1.(b) What will be the storage capacity of a 2·5 inch diameter disk pack having 4 plates with each surface of the plate having 2048 tracks and each track having 512 sectors? A sector can store 1024 bytes of data.

To calculate the storage capacity of the disk pack, we need to multiply the number of plates, the number of surfaces per plate, the number of tracks per surface, the number of sectors per track, and the number of bytes per sector.

Given:

Diameter of disk pack = 2.5 inches

Number of plates = 4

Number of surfaces per plate = 2 (assuming both sides of each plate are used)

Number of tracks per surface = 2048

Number of sectors per track = 512

Number of bytes per sector = 1024

First, let's calculate the total number of sectors in the disk pack:

Total sectors = Number of plates × Number of surfaces per plate × Number of tracks per surface × Number of sectors per track

Total sectors = 4 × 2 × 2048 × 512

Now, let's calculate the total storage capacity in bytes:

Total capacity = Total sectors × Number of bytes per sector

Total capacity = (4 × 2 × 2048 × 512) × 1024

Let's perform the calculations:

Total sectors = 4 × 2 × 2048 × 512 = 16,777,216 sectors

Total capacity = 16,777,216 sectors × 1024 bytes/sector = 17,179,869,184 bytes

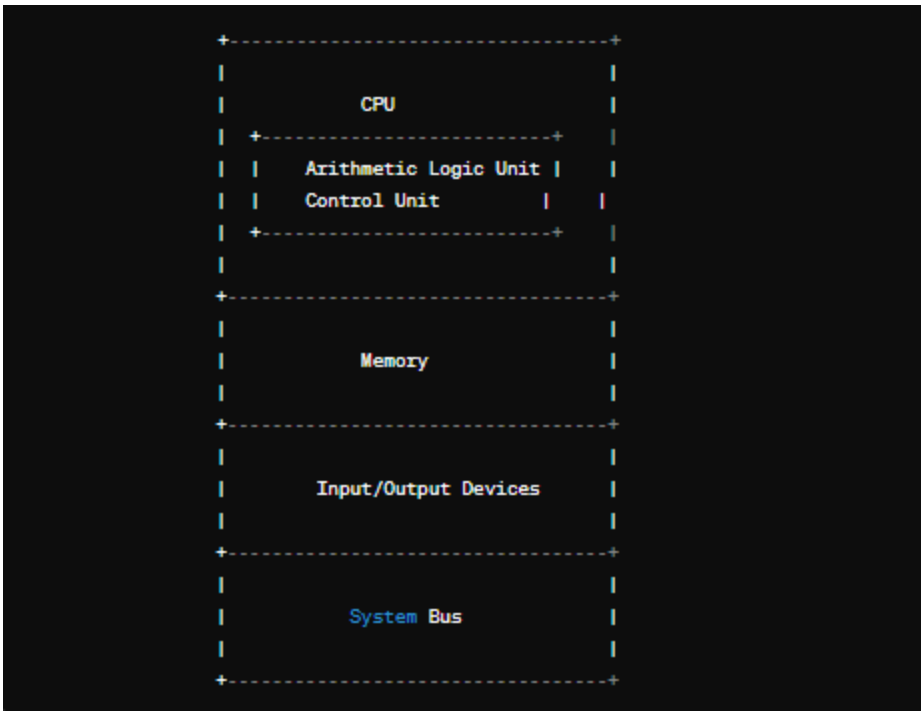
So, the storage capacity of the disk pack is approximately 17,179,869,184 bytes, or about 17.18 gigabytes.

(c) Explain the von Neumann Architecture with the help of a diagram.

The von Neumann Architecture is a conceptual design for a computer's architecture, which has become the foundation for most modern computers. It was proposed by John von Neumann in the 1940s. The key components of the von Neumann Architecture include the CPU (Central Processing Unit), memory, input/output devices, and the system bus, which facilitates communication between these components. Here's a breakdown:

- **CPU (Central Processing Unit):** This is the brain of the computer. It performs arithmetic and logical operations and controls the execution of instructions. The CPU typically consists of an arithmetic logic unit (ALU) for calculations and a control unit (CU) for instruction interpretation and control signals.
- **Memory:** Memory stores data and instructions that the CPU needs to access quickly. In the von Neumann Architecture, both program instructions and data are stored in the same memory unit. This memory is often referred to as RAM (Random Access Memory). It's divided into small addressable units called memory cells or locations, each with its unique address.
- **Input/Output Devices:** These devices allow the computer to interact with the outside world. Examples include keyboards, mice, monitors, printers, and storage devices like hard drives and USB drives.
- **System Bus**: The system bus is a communication pathway that connects the CPU, memory, and input/output devices. It consists of several lines for transferring data, addresses, and control signals between these components.

