In conversion of HLL to machine language the syntax analysis part is called as ... [Raj. IA Exam 2018]
(A) Parsing (B) Lexical analysis
(C) Semantic analysis (D) Linking

15. If two strings are identical then strcmp() function returns— [Raj. IA Exam 2013]
(A) -1 (B) 1 (C) 0 (D) 'y'

16. Which of the following is an Invalid Variable name in C language? [Raj. IA Exam 2013]
(A) StName (B) St_Name
(C) St12Name (D) St.Name

17. The rule for Implicit type conversion in C Language is— [Raj. IA Exam 2013]
(A) int < unsigned < float < double
(B) unsigned < int < float < double
(C) int < unsigned < double < float
(D) unsigned < int < double < float

18. The software which converts a Program into Assembly Language is called— [Raj. IA Exam 2013]
(A) Compiler (B) Assembler
(C) Interpreter (D) Loader

19. What is the name of the Table indicating the logical types of Boolean Expressions? [Raj. IA Exam 2013]
(A) False Table (B) Truth Table
(C) Logical Table (D) None of these

20. Which of the following C Statement is Syntactically Correct? [Raj. IA Exam 2013]
(A) for (); (B) for (;;
(C) for (.); (D) for (;;;

21. The inventor of 'C' language is— [Raj. IA Exam 2013]
(A) Dennis Ritchie (B) L.Bark
(C) James Haward (D) C. Cannon

22. An unconditional control structure is— [RPSC Programmer Exam 2013]
(A) do-while (B) if
(C) goto (D) switch-case

23. A pointer is— [RPSC Programmer Exam 2013]
(A) A keyword used to create variables
(B) A variable that stores address of an instruction
(C) A variable that stores address of other variable
(D) All of the above

24. In 'C' language, a for loop can be prevented from entering an infinite loop state by— [Raj. IA Exam 2011]
(1) continue statement (2) goto statement
(3) return statement (4) break statement
(A) (1), (2), (3) are correct
(B) (1), (2), (4) are correct
(C) (2), (3), (4) are correct
(D) (1), (3), (4) are correct

Answer Sheet

5.(D)	**6.**(D)	**7.**(C)	**8.**(B)	**9.**(B)	**10.**(D)	**11.**(D)	**12.**(A)	**13.**(C)	**14.**(A)
15.(C)	**16.**(D)	**17.**(A)	**18.**(A)	**19.**(B)	**20.**(D)	**21.**(A)	**22.**(C)	**23.**(C)	**24.**(C)

2 Introduction of Object Oriented Programming (OOPs)

Programming Paradigms

❖ Programming paradigms are the way of writing a Computer program. There are four types of Programming paradigms—
1. Monolithic programming paradigm
2. Structured–oriented programming paradigm
3. Procedural–oriented programming paradigm
4. Object–oriented programming paradigm

(1) Monolithic Programming Paradigm

❖ This is the oldest paradigm; it is also called the **imperative programming paradigm**. Its characteristics are as follows—
- ✧ In this, the entire program is written in a **single block**.
- ✧ In this, the **'goto' statement** is used to move from one statement to another.
- ✧ It uses all Data as **global data**, due to which there is **Data insecurity**.
- ✧ **Flow control statements** like if, switch, for, and while etc. are not used in this.
- ✧ There is no concept of **data type** in this.
- ✧ The example of Monolithic programming paradigm is— **Assembly language**.

(2) Structured–Oriented Programming Paradigm

❖ This paradigm is the **advance form** of the monolithic paradigm. Its characteristics are as follows—
- ✧ This paradigm introduces a **modular programming concept**. Where a **large program** is divided into **Small modules**.
- ✧ It provides the concept of **reusability** of Code.
- ✧ In this, the **data type concept** has been used.
- ✧ It also provides **Flow control statements** which give more control to the User.
- ✧ In this paradigm, all Data is used as **global data** which is **insecure**.

❖ Examples of Structured-oriented programming paradigm are— **ALGOL, Pascal, PL/I and Ada**.

(3) Procedural–oriented programming paradigm

❖ This paradigm is the **advance form** of the structure-oriented paradigm. Its characteristics are as follows—
- ✧ This paradigm introduces a **modular programming concept**. Where a **larger program** is divided into **Small modules**.
- ✧ It provides the concept of **reusability** of Code.
- ✧ In this, the **data type concept** has been used.
- ✧ It also provides **Flow control statements** which give more control to the User.
- ✧ It follows all concepts of Structure-oriented programming paradigm but Data is defined as **global data** and **local data** is also defined for individual modules.
- ✧ In this paradigm, **functions** can change data from one form to another and it follows **top-down flow** in execution.

❖ Examples of Procedure-oriented programming paradigm are— **C, Visual Basic, FORTRAN** etc.

(4) Object–oriented programming paradigm

Object-oriented programming paradigm is the **most popular paradigm**, its characteristics are as follows—
- ✧ In this, all programs are created on the concept of **object**.
- ✧ In this, **objects Communicate** with each other through **function**.
- ✧ This paradigm mainly **focuses** on **data** rather than functionality.
- ✧ In this paradigm, the program is divided into parts (which are called **Objects**).
- ✧ It follows **bottom-up flow** in execution.
- ✧ This paradigm introduces concepts like **data abstraction, inheritance and overloading of functions** and **operators overloading**.
- ✧ In this Paradigm, **data is hidden** and cannot be accessed by any **external function**.
- ✧ It holds the Concept of **friend function** and **Virtual function**.
- ✧ In this paradigm, everything is related to **objects**.

❖ Examples of Object-oriented programming are— C++, Java, C#, Python etc.

Concepts of OOP

❖ **Object-oriented programming**, as the name suggests, means **objects** are used in programming.

❖ The **main objective** of **OOP** is to implement **real-world entities** like **inheritance**, **hiding**, **polymorphism**, etc. in **programming** and to **bind** the **data** and the **functions** working on them together, so that **no other part of the Code** can **access** this **data** except the **function**.

The following are the main **Concepts** of **OOPS**:

- ✧ Class
- ✧ Objects
- ✧ Encapsulation
- ✧ Abstraction
- ✧ Inheritance
- ✧ Polymorphism

29. Which statement is true regarding Procedural-oriented programming? (i) It follows the concept of code reusability. (ii) It follows the data type concept. (iii) It defines local data for individual modules.
(A) (i) and (ii) (B) (ii) and (iii)
(C) (i) and (iii) (D) (i), (ii) and (iii)

30. Which Operator overload is used for the Friend function (in C++)—
(A) = (B) –> (C) * (D)()

31. If the member of the Base Class is a protected type specifier and private type inheritance is used, then how will the member of the base class be accessed?
(A) Private (B) Public
(C) Protected (D) All of above

32. Which type of member function of the base class cannot be directly accessed by the derived class in OOPS?
(A) Public (B) Private
(C) Protected (D) All of the above

Previous Year Competitive Exam Questions

1. What does the following code do?

```
public class Example {
private int var;
public Example(int var) {
this.var = var;
}
}
```

[RPSC Programmer Exam 27.10.2024]
(A) Creates a new instance of the class Example.
(B) Throws an error because this cannot be used.
(C) Assigns the parameter var to the instance variable var.
(D) Compilation Error.

2. .....is mechanism by which one class acquires the properties-data fields and methods of another class. [Raj. Informatics Assistant Exam 21.01.2024]
(A) Class (B) Encapsulation
(C) Inheritance (D) Polymorphism

3. …… is the separation of the logical view of data from its implementation. [Raj. Informatics Assistant Exam 21.01.2024]
(A) Control Structure (B) Data Abstraction
(C) Testing (D) Initialisation

4. Class is— [RPSC Programmer Exam 2013]
(A) Collection of objects
(B) Return type
(C) A parameter
(D) A template of object to be created

5. Polymorphism is achieved using— [RPSC Programmer Exam 2013]
(A) Method overloading (B) Method passing
(C) Aliasing (D) All of the above

6. Object oriented programming tends to achieve— [RPSC Programmer Exam 2013]
(A) High coupling, Low cohesion
(B) High coupling, High cohesion
(C) Low coupling, High cohesion
(D) Low coupling, Low cohesion

7. What term is used to describe the internal representation of an object that is hidden from view outside the object's definition? [RPSC Programmer Exam 2013]
(A) Encapsulation (B) Expandable
(C) Polymorphism (D) Inheritance

8. ……. is a blueprint or prototype that defines the variables and the methods common to all objects of a certain kind.
Select the best word to complete this sentence. [RPSC Programmer Exam 2013]
(A) Class (B) Inheritance
(C) Polymorphism (D) Aggregation

9. Which of the statements is true in a protected derivation of a derived class from a base class? [RPSC Programmer Exam 2013]
(A) Private members of the base class become protected members of the derived class
(B) Protected members of the base class become public members of the derived class
(C) Public members of the base class become protected members of the derived class
(D) Protected derivation does not affect private and protected members of the derived class

10. The members of a class, by default are— [RPSC Programmer Exam 2013]
(A) public (B) protected
(C) private (D) mandatory to specify

11. A copy constructor takes— [RPSC Programmer Exam 2013]
(A) no argument
(B) one argument
(C) two arguments
(D) arbitrary no. of arguments

12. In object oriented programming, an object is an instance of : [Raj. IA Exam 2018]
(A) Class (B) State
(C) Behaviour (D) Message

13. When the Compiler cannot differentiate between two overloaded constructors, it is called— [Raj. IA Exam 2013]
(A) Overloaded (B) Destructed
(C) Ambiguous (D) Dubious

14. An object-oriented programming concept that refers to the ability of a variable, function, or object to take on multiple forms is— [Raj. IA Exam 2018]
(A) Inheritance (B) Hierarchy
(C) Polymorphism (D) State Transition

Answer Sheet

29.(D)	**30.**(C)	**31.**(A)	**32.**(B)	**1.**(C)	**2.**(C)	**3.**(B)	**4.**(D)	**5.**(A)	**6.**(C)
7.(A)	**8.**(A)	**9.**(C)	**10.**(C)	**11.**(B)	**12.**(A)	**13.**(C)	**14.**(C)		

3 Introduction of C++ Language

❖ C++ is an **object-oriented programming language (OOPS)** and an intermediate language.
- ✧ In 1979, C++ was initially called **"C with classes,"** and in 1983, its name was changed to C++. "++" is a shorthand for adding one, meaning **"one higher than C."**
- ✧ In 1983, C++ was officially recognized as an Object-Oriented Programming Language. After this, several features were added, such as function overloading, operator overloading, exception handling, and templates.
- ✧ After that, new versions of C++ were released, such as **C++11** (improved support for multithreading, lambdas, and type inference), **C++14** (bug fixes and improvements), **C++17** (feature structured binding, improved constexpr), and **C++20** (coroutines, ranges, modules). Currently, the latest version is **C++23**.
- ✧ C++ was developed by **Bjarne Stroustrup** in 1983 at **AT&T Bell Laboratories**. The C++ language was previously also called the "C with classes" language.
- ✧ C++ is an updated version of the C language, meaning C++ programs include OOP concepts along with C. For this reason, it is also called a **hybrid language**.
- ✧ C++ supports both low-level and high-level programming. Because of this, it is also known as a **middle-level language**.
- ✧ The main objective of C++ programming was to add object-oriented concepts to the existing C programming language.
- ✧ C++ language **(source code)** is machine-independent and platform-independent, but **compiled executable (binary) code** is machine-dependent and platform-dependent. (Meaning, a program compiled on Linux will not run on Windows).
- ✧ C++ language is a **case-sensitive** programming language; for example, "cin" is used to take input from the input stream, but "cin" will not work.
- ✧ There is a requirement for at least **one function** (the main function) to run a program in C++.
- ✧ C and C++ were invented at the same place: **AT&T (American Telephone & Telegraph) Bell Laboratories**, located in the U.S.A.
- ✧ The **operator overloading** concept was borrowed from **Algol 68**.

Structure of C++ Program

❖ In **C++**, a program mainly has **four parts**. These parts can also be kept in **separate source files** and can be compiled together or separately later.

Part 1 → Include file
Part 2 → Class declaration
Part 3 → Definition of Member function
Part 4 → Main () function

❖ Printing "**Hello program**" on the **Output screen** in a **simple program** in **C++ programming language**.

Program :

❖
```
# include < iostream > // include header file
using namespace std ;
int main ()
{
cout << "Hello program" ;
return 0 ;
}
```
Output :
Hello program

❖ The **main () function** is mandatory in a **C++ program**.

❖ In a **C++ program**, the statement is terminated with a **semicolon (;)**.

// (double slash) - It is used to write **comment lines** in the program. This line does not **execute** in the program.

Example –
// This is my first program

❖ **/ * * /** — It is used to write **more than one comment line**.

Example –
/ * I make a
program in C ++ */

❖ **#sigh** This is called the **pre-processor directive statement**.
In **C++**, it is used at the **beginning of the program**. The statement written after this is processed before the **program compilation**.

iostream file

❖ **iostream** is a **header file** that contains **pre-existing programs** or **statements**. By using the statement **# include < iostream >** , all the content of the **iostream**

4 Introduction of Java

History of Java

- James Gosling and his team started Java in **1991** while working at **Sun Microsystems**. Their main goal was to make a language that could easily run on different **types of consumer electronic devices** (like set-top boxes, TV, etc.). At first, James Gosling called it '**GreenTalk**' and its extension was '**.gt**'.
- **Sun Microsystems** officially launched Java in **1995**. Initially, it was named "**Oak**", but later renamed to "**Java**". The first version was called "**Java 1.0**", and its aim was to make **portable, secure, and distributed applications**.
- After the **first public release** in 1996, it got recognition as a **platform-independent language**. This is because Java programs could be compiled into **bytecode**, which could be run anywhere by the **JVM**.
- In 2000, Sun Microsystems launched **J2EE (Java 2 Platform, Enterprise Edition)**, **J2SE (Java 2 Platform, Standard Edition)**, and **J2ME (Java 2 Platform, Micro Edition)** versions. These supported different Java applications – for **enterprise applications**, **standard applications**, and **embedded systems**.
- Sun Microsystems released Java to the **open-source community** in 2004 and developed **OpenJDK (Open Java Development Kit)**. This increased the world's participation in Java's development.
- **Oracle Corporation** acquired Sun Microsystems in **2009-10**. Now, Java is developed and maintained under **Oracle**.
- Java is designed to be **platform-independent**. This means it can run on any **operating system** without changes. The main feature of Java is **Write Once, Run Anywhere (WORA)**. This means after writing the code once, you can run it on any platform without any problem, provided that the **Java Runtime Environment (JRE)** is available on that platform.

Major Features of Java:

1. **Platform Independence**: Java programs compile into **bytecode**. The **Java Virtual Machine (JVM)** can execute this on any platform. This means you can write a Java program once and run it on any system.
2. **Object-Oriented**: Java is an **object-oriented language**. This means everything in Java is in the form of **objects and classes**. This principle increases **code reuse and maintainability**.
3. **Simple and Easy to Learn**: Java's **syntax** is similar to **C and C++**, but some complexity has been removed. This makes it easy to write and use.
4. **Security**: Java has **built-in security features**, like **bytecode verification**, **runtime security checks**, and **secure communication mechanisms**.
5. **Multithreading**: Java supports **multithreading**. This allows executing multiple tasks in **parallel** at the same time.
6. **Automatic Memory Management**: Java has a **garbage collection** facility. This automatically removes **unused objects** from memory, making memory management easy.

- Java is used in **Web, Mobile, Enterprise, Software Tools, and Big Data Technology**.

How Java Program Runs:

- There are many steps in the process to run a Java program. In Java architecture, **Java source code** is compiled into **bytecode**. Later, the **Java Virtual Machine (JVM)** executes it.

Steps to Run a Java Program:

1. **Writing Java Source Code**: We write the Java program in a text file with the "**.java**" extension. We define **classes and methods** following Java syntax.

   Example:

   // File name = HelloWorld.java

   Program:

   ```
   public class HelloWorld {
       public static void main(String[] args) {
           System.out.println(''Hello, World!''); // Prints
        the message
       }
   }
   ```

2. **Compiling Java Source Code:** Java source code is compiled through the **Java compiler (javac)**. While compiling, the source code is converted into **bytecode** (which is **machine-independent**). This bytecode is stored in a **".class"** file.

   Command: javac HelloWorld.java

   - ✧ The **javac** command invokes the compiler.
   - ✧ This command compiles the **HelloWorld.java** file and creates a **"HelloWorld.class"** file, which contains bytecode.

3. **Executing Java Bytecode:** The **Java Virtual Machine (JVM)** is needed to run Java bytecode. The JVM interprets the bytecode and executes it according to the **current operating system** and **hardware architecture**.

   Command: java HelloWorld

   - ✧ The **java** command invokes the JVM, and it

42. What is the Default Value of float Variable in Java (at Class Level)?
(A) 0 (B) 0.0
(C) 0.0f (D) null

43. What is the full name of JDK?
(A) Java Development Kit
(B) Java Deployment Kit
(C) Java Debugging Kit
(D) Java Data Kit

44. Which tag is used to add Applet in HTML?
(A) <java> (B) <applet>
(C) <script> (D) <code>

45. For what is the extends keyword used?
(A) To implement Interface
(B) For Inheritance
(C) To import Package
(D) To declare Variable

46. Where are String objects stored in Java?
(A) Top on Stack (B) String Constant Pool
(C) Register variable (D) In ROM memory

Previous Year Competitive Exam Questions

1. Which of the following is correct definition of Coupling in Java language? [RPSC Programmer Exam 27.10.2024]
(A) Degree to which elements of a module belong together.
(B) The ability of a class to inherit from other classes.
(C) Process of hiding internal details of a module.
(D) Degree of direct knowledge one class has of other.

2. Which command is used to convert the code written in Java to bytecode? [RPSC Programmer Exam 27.10.2024]
(A) javap (B) java
(C) javadoc (D) javac

3. Which of the following streams is used to deserialization the primitive data and objects in Java? [RPSC Programmer Exam 27.10.2024]
(A) PrintWriter (B) BufferedReader
(C) FileWriter (D) ObjectInputStream

4. What is Polymorphism in Java? [RPSC Programmer Exam 27.10.2024]
(A) The ability of a single method to perform different tasks.
(B) The ability of different methods to perform different tasks.
(C) The ability of a class to inherit properties of another class.
(D) The ability of a single variable to hold multiple values.

5. What is the output of the following code?

```
public class Demo {
public static void main(String[] args) {
int x=5;
System.out.println(++x*2);
}
}
```

[RPSC Programmer Exam 27.10.2024]
(A) 12 (B) 11
(C) 10 (D) Compile time error

6. What is bytecode in Java? [RPSC Programmer Exam 27.10.2024]
(A) Machine-dependent code in Java.
(B) Source code in Java.
(C) Intermediate machine-independent code generated by Java compiler.
(D) Machine code specified to a processor.

7. Which of the following class in Java is responsible for handling files? [RPSC Programmer Exam 27.10.2024]
(A) FileStream (B) FileHandler
(C) File (D) FileManager

8. Which syntax is incorrect to initialize a two-dimensional array in Java? [RPSC Programmer Exam 27.10.2024]
(A) int myarr[][] = new int[3][4];
(B) int[][] myarr = {{1, 2, 3}, {4, 5, 6}};
(C) int[][] myarr = new int[3][4];
(D) int myarr = new int[3][4]; [D]

9. Which of the following is the correct way to create an abstract class in Java? [RPSC Programmer Exam 27.10.2024]
(A) class Demo { abstract void fun(); }
(B) class abstract Demo { void abstract fun(); }
(C) abstract class Demo { abstract void fun(); }
(D) abstract class Demo { void fun() { abstract; } }

10. Which of these classes are the direct subclasses of the Throwable Class? [RPSC Programmer Exam 27.10.2024]
(A) Exception and VirtualMachineError Class
(B) Error and Exception Class
(C) IOException and VirtualMachineError Class
(D) Runtime Exception and Error Class

11. Which statement is true about an Interface in Java? [RPSC Programmer Exam 27.10.2024]
(A) An interface cannot extend another interface.
(B) An interface can contain implemented methods.
(C) An interface can contain instance variables.
(D) A class can implement multiple interfaces.

Answer Sheet

42.(C)	**43.**(A)	**44.**(B)	**45.**(B)	**46.**(B)		**1.**(D)	**2.**(D)	**3.**(D)	**4.**(A)
5.(A)	**6.**(C)	**7.**(C)	**8.**(D)	**9.**(C)	**10.**(B)	**11.**(D)			

5 .NET (Dot NET)

.NET

- **.NET** is a **software framework** developed by **Microsoft**.
- It is an **open-source**, **cross-platform framework** that helps **developers** build various types of **applications**.
- The main objective of **.NET** is to provide a **unified platform** on which we can build **applications** like **web**, **mobile**, **desktop**, **cloud**, and **gaming**.
- **Dot Net (.Net)** is a **platform** based on which **Microsoft** has developed many languages.
- The **languages** that use this platform are called **Dot Net programming languages**.
- **Dot Net framework** works as an **intermediate level** between the **operating system** and the **program** written by the user.

History of .NET:

- **1999: Microsoft** introduced **.NET** as **Next Generation Windows Services (NGWS)**. Its purpose was to provide a **unified platform** useful for building various applications.
- **2002: .NET Framework 1.0** was launched, which included key components like **CLR (Common Language Runtime)** and **BCL (Base Class Library)**. It worked only on **Windows**.
- **2005: .NET Framework 2.0** was launched, in which new features like **Generics** and **ASP.NET 2.0** were added.
- **2006-2007: .NET Framework 3.0** and **3.5** were launched, which had new features like **WPF**, **WCF**, **WF**, and **LINQ** was added.
- **2016: .NET Core** was launched, which was **cross-platform** and **open-source**. It worked on **Windows**, **Linux**, **macOS** and was **lighter** and more **scalable**.
- **2020: .NET 5** was launched, which integrated **.NET Framework** and **.NET Core**. It was **cross-platform** and **cloud-friendly**.
- **2021: .NET 6** was launched with **LTS (Long-Term Support)**, making it a **unified**, **high-performance platform** for .NET.
- As of **Nov.-Dec. 2025**, the **latest version** of .NET is **.NET 10.0.1**. This is a **Long-Term Support (LTS)** version, which means that **Microsoft** will provide **Security updates and support** for it for the next **3 years (November 2028)**.

Feature of .Net Framework

- By using the **Dot net framework**, users can **create mobile**, **desktop**, and **web applications**. Its main **features** are as follows:

1. **Common Execution Environment (CEE):** All **.Net applications** execute in a single **environment**. This environment is called **Common Language Runtime (CLR)**.
   - **CLR** provides a **common environment** to execute the **code** of different **languages** like **C#**, **Visual Basic**, **Visual C++**, etc.
2. **Common Type System (CTS): .Net framework** follows **CTS**. Due to this, the **data integrity** of different **languages** can be maintained.
   - Through **CTS**, **objects** of **programs** written in various **programming languages** can **communicate** with each other so that **data** can be **shared** with one another.
3. **Multi Language Support: .Net framework** supports various **programming languages** like **vb.net**, **C#**, **F#**, etc. For this, the **compiler** converts the **code** of different languages into **MSIL Code**. In this, the code of all languages is handled in the same way.
4. **Tool Support:** In the **.net framework**, **CLR** works with various **tools** like **Visual Studio**, **debugger**, **profilers**, etc. The use of these **tools** makes the **developer's** work easier.
5. **Security:** In the **.net framework**, **permissions** are given to the user as per requirement so that the user can be **restricted**. In this, the **identity** of the **code** is also known.
6. **Automatic Resource Management:** In the **.net framework**, **CLR** provides **automatic resource management** like **memory**, **network connections**, **database**, etc.
   - **CLR invokes** (calls) many **built-in functions** to **allocate** and **de-allocate** the **memory** of the **.net object**.
7. **Debugging:** In this, the **IDE (Integrated Development Environment)** provides easy and powerful **debugging support** provides. If any **exception** occurs while running the **Program**, the **IDE** marks the line where the **error** has occurred.
8. **Framework Class Library :** The **Framework Class Library (FCL)** is a group of more than one **Classes**. Using these **Classes**, a **developer** performs specific tasks. Such as – with **files**, **web services**, **data access**, and drawing **graphics**, etc. This is a vast collection of **Ready-made code**.
9. **Portability : Applications** or **software** created in the **.net environment** are **portable**.
   - In the **.net framework**, all **languages** are **powerful**, **type-safe**, and **object-oriented**.
   - **Asp.net** is an **open source**, **web framework** in which the **user** can create a very good **website** using **HTML**, **CSS**, and **Java Script**.

6 Artificial Intelligence (AI)

- The full form of AI is **Artificial Intelligence.** In AI, machines are used to work like humans and think like humans.
- **AI is a branch of computer science that gives machines and systems the ability to think and understand like human intelligence.**
- **Artificial Intelligence includes many technologies, such as machine learning, natural language processing, computer vision, and robotics etc.** These technologies help AI systems to perform complex tasks like **speech recognition** and **face detection** with remarkable accuracy.
- Research on AI started in **1950**. The "Logic Theorist" designed by Newell and Simon in **1955** can be considered the **First AI program**.
- AI is a simulation through which **human intelligence is given to a machine**, meaning the machine is upgraded so that it can think and work like humans.
- There are mainly three processes in this procedure.
  - **First-learning**—In this, **information is put into the machine's brain**. So that it can follow those rules to do a task.
  - **Second–Reasoning**—In this, the **machine is instructed** that it should follow the made rules and give the result accordingly.
  - **Third–self correction**—In this, the **machine has to solve the problem by itself** and finally give the result.

History of AI

- **Early Concepts**—The concept of AI was in old Greek mythology. In the 17th century, philosophers like Rene Descartes understood human thinking and reasoning.
- **1950s : Beginning of Modern AI—Alan Turing** gave the **Turing Test** in 1950, which measures a machine's intelligence. In **1956**, **John McCarthy established AI as a subject at the Dartmouth Conference**. **John McCarthy is called the father of Artificial Intelligence**.
- **1960s : First AI Programs—ELIZA**, a chatbot, was made which simulated human conversation.
- **1980s : Expert Systems—Expert systems** were developed, which did decision-making like human experts.
- **1990s : Deep Blue**—IBM's **Deep Blue** defeated world chess champion **Garry Kasparov** in 1997, which was a major breakthrough for AI.
- **2000s : Machine Learning and Big Data**—AI systems developed due to **Big data** and powerful computing resources, such as in computer vision and speech recognition.
- **2010s : Deep Learning—Deep learning** and **neural networks** took AI to a new level, and applications like **self-driving cars** and **virtual assistants** were developed.

Core Concepts in AI

- **Artificial Intelligence (AI)** works on some core concepts and technologies, which help machines to perform those tasks that usually require human intelligence. Some foundational concepts are these:

1. **Machine Learning (ML):** This is the **backbone of AI**, where algorithms learn from data without any external program. These algorithms are improved by training on a data set, so that predictions or decisions can be made based on new data.
2. **Neural Networks:** These are networks inspired by the **human brain** that mimic the interaction of neurons, allowing computers to recognize patterns and solve common problems. **Neural Networks have many nodes or units** and these are connected in layers and learn patterns by seeing Data.
3. **Deep Learning:** This is a **subset of ML**, in which complex neural networks are used that analyze data in many layers. This is very important for tasks like **image and speech recognition**.
4. **Natural Language Processing (NLP):** In NLP, computers are programmed to process and analyze large amounts of natural language data, so that interactions can happen between humans and machines.
5. **Robotics:** It merges **AI concepts** with **physical components** to make machines that can perform many tasks, like **assembly lines** and **complex surgeries**.
6. **Cognitive Computing:** It is an approach of **AI** that solves complex problems by mimicking **human brain processes**, which uses **pattern recognition, NLP**, and **data mining**.
7. **Expert Systems:** These are **AI systems** that emulate the **decision-making abilities** of human experts to reach conclusions using **reasoning capabilities**. This is **rule-based AI**.

How Does AI Work

- **Artificial Intelligence** helps machines to learn from **data** and recognize **patterns**, so that they can perform tasks more **efficiently** and **effectively**. This is a very **management/business** way of working of AI. Technically, the flow of **AI/ML** is as follows—
  Data collection → Training → Model → Prediction

14. Which rule applies to Simple reflex agent—
(A) Simple-action rule
(B) Simple & Condition-action rule
(C) Condition-action rule
(D) None of the above

15. The reason for uncertainty in the Wumpus World Problem is that the sensor gives only ..... —
(A) Full & Global Information
(B) Partial & Global Information
(C) Full & Local Information
(D) Partial & Local Information

16. The process of capturing the Inference process as a Single Inference Rule is called—
(A) Clauses (B) Ponens
(C) Generalized Modus Ponens
(D) Variables

17. Which AI technique enables the computer to understand the relationships between objects and events—
(A) Heuristic Processing (B) Cognitive Science
(C) Relative Symbolism (D) Pattern Matching

18. The search algorithm which is similar to Minimax search, but removes those branches which do not affect the final output, is known as—
(A) Depth-first Searching (B) Breadth-first Searching
(C) Alpha-beta Pruning (D) None of the above

19. Statement 1: A* Algorithm is an Informed Search Technique which uses Heuristic Function.
Statement 2: BFS (Breadth-First Search) is an Uninformed Search Technique.
(A) Both Statement 1 and Statement 2 are correct
(B) Both Statement 1 and Statement 2 are incorrect
(C) Statement 1 is correct but Statement 2 is incorrect
(D) Statement 1 is incorrect but Statement 2 is correct

20. Which of the given options is known as inference rule—
(A) Reference (B) Reform
(C) Resolution (D) None of the above

21. Which process makes two different Logical expressions identical—
(A) Unification (B) Lifting
(C) Inference Process (D) None of the above

22. Which option is used to construct Complex sentences in Knowledge representation—
(A) Symbols (B) Connectives
(C) Quantifier (D) None of the above

23. Automatic Reasoning tool is used in ... —
(A) Personal Computers (B) Microcomputers
(C) LISP Machines (D) All of the above

24. Which AI based device provides route and assistance to the user to go to a place—
(A) Tesla (B) Google map
(C) Nest (D) Echo

25. From where do we start in Forward Chaining Inference Technique?
(A) From Goal (B) From Known Facts
(C) From Conclusion (D) From Random point

26. The Truth Value of a statement in Fuzzy Logic can be between what?
(A) Only 0 and 1 (B) -1 and 1
(C) Between 0 and 1 (D) True and False

27. Reinforcement Learning is based on what?
(A) On Labeled Data
(B) On making Clusters
(C) On Reward and Penalty
(D) On Rules

28. What is the main use of Backward Chaining?
(A) To extract new facts from Data
(B) To verify Facts starting from Goal
(C) To store Data
(D) To make User Interface

29. What are called Stop Words in NLP?
(A) Important Keywords
(B) Words which are removed
(C) The last word of the sentence
(D) Wrong words

Previous Year Competitive Exam Questions

1. Who is the father of Artificial Intelligence (AI)?
[Senior Computer Instructor Exam 19.06.2022]
(A) Ada Fisher (B) Alan Turing<
(C) John McCarthy (D) Allen Newell

2. Select the correct statements—
(i) Simplex reflex agents make decisions based on current perception and past history.
(ii) When the agent's next state can be completely determined by the uniqueness of the agent's current state, such an environment is called deterministic.
(iii) If the environment does not change with time, but the agent's performance score changes, then it is called a semi-dynamic environment.
[Senior Computer Instructor Exam 19.06.2022]
(A) (i) and (iii) (B) (i) and (ii)
(C) (ii) and (iii) (D) All of the above

3. Which agent in Artificial Intelligence (AI) is related to happy and unhappy states?
[Basic Computer Instructor Exam 18.06.2022]
(A) Simple Reflex Agent (B) Model Based Agent
(C) Learning Agent (D) Utility Based Agent

4. What is the full name of "LISP" programming language? [Exam DSSB-PGT-2021]
(A) Least processing (B) Limited processing
(C) language processing (D) List processing

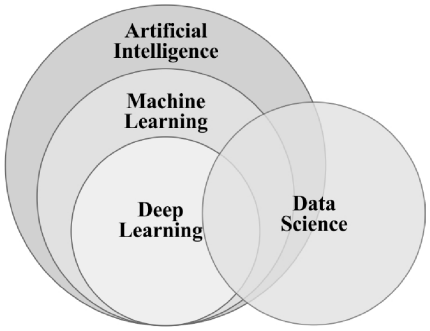
5. What is the full name of FOPL in Artificial Intelligence? [DSSB-PGT-2021]
(A) File open predicate logic
(B) First operator performance logic
(C) File operator perforate logic
(D) First order predicate logic

Answer Sheet

14.(C)	**15.**(D)	**16.**(C)	**17.**(D)	**18.**(C)	**19.**(A)	**20.**(C)	**21.**(A)	**22.**(B)	**23.**(C)
24.(B)	**25.**(B)	**26.**(C)	**27.**(C)	**28.**(B)	**29.**(B)				
1.(C)	**2.**(C)	**3.**(D)	**4.**(D)	**5.**(D)					

7 Machine Learning

- **Machine Learning (ML)** is a technology that is a subset of **Artificial Intelligence (AI)**. In this, machines are given the ability to learn through **data** and understand patterns. This allows them to improve their decisions and actions without external programming.
- In **Machine Learning**, systems **train** themselves to make better decisions based on new data. It uses **algorithms** that understand data patterns, analyze them, and generate **predictions** or decisions.
- **Machine learning** is a branch of **artificial intelligence** that gives algorithms the ability to uncover hidden patterns inside **datasets**. This allows them to make predictions on new and similar data for every task without specific programming. Old machine learning combines data with statistical tools to predict output that creates **Actionable Items**. The **learning algorithm** improves its performance and gains experience over time.
- This technique is used in many different fields, such as **image and speech recognition**, **natural language processing**, **recommendation systems**, **fraud detection**, **portfolio optimization**, and **task automation**.
- **Deep learning** is a part of **Machine learning** where **predictive analytics** is automated.
- **Arthur Samuel** invented the term **machine learning** in **1959**.
- **Geoffrey Hinton** is called the **"Godfather of AI"** or the father of **Deep learning**.
- **Alan Turing** laid the foundation of **Computer Science** and **AI**.
- For example, platforms like **Netflix** use **collaborative and content-based filtering** to recommend movies and TV shows based on the user's viewing history, ratings, and genre preferences. **Reinforcement learning** improves these systems. It gives agents the ability to take decisions based on **environmental feedback** and they continuously improve recommendations.
- The impact of **Machine learning** extends to **autonomous vehicles**, **drones**, and **robots**, which improve their adaptability in these **dynamic environments**. This method is a **breakthrough** where machines learn from data examples to produce **accurate outcomes**. It is deeply connected with **data mining** and **data science**.