Here's a simple diagram illustrating the von Neumann Architecture:



In this diagram:

- The CPU is connected to the memory and input/output devices via the system bus.
- The CPU fetches instructions and data from memory, processes them, and sends the results back to memory or output devices as needed.
- Input/output devices are used to interact with users and other external devices.
- The system bus facilitates communication between the CPU, memory, and input/output devices by carrying data, addresses, and control signals.

(d) Explain two features of the software that will be needed for each of the following operations:

(i) Keeping track of files and directories.

(ii) Translating high level language program to machine language.

(iii) Identify and remove computer virus.

Certainly, let's discuss two features of software needed for each operation:

(i) Keeping track of files and directories:

- **File System Navigation:** A software feature for keeping track of files and directories should include the ability to navigate through the file system efficiently. This can include features like a graphical user interface (GUI) with a file explorer, command-line interface (CLI) commands for listing directories and files, and options for searching and organizing files.
- **File Metadata Management:** The software should also have features for managing file metadata. This includes attributes such as file size, creation date, modification date, permissions, and file type. Additionally, it should support features like file tagging, which allows users to categorize and organize files based on custom tags or labels.

(ii) Translating high-level language program to machine language:

- **Compiler:** A compiler is a software tool that translates high-level language programs into machine language or intermediate code. One key feature of a compiler is syntax and semantic analysis, which checks the correctness of the source code according to the rules of the programming language. It also performs optimization techniques to generate efficient machine code.
- **Debugging Tools:** Effective translation of high-level language programs to machine language requires debugging tools. These tools help programmers identify and fix errors in the source code or generated machine code. Features may include breakpoints, stepping through code, variable inspection, and stack tracing, which aid in the debugging process and ensure the correctness of the translated code.

(iii) Identify and remove computer virus:

- **Antivirus Scanning Engine:** Software designed to identify and remove computer viruses needs a robust scanning engine. This engine should be capable of scanning files, directories, and system memory for known virus signatures or suspicious behavior. It should include features like heuristic analysis to detect new or unknown viruses based on patterns or behaviors.
- **Real-time Protection:** Another essential feature is real-time protection, which actively monitors system activities and incoming/outgoing data for signs of virus infection. Real-time protection features often include on-access scanning of files as they are accessed or modified, email scanning for detecting infected attachments, and web protection to block malicious websites or downloads before they can harm the system. Additionally, quarantine and removal features are necessary for isolating and safely removing infected files.

(e) Write an algorithm and draw the flowchart for finding the sum of the first 10 odd numbers.

Here's an algorithm to find the sum of the first 10 odd numbers:

```
1. Start
2. Initialize variables:
      sum = 0 (to store the sum of odd numbers)
      count = 0 (to count the number of odd numbers added)
      num = 1 (start with the first odd number)
3. Repeat the following steps until count reaches 10:
      a. Add num to sum
      b. Increment count by 1
      c. Find the next odd number (add 2 to num)
4. Display the sum
5. End
```

Now, let's draw the flowchart:

This flowchart represents the algorithm step by step. It starts with initializing variables, then enters a loop to find and sum the first 10 odd numbers. Once the count reaches 10, it displays the sum and ends the program.

(f) Given the following IP addresses and Subnet mask, find the Net-ID:

(i) IP address 10.1.5.7 with subnet mask 255.0.0.0

(ii) IP address 192.168.1.05 with subnet mask 255.255.255.0

To find the Net-ID for each given IP address and subnet mask, we need to perform a bitwise AND operation between the IP address and the subnet mask. This operation preserves the network portion of the IP address while masking out the host portion.

Let's calculate the Net-ID for each scenario:

(i) IP address: 10.1.5.7

Subnet mask: 255.0.0.0

Convert both the IP address and subnet mask to binary and perform the bitwise AND operation:

IP address (binary): 00001010.00000001.00000101.00000111

Subnet mask (binary): 11111111.00000000.00000000.00000000

Performing bitwise AND:

Net-ID: 00001010.00000000.00000000.00000000

Convert the binary Net-ID back to decimal:

Net-ID: 10.0.0.0

So, the Net-ID for the given IP address 10.1.5.7 with subnet mask 255.0.0.0 is 10.0.0.0.