Difference between Machine Learning and Traditional Programming

Machine Learning	Traditional Programming
Machine Learning is a subset of **artificial intelligence** focused on learning from data to develop an algorithm that can make a **prediction**.	In **Traditional programming**, **rule-based code** is written by developers which depends on problem statements.
Machine Learning uses a **data-driven approach**. It is usually trained on **historical data** and then predicts for new data.	**Traditional programming** is usually **rule-based** and **deterministic**. It does not have **self-learning** features like Machine Learning and AI.
Machine Learning can find **patterns and insights** in large **datasets**, which are difficult for humans.	**Traditional programming** depends completely on the developer's **intelligence**, so it has **limited capability**.
Machine Learning is a subset of AI. Now it is used in many **AI-based tasks**, like **Chatbot Question answering**, **self-driven cars**.	**Traditional programming** is used to make **applications** and **software systems** that are for **specific functionality**.

Categorization of Machine Learning

- In the **categorization** of this type of **Machine learning task**, the **user** performs it keeping only the **desired output** of the **machine learned system** in mind.

1. **Classification :** When the **learner** produces a **model** that assigns **unseen input**, then the **input** is divided into two or more **classes** through **classification**.
2. **Regression :** This is a type of **supervised**

8 Python

- **Python** is an **interpreted, High-level and General purpose object oriented programming language**. It is used in many fields like **Data science, Machine learning, Data analysis, Web Scraping, system automation, web development and API development**.
- **Python** was first created in the **1980s** and was released for the first time in **1991** by **Guido Van Rossum**. He is also known as the **creator of Python programming**.
- **Python** is an **Object Oriented Programming Language**. It is an **open source** meaning a **free programming language** because it is available under the **General Public Licence (GPL)**. Python is also a **portable and platform independent language**. Therefore, a **user** can use it on any type of **OS** like **windows, mac and linux**.
- **Van Rossum** first launched **Python's 0.9.0 version** in **1991** and **1.0 version** in **1994**, after which new versions kept coming.
- By **December 2025**, the **latest stable version** of python is **python 3.14.2**.
- **Python** is a **dynamic, high level, free open source and interpreted programming language**.

Key Features of Python :

1. **Simple and Readable Syntax:** Python's syntax is very **simple** and looks like **English**, which makes it easy to **read** and **understand**.

   Example: **print("Hello, World!")**

2. **Interpreted Language:** Python is an **interpreted language**, which means that **Python code** is executed **one by one** at **runtime**. No **compiler** is needed for this, so **developers** get the chance to **test** the code immediately.

   In Python **>>>** means that the **Interpreter** is now ready to take **instruction**. For example—

   ```
   >>> print "Hello World"
   Hello World
   ```

3. **Dynamically Typed:** Python is a **dynamically typed language**, meaning there is no need to **explicitly declare** the **data type**. Python automatically identifies the **data type** at **runtime**.

   Example:

   ```
   x = 10          # x is an integer
   x = "Hello"     # x is now a string
   ```

4. **Object-Oriented:** Python supports **object-oriented programming (OOP)**, meaning **data** and **functions** can be organized as **objects** and **classes**.

   Example:

   ```
   class Dog:
       def _init_(self, name):
       self.name = name
       def bark(self):
        print(f"{self.name} says Hi!")
   dog1 = Dog("Roxy")
   dog1.bark()
   ```

   Output:

   Roxy says Hi!

5. **Extensive Standard Library:** Python has a **huge standard library**, which is prepared to perform various types of tasks, such as **file handling, networking, web services, database connection** and much more.

   Example (File Handling):

   ```
   with open("example.txt", "r") as file:
       content = file.read()
       print(content)
   ```

6. **Cross-Platform:** Python is **cross-platform**, meaning **Python programs** can be run on various **operating systems** like **Windows, macOS, and Linux**.
7. **High-Level Language:** Python is a **high-level language**, meaning it requires less knowledge about **hardware** or the **operating system**. It provides more **abstraction** for **developers**, allowing them to do more work with less effort.
8. **Easy Integration:** Python can be easily **integrated** with other **languages** and **techniques**. It can be added with **languages** like **C/C++, Java and .NET**.
9. **Large Community and Support:** Python has a **large and active community**. If a **user** faces any **problem**, the user can easily find solutions for it **online**.
10. **Versatile and Flexible:** Python can be used for many different types of **applications**, such as **Web Development, Data Science, Machine Learning, Automation, Game Development** etc.

UNIT-IV : DATA STRUCTURE AND ALGORITHMS (DSA)

1 Data Structure & Algorithm for Problem Solving

Data Structure

- **Data Structure** is a way to **store** and **organize** Data in a computer system so that the user can use the data easily. This means Data is organized and stored in such a way that it can be **accessed easily** later as needed.
- **Data Structure** is a way to **collect** and **organize** Data, allowing the user to perform **operations** on the Data effectively.
- **Data Structure** is a method of organizing data so that **Algorithms** can work on it efficiently. It is **not a programming language**. Users use it to provide structure to Data in programming languages.
- Data structure is a **logical** and **mathematical representation** of any organization's data.

Types of Data Structure

- Mainly, Data Structures are of two types—
  1. Primitive Data Structure
  2. Non-primitive Data Structure

Primitive Data Types

Type	Description	Examples
Integer	Integer values like 1, 2, -3	int age = 45; // Integer
Float	Decimal values like 3.14, -0.98	float price = 99.99; // Float
Character	Single letter or character like 'A', 'B', '$'	char grade = 'A'; // Character
Boolean	Only two values: True (1) or False (0)	bool isPassed = true; // Boolean

Non-Primitive Data Types

Category	Type	Subtypes	Examples	Description
Linear	Data stored sequentially			
	Array	—	1, 2, 3, 4	Collection of elements stored in contiguous memory locations.
	Linked List	Singly Linked List, Doubly Linked List, Circular Linked List	10 20 30	A sequence of nodes connected via pointers.
	Stack	—	Push(10) Pop(10)	Follows LIFO (Last In, First Out) principle.
	Queue	Simple Queue, Circular Queue, Priority Queue	Enqueue(20) → Dequeue(20)	Follows FIFO (First In, First Out) principle.
Non-Linear	Tree	Binary Tree, Binary Search Tree, AVL Tree, Heap	Root + Child	Hierarchical structure (where a **root node** can have multiple **child nodes**).
	Graph	Directed Graph, Undirected Graph	A→B, A—B	Shows **nodes** (vertices) connected through **Edges**.

(1) Primitive Data Structure

- **Primitive Data Structure** is a **Data Structure** that can be **operated** directly by **machine instructions**. It is **designed** by the **system** and **compiler**.

(2) Non-primitive data structure

- **Data structures** which cannot be **operated** directly by **machine instructions**. **Non-primitive data structures** are **derived** from **primitive data**

10. What is the worst-case time complexity of heap sort? [DSSB-PGT-2018 (Female)]
(A) O (log n) (B) O (n log n)
(C) O (n) (D) O (n^2)

11. What will be the worst-case time complexity of bubble sort? [DSSB-TGT-2021]
(A) O ($\log_2 x$) (B) O (x)
(C) O (x^2) (D) O ($x \log_2 x$)

12. Which of the following Sorting techniques is mainly used for external sorting? [DSSB-PGT-2018 (Female)]
(A) Bubble sort (B) Selection sort
(C) Merge sort (D) Insertion sort

13. What is a set of step-by-step procedures to complete a task called? [UBI Bank 2011]
(A) Algorithm (B) Hardware program
(C) Software bug (D) Firmware program

14. Which of the following is a graphical representation of an algorithm? [RRB NTPC, (Shift-2) Online, 12.04.2016]
(A) Programming (B) Software
(C) Flow chart (D) Pseudocode

15. What is the type of Data Structure that can be directly operated on by Machine Instructions called? [KVS PGT 2019]
(A) Non-primitive Data Structure
(B) Primitive Data Structure
(C) Linear Data Structure
(D) Non-linear Data Structure

16. In Bubble Sort, if the Array is already Sorted, what will be its Best Case Time Complexity? [GATE CS 2011]
(A) O(n) (B) O(n^2)
(C) O(log n) (D) O(1)

17. Statement 1: Binary Search only works on a Sorted Array.
Statement 2: The Time Complexity of Linear Search is O(log n). [KVS PGT CS 2018]
(A) Both Statement 1 and Statement 2 are correct.
(B) Both Statement 1 and Statement 2 are incorrect.
(C) Statement 1 is correct but Statement 2 is incorrect.
(D) Statement 1 is incorrect but Statement 2 is correct.

18. Which Data Structure is used in Heap Sort? [ISRO CS 2017]
(A) Stack (B) Binary Heap
(C) Queue (D) Graph

19. What is the meaning of Space Complexity O(1)? [NIELIT Scientist 'B' 2016]
(A) The program takes very little time.
(B) The program requires Extra Memory.
(C) The program takes no Memory.
(D) The memory increases with the input size

20. What is the Time Complexity of Jump Search? [UGC NET CS 2019]
(A) O (n) (B) O ($\sqrt{n}$)
(C) O (log n) (D) O (n^2)

21. In which Sorting is Recursion used the most? [IBPS SO IT Officer 2017]
(A) Selection Sort & Heap Sort
(B) Bubble Sort
(C) Merge Sort & Quick Sort
(D) Insertion Sort

22. In Binary Search, if the Target Value is smaller than the Middle Element, where will we search? [TGTCS 2018]
(A) In Right Half (B) In Left Half
(C) Only in the Middle (D) Stop the Search

23. Sorting Algorithms are divided into two types: Internal and _____? [PGT Computer Science 2016]
(A) Outer (B) External
(C) Inner (D) Boundary

24. By what other name is Exponential Search known? [UGC NET CS]
(A) Galloping Search (B) Jumping Search
(C) Binary Search (D) Linear Search

25. What is the meaning of In-place Sorting? [GATE CS 2003]
(A) To sort in the same memory space
(B) To sort on Disk Storage
(C) To sort by copying to a New List
(D) To sort data over a Network

26. An example of a Non-Linear Data Structure is: [ISRO CS 2019]
(A) Queue (B) Linked List
(C) Tree (D) Stack

27. How is Quadratic Time Complexity represented? [NVS TGT (CS) 2017]
(A) O (1) (B) O (n)
(C) O (n^2) (D) O (log n)

28. In Quick Sort, where is the Pivot after Partition? [GATE CS 2009]
(A) At the End of the Array
(B) At the Start of the Array
(C) At the Correct Sorted Position
(D) At a Random Position

29. Which Data Structure is used for the Undo Operation (Recursion)? [ISRO CS 2015]
(A) Queue (B) Stack
(C) Graph (D) Tree

Answer Sheet

10.(B)	**11.**(C)	**12.**(C)	**13.**(A)	**14.**(C)	**15.**(B)	**16.**(A)	**17.**(C)	**18.**(B)	**19.**(B)
20.(B)	**21.**(C)	**22.**(B)	**23.**(B)	**24.**(A)	**25.**(A)	**26.**(C)	**27.**(C)	**28.**(C)	**29.**(B)

2 Array and Linked List

Array

Locality

- Locality is an important concept in computer science, which explains how data is being accessed. This concept is related to time and space and specifically helps in the effective use of cache memory. The main objective of Locality is to access data in such a way that the speed of processing and memory access can be improved.
- In Arrays, locality means that when we access data in an array, the access patterns of the data surrounding that data are considered. It is divided into two main types: spatial locality and temporal locality.

Types of Locality in Arrays:

1. Spatial Locality:

- ❖ Spatial Locality means that when we access a memory location (like an element of an array), there is a possibility of accessing adjacent memory locations situated near it as well. This type of access pattern is called spatial locality.
- The most common example of spatial locality in Arrays is sequential traversal, when the user accesses all elements of the array one after another.

Example: Suppose there is an array:

```
int arr[5] = {4, 8, 7, 1, 9};
int Sum = 0;
for (int i = 0; i < 5; i++)
    {
      Sum += arr[i];
    }
```

In this, the loop will first access arr[0], then arr[1], and after that arr[2], continuing to access in this manner.

2. Temporal Locality:

- Temporal Locality means that once a memory location (like an element of an array) is accessed, there is a high possibility of accessing that data again quickly. If an element has been accessed before, we can access it again in the future. This is called temporal locality.
- Temporal locality occurs in Arrays when we access a single element repeatedly. For example, if we are working on the same element of an array many times, then temporal locality is followed.

Example: Suppose we need a specific element in an array repeatedly:

```
int arr[5] = {4, 8, 7, 1, 9}
int x = arr[2];
x = arr[2] + 5;
```

Here arr[2] is being used repeatedly.

Usage and Importance of Locality:

1. **Cache Optimization**
2. **Performance Improvement**

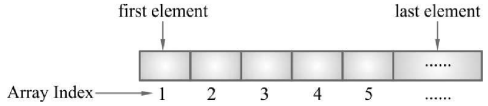
- An Array is a collection of finite sequences of **homogeneous** (similar) Data elements which is Stored in memory locations in a **Sequence**.
- The Data range of the Array is determined.
- Data of the Array is stored in **contiguous memory locations**.
- An Array Stores the **same type of Data**.
- Array is a **static data Structure**. This means that the user can determine the memory of the array at **compile time** and cannot change it at **run-time**. But in modern Programming, size can be decided at runtime according to **Dynamic array**.

Types of Array

(i) One dimensional array
(ii) Two dimensional array
(iii) Multi dimensional array

(i) One dimensional array

- A list of Item or data in which a variable name can be given using only one **subscript**. This kind of variable is called **one dimensional array**.

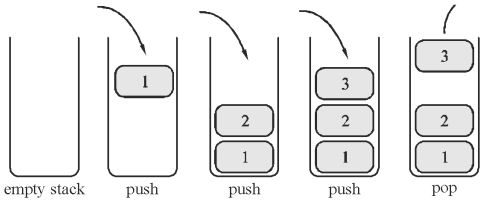


- The declaration of a One dimensional array is like a variable. The array is also declared before using it so that memory can be determined at the **time of compile**.

3 Stack and Queue

Stack

- **Stack** is a special type of **linear data structure**.
- **Stack** works on the principle of **LIFO (Last In First Out)**. That is, the item added at the end is **REMOVED** first, and the item added first is removed last.
- Adding an item to the **Stack** is called **Push operation** and removing an item is called **Pop operation**.
- **Stack** is an **Abstract Data Type (ADT)** and only items of **limited size** can be stored in it.
- The **time complexity** of all types of operations in a **Stack** is **O(1)**.
- Performing a **POP operation** on an **Empty stack** will give a "**stack underflow**" error.
- **Expression evaluation (Postfix/prefix)**, **function calls (Recursion)**, **Undo/Redo functionality in text editor**, etc., can be done through **Stack**.
- **Direct Search (Random access)** of any element cannot be done in a **Stack**.
- The **size** of the **Stack** indicates the maximum number of elements it can hold, and its **Position/index** ranges from **0 to n " 1**.
- The **first value** is stored at **index 0** and the **last value** is stored at **index n " 1**.
- When a **stack** is created, the **initial value of top is -1**. **top == -1** indicates that the **stack is currently empty**. Here, **top** is a variable that holds the **position** of the **most recently added element**.



- In the case of a **linked-list based stack**, **top** is the pointer to the **first node** and its **initial value is 'NULL'**.
- **Stack** is mainly used in all **programming languages**. For example—**Stack of playing cards**, **Pile of plates**, wearing bangles, etc., are examples of **stack** in the **real world**.
- There is only **one end** to **add** and **remove Data** in a **Stack**.

Main Operations of Stack

PUSH Operation

(i) **push ( )** – Inserting or adding an item into the **Stack**.

Push Operation Steps:
Step 1: First, check the **stack** to see if it is full.
Step 2: If the **stack is full**, it exits with an **error message**.
Step 3: If the **stack is not full**, it increments the **value of top by 1** and adds the **data element** to **top**.
Step 4: The **Operation** is complete.

Pop Operation

- The **Pop operation** is done to **delete the top element** from the stack. When we **pop**, the **top element** is removed from the stack and the **top pointer** is decreased by one **position**.

Steps of Pop Operation:

1. **Check for Underflow:** First, it is checked whether the **stack is empty (underflow)**. If the **stack is empty**, the **pop operation** cannot be done.
2. **Remove the Top Element:** Then, the **top element** is deleted from the **stack**.
3. **Decrement the Top Pointer:** The **top pointer** is decreased so that now there is a **new element** at the **top**, meaning the **size of the stack** is reduced.

Peek Operation:

- The **Peek operation** views the **top element** of the stack without removing it. It is accessed only through the **top pointer**.
- **Peek Example:** Suppose there are 30, 20, and 10 in the **stack**.

Initial Stack:
Top → 30 → 20 → 10

Peek Operation:

Step 1: Look at the **Top pointer**, without removing any element, we can see the **top element 30**.
Peek = 30

IsEmpty Operation: The **IsEmpty operation** checks whether the **stack** is empty or not. If the **top pointer** is **NULL** or **-1**, then the stack is empty.

Example:

Initial Stack: Top → NULL

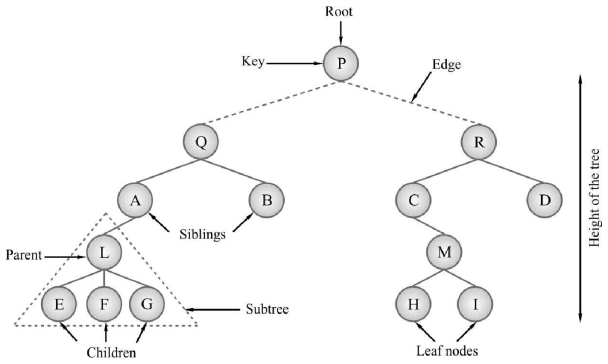
Step 1: We check if the stack is empty.

Because the **top pointer** is **NULL** here, the stack is empty.

then return => IsEmpty = true

4 Tree, Binary Tree and Binary Search Tree

- **Tree** is a hierarchical data structure. It stores information in a hierarchical way.
- Each Data item of the Tree is called a **node**.

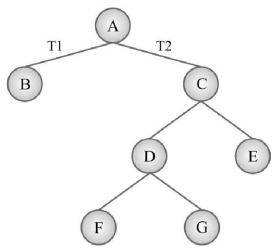


- The node which has no parent is called the **Root node**.
- A node has a maximum of one parent.
- If two nodes have one parent, those nodes are called **siblings**.
- The node which does not have even a single child node is called a **leaf node** or **terminal node**.
- Nodes connected below a node are called **child nodes** of that node.
- The connection between two nodes or the line between two nodes is called an **edge**.
- The node which has at least one child node is called an **internal node**.
- Users can easily do **searching** and **traversing** using the Tree data structure.
- Users can quickly **search, insert**, and **delete** data using the Tree data structure.

Types of Tree

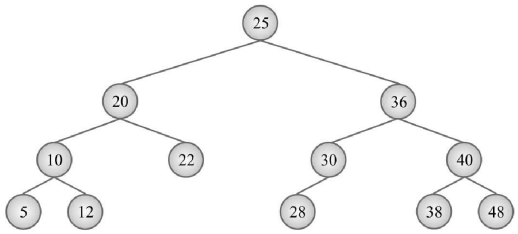
(1) General tree—The tree in which a node has zero or more child nodes is called a **general tree**. There is no restriction on how many child nodes can be in it.

(2) Binary tree—In this type of tree, a node can have a maximum of two child nodes. In which one means 0 and the other means 1, or they are also called **left child** and **right child**.



(3) Binary Search tree (BST)—Binary search tree can be defined as a class of binary tree. In this, nodes are arranged in a specific order.

In a **binary search tree**, the value of the **left sub tree** is less than the **root value** and the value of the **right subtree** is greater than the **root**.



- Searching for a data item in a **Binary search tree** is very easy.

(4) AVL tree–AVL tree is a **self balancing binary search tree**.

- **AVL tree** is also called a **height balanced tree**.
- If an **AVL tree** has N nodes, then its height will be $\log_2(N + 1)$. (For **Best case**)
- A **Binary tree** is height balanced when the difference between the height of its **left sub tree** and **right sub tree** is not more than one.

(5) B-tree–B-tree is a **multi-way tree** which is mainly created for use in disk.

- **B-tree** is also called **M-way** or **balanced tree**, meaning it is a **balanced M-way search tree**.

Maximum key of **B-tree** = $(m^{\{h+1\}} - 1)$

Here **m = order**, **h = height**

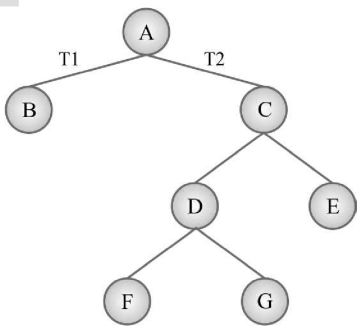
Binary Tree

- A **Binary tree** is a special type of **generic tree**. A **Binary tree** is usually divided into three **disjoint subsets**—

Root, Left sub-tree, Right sub-tree

Types of Binary Tree

1. Strictly Binary Tree : In a **Strictly binary tree**, every **non-leaf** node has **non-empty left** and **right sub-trees**. In other words, the **degree** of every **non-leaf** node will always be 2. A **strictly binary tree** with **n leaves** will have (2^{n-1}) **nodes**.



Previous Year Competitive Exam Questions

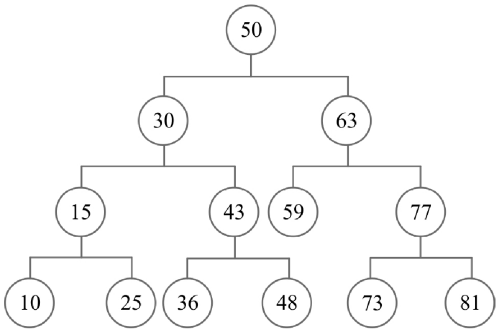
1. The Postfix of expression (A+B)*(C*D"E)*F/G is— [Raj. Senior Computer Instructor 19.06.2022]
(A) AB+CD*E"FG/** (B) AB+CD*E"F**G/
(C) AB+CD*E"*F*G/ (D) AB+CD*"*E"F*G/

2. The Reverse Polish Notation of infix expression (A+B)*C"D/E will be— [Raj. Senior Computer Instructor 19.06.2022]
(A) "*+ABC/DE (B) AB+CD"*E/
(C) AB+C*DE"/ (D) AB+C*DE/"

3. What will be the post order traversal of a binary tree T, if the preorder and inorder traversal of T are ABCDEF and BADCFE respectively? [Raj. Basic Computer Instructor 18.06.2022]
(A) BDFECA (B) BCFDEA
(C) BFDECA (D) BEFDCA

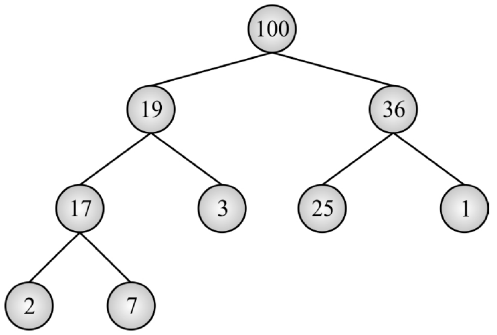
4. What is the result of prefix expression +, ", *, 3, 2, / , 8, 4, 1? [Raj. Basic Computer Instructor 18.06.2022]
(A) 12 (B) 11 (C) 5 (D) 4

5. Consider the given Binary Search Tree, if the root node is deleted, which can be the new root— [Raj. Basic Computer Instructor 18.06.2022]



(A) 43 or 48 (B) 63 or 81
(C) 48 or 59 (D) 30 or 63

6. If we implement the heap as a Max Heap, and add a new node of value 15 to the leftmost node of the right subtree, then what will be the value at the leaf nodes of the right subtree of the heap?



[Raj. Senior Computer Instructor 19.06.2022]
(A) 15 and 1 (B) 25 and 1
(C) 3 and 1 (D) 2 and 3

7. What will be the prefix notation of the given equation? [Raj. Basic Computer Instructor 18.06.2022]
(a+(b/c) * (d^e)-f)
(A) +-a*^/bcdef (B) -+a*b/c^def
(C) -+a*/bc^def (D) -+fa*/bc^de

8. How many distinct Binary Search Trees can be created from 6 distinct nodes? [DSSB-PGT-2021]
(A) 32 (B) 64 (C) 128 (D) 132

9. If a Complete Binary tree T has n leaf nodes, then how many nodes will be there with degree 2? [DSSB-PGT-2021]
(A) 2n (B) n (C) n - 1 (D) n/2

10. Numbers 70, 50, 10, 80, 30, 60, 100, 90, 40, 20 are inserted in a Binary Search tree in the given Order. Then what will be the in-order traversal sequence in the resulting Binary tree? [Exam DSSB-PGT-2021]
(A) 70, 50, 10, 80, 30, 60, 100, 90, 40, 20
(B) 100, 90, 80, 70, 60, 50, 40, 30, 20, 10
(C) 10, 30, 50, 70, 90, 20, 40, 60, 80, 100
(D) 10, 20, 30, 40, 50, 60, 70, 80, 90, 100

11. What will be the pre-order traversal after inserting the following key values (inorder) into a Binary Search tree?
9, 8, 12, 22, 4, 10, 13 [DSSB-PGT-2018 (Male)]
(A) 9, 8, 12, 22, 4, 10, 13 (B) 8, 9, 4, 12, 10, 22, 13
(C) 9, 8, 4, 12, 10, 22, 13 (D) 13, 22, 10, 12, 4, 8, 9

12. What will be the balance factor of an AVL tree?
(A) $| h (T^L) - h (T^R) | \leq 1$ [DSSB-PGT-2021]
(B) $| h (T^L) | \leq 1$
(C) $| h (T^R) | \leq 1$
(D) $| h (T^L) + h (T^R) | \leq 1$

13. A sorted array has 10,00,000 elements. Using binary search, what will be the maximum number of comparisons required to find the location of an item? [DSSB-PGT-2021]
(A) 6 (B) 7 (C) 20 (D) 21

14. If the ... traversal of a Binary tree is sorted (in increasing order), then the Binary tree is called a Binary Search tree (BST)? [Exam DSSB-PGT-2018 (Male)]
(A) Pre order (B) Post order
(C) In order (D) Level order

15. The degree of a tree is the ... degree of any node in the tree. [Exam DSSB-PGT-2018 (Male)]
(A) Minimum (B) Second minimum
(C) Second maximum (D) Maximum

16. In a tree, the node whose degree is ... is called a terminal or leaf node. [DSSB-PGT-2018 (Male)]
(A) 2 (B) 1 (C) 0 (D) 4

Answer Sheet

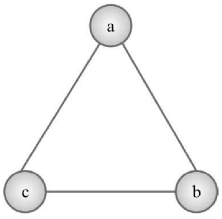
1.(C)	**2.**(D)	**3.**(A)	**4.**(C)	**5.**(C)	**6.**(A)	**7.**(C)	**8.**(D)	**9.**(C)	**10.**(D)
11.(C)	**12.**(A)	**13.**(C)	**14.**(C)	**15.**(D)	**16.**(C)				

5 Graph and Table

Graph

- ❖ **Graph** is a **non-primitive**, **non-linear** type of **data type**.
- ❖ **Graph** is made up of a group of **Vertices** and **Edges**.
- ❖ In this, **vertices** are connected to each other by **edges**.
- ❖ **Graph** is represented by **G(V, E)**. Where **V** means the group of **vertices** and **E** means the group of **edges**.

Example – Graph (V, E)

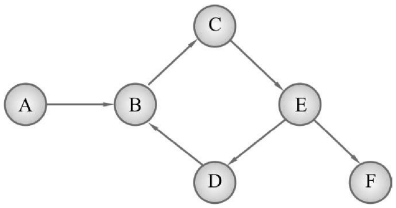


Here V = {a, b, c}
And E = {(a, b), (b, c), (c, a)}

Types of Graph

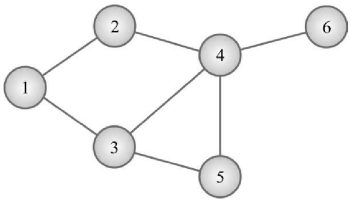
1. Directed graph

- ❖ The **graph** in which **edges** have a **direction**. It is called a **directed graph**.
- ❖ **Edges** of a **directed graph** are shown by an **arrow** mark. These **edges** are also called **directed edges** or **arcs**.



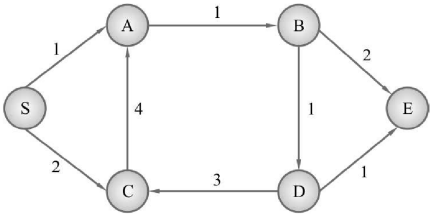
2. Undirected graph

- ❖ In this type of **graph**, **edges** do not have any **direction**.
- ❖ That is, in this, the **edge** is shown by a **line** and there is no **arrow** mark in it.



3. Weighted and non-weighted graph

- ❖ **Graphs** in which the **edge** has some **weight** which is a **real number**. This type of **graph** is called a **weighted graph**.
- ❖ Both **directed** and **undirected** types of **graphs** can be **weighted graphs**.
- ❖ The type of **directed** or **undirected graph** in which **edges** have no **weight**. It is called a **non-weighted graph**.