(ii) IP address: 192.168.1.05

Subnet mask: 255.255.255.0

Convert both the IP address and subnet mask to binary and perform the bitwise AND operation:

IP address (binary): 11000000.10101000.00000001.00000101

Subnet mask (binary): 11111111.11111111.11111111.00000000

Performing bitwise AND:

Net-ID: 11000000.10101000.00000001.00000000

Convert the binary Net-ID back to decimal:

Net-ID: 192.168.1.0

So, the Net-ID for the given IP address 192.168.1.05 with subnet mask 255.255.255.0 is 192.168.1.0.

(g) Explain the purpose of the following Networking devices:

(i) Network Interface Card

(ii) Modem

(iii) Repeater

Sure, here's an explanation of the purpose of each networking device:

(i) Network Interface Card (NIC):

A Network Interface Card (NIC) is a hardware component that allows a device, such as a computer or a server, to connect to a network. The primary purpose of a NIC is to enable communication between the device and the network by providing a physical interface for transmitting and receiving data. NICs are typically installed internally in a computer and connect to the motherboard via a PCI or PCIe slot. They contain a network port (such as Ethernet or Wi-Fi) that allows the device to connect to a network cable or wireless network, respectively. NICs also include drivers and firmware that enable the device's operating system to control network communication functions.

(ii) Modem:

A modem, short for modulator-demodulator, is a networking device that converts digital data from a computer or network into analog signals that can be transmitted over analog communication channels, such as telephone lines or cable lines, and vice versa. The purpose of a modem is to facilitate communication between digital devices, such as computers, and analog communication networks, such as the public switched telephone network (PSTN) or cable television networks. Modems are commonly used for connecting to the internet via dial-up, DSL (Digital Subscriber Line), cable, or fiber-optic connections. They come in various forms, including internal cards, external devices, and integrated modem-router combinations.

(iii) Repeater:

A repeater is a networking device used to extend the reach of a network by regenerating and amplifying incoming network signals before forwarding them to their destination. The purpose of a repeater is to overcome signal degradation and attenuation that occurs over long distances or due to obstacles in a network transmission medium, such as copper or fiber-optic cables. Repeaters operate at the physical layer of the OSI (Open Systems Interconnection) model and are transparent to higher-layer protocols, such as TCP/IP. They receive incoming signals, clean and amplify them, and then retransmit them to extend the range of a network. Repeaters are commonly used in Ethernet and other wired network environments to extend the maximum distance between network devices.

(h) List any six advantages of e-learning.

Certainly, here are six advantages of e-learning:

- **Accessibility:** E-learning allows learners to access educational materials and courses from anywhere with an internet connection. This accessibility eliminates barriers related to geographical location, allowing individuals to pursue education regardless of their location or time zone.
- **Flexibility:** E-learning offers flexibility in terms of scheduling and pacing. Learners can choose when and where to study, enabling them to balance their education with work, family commitments, or other responsibilities. This flexibility accommodates diverse learning styles and preferences, empowering individuals to personalize their learning experience.

- **Cost-effectiveness:** E-learning often reduces the costs associated with traditional classroom-based education. There are typically lower expenses related to travel, accommodation, and printed materials. Additionally, e-learning platforms can serve a larger number of learners simultaneously, leading to economies of scale and reduced per-student costs.
- **Customization and Personalization**: E-learning platforms can offer personalized learning experiences tailored to individual learners' needs, preferences, and skill levels. Adaptive learning technologies can dynamically adjust the content, pace, and difficulty of courses based on learners' performance and feedback, maximizing learning outcomes and engagement.
- **Variety of Learning Resources:** E-learning provides access to a wide range of multimedia resources, including videos, interactive simulations, animations, quizzes, and discussion forums. These diverse learning materials enhance engagement, comprehension, and retention by catering to different learning styles and preferences.
- **Scalability:** E-learning enables organizations and educational institutions to scale their training and educational programs more efficiently. With e-learning platforms, content can be easily updated, replicated, and distributed to large numbers of learners simultaneously. This scalability facilitates rapid deployment of training initiatives and ensures consistent delivery of educational content across diverse audiences.

(i) List two advantages and one disadvantage of using Inkjet Printer.

Certainly, here are two advantages and one disadvantage of using an Inkjet Printer:

Advantages:

- **High-Quality Printing**: Inkjet printers are known for their ability to produce high-quality prints with vibrant colors, sharp details, and smooth gradients. They are particularly well-suited for printing photos, graphics, and documents with rich visual content.
- **Versatility:** Inkjet printers are versatile and can handle a wide range of media types and sizes, including plain paper, glossy photo paper, envelopes, labels, and transparencies. This versatility makes them suitable for various printing needs, from everyday documents to professional-quality photos and marketing materials.