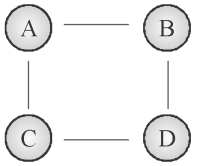
weighted directed graph

- ❖ The graph in which there is weight along with the direction of the edge is called a **weighted directed graph.**
- ❖ Acyclic graph is that graph which has no cycle. It contains both directed and undirected types of graphs.
- ❖ In an acyclic undirected graph with n vertices, max no. of edges = (n - 1).
- ❖ In Adjacency matrix, if the graph is directed, then each (i, j) in the matrix will represent the edge from i to j and it will be a non-zero value.
- ❖ But if it is an undirected graph, then for the edge between i and j, both (i, j) and (j, i) will be non-zero values.
- ❖ For undirected graph with no loops (simple graph), maximum non-zero value in adjacency matrix = $\frac{n(n-1)}{2}$ (max no. of Edges)
- ❖ For directed graph with no loops (simple graph), maximum non-zero values in adjacency matrix = **n(n–1).**
- ❖ A **Tree** is a **graph** but every **graph** cannot be a **tree**.
- ❖ In a **simple graph**, the **sum** of the **degree of vertices** is equal to **twice** the **number of edges**.

$$\sum \text{degree}(v) = 2 \times \text{number of edges}$$

Example:

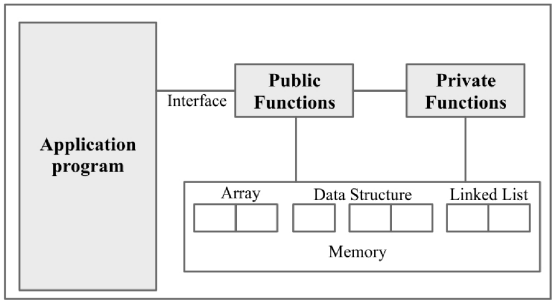
There is a **simple undirected graph**–



6 Abstract Data Type and Symbol Table

Abstract Data Type

- Abstract Data Type (ADT) is defined as the **Behavior** or **type of operation** of any **object**.
- The definition of ADT mentions **which operations** are to be performed, but not **how** these operations will be implemented. Its definition also does not state how the data will be organized in memory and **which algorithm** will be used to implement the operation. This is called "**abstract**" because it gives us an **implementation-independent view**.



- Providing only **essentials** and the **information hiding process** is known as **abstract data**.
- The user of a **General Data type** does not need to know how that data type is used; for example, the user has **int, float, char** etc. data types.
- Just as related information is hidden in any **Black Box**, similarly ADT also hides the **internal structure** and **design** of DATA.
- Based on **Structure**, ADT are of three types—
  (i) List ADT (ii) Stack ADT (iii) Queue ADT.

What is List ADT

- List ADT is an **Ordered Collection**. In this, **Elements** are stored one after another (in **Sequence**).

Main Features:

1. **Ordered Sequence:** Each **Element** has a **Position** (or **Index**). (Like first, second, third).
2. **Duplicates Allowed:** The same **Value** can come repeatedly (Like 10, 20, 10 is valid).
3. **Dynamic:** We can add or remove an **Element** anytime in this; its **Size** is not fixed.

Main Operations of List ADT:

- When we define **List ADT**, we decide **which Functions** the user can perform with that list—
  - **create ( ):** Create an empty **List**.
  - **insert(element, position):** Insert new **Data** at a specific **Position**. If inserted in the middle, the remaining **Elements** will shift.
  - **append(element):** Add **Data** at the end (**End**) of the List.
  - **remove(position):** Delete the **Element** from a specific **Position**. This will change the place of remaining **Elements** (they will **Shift**).
  - **get(position):** Read (**Access**) the **Data** kept at a **Position**.
  - **update(element, position):** Change the old **Value** of a **Position** with a new **Value**.
  - **size( ):** Tell the **total number** of **Elements** in the List.
  - **isEmpty( ):** Check if the **List** is empty or not.

Real World Example

- Imagine there is a **Music Playlist** in your phone—
  - **Songs** are in an **Order** (Song 1, Song 2...).
  - You can insert a new song in the middle (**Insert**).
  - You can remove any song (**Remove**).
  - You can see which song is at number 5 (**Get**).
- This **Music Playlist** is an example of a **List ADT**.

Use of Stack

- **Stack** is used in many places in **Computer Science**—

1. **Function Calls (Recursion):** When one function calls another function, the computer saves the **state** of the old function in the **Stack**.
2. **Undo Feature (Ctrl + Z):** When you **type** in MS Word or any Editor, every **action** is pushed into the **Stack**. When you **Undo**, the previous **action** pops out.
3. **Browser History (Back Button):** When you go to a new page, the old page is saved in the **Stack**. On pressing **Back**, the same page pops out and becomes visible again.
4. **Expression Evaluation:** The computer uses **Stack** to solve mathematical equations (like (A + B) * C).

Main Operations of Queue ADT:

- These are the standard functions to manage a Queue—

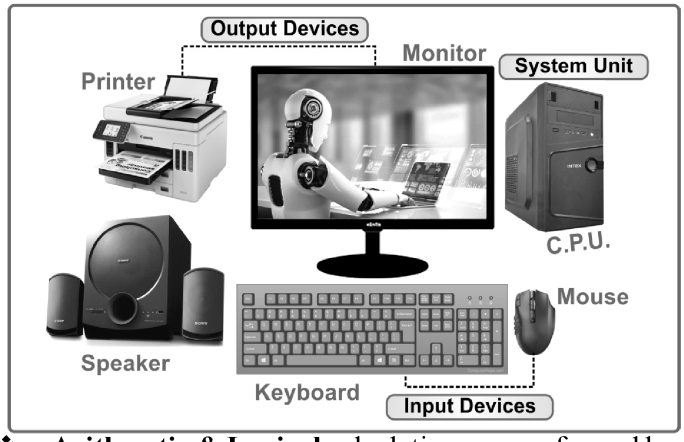
1. **enqueue(item):** Adding a new Element at the **Rear** of the Queue. This is also called **Insertion**.

UNIT-V : COMPUTER ORGANIZATION AND OPERATING SYSTEM

1 Basic Introduction & Development of Computer

Introduction of Computer

- The literal meaning of **Computer** is **'one who calculates'**.
- The word **Computer** originated from the English language word **'Compute'** and the Latin language word **'Computare'**.
- In Hindi, a computer is called **Sanganak**, **Parikalak**, or **Abhikalitra**. All these names are related to performing calculations.
- A **Computer** is a fast-calculating automated **electronic machine,** which processes the input given by the user to provide output and stores the results for future use.



- **Arithmetic & Logical** calculations are performed by a computer. Along with calculating capacity, a computer has logical power and memory (storage).
- In a computer, data or information is stored in **Binary** form. There are two digits in binary: **0 and 1**.

Computer Related Day

- A person is called **computer literate** when he is capable of running essential computer applications.

✧ **World Computer Literacy Day** is celebrated every year on **2nd December**. This day started on **2nd December 2001**.

- This day is celebrated to promote **Digital Literacy** and **Computer skills**.

✧ **International Computer Security Day** is celebrated on **30th November**. This day is also called **International Cyber Security Day**.

- **Safer Internet Day is celebrated** every year on the second Tuesday of February.

History & Development of Computer

- The following devices and machines were used to provide the modern form to the currently used computers—

Abacus

- The **Abacus** is the world's first calculating device that works on the principle of calculation like a digital computer, which means the world's first calculating device is the **Abacus**.
- The Abacus is also called a **Counting Frame**, **Abacus Computer**, **Gintara**, or **Ganakpatt**. It was invented in **Babylon**.
- The Abacus is also called the **first-era computer**.

Napier's Bones

- It was invented in **1617** by **John Napier**.
- Through this, the result of any **Calculation** could be expressed in a **Graphical** format.
- Napier's Bones is called **Rhabdology**.
- **John Napier** invented the **Logarithm** system in **1614**.

Slide Rule & Loom

- To perform **Logarithm** calculations, the **Slide Rule** was developed by **William Oughtred** of Germany.
- The **Jacquard Loom** was developed in **1801** by **Joseph Marie Jacquard**.
- **Joseph Marie Jacquard** was the first to use **Punch Cards** in textile design.

Pascaline

- The **World's First Mechanical Calculator** was developed by the French mathematician and physicist **Blaise Pascal** between **1642 and 1644**.
- This calculator is called **Pascaline**, **Arithmetic Machine**, **Adding Machine**, or **Pascal's Calculator**.
- Pascaline is also called the **first mechanical adding machine**.
- Pascaline works on the principle of an **Odometer**.

2 Computer : Organisation and Working

Basic Working of Computer

Fig. : Computer Basic Working

- The working of a computer system functions according to the **IPO (Input → Process → Output)** cycle.
- Before executing any task or operation, the computer takes input through the input unit. It performs operations or actions on the received input or data according to the given instructions; this is called processing.
- The processing work is done by the CPU in the system unit. The output received after processing is shown to the user by the output unit.

1. Input—

- The data and instructions given to the computer by the user are called input.
- Input devices are used to enter data and instructions into the computer.

2. Process—

- In processing, calculations or operations are performed on the data received through input according to instructions, and that data is converted into information.

3. Output—

- The information or result received by the user after processing by the computer is called output.

4. Storage—

- Data and instructions are stored in the memory.
- The results obtained after processing by the computer are stored in the memory unit itself.

5. Control—

- Controlling the devices, instructions, and information used in the entire process from input to storage, and establishing coordination among them is called control.

Architecture & Organisation of Computer

- **Computer Organisation** tells us how all the operational units of the computer system should be connected and arranged together so that the goals of the system can be achieved.

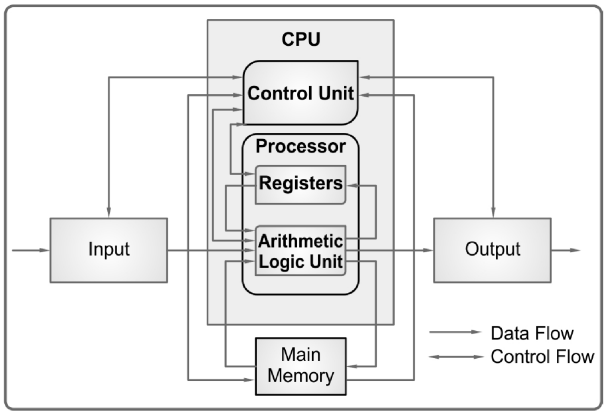


Fig. : Working of Computer

- **Computer Architecture** tells us with what functionalities the computer system will perform any task and how the components of the computer system interact with each other.
- A computer system is made up of 3 units. These three units are as follows—
  1. Input Unit
  2. System Unit
  3. Output Unit

1. Input Unit

- The input unit includes all those devices which are used to enter data or information into the computer. For example – keyboard, mouse, scanner, floppy disk, etc.
- Input devices convert human instructions into computer language (binary/machine language).

2. System Unit

- The system unit is a box made of tin or plastic, which contains various electronic components.
- The system unit has a Power Supply, Main Memory, Motherboard, CPU or Microprocessor, and various types of ports.
- Most of the circuitry of the computer is inside the system unit. The main part of the System Unit is the CPU itself.
- All types of processing tasks in a computer are done by the system unit, and it also controls all the parts of the computer.

3. Output Unit

- The unit used to present the result in human language after processing by the computer is called the output unit. For example – monitor, printer.

84. What is the main purpose of "Expansion Slots" on the motherboard?
(A) To increase the capacity of RAM.
(B) To increase capacity by adding new hardware cards.
(C) To increase the speed of the computer's CPU.
(D) To connect the hard disk.

85. What is a fundamental difference between BIOS and CMOS?
(A) BIOS is volatile, CMOS is non-volatile.
(B) BIOS is a Firmware, CMOS is a chip.
(C) Both are the same thing.
(D) CMOS boots, BIOS saves data.

Previous Year Competitive Exam Questions

Questions asked by Rajasthan Public Service Commission (RPSC) and Rajasthan Staff Selection Board (RSSB)

1. Which of the following units of the processor monitors all parts of the computer and gives them proper instructions? [CET 10+2 Level, 24.10.24 (Ist Shift)]
(A) Memory Unit
(B) Control Unit
(C) Input Unit
(D) Arithmetic and Logic Unit

2. Data is transferred between various components of a computer system using physical wires, these are called— [CET 10+2 Level, 22.10.24 (IInd Shift)]
(A) CPU (B) Flowchart
(C) Bus (D) WAN

3. Which of the following is not a bitwise operator? [CET Gr. Level, 28.09.24 (IInd Shift)]
(A) << (B) . (C) & (D) >>

4. Which of the following best describes the functions of the Control Unit? [CET Gr. Level, 27.9.24 (IInd Shift)]
(A) Control of operation of memory, processor and input/output devices
(B) Execution of logical operations
(C) Converting external data into a format that the computer understands
(D) Execution of arithmetic operations

5. A group of wires that carries a group of bits together, i.e., in parallel, and a related control scheme is known as— [CET Gr. Level, 27.9.24 (Ist Shift)]
(A) Wires (B) Data Cable
(C) Bus (D) Register

6. Which unit of the computer performs all types of calculations? [Raj. Computor - 03.03.2024]
(A) ALU (B) CU (C) RAM (D) ROM

7. ..... ports are also known as COM ports— [Raj. Jr. Inst. COPA 2018]
(A) RJ - 11 (B) Parallel (C) Serial (D) RJ - 45

8. Which of the following is called the brain of a computer? [Jr. Scientific Assistant - 22.09.19]
(A) Processor (B) Memory
(C) Keyboard (D) Motherboard

9. Which computer devices are automatically recognized by Windows? [Jr. Instructor (COPA) - 24.03.19]
(A) Automatic (B) Plug and Play
(C) Install (D) Serial

10. PDF is the short form of .....
(A) Portable Data Format [Informatics Assistant (IA) - 2018]
(B) Printable Document Format
(C) Printable Data Format
(D) Portable Document Format

11. The designed industry standard for establishing a connection between the peripheral devices of the computer and the computer, and for supplying electric power is— [Raj. IA 2018]
(A) IEEE Standard (B) ASCII
(C) USB (D) Peripheral Standard

12. The electric pulse generated by a system clock is called— [Raj. IA 2018]
(A) Clock (B) Cycle (C) Tick (D) Hertz

13. USB port stands for— [JRA Accountant Re Exam - 2016]
(A) United Serial Bus Port
(B) Universal Serial Bus Port
(C) Universal Serial Port
(D) Universal BIOS Port

14. RJ45 UTP cable consists of how many cable pairs? [Raj. IA 2013]
(A) 2 Pairs (B) 4 Pairs
(C) 5 Pairs (D) 3 Pairs

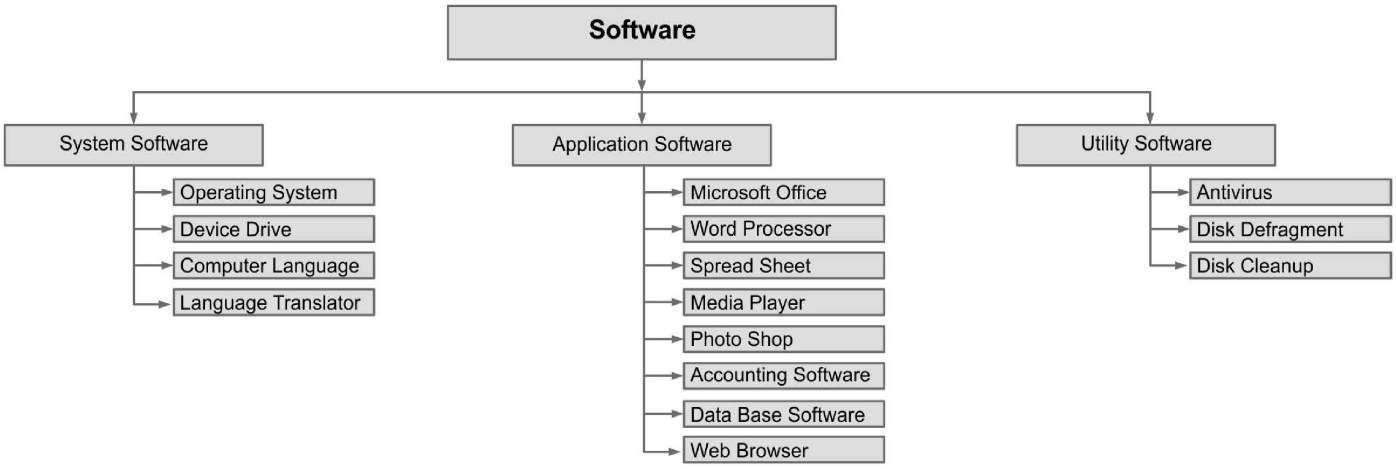
15. Which of the following is considered as the replacement for serial and parallel ports? [Raj. IA 2013]
(A) USB Port (B) PS2 Port
(C) SCSI Port (D) LPT 1 Port

16. The full form of UPS is. [Raj. IA 2011]
(A) Uninterrupted Power Supply
(B) Uninterruptible Power Supply
(C) Uniform Power Source
(D) Uniform Power Supply

Answer Sheet

84.(B)	**85.**(B)		**1.**(B)	**2.**(C)	**3.**(B)	**4.**(A)	**5.**(C)	**6.**(A)	**7.**(C)
8.(A)	**9.**(B)	**10.**(D)	**11.**(C)	**12.**(A)	**13.**(B)	**14.**(B)	**15.**(A)	**16.**(B)	

Classification of Software



System Software

- System software is a group of programs that makes the computer system operational and performs the basic functions of the computer system.
- System software is necessary for the execution of any program on the computer and for the operation of the computer.

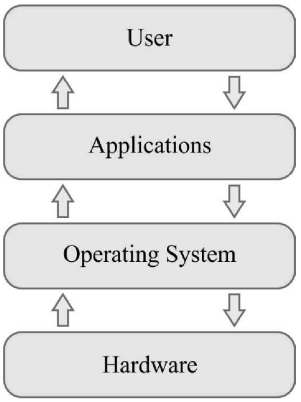
> ✧ System software is **considered the base of other software.** This is because the system software provides the working environment and background for the **application software to function.**

- Other software is created and run on the computer only through system software.
- System software is considered an essential software for the computer system because this software operates the computer system in such a way that application software can run on it.

Major Functions of System Software

- To coordinate and control the various peripheral devices of the computer.
- The system software performs the task of controlling, coordinating, and ensuring the maximum utilization of input-output, memory, processor, peripheral devices, and various hardware resources in the computer system.
- To act as a mediator between the user, application software, and hardware.
- Examples of System Software: DOS, Windows, Linux, Unix, Macintosh.
- The following programs are included in System Software:
  1. Operating System
  2. Programming Language
  3. Language Translator
  4. Utility Program
  5. Device Driver

Operating System



- Operating system is a type of system software; it is also briefly called OS.
- The operating system is a group of special type of programs which is used to manage the various resources of the computer and to execute all the operations of the computer system.
- It is a group of programs that is designed to perform functions of computer resources like starting the computer, managing programs, input-output management, memory management, device management, file management, etc.

> ✧ The **operating system** is an essential and **basic software that operates and controls all the functions** of the computer system.

- The operating system is a master control program that performs the task of operating the computer.
- It is the first program to be loaded into the computer's memory after the computer is switched on.
- The operating system is used to perform many tasks in computing. Providing space for the entire operating system in the computer's working memory (RAM) requires a lot of space. To solve this problem, this program can be divided into several parts—
  - ✧ **Resident Program**—Programs that are always available in memory. These types of programs perform primary operations like starting and ending the user program, memory allocation, file allocation, executing the interrupt handling of

213. Which core part of the Operating System always resides in the Main Memory (RAM) and interacts directly with the hardware?
(A) Shell (B) Compiler
(C) Kernel (D) Device Driver

214. What is the meaning of the problem of "Fragmentation" in Memory Management?
(A) Memory getting corrupted by a virus.
(B) Available free memory space not being contiguous.
(C) Data getting permanently removed from secondary storage.
(D) The total capacity of RAM getting completely full.

215. What is the primary function of "Shell" in the Linux operating system?
(A) To directly control computer hardware and peripherals.
(B) To interpret user commands and send them to the kernel.
(C) To manage virtual memory and the swapping process.
(D) To convert the kernel's binary instructions into a high-level language.

216. How is the concept of Virtual Memory implemented by the hardware and OS?
(A) Through Demand Paging.
(B) Only through Swapping.
(C) By increasing the size of Cache Memory.
(D) By converting ROM into RAM.

217. For which device is Spooling (Simultaneous Peripheral Operation On-Line) technology primarily used to reduce the speed mismatch between the CPU and I/O device?
(A) Keyboard (B) Mouse
(C) Printer (D) Monitor

218. What is the most important feature of a Hard Real-Time Operating System?
(A) Having high memory and cache capacity in the system.
(B) Strictness of deadlines for task execution.
(C) The Graphical User Interface being simple and attractive.
(D) The ability to run multiple heavy applications at the same time.

219. Types of Operating Systems and their examples:

List-I (OS Type)	**List-II (Usage/Example)**
(a) Batch Processing	(i) Scientific Simulations / Weather Forecasting
(b) Distributed OS	(ii) Payroll System/Billing
(c) Real-Time OS	(iii) Multiple CPUs loosely coupled
(d) Network OS	(iv) Air Traffic Control / Robot Control

Codes:
(A) a-ii, b-iii, c-iv, d-i (B) a-ii, b-iii, c-iv, d-i
(C) a-ii, b-i, c-iv, d-iii (D) a-iv, b-iii, c-ii, d-i

Previous Year Competitive Exam Questions

Questions asked by Rajasthan Public Service Commission (RPSC) and Rajasthan Staff Selection Board (RSSB)

1. Which of the following is not a classification of an operating system? [Raj. Patwar (S-1) 17.08.2025]
(A) Multithreading OS
(B) Time-batch processing OS
(C) Multi-programming OS
(D) Multitasking OS

2. Linux is a family of ... operating systems?
[Raj. Patwar (S-1) 17.08.2025]
[Patwar Exam 23.10.2021]
[Raj. Informatics Assistant 2013, 2011]
(A) Adware (B) Open Source
(C) Compiler (D) Application

3. A set of step-by-step procedures to complete a task is called ..... . [CET 10+2 Level, 23.10.24 (IInd Shift)]
(A) Firmware program (B) Software bug
(C) Hardware program (D) Algorithm

4. Which of the following is a system software?
[CET 10+2 Level, 23.10.24 (Ist Shift)]
(A) Excel (B) Power Point
(C) MS Word (D) Linux

5. Which of the following does not correspond to a valid extension of an audio file? [CET Gr. Level, 28.09.24 (Ist Shift)]
(A) .mid (B) .wav (C) .rar (D) .mp3

6. What is the name of the software used for specific tasks executed by the user on a computer?
[CET Gr. Level, 28.09.24 (Ist Shift)]
(A) Operating System (B) Utility Software
(C) Artificial Intelligence (D) Application Software

7. Which of the following languages is not procedural?
[CET Gr. Level, 28.09.24 (Ist Shift)]
(A) FORTRAN (B) COBOL
(C) Pascal (D) Prolog

8. Which of the following is an application software?
[Hostel Superintendent Exam, 28.08.2024]
(A) Centos (B) MAC
(C) Firefox (D) Linux

9. The set of instructions given to a computer is called ..... . [Hostel Superintendent Exam, 28.08.2024]
(A) CU (B) Storage
(C) Program (D) ALU

Answer Sheet

213.(C)	**214.**(B)	**215.**(B)	**216.**(A)	**217.**(C)	**218.**(B)	**219.**(A)			
	1.(A)	**2.**(B)	**3.**(D)	**4.**(D)	**5.**(C)	**6.**(D)	**7.**(D)	**8.**(C)	**9.**(C)

Solution (1-2)—1 Bit =0, 1
1 Nibble = 4 Bit
1 Byte = 8 Bit
1 MB = 1024 KB
1 MB = 1024 × 1024 Bytes
1 MB = 1048576 Bytes

2. Gigabyte = ... Megabyte = ... Kilobyte [Raj. Junior Accountant Re-Exam-2016]
(A) 1024, 1024 × 1024 (B) 1024, 1024
(C) 512, 1024 (D) 1024, 512 **[A]**
Solution— 1 GB = 1024 MB
= 1024 × 1024 KB
[1 MB = 1024 KB]

3. Which of the following is equal to 2 GB?
[Rajasthan Police Exam 7.11.2020]
(A) 2 × 1024 × 1024 × 1024 Bytes
(B) 2 × 1024 × 1024 Bytes
(C) 2 × 1022 × 1022 × 1022 Bytes
(D) 2 × 1022 × 1022 Bytes **[A]**
Solution— 2 GB = 2 × 1024 MB
[1 GB = 1024 MB]
= 2 × 1024 × 1024 KB
[1 MB = 1024 KB]
= 2 × 1024 × 1024 × 1024 Bytes
[1 KB = 1024 Bytes]

4. The sum of 768 Kilobytes and 1.5 Megabytes will be— [UPPSC TG2 2019]
(A) 2 Megabytes (B) 2.25 Megabytes
(C) 2.5 Megabytes (D) 2.75 Megabytes **[B]**
Solution—768 KB + 1.5 MB
1024 KB = 1 MB

$$1\ KB = \frac{1}{1024} MB$$

$$\left(768 \times \frac{1}{1024} MB + 1.5 MB\right)$$

= .75 + 1.5
= 2.25 MB

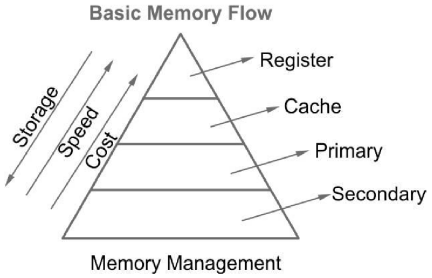
Memory Management Table
Approximate/Actual Values

Unit	Abbreviation	Approximate	Actual
Bit	b (common 'b')		0 or 1
Byte	B (Capital 'B')		8 bits
Kilobyte	KB	1000 bytes (10^3)	1024 bytes
Megabyte	MB	1 million bytes (10^6)	1024 KB
Gigabyte	GB	1 billion bytes (10^9)	1024 MB
Terabyte	TB	1 trillion bytes (10^{12})	1024 GB
Petabyte	PB	10^{15} bytes	1024 TB
Exabyte	EB	10^{18} bytes	1024 PB
Zettabyte	ZB	10^{21} bytes	1024 EB
Yottabyte	YB	10^{24} bytes	1024 ZB
Brontabyte	BB	—	1024 YB

5. ..... is approximately one billion bytes—
(A) Kilobyte (B) Bit
(C) Gigabyte (D) Megabyte) **[C]**
Solution— 1 GB = 1024 MB
= 1024 × 1024 KB
= 1024 × 1024 × 1024 Byte
= $10^3 \times 10^3 \times 10^3$ [Approx]
= $10^9 \Rightarrow$ 1 Billion

- The smallest unit to store data/information or any single character in a computer's memory is called a **byte**.
- A string of eight 0s and 1s is called a **byte**.
- The smallest unit of character data storage in a computer is a **byte**.
- The largest unit of memory is called a **Geop Byte**.

Memory Management Flow



- As shown in the above figure, as the **storage capacity** of memory increases, its **speed** decreases.
Storage Capacity of memory
Register < Cache < Primary < Secondary
Speed of memory
Register > Cache > Primary > Secondary
Note: Register is the **fastest** memory and has the **lowest storage**, whereas secondary memory has the **highest storage** and is the **slowest** memory.

Register

- It is the smallest and fastest memory in the computer.
- It is the smallest unit of data storage and transfer.
- Register memory is considered a part of the CPU itself.
- Registers are of different bits. For example—**16, 32, 64 Bit**.
- Register Memory is also referred to as a **Register**.
- Data is not stored in the CPU, therefore register memory temporarily stores the **Memory Address** of the data and instructions frequently used by the **CPU**.
- The speed of Register memory is high and storage capacity is low.
- Register Memory is of two types—
  - MAR : Memory Address Register
  - MBR : Memory Buffer Register

4. Which of the following is the smallest data unit of a computer? [CET 10+2 Level, 24.10.24 (Ist Shift)]
(A) KB (B) GB (C) Byte (D) Nibble

5. 1 PB (Petabyte) is equal to— [CET 10+2 Level, 23.10.24 (Ist Shift)]
(A) 1024 T.B. (Terabyte) (B) 1024 Bytes
(C) 1024 M.B. (Megabyte)
(D) 1024 G.B. (Gigabyte)

6. The full form of 'EEPROM' is— [CET 10+2 Level, 23.10.24 (Ist Shift)]
(A) Electronically Erasable Programmable Read Only Memory
(B) Electrically Erasable Programmable Read Only Memory
(C) Erasable Electrically Erasable Process Read Only Memory
(D) Electrically Erasable Programmable Read Memory

7. 1 ZB (Zettabyte) is equal to— [CET 10+2 Level, 22.10.24 (IInd Shift)]
(A) 1024 EB (B) 1024 ZB
(C) 1024 KB (D) 1024 GB

8. Which of the following storage devices can store the maximum amount of data? [CET 10+2 Level, 22.10.24 (Ist Shift)]
(A) Hard Disk (B) Floppy Disk
(C) Compact Disc (D) Optical Disc

9. Which of the following statements is not true about a floppy disk? [CET 10+2 Level, 22.10.24 (Ist Shift)]
(A) Only 1.44 MB can be stored in some versions.
(B) Data can only be read or written when the write protect notch is closed or covered.
(C) The floppy disk is made of mylar plastic.
(D) The surface of mylar plastic is coated with iron oxide (magnetic material).

10. What is the smallest unit of data in a computer? [CET Gr. Level, 28.09.24 (IInd Shift)]
(A) Bit (B) Nibble
(C) KB (D) Byte

11. ..... is a memory used to store data temporarily, whereas ..... is used to store data permanently, which cannot be changed or erased. [CET Gr. Level, 28.09.24 (Ist Shift)]
(A) RAM; ROM
(B) ROM; RAM
(C) Compiler, ROM
(D) RAM, Operating System

12. According to the size of the storage space, which of the following options is arranged in descending (decreasing) order? [CET Gr. Level, 27.9.24 (Ist Shift)]
(A) MB, KB, Byte, Nibble
(B) Nibble, KB, MB, GB
(C) Bit, MB, Nibble, KB
(D) Bit, GB, KB, MB

13. Arrange the following memories in order of their speed (fastest to slowest)— [Raj. Jr. Accountant - 11.02.2024]
1. RAM 2. HDD
3. Cache 4. Register
5. SSD

Select the correct answer from the given options—
(A) Register > Cache > RAM > SSD > HDD
(B) Cache > Register > RAM > SSD > HDD
(C) Register > Cache > RAM > HDD > SSD
(D) Cache > Register > RAM > SSD > HDD

14. A pen drive is a very popular device, which can be used in a ..... port— [Raj. Informatics Assistant - 21.01.2024]
(A) SSD (B) USB (C) UBS (D) SD

15. Virtual memory is a memory management technique, where— [Raj. Informatics Assistant - 21.01.2024]
(A) Main memory is used as secondary memory.
(B) Only secondary memory can be used.
(C) Secondary memory can be used as main memory.
(D) Data transfer is done between main and secondary memory.

16. SD RAM stands for— [Raj. CET 10+2, 05.02.2023]
(A) Straight Dynamic RAM
(B) Surface Dynamic RAM
(C) Synchronous Dynamic RAM
(D) Serial Dynamic RAM

17. Data on a CD-R type CD can be .....
(A) read only once [Raj. CET 10+2, 04.02.2023]
(B) read many times, but written only once
(C) read only once, but written many times
(D) written only once

18. BIOS is a part of which of the following? [Raj. CET 10+2, 05.02.2023]
(A) RAM (B) LAN (C) ROM (D) WAN

19. A page fault occurs when— [Raj. CET Grad., 08.01.2023]
(A) the page is present in memory
(B) the page is not present in memory
(C) a deadlock occurs
(D) buffering occurs

20. Which of the following is the largest unit of storage? [Raj. Basic Instructor 18.06.2022]
(A) Terabyte (B) Kilobyte
(C) Megabyte (D) Gigabyte

21. Which of the following statements are true?
I. Compared to secondary storage units, primary storage units have faster access time and less storage capacity.
II. Primary storage units do sequential access.
III. Secondary storage units are non-volatile storage.
[Village Development Officer Direct Recruitment Exam 28.12.2022]
(A) Only I and II (B) Only I and III
(C) Only II and III (D) All I, II and III

Answer Sheet

4.(D)	**5.**(A)	**6.**(B)	**7.**(A)	**8.**(A)	**9.**(B)	**10.**(A)	**11.**(A)	**12.**(A)	**13.**(A)
14.(B)	**15.**(C)	**16.**(C)	**17.**(B)	**18.**(C)	**19.**(B)	**20.**(A)	**21.**(B)		

46. 1 Gigabyte = ... Megabytes = ...Kilobytes [Junior Accountant Re-Exam 2016]
(A) 1024, 1024 × 1024 (B) 1024, 1024
(C) 512, 1024 (D) 1024, 512

47. In CDS/ISIS, the letters CD are used for? [Rajasthan Librarian Grade III 2016]
(A) Computerized Documentation
(B) Compaction Disk
(C) Confirmation Disk
(D) Compact Disk

48. One byte is equal to— [Investigator Exam 2016]
(A) 4 Bits (B) 8 Bits
(C) 12 Bits (D) 32 Bits

49. One Terabyte consists of— [Compiler Exam 2016]
(A) 1024 Gigabytes (B) 1024 Kilobytes
(C) 1024 Megabytes (D) 1024 Bytes

50. The fastest memory is? [Gram Sevak & Hostel Superintendent 2016]
(A) CD ROM (B) Hard Disk
(C) Auxiliary Memory (D) Cache Memory

51. 1 Kilobyte is equivalent to— [Gram Sevak & Hostel Superintendent 2016]
(A) 8000 Bits (B) 1024 Bits
(C) 512 Bits (D) None of the above

52. 1 Nibble is equivalent to? [Gram Sevak & Hostel Superintendent 2016]
(A) 4 Bits (B) 8 Bits (C) 16 Bits (D) 4 Bytes

53. Which technology is used in a compact disk— [Patwari Pre 2015]
(A) Mechanical (B) Electrical
(C) Electro Magnetic (D) Laser

54. Gigabyte refers to— [Patwari Pre 2015]
(A) 1024 Bytes (B) 1024 Kilobytes
(C) 1024 Megabytes (D) None of the above

55. How many bits are equal to 1 byte? [Patwari Pre 2015]
(A) 32 (B) 1024
(C) One Million (D) 8

56. By which method is a large amount of data sent from and to memory in less time? [Rajasthan IA 2013]
(A) DMA (B) Programmed I/O
(C) Interrupt driven I/O (D) None of the above

57. RAM can store— [Rajasthan IA 2013]
(A) Only data (B) Only programs
(C) Programs and data (D) Only operating system

58. Which of the following is a secondary memory device? [Rajasthan IA 2013]
(A) Keyboard (B) Disk
(C) ALU (D) All of the above

59. Tracks and sectors are related to which of the following— [Rajasthan IA 2013]
(A) Hard Disk (B) Mouse
(C) Printer (D) All of the above

60. Which of the following is a sequential access device? [Rajasthan IA 2013]
(A) Floppy Disk (B) Magnetic Tape
(C) Optical Disk (D) Hard Disk

61. DVD is a type of? [Rajasthan Junior Accountant & Accountant 2011]
(A) Non Volatile Storage
(B) Magnetic Storage
(C) Semiconductor Storage
(D) Volatile Storage

62. In modern computers, RAM is available in which size? [Rajasthan IA 2011]
(A) MB (B) GB (C) TB (D) KB

63. Which of the following is a magnetic device? [Rajasthan IA 2011]
(A) Tapes (B) Hard Disk
(C) Both A and B (D) None of the above

64. Which of the following devices is used to read text directly from an image— [Rajasthan IA 2011]
(A) OCR (B) OMR
(C) MICR (D) All of the above

65. Which of the following is a volatile memory? [Rajasthan IA 2011]
(A) ROM (B) RAM
(C) Hard Disk (D) CD

66. Compared to a diskette, a hard disk— [Patwari Direct Recruitment Exam 23.10.2021]
(A) Has less storage capacity.
(B) Is more portable.
(C) Is more expensive.
(D) Is slower.

Answer Sheet

46.(A)	**47.**(D)	**48.**(B)	**49.**(A)	**50.**(D)	**51.**(D)	**52.**(A)	**53.**(D)	**54.**(C)	**55.**(D)
56.(A)	**57.**(C)	**58.**(B)	**59.**(A)	**60.**(B)	**61.**(A)	**62.**(B)	**63.**(C)	**64.**(A)	**65.**(B)
66.(C)									

6 Finding and Processing File

Finding and Processing File

- A **File** is a **named and logical collection** of stored data on a **Secondary Storage Device** (like **Hard Disk Drive**, **SSD**, etc.).
- A **file** is a **software container** used to store information **permanently**.
- The **Kernel** of the **Operating System** and the **File Management System** ensure that any application program can use the files kept on your computer's hard disk **efficiently**.

I. File Finding: .In the process of finding a file, the OS converts your Filename (Symbolic Name/Identifier) into its actual location on the Disk (Physical Address).

A. Directory Traversal और Inode Retrieval

1. **Path Parsing:** When you open a file in any application, it requests the OS through a **System Call (open())**. The OS Kernel starts analyzing your given complete **File Path (/home/user/data.txt)** step by step, starting from the **Root Directory**.
2. **Directory Lookup:** The Kernel looks inside every directory. The directory contains a list in which the names of files and folders are written along with their **Address Pointers (Inode Number)**.
3. **Inode Retrieval:** In UNIX/Linux systems, as soon as the Kernel gets the **Inode Number** of the file, it immediately loads the **Inode (Index Node)** of the file from the disk into the memory.
4. **Metadata:** This **Inode** is the ID card of that file. It stores all the **essential metadata** like **File Size**, your **Access Permissions**, and the most important information—where the data is kept (**Pointers to Disk Blocks**).

B. Changing Logical to Physical Address

1. **Block Pointers:** There are some pointers in the Inode, which point towards those **Data Blocks** on the disk where the **actual data** of the file is kept.
2. **Address Translation:** The OS Kernel changes these **Block Numbers (Logical Address)** into a **Physical Address (Cylinder, Head, Sector)** understandable by the Disk Controller, so that the Disk Head can go to the correct location and read the data.

II. File Processing: Data Read/Write Operations

After finding the file, the OS uses its **I/O Subsystem** to deliver the data to the application.

A. File Opening Mechanism

1. **Permission Check:** As soon as the System Call is received, the OS immediately checks the stored permissions in the Inode to verify whether you have the **authority** to **Read/Write** the file or not.
2. **File Descriptor (FD) Creation:** If the permission is granted, the OS gives a **Unique Identifier (Non-negative Integer)** to that application (process), which is called a **File Descriptor (FD)**. This FD is a **temporary key** to access the file.
3. **Open File Table Entry:** The Kernel stores information in two lists (Data Structures). Among these, the **System-wide Open File Table** is the most important, which tracks the **File Offset (Pointer)** (that is, it tells from where the next Read/Write operation will start).

B. Data Access with Caching

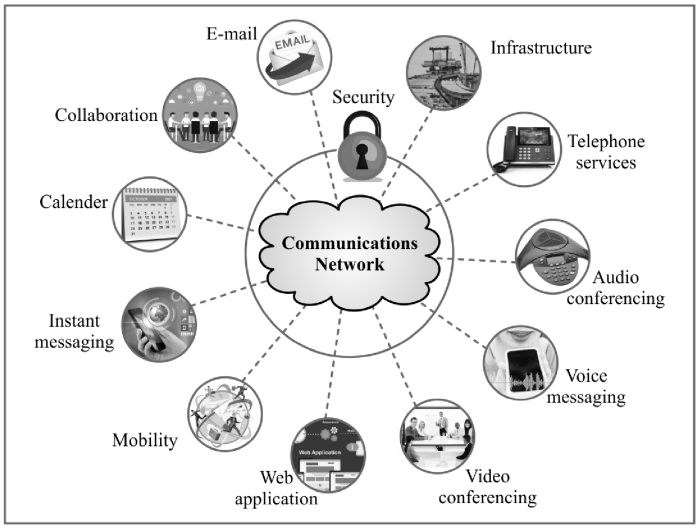
1. **Read/Write System Calls:** The application requests to read or write data using this **FD**.
2. **Buffer Cache Check:** First of all, the OS looks in the **Buffer Cache (or Page Cache)** kept in the Memory (RAM). This cache keeps copies of **recently used disk data**.
   - **Cache Hit:** If the data is in the cache, it is directly given to the application from the RAM (**Fast Access**), which avoids disk access.
   - **Cache Miss:** If the data is not in the cache, the OS has to start **Physical Disk I/O**.
3. **Physical I/O:** The OS sends a command to the **I/O Controller**. Data is transferred from the disk to the RAM (Cache), and then it is delivered to the application's buffer.

C. Closing and Synchronization

1. **System Call:** When the application closes the file (**close()**), the OS takes back the **FD** from the process.
2. **Dirty Blocks Flush:** If something was written in the file, there are **Modified Blocks (Dirty Blocks)** in the memory. The OS Kernel permanently stores those blocks on the disk to save the changes safely.
3. **Resource Deallocation:** The system resources are freed by removing all the entries related to the **File Descriptor**.

1 Computer Communication

- Exchanging information between two or more **Computers** or **Computer Devices** is called **Communication**.
- **Data Communication** is necessary to **Send** or **Receive** any type of information.
- **Data Communication** includes uploading data, measuring **Data capacity**, and sending and receiving it.



- The process through which information and data are exchanged is called a **Communication System**.

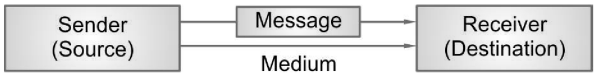


Fig. : Communication System

- Sending or receiving data between one or more computers and various types of terminals is called **Data Communication**.
- Exchanging **Data** between two or more devices through a **Transmission Medium** while following certain protocols is called **Data Communication**.

Components of Data Communication System

- The following **Components** are mainly required for the smooth functioning of any **Data Communication System**—

1. Sender (Source)

- The **Sender** is the device that generates and sends the **data** or **message**. We also call this the **Source**. **Communication** cannot start without a **Sender**.

Examples: Computer, Mobile Phone, Workstation, Video Camera, etc.

2. Message (Data)

- This is the **information** or **data** that has to be communicated. This is the information being sent by the **Sender** to the **Receiver**.

Examples: Text files, Numbers, Pictures (Images), Audio clips, or Video files.

3. Protocol (Rules)

- **Protocols** are the **"Set of Rules"** that **govern** data communication. It works like an agreement between the **Sender** and the **Receiver**. It is a set of rules used for communication.
- If two devices are connected to each other but do not have a **common protocol**, they will not be able to communicate.

4. Transmission Medium (Pathway)

- This is the **physical path** through which the **message** travels from the **Sender** to the **Receiver**. We also call it a **Communication Channel**.
- It can be **Wired** (like **Twisted pair cable, Coaxial cable, Fiber optics**) or **Wireless** (like **Radio waves, Microwaves, Infrared**).

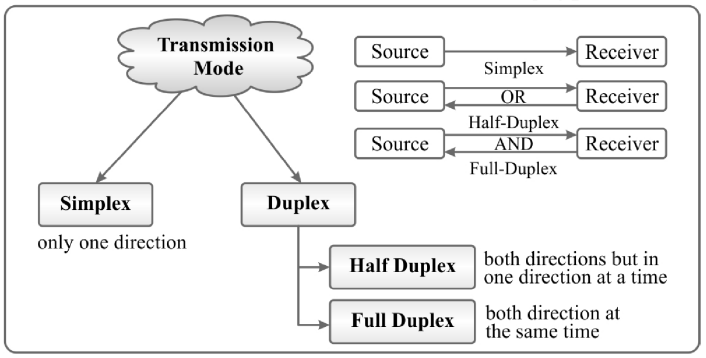
5. Receiver (Destination)

- The **Receiver** is the device that **receives** the **message** sent by the **Sender**.
- The job of the **Receiver** is to accept the signal and process it.

Examples: Computer, Smartphone, Television, Printer etc.

Transmission Mode

- The following **Data Communication** systems are used for the exchange of information, meaning **Communication Channels** can be of the following types—



8. Which waves are used for data transmission in WiFi technology?
(A) Infrared Waves (B) Radio Waves
(C) Microwaves (D) Sonic Waves

9. 'Total Internal Reflection' is necessary for data transmission in Optical Fiber cable. For this, what should be the correct relationship between the refractive index of the Core (n) and the refractive index of the Cladding (n,)?
(A) $n_1 = n_2$ (B) $n_1 < n_2$
(C) $n_1 > n_2$ (D) $n_1 + n_2 = 1$

10. Which statement is true about Shielded Twisted Pair cable?
(A) It does not require a Grounding Cable.
(B) It is cheaper than UTP.
(C) The possibility of Cross Talk in this is negligible.
(D) It is slower than UTP in data transmission.

11. The name of '10BASE5' standard of Coaxial Cable is—
(A) Thinnet (B) Thicknet
(C) Fast Ethernet (D) Cheapnet

12. What is the Bandwidth (Frequency) of CAT-6 and CAT-7 cables respectively?
(A) 100 MHz and 200 MHz
(B) 600 MHz and 1000 MHz
(C) 500 MHz and 1000 MHz
(D) 250 MHz and 600 MHz

13. What is the meaning of 'Line of Sight' in Microwave transmission?
(A) Signal passing through walls.
(B) Transmitter and Receiver being in a straight line.
(C) Spreading of signal in all directions.
(D) Signal moving along the earth's surface.

14. Which frequency band is used for TV Broadcasting and FM Radio?
(A) VLF (B) HF (C) VHF (D) EHF

15. Which connector is generally used in telephone lines?
(A) RJ-45 (B) RJ-11 (C) BNC (D) USB

16. What is the Nature of Radio Waves?
(A) Omni-directional (B) Uni-directional
(C) Bi-directional (D) Multi-directional

17. At approximately what height are Geostationary Satellites established from the Earth?
(A) 20,000 km (B) 36,000 km
(C) 12,000 km (D) 40,000 km

18. What is the maximum segment length of Thinnet Coaxial cable?
(A) 100 meters (B) 500 meters
(C) 185 meters (D) 1000 meters

19. Which Frequency does Bluetooth use for data communication?
(A) 900 MHz (B) 2.4 GHz
(C) 5 GHz (D) 60 GHz

20. Which of the following is not a connector of Fiber Optic Cable?
(A) SC Connector (B) ST Connector
(C) BNC Connector (D) LC Connector

21. Which two standard wiring patterns are used to connect RJ45 connectors in Twisted Pair Cable?
(A) RG-58 and RG-11 (B) T568A and T568B
(C) IEEE 802.3 and IEEE 802.5
(D) CAT-5 and CAT-6

22. Which transmission media is most secure from 'Electronic Interference'?
(A) Twisted Pair Cable (B) Coaxial Cable
(C) Optical Fiber Cable (D) Radio Waves

23. Consider the statements given below:
Statement 1: Propagation Delay (Tp) depends on packet length and bandwidth.
Statement 2: In 10BASE5 Ethernet standard, '5' means a maximum segment distance of 500 meters.
Choose the correct option—
(A) Only Statement 1 is correct.
(B) Only Statement 2 is correct.
(C) Both statements 1 and 2 are correct.
(D) Both statements are incorrect.

24. Consider the statements regarding types of Fiber Optic Cable:
Statement A: Multi-Mode Fiber (MMF) is used for Short Distance communication.
Statement B: Data transmission speed in Single-Mode Fiber (SMF) is less than MMF.
Choose the correct option:
(A) Statement A is true, but B is false.
(B) Statement A is false, but B is true.
(C) Both statements are true.
(D) Both statements are false.

Answer Sheet

8.(B)	**9.**(C)	**10.**(C)	**11.**(B)	**12.**(D)	**13.**(B)	**14.**(C)	**15.**(B)	**16.**(A)	**17.**(B)
18.(C)	**19.**(B)	**20.**(C)	**21.**(B)	**22.**(C)	**23.**(B)	**24.**(A)			

2 Computer Network

- When many independent **Computers** or **Computer Devices** are connected through a medium for **Data** communication, it is called a **Computer Network**.
- The medium of **Communication** between all computers and devices connected to a **Computer Network** is called a **Link**.
- Computers connected to a **Computer Network** follow similar rules to exchange **Data** and **Information** and share **Devices** with each other.
- A **Computer Network** is also called a **Data Network**.
- A **Computer Network** is a group of many **Computers** and **Other Computer Devices** that link or connect with each other through any medium (**Wired** or **Wireless**) to perform **Communication** or **Resource Sharing**.

- A **Computer Network** is made by the **Combination** of **Hardware** and **Software**.
- The technique by which two or more computers/ devices are **connected** to each other so that they can exchange data and information is called a network.
- A network is a mesh that connects computers through an **Online** or **Offline** medium; it connects computers using both **Wired** and **Wireless** techniques.
- The world's first network is **ARPANET** (**Advance Research Project Agency Network**).
- **ARPANET** was a computer network based on **packet switching** developed in America, in which the first message was sent on **October 29, 1969**.
- **Server** — A server is a **Computer System** in which information is stored and it provides information to any other computer through the network.
- **Client** — A client is a **Computer System** that accesses the information of any other **Computer** through the network.
- Data is transferred from one **Computer** to another in the form of **Analog** and **Digital Signals**.
- **Node** — The end point or **Terminal** of all computers or computer devices connected to the **Network** that can use the resources of the network are called **Nodes**.
- **Nodes** work as both **Sender** or **Receiver**.

Nodes in communication

1. **Node**
   - A **Node** is any network device that can send, receive, or forward data.
   - A **Node** has an **address** (like **IP Address**), by which it is identified.
   - **Examples:** Computer, mobile, router, switch, modem, server, printer etc.
2. **End Nodes**
   - **End Nodes** are devices that are the final source (**sender**) or final destination (**receiver**) of data.
   - They do not **forward** data, they only **send/ receive**.
   - They are also called **Hosts**.
   - **Examples:** Laptop, PC, Smartphone, Smart TV, Printer, Server etc.
3. **Intermediary Nodes**
   - **Intermediary Nodes** are devices that transport (**forward**) data from one node to another node.
   - They perform tasks like **path selection**, **routing**, **switching**, **filtering**, and **signal regeneration**.
   - They are not end users themselves, they only decide the path of data in the network.
   - **Examples:** Router, Switch, Hub, Bridge, Gateway, Repeater, Modem etc.

Forms of Data Transmission

- Generally, **Electrical Signals** are used for **Data Transmission**. These signals are of two types—
  1. Analog Signal 2. Digital Signal

1. **Analog Signal**

- These signals change continuously with respect to time. The value of an **Analog Signal** can be anything within a given Range. The telephone System is an example of this.

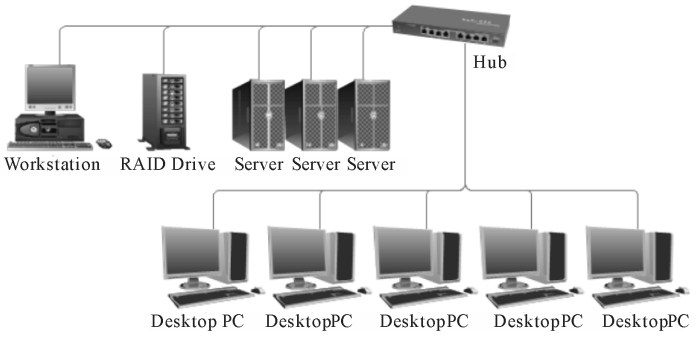
3 Network Topology

- The method of connecting computers together and the **data flow** between them is called **Topology**.
- **Network Topology** determines how different nodes of a network are connected to each other and how they establish communication with each other.
- **Topology** refers to the shape or lay-out of the network. The way computers connect in a computer network is called network topology.
- Every computer connected in a topology is called a **Node** or **Link Station**.
- Topology refers to the **Geometric Arrangement** of computers in a network.
- **Topology** determines which **Paths** are available for **Data Communication** between **Nodes**.
- Topology is of two types—
  - **(i) Physical Topology—**In this type of **Topology**, the **Physical Structure** is described. This is the layout of the network. It tells how **Cables**, computers, and other devices are physically connected.
    Example—Bus, Star, Ring, Mesh, Tree और Hybrid
  - **(ii) Logical Topology—**How **Data** transfers from one **Device** to another **Device** / through which path in a **Network**. This comes under Logical topology. It depends on signal and data flow instead of the network's hardware.
    Example—IP Broadcasting, Token Passing

Type of Network Topology

1. Bus or Linear Topology

- In this **Topology**, all computers or computer devices are connected to a single **backbone cable**. Which is usually a **coaxial Cable** (like – **10BASE2, 10 BASE5**). All **Devices Share Information** through this **Cable**. **Terminators** are attached to both ends of this **Cable**.
- In this, every computer or device is connected to the **Network** by a **NIC (Network Interface Card)**.
- **Bus topology** is a **Multipoint topology**. It is a **Bi-directional** topology but only one device can send a signal at a time.
- Every **Device's NIC** has a **Unique Address** or **Destination Address**.
- In **Bus Topology**, when **Information** is **Shared** from a **Device**, that **Information** goes to all **Devices connected** in the **Network** and the **Destination Address** of the **Device's NIC** is checked. The **Device** whose **Destination Address matches** receives the **Data/Information**. The remaining **Packets** are **Terminated** (finished) by the **Terminator**.
- In **Bus Topology**, all devices use a single '**Shared Medium**', due to which there is a possibility of data collision, this is called **Collision**. To control this, **CSMA/CD (Carrier Sense Multiple Access with Collision Detection)** protocol is used, which acts like '**Traffic Police**'.
- In **Bus Topology**, **Terminator** is used to stop **Signal reflection**. If there is no terminator, the signal will return to the wire and **Corrupt** the data.
- **Bus Topology** is used in **Ethernet (LAN)**.
- In **Bus Topology**, the **Number of Wire** is **[n+1]**
  Where n = **Drop Cable**,
  1 = **Backbone link/cable** (Main wire)
- **BUS topology** is the **less secured** and **less reliable**.
- This is the cheapest and easiest topology.



- Even if one **Device** fails, the rest of the **Network** keeps working.
- In **Bus topology**, the requirement of cable is less compared to other network topologies, so the cost is lower.
- A new node or **Device** can be added anywhere in the bus.
- Mainly this **Topology** is used in **LAN**.
- If there is an error or fault in any one **Device** or **Computer Network**, the whole **Network** is not affected, but if the main cable fails, the entire network fails.
- The **Control** of the network in **Bus topology** is not **centralized**. Therefore, if a fault occurs anywhere, it becomes difficult to find it.

4 Network Device

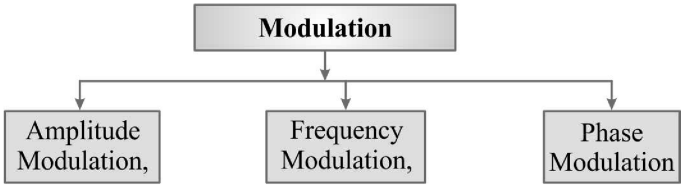
- Network devices are tools used to exchange data in a computer network.
- Network devices are also called network equipment or Networking tool/connecting devices.
- The process of exchanging Information/Data by connecting two or more computers through various communication media in a network using different topologies and protocols is called **Networking**.
- **Networking Devices** are equipment used to connect two or more computers for data sharing and communication.
- Network devices connect the client and server to the Channel and act as **Middleware** between the network and Computer.

These devices are as follows—

1. Modem

- In the word Modem, 'Mo' means **Modulation** and 'Dem' means **Demodulation**.
- The full form of **MODEM** is **Modulator-Demodulator**.
- It is hardware installed between a telephone line and a computer that produces Signals that can easily travel from one computer to another.

- Digital signals are converted into analog signals and analog signals into digital signals by the modem.
- **Modulation** is a technique in which information (data/message) is mounted on a **Carrier Signal** (high-frequency wave) so that it can be sent easily over a long distance.
- **Demodulation** is the process in which the **Receiver** (e.g., radio, mobile) can extract the **Original data** or message from the incoming **Modulated Signal**.
- **Broadband** speed is measured in **Mbps (Megabits Per Second)/Gbps (Gigabits Per Second)**.
- The full form of **DSL** is **Digital Subscriber Line**. Through this, internet Connection facility is provided in a Computer System using a modem and phone line.
- The main use of a **Modem** is to generate Signals and they can be easily sent from one Device/Computer to another Computer/Device.
- Analog signals are in the format of **Continuous Voice** and Digital Signals are in the format of **Discrete Discontinuous Binary digit**.
- A **Modem** acts as a **Transmitter** and **Receiver** in a network.



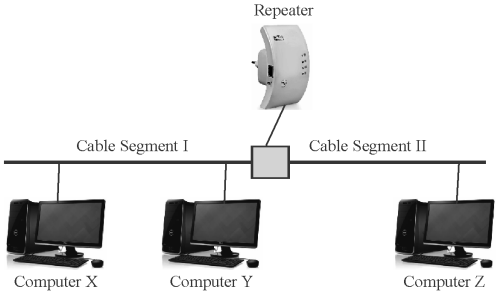
- The slowest connection in a **Modem** is **Dial-UP (PSTN Modem: 56 Kbps)**.
- **Modem** is used in **WAN** but not in **LAN**.
- **Modem's speed** is measured in **bps (bits Per Second)**.
- **Modem** mainly works on **Layer 1** of the **OSI model**, but modern digital modems also help in some functions of the data link layer like - **Framing**.

Types of Modems based on Data Transmission:

- **Asynchronous Modem:** In this, data is sent in the form of bytes. **Start Bit** and **Stop Bit** are used with every byte. It is **Slow**.
- **Synchronous Modem:** In this, data is sent in a **Continuous Stream**. **Clock Signal** is used for timing in this. It is **Fast** and expensive.

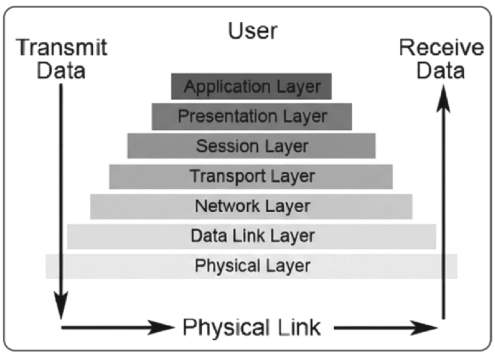
2. Repeater

- When **Data** is sent over a long distance, a **Repeater** is used to **Regenerate** the Signals so that the signal does not get weak due to the long distance.
- The **Repeater** Regenerates the signal before it becomes **Weak**.
- Repeaters are electronic devices that send low-level signals by making them high-level.
- By using this, **Signals** can be sent over long distances.



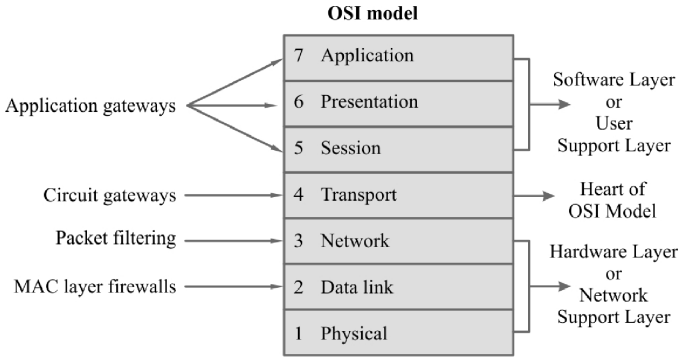
5 OSI Model

- **The full form of the OSI Model is Open System Inter-connection Model.**
- The OSI model is a reference model that establishes communication between **Users** in a **Network**.
- **All layers** of this model do not depend on each other. However, **data transfer** takes place from one layer to another.



Seven Layers of OSI

- The OSI model explains how **Information** or **Data** is **Sent** or **Received** in a Network.
- The OSI model also explains how **Network hardware** and **software** work with each other in layers.
- OSI was developed by **ISO (International Organization for Standardization)** in **1984**.
- There are a total of **7 Layers** in the OSI Model.



Layer Name	Network Devices	Protocols
Application Layer	Gateway (Sometimes), Proxy Server, Application Servers	HTTP, HTTPS, FTP, SMTP, POP3, IMAP, DNS, Telnet, SSH
Presentation Layer	No specific hardware device (Gateway)	JPEG, MPEG, GIF, SSL/TLS, Encryption/ Decryption, Compression
Session Layer	(Gateway)	NetBIOS, RPC (Remote Procedure Call), PPTP, SIP
Transport Layer	Load Balancer, Firewall (Partly), Gateway	TCP, UDP, SCTP
Network Layer	Router, Layer-3 Switch, Gateway	IP, ICMP, IGMP, ARP, BGP, IPsec, OSPF
Data Link Layer	Switch, Bridge, NIC, Layer-2 Switch	Ethernet, PPP, Frame Relay, ATM, HDLC, MAC, LLC
Physical Layer	Hub, Repeater, Modem, Cables, Connectors, Media Converter	बिट/सिग्नल level standards (IEEE 802.3), DSL, ATM, Frame Relay

Note—Gateway is a protocol converter that can work on **all 7 Layers** (from Physical to Application) of the OSI model.

- **Host Layer/Upper Layer** ⇒ Application layer, Presentation layer, Session layer
- **Media Layer/Lower Layer** ⇒ Physical Layer, Data link layer, Network Layer

1. Physical Layer

- This is the **lowest level layer**. This layer is used for **physical** and **electronic connections**. For example—**Voltage**, **Data Rates**, etc.
- In this layer, **Digital Signals** are converted into **electronic signals**.
- The work of **Network Topology**, meaning **Layout of Network**, happens in this layer.
- Whether the connection will be **wired** or **wireless** for exchanging **Data** or **Information** in the network is identified by the **physical layer** only.
- This Layer is also called **Bit Unit**.
- **Main Functions of Physical Layer—**
  1. **Physical Topology:** Deciding how devices will connect in the network (**Bus, Star, Ring** etc.).