Disadvantage:

- **Ink Cost and Consumables:** One disadvantage of using an Inkjet Printer is the ongoing cost of ink cartridges and other consumables. Inkjet printers typically require replacement ink cartridges periodically, which can be expensive, especially for printers

with multiple color cartridges. Additionally, if the printer is not used frequently, the ink cartridges may dry out, leading to wasted ink and additional costs.

2. (a) Define the term Instruction in the context of a computer processor. Explain the role of control unit for execution of an instruction.

In the context of a computer processor, an instruction refers to a basic operation or command that the processor can execute. Each instruction corresponds to a specific task or operation that the processor performs, such as arithmetic calculations, data movement, logical operations, or control flow decisions.

An instruction typically consists of two parts: an opcode (operation code), which specifies the operation to be performed, and operands, which are the data or addresses involved in the operation. The processor's instruction set architecture (ISA) defines the set of instructions that it can execute, along with their corresponding opcodes and operand formats.

The role of the control unit in the execution of an instruction is crucial. The control unit is a component of the processor responsible for managing the execution of instructions and coordinating the operation of other processor components. Its main functions include:

- **Instruction Fetch:** The control unit fetches instructions from memory, typically from the program's instruction sequence stored in main memory or cache. It retrieves the next instruction based on the program counter (PC) or instruction pointer.
- **Instruction Decoding**: Once an instruction is fetched, the control unit decodes it to determine the operation specified by the opcode and identify the operands involved in the instruction. This involves interpreting the instruction's binary representation and generating control signals to coordinate the execution of the instruction.
- **Operand Fetch:** After decoding the instruction, the control unit retrieves the operands required for the instruction's execution. This may involve accessing data from memory, registers, or other input/output devices.
- **Execution Control:** The control unit orchestrates the execution of the instruction by directing the appropriate functional units within the processor to perform the required operation. For example, it may activate the arithmetic logic unit (ALU) for arithmetic operations, the memory unit for data transfers, or the branch unit for control flow instructions.

- **Instruction Completion**: Once the instruction is executed, the control unit updates the processor's state, including the program counter (PC) to point to the next instruction in sequence, and flags or status registers to reflect the outcome of the operation (e.g., arithmetic overflow, comparison results).

Overall, the control unit plays a critical role in the execution of instructions by coordinating the various stages of instruction processing and ensuring that instructions are executed correctly and in the correct sequence.

(b) Differentiate between the following:

(i) Static RAM and Dynamic RAM

(ii) RAM and ROM

(iii) Hard disk and Magnetic tapes

(iv) DVD and CD

(i) Static RAM (SRAM) and Dynamic RAM (DRAM):

Construction:

- **SRAM:** Uses flip-flops made of transistors to store each bit of data. It doesn't need to be refreshed constantly to maintain data.
- **DRAM:** Uses capacitors to store each bit of data. It needs to be refreshed periodically (every few milliseconds) to maintain data, as capacitors leak charge over time.

Speed:

- **SRAM:** Generally faster than DRAM due to its simpler structure and lack of the need for refreshing.
- **DRAM**: Slower compared to SRAM due to the need for refreshing cycles.

Density and Size:

- **SRAM:** Typically has lower storage density and is more expensive per bit compared to DRAM.
- **DRAM:** Higher storage density compared to SRAM, making it more suitable for large memory arrays in computers.

(ii) RAM (Random Access Memory) and ROM (Read-Only Memory):

Read/Write Capability:

- **RAM:** Allows both reading from and writing to memory. It is volatile, meaning data is lost when power is removed.
- **ROM:** Generally allows only reading from memory. It is non-volatile, meaning data is retained even when power is removed.

Purpose:

- **RAM**: Used for temporary storage of data and program instructions during the operation of a computer or electronic device.
- **ROM:** Used to store firmware or permanent software instructions that are not intended to be modified or deleted during normal operation.

Write ability:

- **RAM:** Can be written to and rewritten, making it suitable for dynamic data storage and program execution.
- **ROM:** Typically programmed during manufacturing and is not designed for frequent writes or updates.

(iii) Hard disk and Magnetic tapes:

Physical Structure:

- **Hard Disk**: Consists of rigid, rotating disks (platters) coated with magnetic material. Data is stored magnetically on the platters.
- **Magnetic Tapes:** Consists of a long strip of plastic film coated with magnetic material. Data is stored linearly along the length of the tape.