Multiple Choice Questions

1. How many Layers are there in the OSI model? [Raj. Informatics Assistant Exam 21.01.2024]
(A) 3 (B) 7 (C) 4 (D) 6

2. Network devices ..... and ..... are used on the Physical Layer. [Senior Computer Instructor Exam 19.06.2022]
(A) Gateway, Bridge (B) Router, Repeater
(C) Hub, Switch (D) Repeater, Hub

3. Network Layer Firewall works as ..... . [Basic Computer Instructor 18.06.2022]
(A) Frame Filter (B) Packet Filter
(C) Both (A) and (B) (D) None of these

4. Which of the following layers is responsible for 'Encryption' and 'Decryption' of data? [Basic Computer Instructor - 18.06.2022]
(A) Application Layer (B) Presentation Layer
(C) Session Layer (D) Transport Layer

5. Which protocol layer uses SMTP, HTTP, FTP protocols? [Informatics Assistant - 2018]
(A) Application Layer (B) Transport Layer
(C) Internal Layer (D) Hardware Layer

6. The first layer of Open Systems Interconnection (OSI) model is— [Informatics Assistant 2018]
(A) Physical layer (B) Data link layer
(C) Transport layer (D) Network layer

7. At which layer of the OSI model does the Router work? [Informatics Assistant - 2018]
(A) Physical Layer (B) Data Link Layer
(C) Network Layer (D) Transport Layer

8. How many OSI Layers are covered in X.25 standard? [Raj. IA Exam 2013]
(A) Two (B) Three (C) Seven (D) Six

9. What is the full name of O.S.I.? [BSNL JE-2016]
(A) Open Systems Interconnection
(B) Organization of System Interface
(C) Operational Systems Interface
(D) Open Systems Interface

10. The fifth layer of the OSI model is— [DSSB TGT 2021]
(A) session layer (B) presentation layer
(C) network layer (D) transport layer

11. Which of the following statements is true for the OSI model—
1. Layers 1 to 3 are end-to-end
2. Layers 4 to 7 are Chained [DSSB TGT 2021]
(A) Neither 1 nor 2 (B) Both 1 and 2
(C) Only 1 (D) Only 2

12. When a Web Page opens, which does the Application Layer use—
(A) SMTP (B) HTTP
(C) FTP (D) All of the above

13. On which layer of the OSI Model do Repeaters of Network Devices work—
(A) Network layer
(B) Transport Layer
(C) Physical Layer/Layer-1
(D) Data Link Layer

14. In the OSI model, the Network layer is Responsible for ..... . [DSSB TGT 2021]
(A) Routing (B) Token Management
(C) Dialog Control (D) Physical Transmission

15. Which of the following layers is Responsible for dialogue control and token management— [DSSB TGT 2021]
(A) Session layer (B) Transport layer
(C) Physical layer (D) Network layer

16. Which layer of the OSI model is responsible for transmitting data in the form of 'Bits'?
(A) Application Layer (B) Network Layer
(C) Physical Layer (D) Session Layer

17. Which layer acts as an 'Interface' between the User and the Network?
(A) Physical Layer (B) Network Layer
(C) Session Layer (D) Application Layer

18. What is the Data Unit at the Transport Layer called?
(A) Segment (B) Packet
(C) Frame (D) Bit

19. Which layer of the OSI model is known for 'Service Point Addressing'?
(A) Network Layer (B) Transport Layer
(C) Data Link Layer (D) Session Layer

20. What is selecting the 'Best Path' to deliver data packets to the destination at the Network Layer called?
(A) Switching (B) Routing
(C) Framing (D) Encapsulation

21. Match the Following:

List-I (Layer)	**List-II (Protocol Data Unit-PDU)**
(a) Physical Layer	(i) Packets
(b) Data Link Layer	(ii) Segments
(c) Network Layer	(iii) Bits
(d) Transport Layer	(iv) Frames

(A) a-iii, b-iv, c-i, d-ii (B) a-ii, b-i, c-iv, d-iii
(C) a-iii, b-i, c-iv, d-ii (D) a-iv, b-iii, c-ii, d-i

22. What is added at the end of the frame for Error Detection at the Data Link Layer?
(A) IP Header (B) Port Number
(C) CRC Trailer (D) Start Bit

Answer Sheet

1.(B)	**2.**(D)	**3.**(B)	**4.**(B)	**5.**(A)	**6.**(A)	**7.**(C)	**8.**(B)	**9.**(A)	**10.**(A)
11.(A)	**12.**(B)	**13.**(C)	**14.**(A)	**15.**(A)	**16.**(C)	**17.**(D)	**18.**(A)	**19.**(B)	**20.**(B)
21.(A)	**22.**(C)								

6 Mobile Communication

Mobile Communication

- **Mobile Communication** is a technology that gives users permission to exchange data and voice without physical connection (wires), even if they are in motion. This communication is based completely on **Radio Waves** and **Electromagnetic Spectrum**.
- The process of making and receiving calls on a **Cellular Network** is called **Cellular Telephony**.

Main Principles of Mobile Communication

- Mobile Communication is mainly based on the Cellular Concept, due to which it is able to cover a Large Geographic Area.
  - **Cellular Concept:**
    - In this, the entire service area is divided into small geographical regions which are called **Cells**. These cells are generally of **Hexagonal Shape**.
    - Each cell has a **Base Transceiver Station (BTS)** or **Base Station** which establishes **Wireless Communication** with the mobile devices of that cell.
  - **Frequency Reuse:**
    - This is the most important technique of the Cellular Network. In this, the same **Frequency Band** is used repeatedly in **Non-Adjacent Cells**.
    - This technique helps in using limited **Radio Spectrum Efficiently** and increasing **Network Capacity**, while keeping **Interference** to a minimum.
  - **Handover/Hand-off:** When a mobile user goes from the boundary of one cell to the boundary of another cell, the call is transferred from one **Base Station** to another **Base Station** without dropping. This process is called **Handover** or **Hand-off**.

Main Types of Handover

1. **Hard Handover (Break-before-make)**

- In this, the connection with the old base station is broken completely before connecting with the new base station. This is mainly used in **2G (GSM)** networks. In this, the probability of **Call Drop** is high.

2. **Soft Handover (Make-before-break)**

- In this, the connection with the old base station is broken only after the connection is established with the new base station. This is used in **3G (CDMA)** networks. Due to this, the **Continuity** of the call remains.

Key Components

1. **Mobile Station (MS)/User Equipment (UE):** This is the device present with the user (like **Smartphone**).
2. **Base Station Subsystem (BSS):** This includes **BTS** and **Base Station Controller (BSC)**. It manages the **Radio Interface**.
3. **Network Switching Subsystem (NSS)/Core Network:** This has the **Mobile Switching Center (MSC)**. It handles **Call Routing**, **Mobility Management**, and the interface with **PSTN (Public Switched Telephone Network)**.

History of Mobile Communication

1. **Analog Era and First Public Call**
   - **Motorola** Engineer, **Martin Cooper** made the world's first **Public Mobile Telephone Call** on **3 April 1973**.
   - **Motorola DynaTAC 8000x** was the first **Commercially Available Mobile Phone**. Its launch happened in **1983**. It operated on the **First Generation (1G) Analog Network**.
   - Introduced in the early **1980s**, **1G Networks** were completely based on **Analog Signaling**. Their primary focus was only on **Voice Calls** and they did not have **Data Transfer Capabilities**.
2. **Digital Shift and Data Services**
   - **Second Generation (2G) Networks:** Launched in **Finland** in **1991**, **2G Networks** shifted from **Analog Signaling** to **Digital Signaling**. The main standard was **GSM (Global System for Mobile)**.
   - **Security** improved due to **Digital Encryption**. It enabled **Data Services** like **SMS (Short Message Service)** first and later **MMS (Multimedia Messaging Service)**, which changed the way of **Communication**.
3. **The Rise of Smartphones**
   - **First Smartphone (Conceptually):** Although **IBM Simon** (Touchscreen and Basic Apps) in 1994 is considered the first Smartphone, Devices integrating modern Smartphone Features like **Ericsson R380 (2000)** and **Nokia 9210 Communicator (2001)** supported **Mobile Web Browsing** and **Email** using **Symbian OS**.
   - **iPhone Revolution (2007): Apple launched the iPhone in 2007.**
4. **India's Largest Mobile Operating System**
   - **Dominant OS:** Currently, the largest **Mobile**

- ✧ **CDMA** technique uses **'Spread Spectrum'**, which ensures the maximum and **Efficient** use of **Bandwidth** available in the entire **Frequency Range**.
- ✧ Due to a separate **'Unique Code'** for each **User** and **Spread Spectrum** technique, **CDMA** is considered **More Secure** compared to **GSM**.
- ✧ It is extremely difficult to **Intercept (Hack)** signals in a **CDMA Network**, which makes it better from a **Security** point of view.
- ✧ Traditional **CDMA Devices** (like **CDMAone**, **EV-DO**) did not mandatorily require a **SIM Card** to work, because these were **Handset-locked**.

Feature	GSM (Global System)	CDMA (Code Division)
Access Technique	SIM Card Based	Device (ESN) Based
Identity	900/1800 MHz	800/1900 MHz
Frequency	Slow	Fast
Data Transfer	SIM Card Based	Device (ESN) Based

- ✧ Unlike **GSM**, where a **SIM Card** is always required for communication, the old **CDMA** technique was based on **Electronic Serial Number (ESN)**.

❖ **GSM (Global System for Mobile Communications)**

- ✧ The full name of **GSM** is **Global System for Mobile Communications** and it is the global standard for **2G (Digital)** communication. **GSM** technique was **Developed** in **Europe** by the **European Telecommunications Standards Institute (ETSI)**.
- ✧ It is mainly based on the combination of **TDMA (Time Division Multiple Access)** and **FDMA** access technique.
- ✧ The use of a **SIM Card** is mandatory in a **GSM Network**, which keeps the **User's Identity** and **Data** safe.
- ✧ Its main components in **Architecture** are **MS (Mobile Station)**, **BSS (Tower & Controller)** and **NSS (Core Network)**.
- ✧ **HLR (Home Location Register)** keeps the permanent information of the **User**, whereas **VLR (Visitor Location Register)** stores temporary **Data** during **Roaming**.
- ✧ **SMS (Short Message Service)** and **International Roaming** started in the world through this technique only.
- ✧ **GSM** uses **Digital Encryption** for **Security** and mainly works on **900 MHz** and **1800 MHz Frequency Bands**.
- ✧ In this, the validity and security of the **SIM Card** are checked by the **AuC (Authentication Center)**.

❖ **Orthogonal Frequency Division Multiple Access (OFDMA)**

- ✧ This **Technique Combines Frequency Division** with **Time Division**. **Data** is **Transmitted** by dividing it into many **Small, Orthogonal Sub-carriers**. **OFDMA** eliminates the need for **Guard Bands**.
- ✧ This is used in **4G (LTE)** and **5G (NR)**.

❖ **Massive MIMO (Multiple Input Multiple Output)**

- ✧ This **Technique** uses a large number of **Antennas** at the **Base Station** and sometimes at the **Mobile Device** too, so that **Spatial Multiplexing** (sending multiple **Independent Data Streams** on the same **Frequency**) and **Diversity (Signal Reliability)** can be increased.
- ✧ **Usage : 4G (LTE-Advanced)** and **5G**

❖ **Beamforming**

- ✧ This is a **Signal Processing Technique** where the **Energy** of the **Signal** is **Focused** directly towards the **User** using an **Antenna Array**, which increases **Signal Strength** and reduces **Interference**.
- ✧ **Used in:** 5G।

Multiple Choice Questions

1. Global Positioning System uses— [Sr. Computer Instructor 19.06.2022]

(A) CDMA (B) SDMA
(C) FDMA (D) TDMA

2. What is the full form of 'SIM' in mobile communication? [Informatics Assistant - 2018]

(A) Subscriber Identity Module
(B) System Information Module
(C) Service Identity Machine
(D) Subscriber Interface Mode

3. What is the process of transferring a call from one cell to another called? [Informatics Assistant - 2013]

(A) Roaming (B) Handover
(C) Switching (D) Tracking

4. Which code is used for the hardware identity of a mobile device?

(A) IMSI (B) MSISDN
(C) IMEI (D) ICCID

Answer Sheet

			1.(A)	**2.**(A)	**3.**(B)	**4.**(C)		

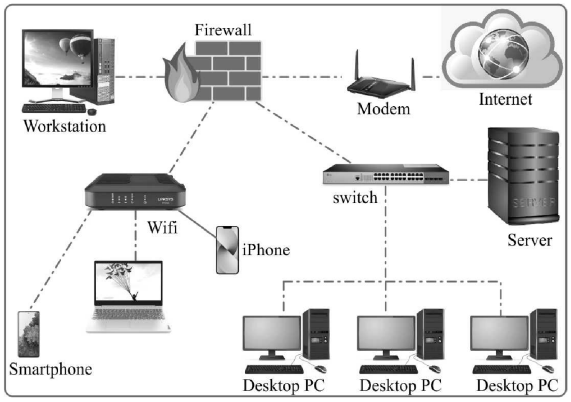
UNIT-VII : NETWORKING SECURITY

1 Protecting Computer System from Viruses & Malicious Attack

Computer Network & Security

❖ A **Computer Network** is a group of two or more computers and devices (such as **Printers, Scanners, Servers, and Routers**) that connect together to perform **Data Communication** and **Resource Sharing**.

❖ **Resource Sharing** means that all connected users can use the available **Hardware** (like printers) and **Software** (files or applications) on the network.



❖ We use **Communication Channels** or **Transmission Media** to connect devices together. These are of two types—

✧ **Wired/Guided Media**: It uses physical cables for connectivity. Examples: **Twisted Pair Cable, Coaxial Cable, Optical Fiber Cable**.

✧ **Wireless/Unguided Media**: In this, data travels through the air or space. Examples: **Bluetooth, Radio Waves, Micro Waves, Satellite Communication**.

✧ The transmission of various types of information and data is called **Data Communication**. We use a computer network for data communication.
For example, employees work in various positions in an institution or office. We use computers to run that institution or office smoothly. A computer network connects all these computers together to exchange information.

Note—

1. The **US Department of Defense** started the computer network in the world in **1969**. The name of this computer network was **ARPANET (Advanced Research Project Agency Network)**.
2. **ARPANET** was the world's first network based on **Packet Switching**.

Network Attack

❖ **Network Attack** means making an unauthorised access into an organisation's network to steal information and data, destroy data, or perform malicious activity.

❖ This creates an interruption in all system operations.

❖ Attackers can perform network attacks in two ways—

(i) Passive Attack :

⌑ In this attack, the attacker only monitors the network and listens to or steals the data (**Eavesdropping**). The attacker makes no modification to the data.

⌑ Its main purpose is **Information Gathering**.

⌑ Its detection is difficult because the attacker makes no changes to the data.

⌑ **Examples:** Traffic Analysis, Packet Sniffing.

(ii) Active Attack : In this type of network attack, the attacker accesses the network and modifies the data. The attacker can also delete or corrupt the data and cause damage to it.

✧ An **Active Attack** changes the data and makes it incorrect. In this attack, the attacker not only enters the network but also modifies, deletes, or corrupts the data.

✧ **Types of Active Attack:**

1. **Masquerade**: Using someone else's identity.
2. **Replay Attack**: Capturing old data and sending it again.
3. **Modification of Message**: Changing the original message.
4. **Denial of Service (DoS)**: Shutting down the service.

❖ A deliberate interruption caused in a network is called a **Network attack**.

❖ Information connected to the internet or network is damaged by a **Network attack**. Nowadays, an attacker can enter your network in various ways.

❖ Network attacks can be of the following types—

Multiple Choice Questions

1. **An attacker sends a 'SYN' packet during TCP connection establishment (handshake) but does not send an 'ACK' packet back. This fills up the server's resources. What type of attack is this?**
   (A) Tear Drop Attack (B) SYN Flood Attack
   (C) Smurf Attack (D) IP Spoofing
2. **If a public key is used for encryption and a private key is used for decryption in a cryptographic system, what does this ensure?**
   (A) Authentication (B) Integrity
   (C) Confidentiality (D) Non-Repudiation
3. **In the creation of a digital signature, with which key is the message digest (hash value) encrypted?**
   (A) Sender's Public Key (B) Sender's Private Key
   (C) Receiver's Public Key (D) Receiver's Private Key
4. **Why is a polymorphic virus difficult to catch by a traditional antivirus (signature-based)?**
   (A) It does not stay in memory.
   (B) It changes its code on every infection.
   (C) It hides in the boot sector.
   (D) It does not use the internet.
5. **Which of the following attacks falls in the "Time-of-Check to Time-of-Use" (TOCTOU) category?**
   (A) File Access vulnerability
   (B) SQL Injection
   (C) Phishing
   (D) DDoS
6. **In a MiTM attack, the attacker often takes advantage of the weakness of which protocol to do session hijacking?**
   (A) ARP (B) ICMP (C) SMTP (D) POP3
7. **In the Data Encryption Standard, what is the effective key length?**
   (A) 64 bits (B) 56 bits
   (C) 128 bits (D) 256 bits
8. **What is the characteristic of a hash function called, according to which two different inputs should not have the same hash value?**
   (A) Pre-image resistance (B) Collision Resistance
   (C) Avalanche Effect (D) Confusion
9. **What is the botnet command and control (C&C) architecture mainly used for?**
   (A) For the coordination of DDoS attacks.
   (B) For database encryption.
   (C) For firewall configuration.
   (D) For valid software updates of the user.
10. **Two statements are given below:**
    Assertion (A): Asymmetric encryption is not used to encrypt large amounts of data.
    Reason (R): Asymmetric encryption algorithms are mathematically complex and much slower than symmetric encryption.
    (A) Both (A) and (R) are correct and (R) is the correct explanation of (A).
    (B) Both (A) and (R) are correct but (R) is not the correct explanation of (A).
    (C) (A) is correct but (R) is incorrect.
    (D) (A) is incorrect but (R) is correct.
11. **Consider the following statements:**
    Statement-I: In phishing, the attacker pretends to be a reputable organization and tries to obtain sensitive information through email.
    Statement-II: In pharming, the attacker corrupts the DNS, due to which the user reaches a fake website despite typing the correct URL.
    (A) Both Statements I and II are correct.
    (B) Both Statements I and II are incorrect.
    (C) Only Statement I is correct.
    (D) Only Statement II is correct.
12. **In the context of the spread of malware:**
    Statement-I: A virus does not require human action like file sharing or program execution to spread from one computer to another.
    Statement-II: A worm is a standalone program that spreads automatically on the network and does not need any host file.
    (A) Both statements are correct.
    (B) Both statements are incorrect.
    (C) Only Statement I is correct.
    (D) Only Statement II is correct.
13. **In the context of cryptography:**
    Statement-I: In symmetric key cryptography, the sender and receiver use different keys.
    Statement-II: AES is an example of an asymmetric key algorithm.
    (A) Both statements are correct.
    (B) Both statements are incorrect.
    (C) Only Statement I is correct.
    (D) Only Statement II is correct.
14. **About Authentication:**
    Statement-I: Smart Card is an example of "Something you have".
    Statement-II: Password is an example of "Something you are".
    (A) Both statements are correct.
    (B) Both statements are incorrect.
    (C) Only statement I is correct.
    (D) Only statement II is correct.

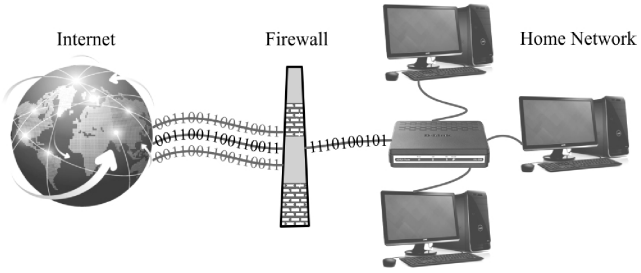
Answer Sheet

1.(B)	**2.**(C)	**3.**(B)	**4.**(B)	**5.**(A)	**6.**(A)	**7.**(B)	**8.**(B)	**9.**(A)	**10.**(A)
11.(A)	**12.**(D)	**13.**(B)	**14.**(C)						

2 Introduction to Firewalls and its Utility

Introduction to Firewall

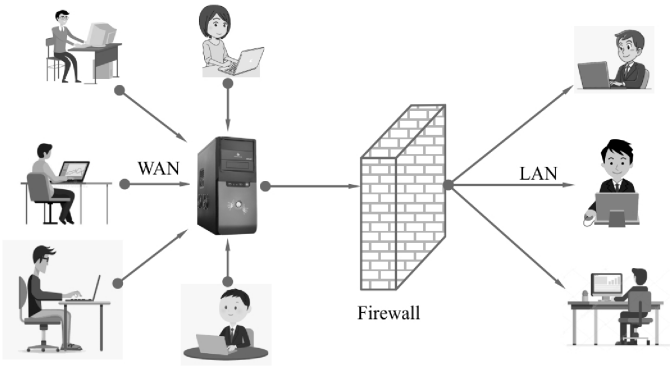
- A **firewall** is a hardware or software type of **network security device** that monitors the incoming or outgoing traffic on a network device. Based on a defined set of security rules, it **accepts, rejects, or drops** that specific traffic.
- **Accept/Allow:** It means giving permission to the traffic to enter the network.
- **Reject:** It means blocking the traffic, but at the same time sending an **"Unreachable Error"** message (**ICMP response**) to the sender stating that their connection has been rejected.
- The **Ping** command also uses the **ICMP** protocol.
- **Drop:** It means blocking the traffic without any notification or reply (the sender does not know whether the packet reached or not).
  Note: From a security point of view, **'Drop'** is considered better than **'Reject'** because it does not let the hacker know the status of the network.
- A firewall establishes a barrier between a **secured internal network** and an **untrusted outside network** like the internet.
- Before firewalls, network security was managed by **Access Control Lists (ACLs)** located on the router.
- **ACLs** are rules that determine whether network access should be granted or denied to a specific IP address. But an ACL cannot determine the nature of the packet it is blocking.
- We need a firewall to secure the internal network from **unauthorized traffic**.



- A firewall is a technology used to keep a network safe and secure. In other words, a firewall is a **network security system** that monitors and controls the **incoming and outgoing network traffic** according to predetermined security standards.
- A firewall is a **security wall** between an authorized and unauthorized network. Simply put, a firewall is a **barrier** between a trusted and an untrusted network.
- A firewall applies a set of rules that decides which **data packet** is allowed to enter a network and which data packet is prevented from entering.
- Firewalls are available in both **software and hardware** formats.
- Firewall **software programs**, like antivirus, are installed and used on a system.
- By purchasing a **hardware device**, it can also be used as a **hardware firewall** in any network.

Working of Firewall

- Let us understand the working of a firewall as follows—suppose you work in an organization. Many computers in the office of this organization are connected to each other via Wi-Fi; such a network is called a **private network**. Now, when a user connects to a **public network** like the internet through this office computer, there is a chance of various **harmful software** from the internet reaching their computer. The firewall prevents this harmful software from reaching that computer, which means the firewall is acting as a **security wall** between the public network and the private network.



  According to the example given above, the firewall is providing **security to both networks** because it—
  - ✧ Prevents any **virus or suspicious content** from going to the internet from the user's computer.
  - ✧ Prevents any **harmful content** available on the internet from entering the user's computer.
- That is why Firewall is also called a **Two Way Protection System**.

3 Backup & Restoring Data

Backup

- The general meaning of **Backup** is to create copies of data. This means that through the **Data Backup** process, a copy of the data is made so that in the future, if the **Original data** gets lost, destroyed, or unusable, these copies can be used to reuse the data.
- The user stores their data in the system's **Hard drive**. Since the hard drive is also an electronic device, when it crashes, the data also gets lost and the user's important data cannot be found. To avoid this problem, a copy of the data is made, so that even if the hard disk crashes, the data can be **Restored** again through the backup.
- When the user works on the computer, a file of any task is created in the computer, which is called **Data**.
- This data is copied and saved to another location along with its main location. This means, the copy of Computer data which is saved in one or more places is called **Data Backup**.
- Whenever the data kept in the System gets corrupted or deleted, the Backup data is **Restored** and used. Through this, Data loss can be prevented.
- The selection of a Data Backup Device depends on the following **Facts**—
  - The quantity of data that the user wants to store.
  - **Speed** of data backup.
  - **Cost** of data backup.
  - **Security** of data.
  - **Reliability** of Backup.
  - **Availability of data**.
- Data backup devices are selected by keeping all the above **Parameters** in mind.
- There are two important **Objectives** while taking the backup of any database—
  1. RPO (Recovery Point Objective)
  2. RTO (Recovery Time Objective)

1. RPO (Recovery Point Objective):

- It is related to **"Maximum Allowable Data Loss"**.
- This is the time limit which tells how much old data we can tolerate losing in case of a disaster.
- **RPO** decides what the **Backup Frequency** should be (i.e., how often the backup should be taken). If the RPO is low, the backup will have to be taken frequently.

2. RTO (Recovery Time Objective):

- It is related to **"Maximum Allowable Downtime"**.
- This is the target time within which it is mandatory to restart (**Restore**) the system or service after a breakdown.
- **RTO** decides how fast your **Recovery Speed** should be.

Data Backup and Data Copy

- When we take a backup of data, the data is **Encrypted** in the backup and stored in a safe place so that this **Original data** can be restored when required. This data can only be **Saved** as a backup. It cannot be **Opened/ Edited**.
- To **Copy** data means to make a copy of any file, folder, or data. When data is copied, the copied data has no relation with the old source afterwards. After copying, the data remains secure (**Safe/Backed Up**).
- The user uses CD-R, DVD-R, Floppy disk, Optical disk, SD card, Flash drive, USB thumb drives, External Drives, and Cloud Storage, etc. to securely backup their data and information. If these are used correctly, important **Data** can be backed up very easily and this Data Backup can be used when needed.

Backup Devices

- The user can take a backup of their data on any of the following devices—

1. Optical Discs (CD / DVD / Blu-ray)

- It is a **Laser-based media** which is considered safe for long-term offline archival backup.
- Both **WORM** and **rewritable** types are available and provide virus-resistant storage.

2. External Hard Disk Drive (HDD)

- This is the most common backup device in which **high-capacity (1TB-10TB)** data is stored.
- Due to the **USB 3.0/3.2 interface**, fast transfer and full system backup are done easily.

3. External Solid State Drive (SSD)

- Since it is **flash-based**, its **read/write speed** is many times faster than an HDD.
- Due to being **shock-proof** and **lightweight**, it is the **best option for portable backup**.

4. USB Flash Drive/Pen Drive

- It is a **small-size portable storage** in which you take a **quick file-level backup**.
- It is a **plug-and-play device** and provides a **fast transfer** of **documents and configurations**.

5. Network Attached Storage (NAS)

- It is a **network-based centralized backup system**

4 Hacking and Ethical Hacking

- **Hacking** is a technical process aimed at identifying the **Security Vulnerabilities** or **Loop Holes** of a Computer System, Network, or Application and taking advantage of them to gain **Unauthorized Access** to that system.
- Its purpose can be **Data Theft**, causing **Damage** to the system, or **Security Hardening** of the system.
- After establishing **Control** over the system, the hacker can lock that system, **Modify** the data, or steal **Sensitive Information**.

Phases of Hacking

- A hacker (whether ethical or malicious) usually follows a **Systematic Process** to hack a system. Its steps are as follows—
  - **Reconnaissance (Footprinting):** This is the **First Step**, also known as **Information Gathering**. In this, the hacker collects information about the target (**IP Address, Domain Details, Employee Info**). This can be **Active** (interacting directly) or **Passive** (gathering information without being detected).
  - **Scanning:** In this step, the network is scanned using technical tools (like **Nmap, Zenmap**) to find out about **Open Ports, Live Systems**, and the **Operating System (OS)**.
  - **Gaining Access:** This is the actual hacking phase. Using the **Vulnerabilities** found during scanning, the hacker makes an **Entry** into the system and gains **Unauthorized Access**.)
  - **Maintaining Access:** After entering the system, the hacker strengthens their hold there. They install **Backdoors, Trojans**, or **Rootkits**, so that even if the user restarts the system, the hacker's connection remains intact.
  - **Clearing Tracks:** To avoid getting caught, the hacker erases the traces of their activities. This includes deleting **Log Files**, modifying the **Registry**, or changing the **Timestamp**.)
- **Hacker:** A Hacker is a person who is an expert in understanding and analyzing the **vulnerabilities, security flaws**, and **protocol weaknesses** of computer systems and networks, and can use them for authorized or unauthorized purposes.
- **Cracker:** A Cracker is a person who breaches or bypasses any system, software, or security mechanism to gain **illegal access** and performs malicious activities, such as **software cracking, password breaking**, and **unauthorized intrusion**.)
- The person who performs hacking is called a **Hacker**. These hackers are highly skilled computer experts because they can easily steal data from someone else's computer. Hackers are of the following types—

1. **Black Hat Hackers**
   - They are also called **Crackers** in the technical world.
   - These are the hackers who **Enter** the system **Without Permission** from the system owner.
   - Their motive is always **Malicious**. They work for their own benefit and cause harm to others.
   - They steal your **Personal Data** (like **Corporate Data, Fund Transaction Details, ATM/Credit Card Details**).
   - Often, after stealing data or locking the system, they take advantage of the user's helplessness and demand a **Ransom**.)
2. **White Hat Hackers**
   - They are known as **Ethical Hackers**.
   - They work completely opposite to Black Hat Hackers and help in making the system secure.
   - They take written **Permission** from the system owner to check the **Security** of the system.
   - Their main job is to find out how strong the security of a system or network is and whether it can be easily breached or not.
   - They find the **Loop Holes** present in the system and **Patch** them so that no outsider can cause harm.
3. **Grey Hat Hackers**
   - They are a **Combination** of both Black Hat and White Hat hackers.
   - They hack the system without the permission of the system owner (so they are not **White Hat**).
   - Their intention is not to steal data, damage the system, or make money (so they are not **Black Hat**).
   - They often hack to test their skills, for learning, or for fun.

Main Hacking Techniques Technical Explanation (3 lines each)

1. **Phishing**
   - In this, the attacker creates fake emails or fake

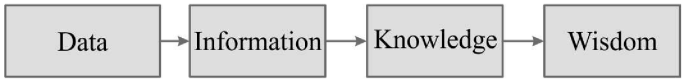
UNIT-VIII : DATABASE MANAGEMENT SYSTEM

1 Database Management System

An Overview of Database Management System

Data

- Data is a type of information or **fact** that can be **stored**, **processed**, and **analyzed**. Data is an entity that exists in the form of **raw material**. Data can be of various types such as **numerical**, **textual**, **audio**, **visual**, etc.
  Example – 500 kg, PANKAJ, RAM, etc.
- Data is always **meaningless**, **unorganized**, and **unprocessed**.
  Note: After data is processed, it turns into **information**.
- Data is processed and converted into **information**.
- The processing of data happens as follows:
  DIKW:-



- **Information:-** Processed and **organized data** is called information.
  For example—

Name	Address	Mob. No.
Bhumika	Bikaner	10203040

- **Knowledge :** Knowledge is gained by using the processed information.

Database

- A database is a store of any related data. A database is an **organized collection** of data, in which data is stored in such a way that it can be easily **accessed**, **managed**, and **modified**.
- A database is **organized data** or an **organized collection** of information, which is also known as **structured data**.
- A database organizes data into tables, which are in the form of rows and columns.
- A database is used to keep data organized and secure on a large scale.
- A database is a collection of **consolidated**, logically **managed**, inherently meaningful data, and **real data**.

Types of Database:

1. **Relational Database**
   - In a relational database, data is stored in the form of tables, and **relationships** are created between the tables.
     Example- **MySQL, PostgreSQL, Oracle**
2. **Non-Relational Database**
   - In a non-relational database, data is stored in other formats (such as – JSON, graph, document) instead of tables.
     Example- **MongoDB, Cassandra**
3. **Hybrid Database**
   - A hybrid database works by combining the features of both relational and non-relational databases.
4. **Cloud Database**
   - This database is based on the internet and is hosted by cloud service providers.
     Example - **Amazon RDS, Google Cloud SQL**

File System

- A file system is used to manage files in a computer.
- The file system creates and maintains the database using the file management module of the operating system. In this, the user had to write programs for database management.
- A file system is good for storing small-sized files (such as - KB, MB), but it is difficult to manage large-sized files. For this purpose, a DBMS is used.
- The file system has the following drawbacks—
  1. **Redundancy (data duplication) :** In a file system, when a user manages data in different files, the common data (such as - Name, Address) has to be stored in all files. Since the same data is kept at multiple locations, it becomes **duplicate** or **redundant**.
  2. **No Security :** In a file system, different users cannot be given different access. However, security has started coming in new file systems (such as NTFS, ext4).
  3. **No Concurrency :** Multiple users cannot work on the same file in a file system.
  4. **Data Inconsistency:** When the same data is present in different formats/values at multiple places, it is called inconsistent data.
  5. **Poor Data Integrity :** The data stored in the

and perform tasks like inserting, extracting, or deleting information in them.

(1) Database Language

❖ To create or maintain a database in any system, a language is required, which is called a **Database language**.

This language is of two types—

(i) DDL (Data Definition Language)

❖ The full form of DDL is **Data Definition Language**. It is used to define the **Conceptual Schema** and also provides information on how this type of schema is implemented in physical devices.

❖ DDL is used to create and modify **Database Objects** like table, user, views, and indices.

❖ The DDL command defines the **Structure/Schema** of the database.

❖ All DDL commands are **Auto-Committed**, which means changes are saved automatically.

❖ Using DDL commands permanently changes the data structure.

The important commands of DDL are as follows—

✧ **CREATE** — The CREATE command is used to create an object in the database. Through the CREATE command, we create a new database, table, view, or user.

✧ **ALTER** — It is used to make changes to the structure of the existing database. This command is used to add, delete, and modify a new column in a table.

✧ **DROP** — The DROP command is used to permanently remove or delete a database object like a table or view.

✧ **TRUNCATE** — The TRUNCATE command is used to permanently delete all the data/records of a table, but the structure of the table remains. It is faster compared to the DELETE command because it removes the data without logging.

✧ TRUNCATE is a **DDL command**. In most databases (like SQL Server), if it is run inside a transaction, it can be **rolled back**. But in Oracle, DDL is **Auto-Committed**, so it cannot be rolled back there.

✧ **RENAME** — It is used to rename an object. Through this command, we can change the name of the table.

(ii) DML (Data Manipulation Language)

❖ The full name of DML is Data Manipulation Language.

❖ This language provides the facility to the user to access or manipulate data.

❖ DML mainly works on the data of the database and not on its structure.

❖ DML commands are used to access and modify the data present in the database.

For Accessing – SELECT

For Modify – INSERT, UPDATE, DELETE

❖ DML commands are used to manipulate data. In DML, we perform operations on the actual data of the table, which means we insert a new record or update an old record in the table.

❖ DML is not auto-committed, which means all DML statements have to be committed separately.

For example - Students

Roll No.	Name	Subject	
201	R	Maths	→ Insert a new row
202	~~S~~ M	English	→ Update row
~~203~~	~~T~~	~~Science~~	→ Delete row

❖ Until we perform the commit operation, all tasks like insert, update, and delete are performed in RAM. After the commit operation, all tasks are permanently saved in the database.

❖ The main commands in DML are as follows—

1. **INSERT** – The insert command is used to add new data or records to the table.
2. **UPDATE** – The update command is used to modify the already existing data or records in the table. This means we can update one or more records.

❖ The **Where clause** is always used with the update statement so that only the selected record gets updated. If the **Where clause** is not used, all the records present in the table get updated.

3. **DELETE** – This command is used to delete or remove the data or records present in the table.

❖ The **Where clause** is always used with the delete statement so that only the selected record gets deleted. If the **Where statement** is not used, all the records present in the table get deleted. This means all the entries or tuples in the table will be deleted.

DELETE V/s TRUNCATE

❖ Truncate resets the **high water mark (HWM)** of the table (frees up the space) whereas delete does not free up the space (it only removes the data, the structure remains the same). **Note: High water mark (HWM)** is the mark that keeps increasing when we insert data into the table, but when we delete data, its level does not come down. This means it shows that the data had reached this level.

❖ When we remove data with the delete command, the HWM remains in its place. But if we remove data with truncate, it brings the high water mark back to zero.

❖ **Select** – The select command is used to retrieve data from the database.

❖ Select mainly comes under **DQL (Data Query**

65. Which of the following Data Model uses 'Tree Structure'? [IBPS SO IT Officer 2016]
(A) Relational Model (B) Network Model
(C) Hierarchical Model (D) E-R Model

66. What is the Database that contains Tables linked by a Common Field called? [CUET PG-2021]
(A) Centralized Database (B) Flat File Database
(C) Relational Database (D) Distributed Database

67. Which Data Model was generally used in 'Legacy Systems'? (UGC NET 2013)
(A) Relational Model (B) Object Oriented Model
(C) Network Model (D) NoSQL

68. The Device used to Input Data into a database is— [Rajasthan Police Constable 2020]
(A) Printer (B) Monitor
(C) Keyboard (D) Speaker

69. Which of the following is not a Level of Database Abstraction? [HTET PGT CS 2020]
(A) Physical Level (B) Logical Level
(C) View Level (D) Data Level

70. In the E-R Model, an Attribute which is obtained by deriving from other Attributes is called—
(A) Simple Attribute [KVS CS 2017]
(B) Composite Attribute
(C) Derived Attribute
(D) Multi-valued Attribute

71. A Weak Entity Type must always be linked with an Identifying Relationship to which of the following? [VGL NET CS 2023]
(A) Weak Entity Type (B) Strong Entity Type
(C) Recursive Entity (D) Composite Attribute

72. What is the Candidate Key called which is not selected as a Primary Key? [SSC IMD 2022]
(A) Prime Attribute (B) Alternate Key
(C) Super Key (D) Composite Attribute

73. In the Relational Model, 'Cardinality' is— [GATe CS 2022]
(A) Total number of Tuples
(B) Total number of Attributes
(C) Total number of Tables
(D) Total number of Constraints

74. By which symbol is 'Identify Relationship' (for a Weak Entity) represented in an ER diagram? [NIC (Scientist B) 2023]
(A) Double Diamond (B) Single Diamond
(C) Rectangle (D) Double Rectangle

75. In a Relation, which statement is always true for a Primary Key? [UGC NET CS 2017]
(A) It can be NULL.
(B) It can be Duplicate.
(C) It must be Unique and Not Null.
(D) It must always be an Integer.

76. In an E-R diagram, what does a 'Double Ellipse' represent? [KVS PGT CS 2018]
(A) Key Attribute (B) Derived Attribute
(C) Multivalued Attribute (D) Weak Entity

77. If A → B (A determines B), then what is A called? [ISRO Scientist/Engineer 2015]
(A) Dependent (B) Determinant
(C) Relationship (D) Surrogate Key

78. What is a 'Self-Referencing Relationship' (or Recursive Relationship)? [GATE CS 2012]
(A) Relationship between two different Entity Sets.
(B) Relationship of an Entity Set with itself.
(C) Relationship between a Weak Entity and a Strong Entity.
(D) None of these.

79. Who developed the E-R model? [GATE (CS) 2021]
(A) E.F. Codd (B) Peter Chen
(C) Charles Bachman (D) James Gosling

80. The number of Candidate Keys in a table can be—
(A) 1 (B) 0 [NIM CET - 2021]
(C) 1 1 (D) 2

81. The ALTER Command is used in SQL—
(A) To insert a new Row in a Table. [KVS CS 2021]
(B) To modify the Table Structure.
(C) To delete Data from a Table.
(D) To create a Database.

82. Which Join in SQL Returns those Rows that have Matching Values in both Tables? [UGC NET (CS) 2018]
(A) Left Join (B) Right Join
(C) Full Outer Join (D) Inner Join

83. What is the TRUNCATE command called in SQL (Category)? [GATE CS (2021)]
(A) DML (B) DDL
(C) DCL (D) DSL

84. Which Command is used to add a Column to a table in SQL? [IBPS SO (IT officer 2017)]
(A) ALTER TABLE table_name ADD column_name datatype
(B) UPDATE TABLE table_name ADD column_name datatype
(C) INSERT COLUMN column_name
(D) MODIFY TABLE ADD COLUMN

Answer Sheet

65.(C)	**66.**(C)	**67.**(C)	**68.**(C)	**69.**(D)	**70.**(C)	**71.**(B)	**72.**(B)	**73.**(A)	**74.**(A)
75.(C)	**76.**(C)	**77.**(B)	**78.**(B)	**79.**(B)	**80.**(C)	**81.**(B)	**82.**(D)	**83.**(B)	**84.**(A)

UNIT-IX : SYSTEM ANALYSIS AND DESIGN

1 System Analysis and Design

System Analysis and Design (SAD)

- System Analysis and Design (SAD) is a process through which we understand, examine, design and implement an information system to fulfill the specific needs of an organization.
- It plays a crucial role in software development, business process optimization and IT system implementation.

SAD is Useful for—

- Understanding business requirements and defining system objectives.
- Identifying problems in the existing system and proposing solutions.
- Designing structured models for software or business process automation.
- Ensuring system reliability, scalability and user-friendliness.
- SAD is mainly used to develop efficient systems in industries like banking, healthcare, e-commerce, manufacturing and education to improve operations.

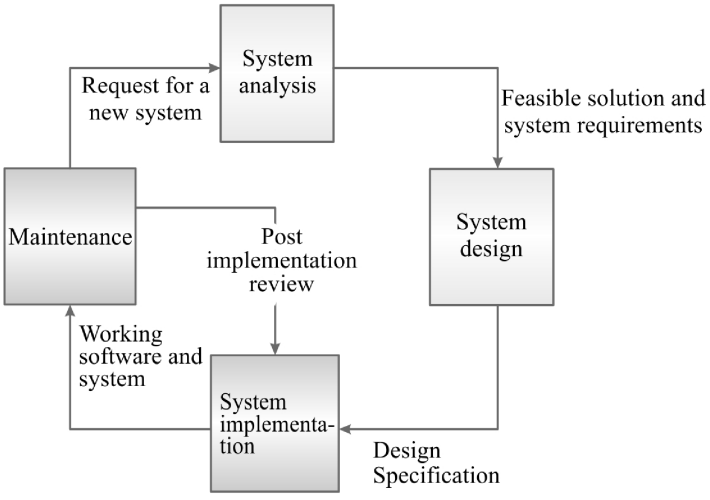


Fig.: System Analysis and Design

Importance of SAD

- **Enhances Efficiency:** It streamlines business operations through automation.
- **Improves Decision Making:** It provides structured data and insights for better management.
- **Ensures User Satisfaction:** It designs user-friendly systems with optimal functionality.
- **Reduces Costs & Errors:** It automates processes to eliminate manual errors and save resources.
- **Future-Proofing:** It develops scalable systems that can adapt according to changing requirements.

1. System Analysis

- It is the first step and a critical phase of any system development where developers work together to understand the problem, needs and objectives.

Some key aspects of System Analysis are—

- **Problem Identification:** In this, the issues that the system is addressing are identified. Whether it is automating a business process, improving data management, or enhancing user experience, understanding the problem first is important.
- **Requirements Gathering:** Once the problem is identified, the next step is to gather and write down the requirements. It involves communication between the customer and the developer to know how the system will be designed.
- **Feasibility Study:** Before moving into development, it is necessary to check the feasibility of the project. It includes the evaluation of technical, operational, and financial aspects to determine the feasibility of the proposed solution.
- **Analysis and Modeling:** To understand the system deeply, analysts develop various models, such as Data Flow Diagrams (DFD), Use Cases, and Entity-Relationship (ER) diagrams. These models help the customer to visualize the system and its interactions.

2. System Design

- System design is the phase where the blueprint of the project is created. In this, the requirements identified in the analysis phase are transformed into a visual solution. The main components of system design are as follows—
- **Architecture Design:** This phase describes the high-level structure of the system. It involves the decision of software and hardware components, their connectivity and the plan for the overall system design. Architects create critical designs to ensure scalability, performance, and security.

but no **Input Flow** (data is generating without any input).

- **Gray Holes:** When the **output data** has no **logical connection** with the **input data**.

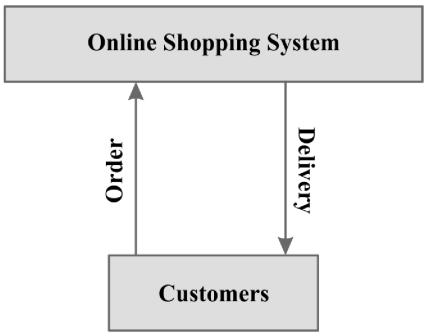
3. **Balancing Errors:** When we move from a **Context Diagram** to **Level 1** or **Level 2**, the **data flow** must remain the same:
   - **Unbalanced Decomposition:** If the Parent Process has 2 inputs and 1 output, then its Child Diagram must also have the same total number of inputs and outputs.
4. **Labeling and Formatting Mistakes**
   - **Incorrect Naming:** The names of the Processes should always be Verb-Noun (like: Calculate Salary), whereas the names of Data Flows and Data Stores should be Nouns.
   - **Unlabeled Flows:** No data flow arrow should be left without a name.
5. **DFD vs Flowchart Confusion**
   - Control Logic (like 'If-Else' or 'Loops') should never be shown in DFD. DFD only shows Data Flow, not the sequence of events.

Levels of DFD

❖ **Level 0 Data Flow Diagram (DFD):–**

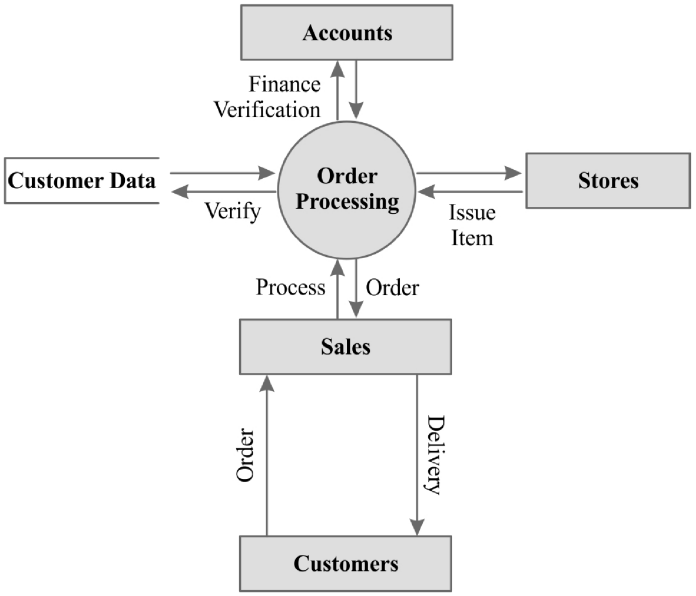
- ✧ Level 0 is the first highest-level Data Flow Diagram (DFD), which provides an overview of the whole system. It shows the major processes, data flows, and data stores of the system without going into the internal workings of the processes.
- ✧ Level 0 DFD (Context diagram) is designed as an abstraction view, which shows the system as a single process and also shows its relationship with external entities. It presents the entire system as a single bubble, in which input and output data are shown through incoming and outgoing arrows.

Context Diagram = 1 Bubble (No Data store)



❖ **Level 1 Data Flow Diagram (DFD):-**

- ✧ Level-1 provides a detailed view of the system, in which the context diagram is decomposed into multiple bubbles/processes.
- ✧ Every sub-process is shown as a separate process on the Level 1 Data Flow Diagram (DFD).



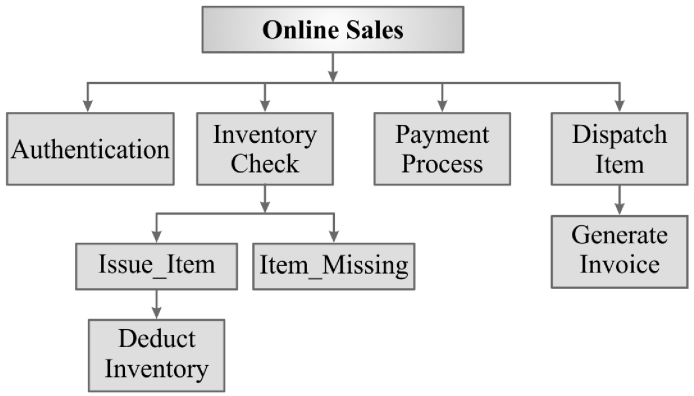
❖ **Level-2 Data Flow Diagram (DFD):**

- ✧ Level-2 provides an even more detailed view of the system, in which the complex sub-processes identified in the Level-1 Data Flow Diagram (DFD) are broken down into further sub-processes.
- ✧ **Balancing Rule:** The data flow (Input/Output) that was coming into the parent process of level-1 should also be seen in level-2. It is not necessary that a level-2 is created for every process of level-1.

HIPO Diagram

❖ HIPO (Hierarchical Input Process Output) diagram is a combination of two organized methods which is used to analyze the system and provide documentation. The HIPO model was developed by IBM in 1970.

❖ HIPO diagram represents the hierarchy of modules in a software system. The analyst uses the HIPO diagram to get a high-level view of the system functions. It breaks down the functions into sub-functions in a hierarchical manner. It describes the functions performed by the system.



❖ **HIPO diagrams** are good for documentation. Their

system can gracefully handle any unexpected event.

- **Recovery Testing** is essential to maintain high software reliability. This testing ensures that the software's recovery process is efficient and users get an uninterrupted experience.

Alpha Testing: (at developer site)

- In Alpha Testing, the software is tested in a controlled environment where real-world conditions are simulated. This testing process helps to identify and fix software bugs.
- White-box and black-box testing techniques are combined in **Alpha Testing**. In white-box testing, the internal structure and logic are tested, and in black-box testing, the external functionality of the system is tested.
- **Alpha Testing** is done before beta testing to ensure that the product is working properly before releasing it to external testers or customers.

Beta Testing: (at real user site)

- In Beta Testing, real users use the software in a real environment and provide their feedback. The purpose of this testing is to validate the product's quality.
- **Beta Testing** helps to minimize the risks of product failure because it provides validation through real users, which improves the software quality.
- **Beta Testing** is the last test before shipping the software/ system. After this phase, the product is sent to the customers.

Globalization Testing:

- Globalization Testing is a process that validates whether a website provides a customized user experience to users around the world. It is used to test the software for multiple languages and improves the application for different languages.
- **Globalization Testing** ensures that the application supports multiple languages and provides a customized user experience to all users worldwide.
- **Globalization Testing** confirms that the code can handle all international support without breaking the functionality.
- It detects **potential problems** in the application.

User Acceptance Testing (UAT):

- The main purpose of User Acceptance Testing is to test the software from the end-users' perspective. It ensures whether the software matches their expectations and requirements.
- **UAT** is crucial for **quality assurance** because it validates the usability and performance of the software in real-world conditions to ensure **customer satisfaction**.
- **User Acceptance Testing (UAT)** is generally performed by **end-users or clients**, who will ultimately use the software in their daily operations. These people represent the **target audience** of the software and validate whether the software matches their requirements and expectations.

System Implementation and Maintenance

System Implementation:

- In System Implementation, the software is deployed in a live environment where end-users use it. In this phase, the software is installed, configured, and integrated.
- After implementation, the system is tested in **real-world conditions**. This testing is done to validate the **functionality, performance, and usability** of the system.
- In the implementation phase, **training** is provided to the end-users so that they can use the software properly.
- When the system is successfully deployed and all functionalities are working correctly, the system is made **go-live**, in which the software becomes **fully operational**.

Implementation Deployment Strategies

- These strategies explain how to remove the old system and bring in the new system:
- **Direct Cutover (Crash):** In this, the old system is closed on a set date and the new system is started immediately. It has **high risk** (because if the new system fails, there is no backup), but it requires fewer **resources** (money and effort).
- **Parallel:** In this, both the old and new systems are run simultaneously. It has **minimal disruption**, but the **resource demand** is very high because you have to manage two systems at the same time.
- **Phased:** In this, the new system is introduced module-by-module or in different stages. It provides an opportunity for **gradual adoption** and testing of the system.
- **Pilot:** In this, the new system is first implemented for a small group. When feedback is received from them and everything is fine, only then it is given a **full rollout** in the entire organization.

Purpose of System Implementation:

- To convert final physical system specifications into working and reliable software.
- To do the **documentation** of the completed work.
- To provide help for current and future users. The **six major activities** used in system implementation are: **Coding, Testing, Installation, Documentation, Training, Support**, etc.
- The main purpose of **system implementation** is to make the system successfully operational so that it works properly and provides help to the users.

7. System Requirements Specification (SRS) document does NOT include .....
[RPSC Programmer Exam 27.10.2024]
(A) Non-Functional Attributes
(B) Design Solutions
(C) Schedule and Budget
(D) Functional Requirements

8. In the 'System Requirements Specification' document, behavioural description covers .....
[RPSC Programmer Exam 27.10.2024]
(A) classes of tests to be performed to validate functions, performance and constraints.
(B) Diagrammatic representation of functions; Processing narrative for each function; Interplay among functions; Design constraints.
(C) goals and objectives of the software context of the computer-based system; information description.
(D) response to external events and internal controls.

9. "System Requirements Specification (SRS)" document is prepared by the System Analyst at the end of ..... phase of System Development Life Cycle. [RPSC Programmer Exam 27.10.2024]
(A) Systems Design
(B) Systems Implementation
(C) Preliminary Investigation
(D) Systems Requirement Analysis

10. Technical Feasibility is carried out by the System Analysts to evaluate ..... .
[RPSC Programmer Exam 27.10.2024]
(A) that the needed technology is available.
(B) that there will be no resistance for the implementation of the new system.
(C) the cost of converting and preparing data files and the cost of preparing new or expanded computer facilities.
(D) the time within which the new system will become operational.

11. Conducting study to find out if the proposed system can be used by the employees or not is covered under the ..... feasibility.
[RPSC Programmer Exam 27.10.2024]
(A) Technical (B) Schedule
(C) Economic (D) Operational

12. Financial Feasibility Study is carried out by the System Analysts to evaluate that ..... .
[RPSC Programmer Exam 27.10.2024]
(A) it will be profitable to implement the system.
(B) the proposed system will result in improved operations.
(C) finances are available to implement the proposed system and it will be cost-effective.
(D) implementation will lead to low operating cost.

13. ..... is a visual representation that depicts the information flow and the transformation that are applied to data as data moves from input to output.
[RPSC Programmer Exam 27.10.2024]
(A) Data Flow Diagram (B) System Flow Chart
(C) Layout Form (D) Hierarchy Chart

14. Which of the following Symbol in Data Flow Diagrams represents Data Store?
[RPSC Programmer Exam 27.10.2024]
(A) [Arrow symbol] (B) [Parallel lines symbol]
(C) [Rectangle symbol] (D) [Oval symbol]

15. ..... is a structured repository of data, about data. [RPSC Programmer Exam 27.10.2024]
(A) Data Flow Diagram
(B) System Components Matrix
(C) Data Dictionary (D) Decision Table

16. Which part of a Decision Table comprehensively lists the comparisons or conditions?
[RPSC Programmer Exam 27.10.2024]
(A) Action Entries (B) Condition Entries
(C) Condition Stub (D) Action Stub

17. ..... is an indication of the relative functional strength of a module. [RPSC Programmer Exam 27.10.2024]
(A) Aversion (B) Cohesion
(C) Ripple effect (D) Coupling

18. The process of organizing subsystems so as to reduce the number of interconnections is termed as ..... [RPSC Programmer Exam 27.10.2024]
(A) Decomposition (B) Simplification
(C) Regrouping (D) Decoupling

19. A ..... describes how a user interacts with the system by defining the steps required to accomplish a specific goal.
[RPSC Programmer Exam 27.10.2024]
(A) DFD (B) Program Flow Chart
(C) Use Case Diagram (D) System Chart

20. ..... is a usable system or system component that is built quickly and at lesser cost and with the intention of modifying or replacing it by a full-scale and fully operational system.
[RPSC Programmer Exam 27.10.2024]
(A) Approved system (B) Increment
(C) Prototype (D) Spiral

21. ..... approach of system development is easy to accommodate product changes, but not suitable for large high-risk or mission critical projects.
[RPSC Programmer Exam 27.10.2024]
(A) Rapid Application Development (RAD)
(B) Spiral
(C) Agile
(D) Prototype

Answer Sheet

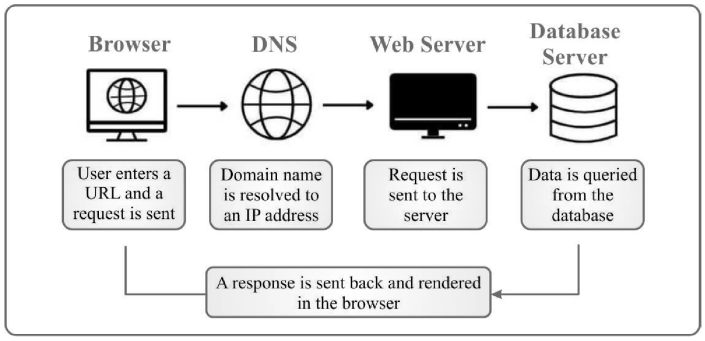
7.(B)	**8.**(D)	**9.**(D)	**10.**(A)	**11.**(D)	**12.**(C)	**13.**(A)	**14.**(B)	**15.**(C)	**16.**(C)
17.(B)	**18.**(B)	**19.**(C)	**20.**(C)	**21.**(C)					

UNIT-X : INTERNET OF THINGS AND ITS APPLICATION

1 Introduction of Internet Technology & Protocol

Internet

- The **Internet** is a huge **network** of **computers**, through which many small and large computer networks spread across the world remain connected to each other via various communication mediums.
- Through the Internet, **government databases**, **school** and **college databases**, as well as mobiles and computers are connected, through which we can receive and share all types of information.
- Internet services work on the **Client/Server** model.
- The Internet is a **Network of Networks**, in which networks of the entire world are connected.
- The Internet is a **Global network** and the world's largest network.
- The Internet is called the **Information Superhighway**.
- **Vint Cerf** and **Bob Kahn** are considered the **Father of Internet**.
- The **Ownership** of the Internet does not belong to any **Single Person/Authority**. The following organizations look after the work of the Internet:-
- **IAB (Internet Architecture Board):-** It is a **Technical Advisory group** responsible for the **Technical Aspects** of the Internet.
- **IETF (Internet Engineering Task Force):-**
  - ✧ It is the organization that develops **Internet Standards**.
  - ✧ This organization provided **IPv6**, **RFC**, and **IPSec**.
  - ✧ This organization provides registration services to the **Internet Community**.



History of Internet

Internet in World

- In the world, the Internet was first started in **1969** by the **Department of Defense of America** as **ARPANET (Advanced Research Project Agency Network)**.
- **ARPANET** was the first Wide Area Network (**WAN**) with **Distributed Control**.
- The very first **Creeper Virus** was discovered on **ARPANET**.
- The **Creeper Virus** was removed by the world's first antivirus "**The Reaper**", created by **Ray Tomlinson** in **1971**.

Internet in India

- In India, the Internet was first launched on **14 August 1995** and it was first used on **15 August 1995**, which means the Internet started in India on **15 August 1995**.
- The Internet in India was started by **VSNL (Videsh Sanchar Nigam Limited)**.
- After this, internet services gradually expanded and in the year **2000**, the **Information Technology Act** was passed in the Parliament of India.

Note:-

- The Internet can also be accessed with the help of **Web Browsers**.
- **Java** is the programming language used in the Internet.
- The Internet is a **Public network**.

Internet Connectivity

- For the smooth operation of the Internet, **Database Servers** are established first.
- **Database Computers** made from Database Servers are connected by **Fiber Cable** through **IP** and **TCP Technology**.
- By connecting other large databases through **Fiber Cables**, such a web of the Internet is created which remains connected with the databases around the world.
- After this process, the **Database** remains connected to the computer through your **Router**. To connect it, **Wired** or **Wireless** medium is used. Through the above process, the Internet can be run easily.
- With the help of the Internet, a **file** or **voice** can be sent instantly through your **phone** or **laptop**.

Note:

(1) The Internet is exclusively used for fast **Communication** through **E-mail, Video Call,**

2 LAN, MAN, WAN

- When two or more devices connect with each other to share information, it is called a network. These devices can be a computer, server, mobile, router, etc.
- A network is a technology through which two or more devices/computers are connected to each other so that they can exchange data and information. These devices also share resources by connecting to the network. For example— If there are five computers and one printer in an institute, then by sharing the printer on the network, all five computers will be able to print through that printer.
- To connect devices in a network, two types of technologies are used—

1. Wired Technology

- In wired technology, a wire is used to make a connection. Various types of cables like twisted pair, coaxial cable, and fiber optic cable are used to make a wired connection in it.

2. Wireless Connection

- In a wireless connection, wires are not used, such as radio wave, bluetooth, and satellite, etc.

Computer Network

- A computer network is a technology in which multiple independent computers or computer devices are connected through a medium for data communication.
- A computer network is a group of many computers and computer devices that connect to each other through any medium (wired or wireless) to perform communication or resource sharing.
- Computers connected to a computer network follow the same rules to exchange data and information and share devices with each other.
- A computer network is made by a combination of hardware and software.
- A computer network is also called a data network.

Type of Computer Network

- Computer networks are divided into various types based on size, geographic area/region, number of computers connected in a network, etc.
- Based on various parameters, the main types of computer networks are as follows—
  1. PAN (Personal Area Network)
  2. LAN (Local Area Network)
  3. WAN (Wide Area Network)
  4. MAN (Metropolitan Area Network)
  5. WLAN (Wireless Local Area Network)
  6. CAN (Campus Area Network)
  7. SAN (Storage Area Network)
- Other types of computer networks are as follows—
  1. SAN (System Area Network)
  2. EPN (Enterprise Private Network)
  3. VPN (Virtual Private Network)
  4. HAN (Home Area Network)
  5. POLAN (Passive Optical Local Area Network)

The description of mainly used types of computer networks is as follows—

1. PAN (Personal Area Network)

- The full form of PAN is Personal Area Network.
- PAN is the smallest and most personal network that connects devices around a single user to each other.
- It is a computer network that works to connect the workspace of a single person.
- A PAN network works to connect a user's personal devices like a mouse and keyboard.
- The connectivity range of PAN is 10 meters.
- "At present, the scope of PAN is not limited to only mobiles and laptops. It now also includes IoT (Internet of Things) devices like Smart Watches, Earbuds, Fitness Trackers, and Smart Home Appliances (like smart bulbs or smart plugs), which create a personal network through a smartphone."
- This type of network is used to connect mobile phones, computers, tablets, PDAs, etc., for data transmission.
  Example – If you connect your mobile phone to another device and transfer photos, videos, audio, and many other files with each other, then it is called a Personal Area Network.
- PAN provides a **Plug and Play** environment where devices connect instantly without complex configuration.

Types of PAN

(A) Wired PAN

- ✧ It uses cables to connect devices.
- ✧ **Example:** USB (Universal Serial Bus), FireWire (IEEE 1394), USB-C, Thunderbolt.

- Currently used smartphones, computers, tablets, printers, CCTV cameras, mice, etc., have a **Wi-Fi adaptor chip** installed in them. By using this chip, users can connect these devices to **wireless routers** and use the internet.
- Users can connect to the internet only by connecting to a **Wireless Router**. The wireless router uses a **cable modem** to stay connected to the internet. This cable modem is connected to the **Internet Service Provider (ISP)**.
- To avoid collisions, WLAN uses the **CSMA/CA (Carrier Sense Multiple Access with Collision Avoidance)** protocol.

Parameter	PAN	LAN	MAN	WAN
Full Form	Personal Area Network	Local Area Network	Metropolitan Area Network	Wide Area Network
Range	10 meters (Approx.)	100m - 2 Km (Building/ Campus)	5 - 50 Km (Entire City)	> 100 Km (Country/ Continent)
IEEE Standard	802.15.1 (Bluetooth)	802.3 (Ethernet)	802.6 (DQDB)	No single standard (TCP/IP Suite)
Transmission Speed	Low	Highest	Moderate	Low to Moderate
Error Rate	Very Low	Lowest	Moderate	High
Ownership	Private (Personal)	Private (Organization)	Public/Private	Distributed/Public
Key Technology	Bluetooth, Zigbee	Ethernet (CSMA/CD), Wi-Fi	FDDI, CDPD, ATM	Frame Relay, X.25, MPLS
Switching	—	Packet Switching	Circuit/Packet	Packet & Circuit

- "Networks use security protocols to protect **WLAN (Wi-Fi)** from unauthorized access. They mainly use **WPA2 (Wi-Fi Protected Access 2)** and the latest **WPA3**. WPA3 provides more advanced encryption (**SAE - Simultaneous Authentication of Equals**). This makes cracking the Wi-Fi password almost impossible."

CAN (Campus Area Network)

- Users know CAN as **Campus Area Network**, **Controller Area Network**, or **Cluster Area Network**.
- CAN is an interconnected network. Multiple **Local Area Networks** connect to form CAN within a limited area or a campus.
- **CAN** is smaller than **WAN** and **MAN**. It works in a shorter range than them. We also call it a **Corporate Area Network**.
- A single organization completely holds the ownership of this network.
- It uses a **Private IP Addressing Scheme**.
- CAN often uses high-speed fiber optic cables for backbone connectivity.