Access Time:

- **Hard Disk:** Typically has faster access times compared to magnetic tapes, allowing for quicker retrieval of data.
- **Magnetic Tapes:** Generally have slower access times, as the tape needs to be sequentially read or rewound to access specific data.

Usage:

- **Hard Disk:** Commonly used as the primary storage device in computers and servers for storing operating systems, software applications, and user data.
- **Magnetic Tapes:** Often used for long-term archival storage of large volumes of data, backup purposes, and data transfer between systems.

(iv) DVD (Digital Versatile Disc) and CD (Compact Disc):

Storage Capacity:

- **DVD:** Generally has a higher storage capacity compared to CD. DVDs can store up to 4.7 GB (single-layer) or 8.5 GB (dual-layer) of data.
- **CD:** Typically has a lower storage capacity. Standard CDs can store up to 700 MB of data.

Data Types:

- **DVD:** Can store various types of data, including video, audio, software, and data files.
- **CD:** Originally designed for storing audio recordings but later adapted for storing data, music, and other multimedia content.

Usage:

- **DVD:** Commonly used for distributing movies, software applications, video games, and large data files.
- **CD:** Used for music albums, software installations, data backups, and other applications requiring moderate storage capacity.

(c) What is the role of a port in a computer? Explain the use of (i) Parallel port, and (ii) Serial port in a computer.

The role of a port in a computer is to provide a physical interface for connecting peripheral devices to the computer. Ports allow for the transfer of data, signals, and power between the computer and external devices, enabling communication and interaction with various hardware components.

(i) Parallel port:

Role: A parallel port is a type of port used for connecting devices that require high-speed data transfer, such as printers, scanners, and external storage devices.

Usage:

- Parallel ports transmit data in parallel, meaning multiple bits of data are sent simultaneously over multiple wires.
- They typically use a 25-pin female DB-25 connector (Centronics connector) for connecting to devices.
- Parallel ports were commonly used for connecting printers, especially older dot matrix printers and early laser printers.

- They were also used for connecting other peripheral devices like scanners, external storage drives, and even some early networking equipment.

Functionality:

- Parallel ports transmit data in parallel, allowing for faster data transfer rates compared to serial ports.
- They are capable of bidirectional communication, meaning data can be sent and received between the computer and connected devices.
- Parallel ports typically use a standard communication protocol, such as the IEEE 1284 standard, to facilitate communication with devices.

(ii) Serial port:

Role: A serial port is a type of port used for connecting devices that require serial data transfer, such as modems, mice, keyboards, and serial printers.

Usage:

- Serial ports transmit data sequentially, one bit at a time, over a single data line.
- They usually use either a 9-pin DE-9 connector (commonly known as RS-232) or a 25-pin DB-25 connector for connecting to devices.
- Serial ports have been widely used for connecting modems for dial-up internet access, as well as for connecting other peripheral devices like mice, keyboards, barcode scanners, and serial printers.

Functionality:

- Serial ports typically offer slower data transfer rates compared to parallel ports due to their serial nature.
- They are capable of bidirectional communication, allowing data to be sent and received between the computer and connected devices.
- Serial ports use asynchronous communication, where data is transmitted without the need for a clock signal, making them suitable for devices with varying data transfer rates.
- Serial ports can also support hardware flow control (such as RTS/CTS) and software flow control (such as XON/XOFF) to manage data transmission between devices.

3. (a) Explain the terms client and server in the context of client/server architecture. Explain the three-tier client/server architecture with the help of a diagram.

In the context of client/server architecture:

Client: A client is a computing device or application that requests services or resources from another computer or server over a network. Clients initiate communication with servers to perform specific tasks, such as accessing files, retrieving data, or processing requests. Clients can be desktop computers, laptops, smartphones, tablets, or software applications running on these devices. In client/server architecture, clients typically send requests to servers and receive responses in return.

Server: A server is a computer or software application that provides services or resources to clients over a network. Servers fulfill client requests by processing data, executing tasks, or managing resources. They are designed to be robust, reliable, and scalable, capable of handling multiple client connections simultaneously. Servers can provide various services, such as web hosting, file sharing, database management, email processing, or application hosting.