SAN (Storage Area Network)

- SAN stands for **Storage Area Network**. SAN is a special type of network. Designers specially created it to connect servers with data storage devices.
- Its main task is to store, manage, and access data at a fast speed. It is a **High-Speed Data Transfer Network** that provides the facility to access **Block-Level Storage**.
- SAN is a network that connects multiple storage devices. It makes these storage devices accessible to multiple servers.
- Users also call SAN as **SAN storage**, **SAN Network**, and **Network SAN**.
  Microsoft cloud – **AZURE and OneDrive**
  Amazon cloud – **AWS (Amazon Web Services)**
  Google cloud – **GCP (Google Cloud Platform)**
  Apple cloud – **iCloud**
  Rajasthan cloud – **RajMegh**
  SAN has two main protocols: **Fibre Channel** and **iSCSI (Internet Small Computer System Interface)**.
- **SAN Fabric:** It is the interconnection infrastructure of SAN. It includes fibre channel switches and cabling.
- **LUN (Logical Unit Number):** It is a logical address. It tells the server which disk volume or part of the storage it can access.
- **Zoning and Masking:** These are security and management techniques.
- Zoning decides which devices can communicate with each other. Masking decides which server can access which LUN.
- **Uses:** It is very important for mission-critical services like large databases, Virtualization Platforms, and Disaster Recovery.

VPN (Virtual Private Network)

- It creates a secure tunnel over a public network (like the Internet). It hides the online identity (**IP Address**) of the user and keeps the data safe. Currently, it has become an essential network for **Work From Home**.

3 Search Services/Engine

Introduction of Search Engine

- Search Engines are computer programs or software used to search for the required information from the stored information on the World Wide Web.
- Search Engines are web-based software used by Internet users to get any information located on the World Wide Web (WWW).
- A Search Engine is a service that a user can access through the Internet.
- Search Engines find the information present on the World Wide Web using a Keyword.
- A Search Engine is a very useful Internet tool through which users get useful information for themselves from many different websites, and they can also access different websites through a Search Engine.
- Through a Search Engine, you can easily access any website on the Internet.

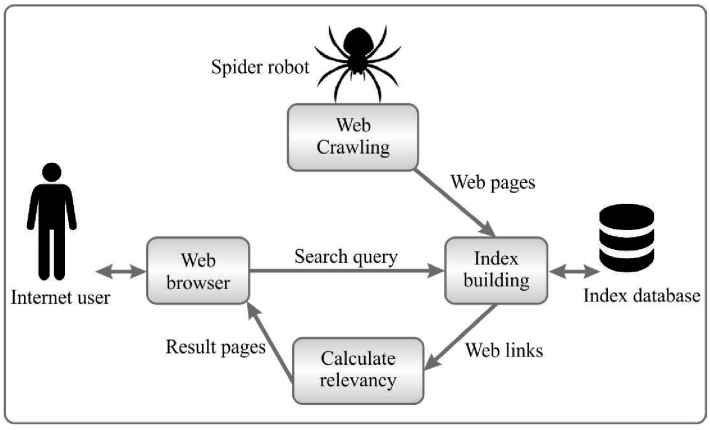
Working of Search Engine

- A Search Engine is a computer program used to find information available on the World Wide Web using various types of Keywords.
- When a user enters and submits a keyword in the Search Box, the Search Engine finds the information related to that keyword and shows it systematically on the **SERP (Search Engine Result Page)**. SERP is the result of the search.
- The working method of every Search Engine is different.
- Every Search Engine has a secret mathematical formula, which is called an **Algorithm**.
- The ranking of any website on a result page is determined through this algorithm. This means the algorithm decides which website will appear first and which will appear last upon searching.
- Search Engines use **Boolean Operators (AND, OR, NOT)** to search for information on the World Wide Web.
- Search Engines have automatic programs that visit different websites and webpages available on the Internet and store the information systematically in their database, so they can be found easily when needed.

Note:—

1. The main function of a Search Engine is to visit different web pages to search for various types of information, organise them, and provide them a ranking according to the quality of the content.
2. The priority of any Search Engine is to quickly provide correct information to the user.

- **A Search Engine uses the following steps to work—**



1. Crawling

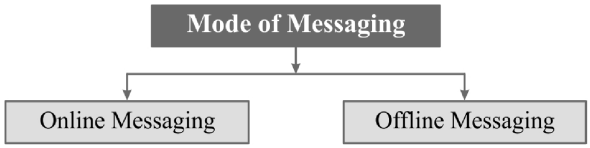
- The first step in the working of any Search Engine is **Crawling**.
- Crawling is a process in which some automatic programs visit various websites available on the Internet, collect the data of those websites, and store this data in their database.
- Such automatic programs that roam around the World Wide Web to collect data from various websites are called **Crawlers, Bots, or Spiders**.
- When these Crawlers visit any website, they collect the following types of information—
  - The title of various pages of that website and the description of those pages.
  - How many pages are there in the website, when were the pages of the website updated, which new page was added, and which page was deleted.
  - Whether images, videos, and links are available on the website's page or not.
  - Which keywords are used in any page of the website.
  - **Crawling** is the process of collecting information. Through this process, data is fetched and collected in the database server.

2. Indexing

- Listing the data stored in the database through the

4 Introduction to Online and Offline Messaging

- Messaging is a process in which a message or information (such as Text, Voice) is sent from one place to another, or from one medium to another, or from one application to another.
- Application Software is used for the messaging process, which are called **Messaging Apps**.
- The messaging process is of two types—



(1) Online Messaging:

- Online messaging means sending information or a message through the internet.
- According to computer technology and telecommunication, online means devices are connected to each other, and the **Sender** and **Receiver** are active at the same time. Examples: Telegram, WhatsApp, Google Talk, Facebook Messenger, Signal, Skype, Snapchat.

(2) Offline Messaging:

- This type of messaging means the medium is not connected to the internet, which means the message or information is sent through an offline software or communication.
- These apps work without the internet or mobile network. They use **Bluetooth** and **Wi-Fi Direct** technology to send messages. They are used in places where there is no internet (such as in an airplane or during a natural disaster). Examples: Briar, PeerChat, KizoChat, Bridgefy, FireChat, Signal Offline Messenger, Vojer.

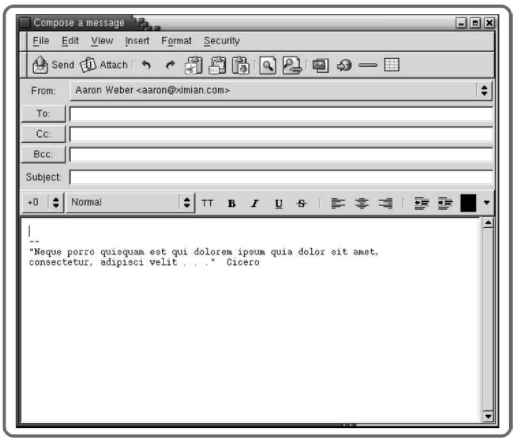
Type of Messaging Process

1. E-mail :

- When it comes to messaging, E-mail is the most important messaging application. It is mainly useful for PC, User, Mobile, and Wireless users to send and receive messages.
- The full form of E-mail is **Electronic Mail**.
- Through e-mail, any user can send an electronic message from one computer system to another using the internet.

✧ The world's first e-mail was sent by **Ray Tomlinson** in **1971**. Ray Tomlinson is called the **Father of E-mail**.

- The world's first free e-mail service was started in **1996** by an Indian youth, **Sabeer Bhatia**, under the name **Hotmail**.



- The one who sends the e-mail is called the **Sender**, and the one who receives the e-mail is called the **Receiver**.
- To send and receive e-mails, both the Sender and Receiver must have their own **E-Mail Address**.

✧ To send a message via e-mail on the internet, **SMTP (Simple Mail Transfer Protocol)** is used, and to receive incoming mail, **POP (Post Office Protocol)** is used. The latest version of POP is **POP3**.

- In the e-mail service, every user has a **unique** e-mail address. This e-mail address consists of a User Name and a Domain Name:
  - ✧ **User Name**—The User Name is given by the user. A User Name is used only once on an e-mail server, which means if the username you want to create a mail ID with already exists, the e-mail service provider (like Yahoo, Gmail) gives the option to choose another username.

  @—This is called the **at symbol**. It gets automatically added to the e-mail address.

  - ✧ **Domain Name**—This is the name of the server that provides the e-mail account.

  Example— computerwala@gmail.com

  Computerwala (User Name) @ (at) gmail (Domain Name) .com (Top Level Domain)

- There are many e-mail servers related to e-mail on the

5 WWW (World Wide Web)

Introduction

- The full form of WWW used in the internet world is **World Wide Web**.
- WWW is also called Web, **W3**, or **W3C**. The full form of W3C is **World Wide Web Consortium**.
- W3C is the organization that establishes standards for the web.
- **Tim Berners-Lee** invented WWW in 1989. At the time of inventing WWW, Tim Berners-Lee was working in an organization named **CERN**.
- Tim Berners-Lee also created and developed **HTML**, **HTTP**, and **URL** in 1990, which are currently used as the foundation of the Web in the internet world. In 1991, WWW reached most parts of the world.
- WWW is an internet-based information system or service. **Note:** Tim Berners-Lee also created the world's first web browser, which was also named World Wide Web. Later, he changed its name to **Nexus** to differentiate it from the real World Wide Web.

Versions of Web

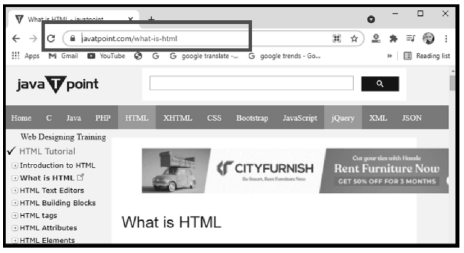
- **Web 1.0 (Static Web):** This was the initial stage of the web. Here the content was 'Read-only', meaning the user could only read the information.
- **Web 2.0 (Social Web):** This is the 'Read-Write' web. Here the user can also create content (like Facebook, YouTube, blogs). It is based on 'interactivity'.
- **Web 3.0 (Semantic Web):** This is the future of the web. It is based on **AI (Artificial Intelligence)** and **Machine Learning**, where machines can understand data like humans.
- **Web 3.0** is also mainly associated with decentralization and **blockchain** technology.

Definition, Concept and Development of World Wide Web

- WWW is an information space or system in which webpages and websites of the entire world are interconnected. This means the place where webpages and websites link to each other is WWW. We use the internet to access all these interconnected webpages and websites.
- World Wide Web is a service of the internet which is a collection of addresses of websites across the world. These websites connect or link to each other.
- World Wide Web is the most used service on the internet that connects multiple web servers and clients together. These web servers store **HTML documents**, **Images**, **Videos**, and many other types of online content, which users access through the Web.
- World Wide Web is a special type of technology that connects computers all over the world to each other. This means World Wide Web is a repository of information on the internet which exists in the form of links.
- World Wide Web works on **HTML**, **HTTP**, **Web Browser**, and **Web Server**.
- World Wide Web is an information space where we use **URLs** to identify various documents and web resources located there. The full form of URL is **Uniform Resource Locator**.
- Documents, Web Resources, Webpages, Websites, etc., located on the World Wide Web connect through hypertext links and all these are accessible through the internet.

Web Page

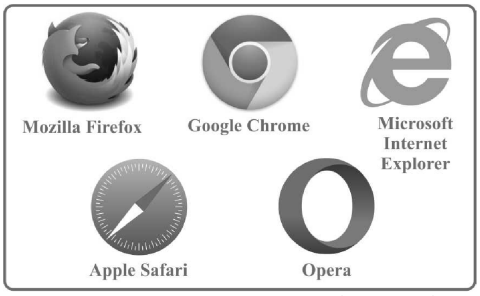
- Every page of all the websites available on the World Wide Web is called a **Web Page**.



- The first web page went live on **August 6, 1991**. Its URL was **www.info.cern.ch**.
- Developers prepare these web pages using **HTML (Hypertext Markup Language)** and connect them to each other through hyperlinks.
- The place where web pages are stored on the server is called a **website**.
- The first page of every website, which provides a list of the information present in it, is called the **Home Page**. When opening any website, the home page appears first.
- **HTTP (Hypertext Transfer Protocol)** is used to send a web page from one computer to another.
- A web page is created using **HTML (Hyper Text Markup Language)**.

6 Web Browsers

- **A Web browser is a computer program** that finds various webpages on the internet for the users and translates them into a language that the user can easily understand. These webpages contain information in the form of **graphics, multimedia, web programs, and normal text**.
- Various types of information are available on any website. This information is made of different types of languages that the user cannot understand. The web browser reads this information and converts it into a language that the user can easily understand. This shows that **web browsers translate various websites available on the internet**.
- A **web browser is a type of application software** that displays the information of any website available on the World Wide Web on the user's computer. The **web browser follows the standards of W3C**.
- A browser is a software application that works as a **"user agent"**.



- A **web browser allows users to view various websites and their web pages** present on the internet. It translates the files and other content of those web pages like **video, image, text**, etc., and displays them on the device (computer/mobile) screen.
- A web browser takes the user into the world of the World Wide Web, where all the content is in the computer language **HTML (Hypertext Markup Language)**.
- A web browser translates the computer language HTML into a language that internet users can easily read.
  Note: Some web browsers can only translate text, while some web browsers can also translate **graphics and animation**.
- A web browser is a software program that allows a user to **display and access a web page**.
- A web browser is generally called a browser. These are software or programs that allow users to display and access a web page.
- A web browser is mainly used to display and access various websites on the internet.
- A web browser is used to display content created with the help of **HTML and XML languages**.
- The **F11 key** is used to make the internet browser window full-screen.
- A web browser acts as an **interface between the internet and the user**.
- **Web browsers are mainly of two types:-**
  1. **Text Based web browser:-**This type of web browser supports only text. **Example:- Lynx**
  2. **Graphical web browser:-** A graphical web browser supports photos, audio, video, animation, PDFs, etc., in addition to text. **Example:- Google Chrome, Mozilla Firefox, Netscape Navigator, etc.**

History of Web Browser

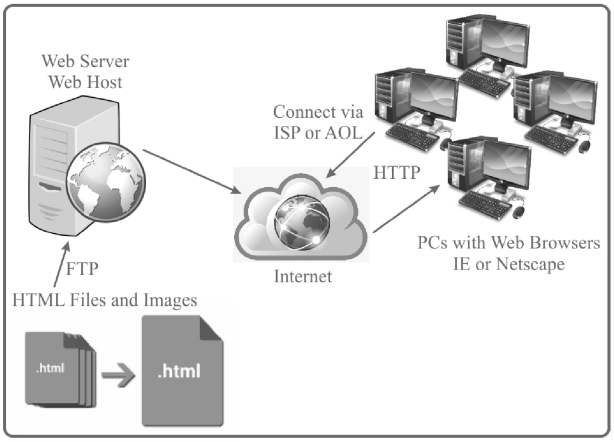
- The credit for developing the concept of the web browser goes to **Tim Berners-Lee**.
  - The world's first web browser was created in **1990-91**. The name of this web page browser was **WWW (World Wide Web)**, which was later changed to **Nexus**.
  - India's first web browser is **EPIC**, which was created by the Bangalore-based startup **Hidden Reflex**.
  - The world's first web browser available with a Graphical User Interface was **Erwise**.
  - Created by **Marc Andreessen in 1993**, the **Mosaic** web browser became the world's first popular internet browser.
- The world's first commercial web browser is **"Netscape Navigator"**, which was developed by the **Netscape Communication Corporation in 1994**.
- The first web browser **'Internet Explorer'** was developed by **Microsoft in 1995**.
- The web browser **"Safari"** was designed by **Apple in 2003** for the Macintosh Computer, and it was launched for Apple Mobile in **2007**.

Working of Web Browser

- The World Wide Web is a system of internet servers that is operated as a **Client/Server model**. When a user opens a web client on their computer, it is called a **Web Browser**.
- The client, that is the **Web Browser**, establishes a connection with the server and sends a request to the

7 Web Publishing

- Web publishing is a process in which content is uploaded on the Internet. **Web Publishing** is also called **Online Publishing**.
- This content can be of types like text, image, audio, video, etc.
- The process of preparing a website, completing it, and uploading it to a host server is called **web publishing**.
- The tasks of **Web Publishing** include uploading files on the Internet, updating web pages, creating websites, writing blog posts, etc., and uploading them on the Internet.



- **Web publishing** mainly takes place in five steps. The steps of the process of preparing a website and putting it on the Internet are as follows—
  1. Registration of Domain Name
  2. Web hosting
  3. Web site design and development
  4. Publish and promotion
  5. Maintenance

1. DNR—Domain Name Registration:

- The **domain name** of a website is its name or address by which it is identified and accessed by Internet users.
- The first step of web publishing is to decide the **domain name** for that website and register that domain name on a web server.
- **Choosing a Domain Name:** The user has to select the domain name themselves. This name should be such that it does not belong to any already existing website. Generally, a company keeps the domain name according to its name; if it is not available, then it selects another domain name that is almost similar to it.
- Before selecting a **domain name** for a website, the following main points must be kept in mind—
  1. The **domain name** should be the name of your company or brand. Doing this makes it easy for the customer or user to search.
  2. The smaller the **domain name** is in size, the simpler it is. Therefore, it will be easier to remember or type the domain names.
  3. The use of capital letters in a **domain name** should be minimum because small letters are easier to remember.
  4. A hyphen (-) or dash should generally not be used in a **domain name**.
  5. The use of plural words in a **domain name** should be avoided.
  6. If the site is a charity or an organization, the **domain name** should generally not use the .com extension.
- **Registering a Domain Name:** In India, the management of the **.in** domain is done by **NIXI (National Internet Exchange of India)**. It handles the **.IN Registry**.
- **NIC (National Informatics Centre)** manages government domains such as **.gov.in**, **.nic.in**, and **.res.in**.
- Tasks such as managing the domain name, making policies to allot domain names, and operating high-level domains are done by the **Internet Assigned Numbers Authority (IANA)**. **IANA** is a committee that registers high-level domains itself and leaves the rest of the work to various organizations.
  For example, in India, Yahoo.com, GoDaddy.com, BigRock.com, Sify.com, Dotster.com, Register.com, etc., are domain name registration organizations.

2. Web hosting:

- This is the most important part of web publishing. When a user gets the domain name of their website registered and designed, storing it on a web server is called **web hosting**. This task is done by the **web server**.
- **Web Hosting** is a service that is used to make the content and pages of a website available on the World Wide Web. The pages and content of the website are stored on a server; every server has an IP.
- Hostgator, Bluehost, etc. are companies providing web hosting.
- **Types of Web Hosting —**

8 Creation and Maintenance of Websites

- To create a website, a user requires the following components:—
  1. Domain name
  2. Hosting
  3. Computer/mobile
  4. Internet Connection
- To create a website, first, you have to purchase a **Domain**. A Domain means the name of the website, such as www.kumar.com. There are many websites in the market from where a domain can be purchased, like GoDaddy, BigRock, Hostinger, etc.
- After that, **Hosting** is required. Hosting means the place where the client's website is stored. In other words, the memory inside which the website is stored is called hosting.
- The third step is to **connect the domain and hosting** with each other so that if any user searches the domain, the website stored in the connected hosting opens up.

Website Creation

- In technical terms, we call Website Creation **Web Development**. It mainly has 5 steps:

1. **Planning & Strategy:** Before creating any website, this is the most important step. A website created without planning may fail later.
   - **Defining Purpose**: You have to decide why you are creating the website.
     - Is it for **Brand Awareness**?
     - Is it to sell products (**E-commerce**)?
     - Or is it just to provide information (**Blog** or **Portfolio**)?
   - **Target Audience**: You should know who your users are (Students, Business Owners, or Housewives). **Design and Language** are decided accordingly.
   - **Sitemap Creation**: This is the blueprint of the website. In this, you make a list of what pages will be on the website (like: Home, About Us, Services, Contact Us) and how they will be linked to each other.
2. **Domain Name & Web Hosting :** This step is to get your website a space on the Internet.
   - **Domain Name:** This is the digital address of your website (like: amazon.com or yourname.in).
     - A domain should always be **short, unique, and easy to remember**.
     - It is purchased from sites like GoDaddy or Namecheap.
   - **Web Hosting:** A domain is the address, but hosting is the house where all the files, images, and code of your website are stored.
     - Choosing a good hosting (server) keeps the website speed fast and it never goes down (**High Uptime**).
   - **SSL Certificate:** This is essential for **security**. When you buy hosting, definitely take SSL too. Due to this, a **'Lock'** sign appears near the URL, which increases the trust of the users.
3. **Technology Selection:** Now you have to decide how the website will be built technically. It has two main methods:
   - **Coding (Custom Development):** If you need very advanced features, developers create the website by writing code.
     - **Frontend:** What the user sees (buttons, design). **HTML, CSS, and React** are used for this.
     - **Backend:** What works in the background (handling data). **Node.js, PHP, and Python** are used for this.
   - **CMS (Content Management System):** If you do not know coding, then CMS is the best option.
     - **WordPress:** 40% of the world's websites are built on this. In this, a site can be built without writing code by using **Themes and Plugins**.
     - **Shopify:** If you want to open an online store, this platform is the best.
4. **Design & UI/UX :** How the website looks and how it operates is very important to retain the user.
   - **UI (User Interface):** This is the external appearance of the website. It includes the color scheme, fonts, images, and styling of buttons. The design should be **clean and professional**.
   - **UX (User Experience):** This means how easily the user can use the site.
     - **Navigation** should be easy so that whatever the user is looking for, they can find it in 2-3 clicks.
   - **Responsive Design:** This is the most important thing today. Your website should be such that it automatically adjusts according to the screen size of mobile, tablet, and laptop. This is called being **Mobile-Friendly**.
5. **Content Creation & SEO :** After the website framework is ready, content does the work of breathing life into it.
   - **Content Creation:** This includes Text, Images, Videos, and Infographics.
     - Content must always be original (do not copy from anywhere).
     - It should solve the user's problem.
   - **SEO (Search Engine Optimization):** No matter how

9 HTML Interactivity Tools

Markup Language

- **Markup language** refers to a text-encoding system that consists of a set of symbols inserted into a text document to control its structure, formatting, or the relationship between its parts.
- **Markup language** refers to the codes and tokens that are to be placed in a document, through which the data is interpreted.
- **Markup language** is a system that groups words separately and helps to display the document correctly.
- When a document is processed to be displayed, the text written in the **markup language** is not visible. The markup language uses this text only for formatting.
- **HTML, GML, XML, XHTML**, etc., are examples of **markup languages**.

HTML

- **HTML** stands for **Hypertext Markup Language**. It is a standard markup language used to design documents displayed in browsers as a webpage.
- By using **CSS (Cascading Style Sheet)** and **JS (JavaScript)**, this language can become more interactive and attractive.
- The word **HTML** itself has a specific meaning derived from **Hypertext** and **Hyperlink**, which means having a connection between multiple pages, and **markup** means defined elements that will form the page layout and the elements within the page. The language that combines both these features makes it the **Hypertext Markup Language**.
- **HTML** is a markup language. Its full name is **"Hypertext Markup Language"**.
- The extension of **HTML files** is **".html"** or **".htm"**.
- **HTML codes** are written in a text editor (like **Notepad**) and are saved with an **HTML extension**.
- A **web browser** is used to view an **HTML file**, such as **Internet Explorer, Google Chrome, Mozilla Firefox, and Safari**, etc.

HTML is used to create a Website.

- **HTML** is made up of a series of small codes called **Tags**. An **HTML tag** tells the browser where and how the elements written inside that tag should be displayed on the website.
- **HTML tags** are like keywords or hidden keywords. They tell how the content should be displayed on the web browser, whereas the tags themselves do not show in the browser.

HTML History

- **HTML** was developed in the 90s by **Tim Berners-Lee** at **CERN**.
- **HTML 5** and its versions are the latest editions that started in 2012 and were published subsequently.
- In the early days of the **WWW (World Wide Web)**, there were many versions of **HTML**.

Year	Version
1989	Tim Berners-Lee invented the WWW.
1991	Tim Berners-Lee invented HTML.
1993	Dave Raggett drafted HTML+.
1995	HTML Working Group defined **HTML 2.0**
1997	HTML 3.2
1999	HTML 4.01
2000	XHTML 1.0
2008	WHATWG HTML 5 First Public Draft
2012	WHATWG HTML 5 Living Standard
2014	HTML 5 [W3C Recommendation]
2016	HTML 5.1 [W3C Recommendation]
2017	HTML 5.1 2nd Edition [W3C Recommendation]
2017	HTML 5.2 [W3C Recommendation]

*Here **WHATWG** (Web Hypertext Application Technology Working Group) एवं **W3C** (World Wide Web Consortium)

What is an HTML Element?

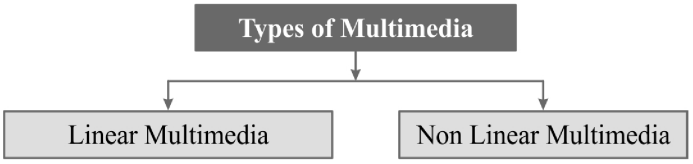
- An **HTML element** is defined by a start tag, some content, and an end tag.
  Syntax :
  <tagname> content goes here .... </tagname>
- An **HTML element** is everything from the start tag to the end tag. For example-
  <h1> My first Heading </h1>
  <P> My first paragraph </P>
- Some HTML elements do not contain content (like <br>). These elements are called **'empty elements'**, and empty elements do not have an end tag.

10 Multimedia and Graphics

Multimedia

- The word "**Multimedia**" is derived from '**Multi**' (many) and '**Media**' (medium). It is a medium through which information is delivered to the user by combining more than one element (such as **Text, Graphics, Images, Audio, Video, and Animation**) together.
- Multimedia establishes a **Two-Way Communication** between the computer and the user.
- Due to the large size of multimedia data (Audio, Video, Animation), a **High Storage Capacity** is required to store it. For this, system components like **Hard Disk, RAM, Video Card, Audio Card, CD ROM, DVD, and MPEG Card** are necessary in the computer.

Types of Multimedia



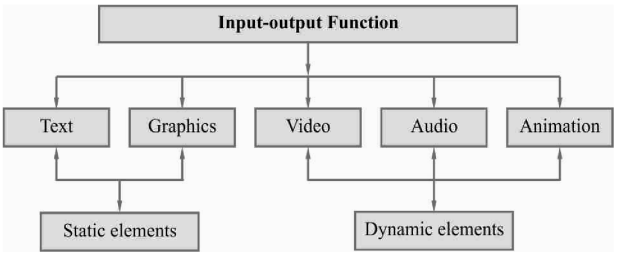
1. Linear Multimedia

- It is also called **Non-Interactive Multimedia**.
- In this, the end-user cannot control the content of the application. The user lacks features like choosing options, clicking on icons, or controlling the **Media Flow**.
- Its main objective is to present information in a fixed **Sequence** and **Logical Flow** from beginning to end.
- It is suitable for providing information to a large group of people, such as: **Movies, Training Sessions, Seminars, and Workplace Meetings**.

2. Non-Linear Multimedia

- It is also called **Interactive Multimedia**.
- It allows the user to control the movement of data and interact with the content. The user is allowed to navigate through the multimedia content according to their wish.
- Information is not presented in a single sequence, rather it works according to the requirement of the user.
- Its best examples are **Computer Games** and **Interactive Websites**, where **Navigation Control** is provided to the user.

Elements of Multimedia



- The main media or elements used to present information are as follows—
  - **Text:** Presentation through characters, numbers, and special characters.
  - **Graphics:** Pictures or drawings made of lines.
  - **Images:** Still pictures created by pixels.
  - **Animation:** Such drawings that appear to be moving.
  - **Audio:** Sound signals.
  - **Video:** Moveable presentation of events with sound.

Text

- It is the most basic component of multimedia. It is used to display information in written form.
- **Types of Text:**
  - **Plain Text (.txt):** It does not have any formatting (color, bold, style). It is created in Notepad.
  - **Rich Text (.rtf, .doc):** It has the facility of formatting. It is created in MS Word, etc.
  - **Hypertext:** The text in which a link to another webpage or file is attached. It is used in webpages.
- **Typography (Fonts):**
  - **Serif Font:** There are small decorative lines on the edges of the letters (e.g., Times New Roman). It is better for printing or newspapers.
  - **Sans-Serif Font:** The edges of the letters are perfectly straight and flat (e.g., Arial, Calibri). It is better for reading on a computer screen.

Image and Graphics

- An **Image** is a component of multimedia through which any **Information** can be easily understood.
- Images are used instead of text in various types of offices, traffic management, life safety messages, hospitals, and advertisements.

11 Voice Mail and Video Conferencing

Voice Mail

- Voice mail is an **electronic and computer-based system** that allows a **caller** to leave a recorded **voice message** when the **recipient** is unavailable. It is also called a **Voice Message** or **Voice Bank**.
- **VMS (Voice Messaging System):** Technically, voice mail is called VMS. It is a centralized system that stores telephone messages in digital form.
- **Unified Communications (UC):** Voice mail is now an integral part of Unified Communications (UC). UC is a technology that integrates email, voice mail, video conferencing, and instant messaging onto a single platform.
- It is an **automatic phone system**, known as a **Digital SMS System** (Digital Message Transmission Service). Gordon Matthews developed it mainly for the telephone in 1970.
- This system records **spoken messages** in digital form and keeps them **stored**. This allows the **recipient** to easily **retrieve** them later through their phone, desktop, email, or other communication devices.

- This feature enables employees to screen incoming calls (**Call Screening**). Therefore, they can give **immediate attention** to **high priority calls** and send **non-urgent calls** to voice mail.

Video Conferencing

- Video conferencing is a **virtual** and **real-time communication** technology.
- Using the **Internet and IP-based networks**, it allows two or more **participants** sitting in different geographical locations to exchange **two-way audio-video** signals.
- This technology provides a face-to-face meeting experience without physical presence. It is also called **Video Tele Conferencing**.

History and Evolution

- **Beginning (1964):** AT&T introduced the first **Picture Phone** for video calls in New York, which laid the foundation for this technology.
- **System Introduction (1982):** Compression Labs introduced the first **commercial video conferencing system**.
- **Usage on PC (1991):** The use of video conferencing on **Personal Computers (PCs)** started.
- **HD Era (2005):** Life Size launched the first video conferencing in **High Definition (HD)**, which significantly improved video quality.
- **Present:** Now, this technology has moved out of a dedicated conference room and reached small mobile devices like **smartphones and tablets**.

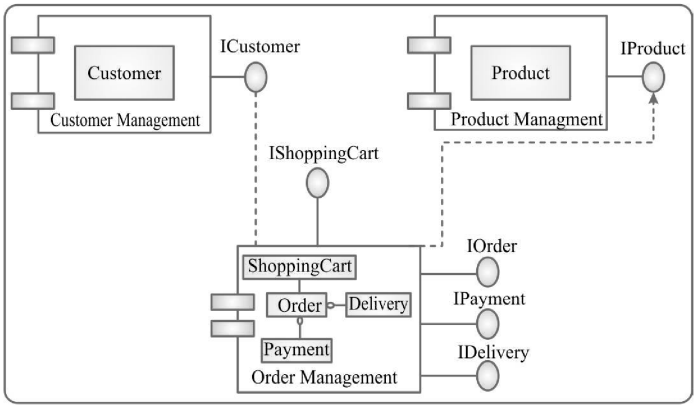
Processing of Video Conferencing

- The process of video conferencing involves several **technical steps** that ensure **real-time communication**:
- **Device and Signal Capture::**
  - The **web camera** captures the user's **live video**, while the **microphone** records the **audio**.
  - These **analogue signals** are in **raw** form and get prepared for transmission.
- **Digitization and Compression:**
  - The captured **analogue signals** convert into **digital data**. The system performs **compression** to reduce the size of this digital data.
- **Packetization and Transmission:**
  - The system divides the **compressed data** into small **packets**. It sends these packets over the **Internet (TCP/IP network)** using special protocols for real-time communication, such as **SIP (Session Initiation Protocol)** and **VoIP (Voice over IP)**.
  - **WebRTC (Web Real-Time Communication):** This is the latest technology for video conferencing. It facilitates direct audio-video communication in web browsers (like **Chrome** and **Firefox**) without any extra plugin or software.
- **Data Reception and Decoding:**
  - On the receiver's device, packets are received from the internet and reassembled in the correct order.
  - The software decodes this compressed data back

12 Introduction of E-Commerce

Introduction & History of E-commerce

- The full form of E-commerce is **Electronic Commerce**, which is the process of buying and selling products and services, and transferring money online through the internet and other digital mediums.
- This technology is **Paperless** and can be operated with **Less Manpower**.
- The main objective of E-commerce is to display **Goods and Services** through the internet in such a way that people can buy them, which increases **Sales and Brand Awareness**.
- The historical beginning of E-commerce happened in **1979**, when **Michael Aldrich** created a system called 'Teleshopping' by connecting a modified TV to a telephone line. Because of this, Michael Aldrich is also called the **'Father of Online Shopping'**.
- The **First Secure Retail Transaction** on the internet was done with a credit card on **August 11, 1994**, on a website named '**NetMarket**'.
- Since the 1960s, businesses were sharing **Business Documents** electronically using **Electronic Data Interchange (EDI)**, for which a **Universal Standard** named **ASC X12** was created in **1979**.
- Some main features of E-commerce include allowing **Non-cash Payment**, availability of **24×7 Service**, and **Click & Purchase** (buying an item with a single click).



- E-commerce uses methods like **EDI**, **Electronic Mail (E-mail)**, **Electronic Bulletin Board (EBB)**, and **Electronic Fund Transfer (EFT)** to transfer business information.
- **M-paisa** is a facility to transfer money through mobile, which was introduced by the **Vodafone** company in **2007**.
- E-commerce uses the following methods for transferring business information—
  - Electronic Data Interchange (EDI)
  - Electronic Mail (E-mail)
  - Electronic Bulletin Board (EBB)
  - Electronic Fund Transfer (EFT)

Major E-Commerce Companies in India

Company Name	Headquarters	Founders	Web Address
Flipkart	Bengaluru, Karnataka, India	Sachin Bansal, Binny Bansal	https://www.flipkart.com
Snapdeal	New Delhi, India	Kunal Bahl, Rohit Bansal	https://www.snapdeal.com
Myntra	Bengaluru, Karnataka, India	Mukesh Bansal, Vineet Saxena, Ashutosh Lawania	https://www.myntra.com
Nykaa	Mumbai, Maharashtra, India	Falguni Nayar	https://www.nykaa.com
Meesho	Bengaluru, Karnataka, India	Vidit Aatrey, Sanjeev Barnwal	https://www.meesho.com

- Other E-commerce companies are **JioMart, Tata CLiQ, Lenskart, Jabong.com, Ebay.in, BookMyShow**, etc.
- **Zepto, Blinkit, Swiggy, Instamart**, etc., are **Quick Commerce** companies that deliver groceries and essentials in 10-30 minutes.

Note: In January 2026, the **Labour Ministry of India** advised **Quick Commerce** companies to remove the 10-minute delivery promise from their branding.

6. The facility to provide brick and mortar stores with the same data that online stores have, by connecting various types of devices, machines, and sensors through the internet, comes under the following technology: [Raj. IA Exam 2018]

(A) Click and Send (B) Click and Purchase
(C) Click and Reserve (D) Click and Collect

7. Which of the following is/are segments of e-commerce? [Raj. IA Exam 2013]

(A) B2B (B) B2C
(C) C2B (D) All of the above

8. Which of the following is essential for B2B e-commerce? [Raj. IA Exam 2011]

(A)World Wide Web
(B) Secure payment service
(C) Secure electronic communication facility
(D) All of the above

9. EDIFACT is a standard for— [Raj. IA Exam 2011]

(A) showing business forms in e-commerce
(B) email in e-commerce
(C) FTP in e-commerce
(D) protocol in e-commerce

10. E-commerce, e-learning, e-banking, m-commerce etc. are which of the following services? [Raj. Junior Instructor (COPA) - 2019]

(A) Bank loan
(B) Large retail organizations
(C) Venture capital fund
(D) e-Services

11. Which of the following is not an e-commerce website? [SSC CHSL, 16.10.2020, Shift-Ist]

(A) Uber (B) Google Maps
(C) Flipkart (D) Swiggy

12. The type of e-commerce in which a company sells its products to another company through the internet is called—[Raj. Junior Instructor (COPA) - 2019]

(A) B2G (B) B2C (C) B2B (D) C2B

13. Which E-commerce company has launched an app named 'Shopsy' that allows Indians to start online shops for free? [UPPCL 2018]

(A) Amazon (B) Flipkart
(C) Paytm (D) Snapdeal

14. This type of e-commerce is used for auction: [SSC 2015]

(A) B2B (B) B2C)
(C) C2C (D) All of the above

Answer Sheet

6.(D)	**7.**(D)	**8.**(D)	**9.**(D)	**10.**(D)	**11.**(B)	**12.**(C)	**13.**(B)	**14.**(C)	

UNIT-XI : MAJOR DEVELOPMENT IN THE FIELD OF IT

1 Major Development in the Field of IT

- The meaning of **Information Technology** is to **collect**, **store**, **process**, and **implement/use** various types of **information**.
- By using **Information Technology**, every task is done at a **fast speed**. **Quick data transmission** has become possible through **IT**.
- **Information Technology** is also used to send any **information quickly** from one place to another.
- In India, the task of making and implementing the **IT policy** is done by **MeitY**. The full name of **MeitY** is the **Ministry of Electronics & Information Technology**. For the development of IT in the Government of India, the **Ministry of Electronics & Information Technology** is working. The current Minister of the IT Ministry is **Shri Ashwini Vaishnaw** and the Minister of State is **Shri Jitin Prasada**.
- The operation and **policy making** of Information Technology are done according to the various provisions of the **Information Technology Act 2000**.

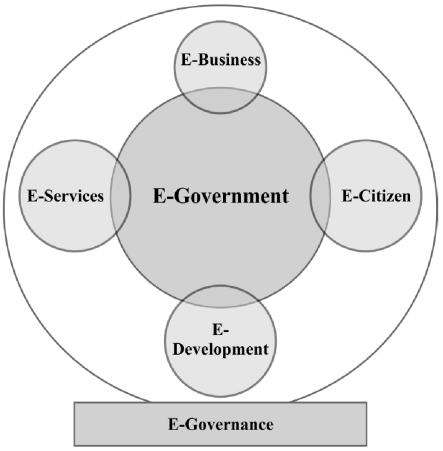
Information Technology Act 2000

- The **Information Technology Act 2000** is an act passed by the **Indian Parliament**, which was passed on **October 17, 2000**.
- Following the United Nations resolution, India passed the **Information Technology Act 2000** in **May 2000** and implemented it by issuing a notification on **October 17, 2000**.
- The **Information Technology Act, 2000** was significantly amended through the **Information Technology Amendment Act, 2008**, which was passed by both houses of the **Indian Parliament**.
- Through the **Information Technology Act**, tasks like providing legal recognition to various **digital documents** and **electronic signatures**, the provision of laws for **cyber-crime**, **quick information transmission**, etc., are done.

Development & Application in the Field of IT

E-Governance

- **E-Governance** means **Electronic Governance**, which promotes the **digitalization** of **services**.
- The meaning of **E-Governance** is to easily deliver all government works, schemes, and facilities to the public through **online services**.
- Making the facilities available to common citizens by the government through the internet using **technology** is called **E-Governance**.
- **E-Governance** is also called E-Government, Digital Government, Online Government, and Connected Government.



- The objective of **E-Governance** is to provide facilities to citizens by the government through a **single point delivery system**. The **single point delivery system** means that all facilities are available in one place. The **services** provided in E-Governance are as follows—
  - **E-Citizen**: Under this, the government provides various facilities to citizens through **Integrated Service Centers**. For example – issuing ration cards and passports, issuing birth and death certificates, and paying electricity, water, and mobile bills.
  - **E-Medicine**: The government provides better health services to citizens by creating a network of various hospitals in the country.
  - **E-Transport**: Transport-related works like making driving licenses, doing vehicle registration, etc., are done online.
  - **E-Registration**: The registration and transfer of citizens' property are done online.
  - **E-Education**: Providing education to citizens located in remote areas of the country through electronic mediums like radio and TV.
  - **E-Secretariat**: Creating a network for the online exchange of information among various departments.
  - **E-Court:** Under this, a database of all the cases and records is prepared and made available on the internet. If needed, this data can be viewed

8. The portal launched by the Rajasthan Government in September 2019 which is used for quick access to information in the departments is—
(A) Jan Soochna Portal (B) Jan Sanchar Portal
(C) Soochna Portal (D) Soochna Bulletin

9. IThe term PAN used as an Income Tax and identity document stands for—
(A) Permanent Account Number
(B) Personal Account Number
(C) Personal Assessment Number
(D) Permanent Access Number

10. The full form of MNP is—
(A) Mobile Number Portable
(B) Mobile Number Prime
(C) Mobile Number Portability
(D) Mobile New Portability

11. The full form of the money transfer system EFT is—
(A) Electronic Fund Tax
(B) Electronic Finance Transfer
(C) Electronic Fund Transfer
(D) Electric Finance Transfer

12. What is the meaning of a "Decentralized" currency in the context of cryptocurrency (like Bitcoin)?
(A) The currency which has no central bank or regulatory authority
(B) The currency which is controlled only by the government
(C) The currency which is available only in physical form (notes)
(D) None of these

13. The full form of EPIC used in the voting system is—
(A) Election Passport Identity Card
(B) Election Photo Identity Card
(C) Elector's Photo Identity Card
(D) Economy Photo Identity Card

14. Which of the following services is provided by e-Governance—
(A) e-Citizen (B) e-Transport
(C) e-Medicine (D) All of the above

15. The benefits of e-Governance are—
(A) Better access to information and quality services for citizens
(B) Simplicity, efficiency and accountability in government
(C) Expanded reach of governance
(D) All of the above

16. Many processes are carried out by e-Governance, the mismatched one among them is—
(A) G TO G (B) G TO P
(C) G TO C (D) G TO E

17. The correct matching of the full forms of different formats of e-Governance is—

e-governance Service	Full Form
a. G2B	(i) Government to Government
b. G2G	(ii) Government to Citizen
c. G2C	(iii) Government to Employee
d. G2E	(iv) Government to Business

(A) a-i, b-ii, c-iii, d-iv (B) a-iv, b-i, c-ii, d-iii
(C) a-iv, b-ii, c-iii, d-i (D) a-ii, b-i, c-iii, d-iv

18. What kind of study material is provided in Raj e-Gyan?
(A) E-Content (B) Power Point/Videos
(C) E-Book (D) All of above

19. When was the 'e-Governance' centre established in the Ministry of Information Technology by the Government?
(A) 26 January, 2000 (B) 30 August, 2001
(C) 2 April, 2002 (D) 15 August, 2000

20. The option showing the proper relationship of various portals used by the State Government to promote the Digital Rajasthan initiative with their utility is—

Digital Platform	Utility
a. Raj e-Sign	i. To host services of various departments on a common infrastructure
b. Raj Payment	ii. Audio/Video streaming of government innovations
c. Raj Bioscope	iii. For online payment to individuals/firms
d. State Data Centre (SDC)	iv. Used in coded information transmission

(A) a-i, b-ii, c-iii, d-iv (B) a-iv, b-iii, c-ii, a-i
(C) a-iv, b-iii, c-ii, d-i (D) a-iii, b-iv, c-i, d-ii

21. The appropriate option regarding the use and features of various terms related to e-banking is—

Banking Term	Use/Facility
a. ATM	i. Indian version of Debit Card
b. Check point Machine	ii. Used for money credit/ debit
c. Money Deposit Machine	iii. Check deposit facility
d. Rupee Card	iv. Facility to deposit money

(A) a-i, b-ii, c-iii, d-iv (B) a-ii, b-iii, c-iv, d-i
(C) a-ii, b-iii, c-iv, d-iv (D) a-iii, b-ii, c-i, d-iv

22. The name of the application used for COVID-19 infection updates and the quarantine process during the Corona period is—
(A) RajCovid World App (B) E-Covid App
(C) RajCovid Info App (D) None of the above

23. The name of the online service platform available for leave management, annual performance appraisal, and obtaining a No Objection Certificate (NOC) for government employees in Rajasthan is—
(A) E-Employee (B) E-leave
(C) Raj-Kaj (D) Raj-Employee

Answer Sheet

8.(A)	**9.**(A)	**10.**(C)	**11.**(C)	**12.**(A)	**13.**(C)	**14.**(D)	**15.**(B)	**16.**(B)	**17.**(B)
18.(D)	**19.**(D)	**20.**(C)	**21.**(B)	**22.**(C)	**23.**(C)				

UNIT-XII : PEDAGOGY

1 Pedagogy

- Pedagogy is called the science of education in Hindi.
- The word pedagogy originates from two Greek words: **Paidos** (child) and **Agogos** (guide/leader). Its literal meaning is '**one who guides the child**'.
- In Pedagogy, '**how to teach**' is studied. In this, special emphasis is placed on understanding-based knowledge along with subject knowledge, which means pedagogy is the study of **teaching methods, principles, and their practical applications**.

Teaching

- Teaching refers to a **tripartite process**, in which attention is given to the source of teaching, the student, and the planning of all activities that bring changes in the student's behaviour.
- **John Dewey** considered education as a **three-way process** and has given place to the **teacher, learner (student), and curriculum** in it.
- The medium of interaction between the teacher and the student are teaching methods, books, curriculum, and teaching materials, etc., hence they are termed as intermediate variables.
- **Curriculum, teaching tools, teaching methods, educational environment, evaluation techniques**, etc., are intermediate variables.

Variables of Teaching

Variables

A '**variable**' refers to any condition, number, object, quality, or quantity that changes or is changed.

- The **variables of teaching** refer to those basic elements that affect and operate the teaching process.
- There are considered to be **three variables of teaching**—

1. **Dependent Variable**—
   - The one in which the change is brought is called the '**dependent variable**'.
   - In the teaching process, changes are brought in the student and their behaviour. Therefore, the '**student**' is called the dependent variable of the teaching process.
2. **Independent Variable**—
   - The one who makes the change is called the '**independent variable**'.
   - In the teaching process, the '**teacher**' is termed as the independent variable because the teaching system is operated by the teacher.
   - In the teaching process, the teacher keeps the students active and establishes control over all types of intermediate variables.
3. **Intermediate Variable**—
   - Those through which the change occurs are called '**intermediate variables**'.

Characteristics of Teaching—

1. Teaching is a complex social process.
2. Teaching is a mutual interaction.
3. Teaching is a purposeful process.
4. Teaching is a developmental process.
5. Teaching is both an art and a science.
6. In teaching, language acts as communication.
7. Teaching is a face-to-face process.
8. Teaching is a remedial method.
9. Teaching is a logical activity.
10. Teaching can be measured.
11. Improvement and development can also be done in teaching.
12. Teaching is a **tri-polar** (teacher, learner, and curriculum) process.
13. Teaching is a process of direction.
14. Teaching is both formal and informal activity.
15. Teaching is a specific task equipped with various skills.
16. Teaching is the result of the teacher's hard work.
17. Teaching is an organized system of various types of activities.
18. Teaching is a professional activity.
19. Teaching can be observed and analysed scientifically.

Types of Teaching

- Scholars have classified teaching in different ways on various bases, some of the major classifications are as follows—

11. Audio-Visual Aids Strategy
12. Brainstorming Strategy
13. Sensitivity Training Strategy
14. Computer-Assisted Instruction Strategy
15. Historical Research Strategy
16. Review Strategy
17. Team Teaching

❖ The detailed description of the main strategies from the above is as follows—

1. Group Discussion Strategy—

- ❖ In this method, a topic is taken and the teacher motivates the students to talk or debate on that topic.
- ❖ This method increases the opportunities for interaction between the teacher and the students.
- ❖ For the success of this method, it is necessary that students should have the freedom to express their thoughts.
- ❖ Under group discussion, **Edward Harkness** gave the **Harkness Method** in **1930**. In this, students are made to sit around a round table for group discussion and every student participates in the discussion with individual responsibility.

2. Questionnaire Strategy—

- ❖ Its originator is the famous philosopher **Socrates**, hence this policy is also called the **Socratic Method**.
- ❖ According to Socrates, there are three main steps of the questionnaire system—
  1. To construct the questions systematically.
  2. To present the questions properly to the students so that curiosity for new knowledge can be awakened in them.
  3. To give new knowledge by establishing a relationship among the questions through the students.
- ❖ In psychology, the originator of this method is considered to be **Woodworth**.

3. Heuristic Strategy—

- ❖ This is also called the **Discovery Method**.
- ❖ Its originator was **Prof. Armstrong**.
- ❖ In this method, students learn by discovering themselves. The teacher acts as a guide, who helps in correcting mistakes at the right time.
- ❖ In this method, the student acts like an investigator.
- ❖ According to **Prof. Armstrong** — "**The process of learning any subject is discovery itself and the students should discover the facts and principles related to the subject themselves.**"

4. Problem-Solving Strategy—

In this method, students analyse and synthesise problems with the help of the teacher and try to reach a solution.

The following steps are used in this method—

1. Selection of the problem
2. Presentation of the problem
3. Collection of facts
4. Formulation of hypothesis
5. Reaching a conclusive solution
6. Evaluation

5. Project Strategy—

- ❖ The originator of this method is **Kilpatrick**.
- ❖ In this method, students prepare different plans on a single problem, execute the plan and the teacher evaluates the plan at the end.
- ❖ This method is based on **learning by doing**.
- ❖ It gives special emphasis on the **socialisation of children**.

6. Independent Study Strategy—

- ❖ In this method, students work independently, either alone or in small groups.
- ❖ In this student-centred method, the teacher tries to develop such an ability in the students that they can do self-study and solve the problem by studying independently.

7. Assignment Strategy—

- ❖ In this method, the syllabus is divided into small assignments and given to the students to complete within a set time.

8. Role Play Strategy—

- ❖ This is an acting method; it is related to developing cognitive and social skills.
- ❖ In this, importance is given to **simulated teaching**.
- ❖ In this role-playing or dramatic method, the class is divided into small groups and students are made to imitate the experiences of others.
- ❖ In this, students have to act as both the teacher and the student.

9. Field Trip Educational Tour—

Through educational tours, students not only gain educational knowledge but also get an opportunity to use real knowledge and their observation power also develops.

10. Brain Stroming Strategy—

- ❖ This method is originated by **Osborn**.
- ❖ Brainstorming method, as the name suggests, is a method in which such tools are used which create a stir in the students' minds towards gaining knowledge and thinking.
- ❖ In this, a problem is presented to the students, on which all students think freely, converse, and debate.
- ❖ While debating, thinking, and conversing, a stage comes when students completely solve the problem.

school research in which school teachers solve their problems using the **scientific steps of research**.

❖ **'Action Research'** was permanently established in the education world by Columbia University Professor **Stephen M. Corey** in **1953**.

Meaning & Definition of Action Research

❖ The meaning of action research is the scientific study of personal and school problems by people related to the school to improve their actions and school activities.

❖ Inspectors in their administration, managers in their school management, principals in their school operations, and teachers in their teaching use **action research** for improvement.

Objectives of Action Research

1. To develop the skill of solving classroom problems among teachers.
2. To test the principles of education in the **real environment** of the school.
3. To know the effectiveness of school processes.
4. To give maximum importance to **democratic values** in the working system of the school.
5. To make improvements by changing the organization and management of the school.
6. To make progress by keeping the school's activities dynamic.
7. To study the school curriculum in real situations and adapt it to **local needs**.
8. To make progress possible by making the students, teachers, etc. of the school aware of their faults.
9. To make the principal, managers, inspectors, and teachers of the school aware of their duties and responsibilities.
10. To increase the teacher's progress, thinking power, professional spirit, and the ability to work together with others.
11. To contribute to the progress of the school by studying and solving its daily problems.
12. To give people related to the school an opportunity to improve their methods by scientifically studying their problems.

Features of Action Research

1. In action research, more emphasis is given to **experimentation** rather than theory.
2. The focus of action research is not centered on any specific part but on the **entire situation**.
3. This research does not establish any kind of generalization regarding other situations.
4. Action research resolves the real problems of the school in **social situations**.
5. People doing action research are always thinking about improving their own methods.
6. This research creates tools to collect different types of material and information.
7. Action research ends the tendency of centralization in decision making and working.
8. In this, the school teachers, administrators, and inspectors work in **mutual cooperation** with each other.
9. Changes in time objectives, creation of new hypotheses, and their testing can be done in the school.
10. People implementing the results of this research take an active part in it from beginning to end.

Problem Area of Action Research

❖ The main objective of action research is to achieve qualitative improvement by solving school problems.

❖ Therefore, its area is very wide and includes the following problems:—

1. Child behavior problems
2. Teaching problems
3. Examination related problems
4. School organization and administration related problems
5. Extracurricular activity related problems

Steps of Action Research

❖ Action research is mainly considered to have **seven steps**—

1. Knowledge of the problem
2. Selection of the problem
3. Suggestion and hypothesis formulation
4. Creation of methods for data collection
5. Implementation of the plan and data collection
6. Conclusion based on facts
7. Informing others of the results

Importance of Action Research

1. The person doing action research makes progress by solving the problem.
2. Action research makes modifications and improvements in the working system of the school.
3. It emphasizes the establishment of **democratic values** in the school.
4. It helps in facing new situations arising due to scientific inventions.
5. It develops mutual cooperation, love, and goodwill among teachers.
6. It ends the **mechanical environment** of the school.
7. It provides practical solutions to the problems of students, teachers, inspectors, managers, etc.
8. It motivates teachers and principals to organize their daily experiences and benefit from them.

72. Which of the following is not a prescribed level of teaching? [School Lecturer Mathematics Sanskrit Education-2020]
(A) Memory level (B) Understanding level
(C) Reflective level (D) Affective level

73. Which of the following statements is incorrect regarding the characteristics of good teaching? [School Lecturer Mathematics Sanskrit Education-2020]
(A) Good teaching is diagnostic and remedial.
(B) Good teaching is autocratic.
(C) Good teaching is based on cooperation.
(D) Good teaching is an organization of learning.

74. Which of the following teaching maxims is based on Gestalt psychology? [School Lecturer Mathematics Sanskrit Education-2020]
(A) From known to unknown
(B) From concrete to abstract
(C) From specific to general
(D) From whole to part

75. Who was the originator of the Advance Organizer Model? [School Lecturer Sanskrit Education Mathematics-2020] [School Lecturer Sanskrit Education, Economics-2020]
(A) David Ausubel (B) Joyce and Weil
(C) Jerome Bruner (D) Robert Glaser

76. Which statement is not correct regarding the Scientific Inquiry Training Model? [School Lecturer Sanskrit Education Mathematics-2020]
(A) Knowledge is not eternal, but changeable.
(B) There is no single answer to a question. There can be many ways to express a thing.
(C) Generally, we all take the help of the inquiry process to solve any problem.

77. Which teaching model is related to information processing? [School Lecturer Economics-2020]
(A) Non-directive model
(B) Social inquiry model
(C) Basic teaching model
(D) Concept attainment model

78. The main objective of the 'Scientific Inquiry Training Model' is— [School Lecturer Sanskrit Education, Hindi-2020]
(A) To develop the inductive reasoning power of the students.
(B) To develop cognitive skills in the students.
(C) To make the content interesting and meaningful.
(D) To develop thinking strategies in the students

79. In a teaching model, 'syntax' refers to— [School Lecturer Sanskrit Education, Economics-2020]
(A) The objectives of teaching
(B) The interaction between student and teacher
(C)The description of the phases of the model
(D) The additional requirements for teaching

80. Linear programmed instruction is based on the ideas of which of the following? [School Lecturer Chemistry-2020]
(A) Edward (B) Gilbert
(C) Pavlov (D) Skinner

81. The propounder of the Scientific Inquiry Teaching Model is— [School Lecturer Political Science-2020]
(A) Jean Piaget (B) David P. Ausubel
(C) Joseph J. Schwab (D) Richard Suchman

82. Which of the following are the basic elements of a teaching model? [School Lecturer Drawing-2020]
a. Focus b. Social system
c. Syntax d. Support system
e. Evaluation
Select the correct answer from the codes given below:
(A) a, c, b, d (B) b, c, d, e
(C) a, b, c, e (D) c, e, b, d

83. Which of the following is not an example of the Information Processing Model of teaching? [School Lecturer Commerce-2020]
(A) Inquiry Training Model
(B) Concept Attainment Model
(C) Inductive Thinking Model
(D) Classroom Meeting Model

84. Teaching models are— [School Lecturer Home Science-2020]
(A) Principles of teaching
(B) Maxims of teaching
(C) Phases of teaching
(D) Instructional designs of teaching

85. The basis of the Advance Organizer Model is— [School Lecturer (Sanskrit Education) Pol. Science-2020]
(A) Verbal learning (B) Active learning
(C) Non-verbal learning (D) None of these

86. Match List-I with List-II for the adolescent learner and give the correct answer from the codes given below. [School Lecturer Public Administration-2020]

List-I	List-II
I. Inquiry Training Model	a. Richard Suchman
II. Inductive Thinking Model	b. Hilda Taba
III. Concept Attainment Model	c. Flanders
IV. Social Interaction Model	d. Bruner
	e. Skinner

Codes :	I	II	III	IV
(A)	e	d	c	b
(B)	b	c	d	a
(C)	a	b	d	c
(D)	a	b	c	d

Answer Sheet

72.(D)	**73.**(B)	**74.**(D)	**75.**(A)	**76.**(B)	**77.**(D)	**78.**(B)	**79.**(C)	**80.**(D)	**81.**(C)
82.(A)	**83.**(D)	**84.**(D)	**85.**(A)	**86.**(C)					

- **PPP** : Public Private Partnership
- **Prolog** : Programming in Logic
- **PROM** : Programmable Read Only Memory
- **PSTN** : Public Switched Telephone Network
- **RAM** : Random Access Memory
- **RDBMS** : Relational Database Management System
- **RFID** : Radio Frequency Identification
- **RGB** : Red, Green, Blue
- **RJ** : Registered Jack
- **ROM** : Read Only Memory
- **RPG** : Report Program Generator
- **RPM** : Revolutions Per Minute
- **RTS** : Real Time Streaming
- **SAD** : System analysis and Design
- **SAN** : Storage Area Network
- **SD Card** : Secure Digital Card
- **SDLC** : System Development Life Cycle
- **SHF** : Super High Frequency
- **SIM** : Subscriber Identity Module.
- **SIS** : Symbian OS Installer File
- **SMPS** : Switched Mode Power Supply
- **SMTP** : Simple Mail Transfer Protocol
- **SNOBOL** : String Oriented Symbolic Language
- **SQL** : Structured Query Language
- **SRAM** : Static Random Access Memory
- **SRM** : System Reference Manual
- **SSD** : Solid State Drive
- **SSI** : Small-Scale Integration
- **SSO** : Single Sign On
- **STP** : Shielded Twisted Pair
- **SWF** : Shock Wave Flash
- **TB** : Tera Byte
- **TCL** : Transaction Control Language
- **TCP** : Transmission Control Protocol
- **TCP/IP** : Transmission Control Protocol/Internet Protocol
- **TDM** : Time Division Multiplexing
- **TELNET** : Telecommunication Network Protocol
- **UDP** : User Datagram Protocol
- **UHF** : Ultra High Frequency
- **UIDAI** : Unique Identification Authority Of India
- **ULSI** : Ultra Large Scale Integration
- **UML** : Unified Modeling Language
- **UMTS** : Universal Mobile Telecommunication System.
- **UNIVAC** : Universal Automatic computer
- **UPI** : Unified Payment Interface
- **UPS** : Uninterrupted Power Supply
- **URI** : Uniform Resource Identifier
- **URL** : Uniform Resource Locater
- **USB** : Universal Serial Bus
- **UTP** : Unshielded Twisted Pair
- **UVEPROM** : Ultra Violet Erasable Programmable Read Only Memory
- **VCR** : Video Cassette Recorder
- **VDU** : Video Display Unit
- **VGA** : Video Graphics Array
- **VGA** : Video/Visual Graphic Adapter/ Array
- **VHF** : Very High Frequency.
- **VIRUS** : Vital Information Resources Under Seize
- **VLSI** : Very Large Scale Integration
- **VOIP** : Voice Over Internet Protocol
- **VSNL** : Videsh Sanchar Nigam Limited
- **WAN** : Wide Area Network
- **WAP** : Wireless Application Protocol.
- **WAV** : Waveform Audio
- **WBMP** : Wireless Bitmap Image
- **WiFi** : Wireless Fidelity
- **WLAN** : Wireless Local Area Network
- **WLL** : Wireless Local Loop
- **WMA** : Windows Media Audio
- **WMP** : Windows Media Player
- **WMV** : Windows Media Video
- **WORM** : Write Once – Read Many
- **WWW** : World Wide Web
- **XMF** : Extensible Music File

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(Selected Senior Computer Instructor)
(Selected Basic Computer Instructor)

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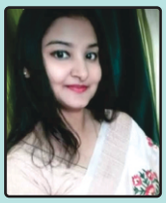

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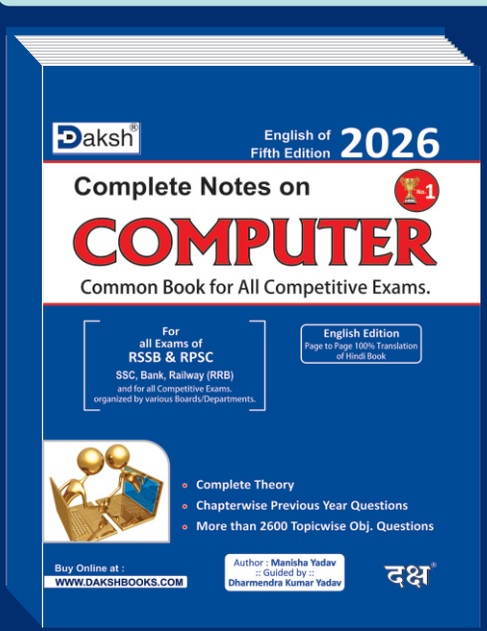

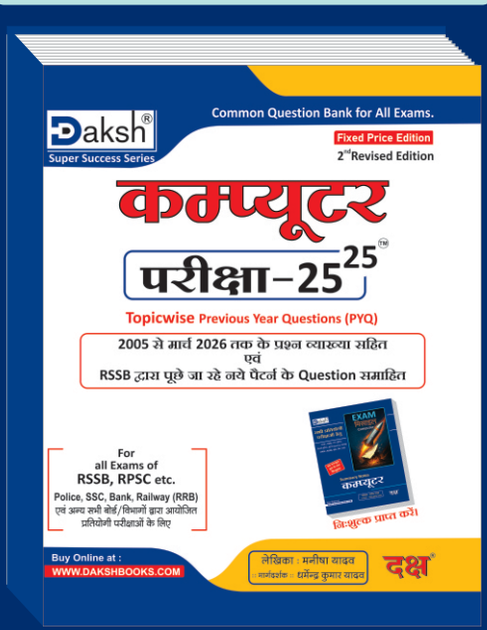

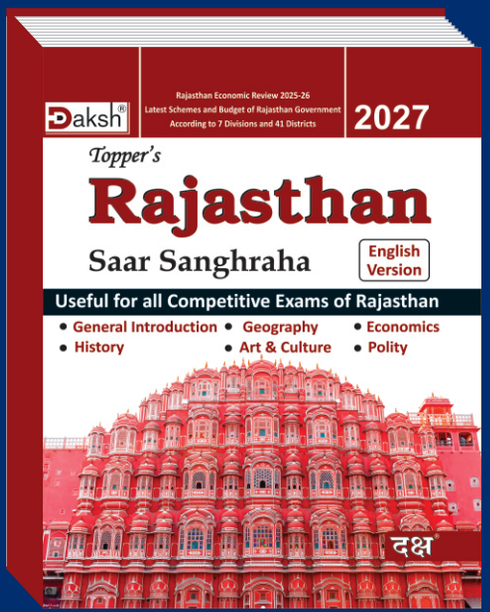

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