Now, let's discuss the three-tier client/server architecture:

The three-tier client/server architecture is a software design pattern that divides an application into three separate layers, each responsible for specific functions and tasks. These layers include the presentation layer (client), the application layer (middleware or server-side logic), and the data layer (database server). Here's an explanation of each tier along with a diagram:

Presentation Layer (Client):

- The presentation layer is the topmost layer of the architecture and represents the user interface or user-facing components of the application.
- Clients interact with this layer to access and manipulate data or perform tasks through graphical user interfaces (GUIs), web browsers, or other client-side applications.
- This layer is responsible for presenting information to users, gathering input, and transmitting user requests to the application layer for processing.
- Examples of presentation layer components include web browsers, mobile apps, desktop applications, or web-based interfaces.

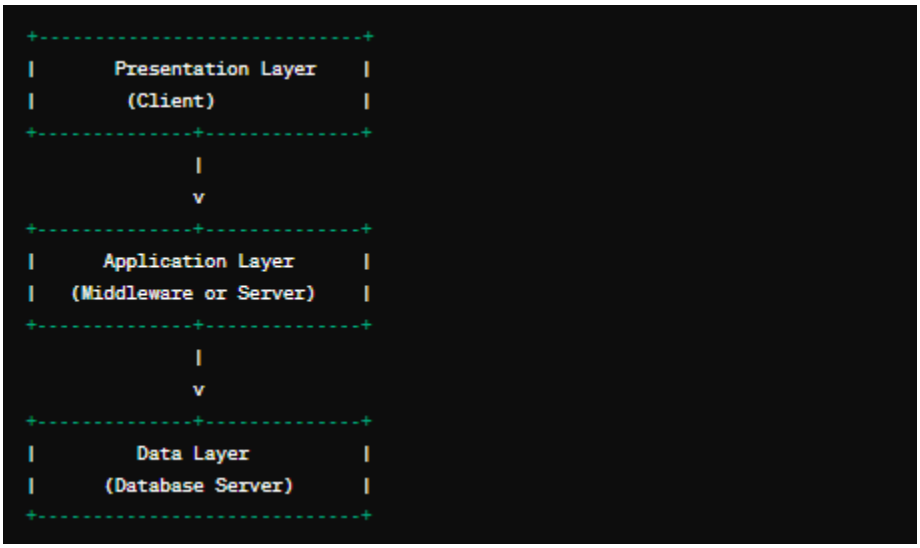
Application Layer (Middleware or Server-Side Logic):

- The application layer is the middle layer of the architecture and serves as an intermediary between the presentation layer and the data layer.
- It contains the business logic, processing logic, and application functionality required to fulfill client requests and process data.
- This layer handles tasks such as data validation, business rules enforcement, workflow management, and application logic execution.
- Application servers, web servers, or middleware components often reside in this layer to process client requests, generate dynamic content, and communicate with the data layer.

Data Layer (Database Server):

- The data layer is the bottom layer of the architecture and is responsible for managing and storing data used by the application.
- It includes database servers, storage systems, or data repositories where data is stored persistently.
- This layer handles tasks such as data storage, retrieval, manipulation, and management, ensuring data integrity, security, and consistency.
- Database management systems (DBMS) such as MySQL, PostgreSQL, Oracle, or Microsoft SQL Server are commonly used in this layer to store and manage structured data.

Here's a simplified diagram illustrating the three-tier client/server architecture:



In this architecture:

- Clients interact with the presentation layer to access application functionality.
- The presentation layer communicates with the application layer to process requests and retrieve data.
- The application layer interacts with the data layer to retrieve or store data as needed.
- Each layer is responsible for specific tasks and functions, promoting modular design, scalability, and maintainability.

(b) What is an Open-source Software? List any two objectives of an Open-source movement. List the name and purpose of any four Open-source Software.

Open-source software refers to software whose source code is freely available to the public, allowing anyone to view, modify, and distribute the code according to specific licensing terms. Open-source software is typically developed collaboratively in a decentralized manner, with contributions from a global community of developers and enthusiasts. Here are two objectives of the open-source movement:

- **Promote Collaboration:** One objective of the open-source movement is to foster collaboration and knowledge-sharing among developers by making source code accessible to everyone. By allowing anyone to view, modify, and contribute to the codebase, open-source projects can benefit from the diverse expertise and perspectives of a global community of contributors.
- **Encourage Innovation:** Another objective is to promote innovation and creativity by providing a platform for experimentation and exploration. Open-source software empowers developers to build upon existing codebases, customize software to meet specific needs, and create new solutions to address emerging challenges. By removing barriers to access and modification, open-source projects can drive innovation and advancement in technology.

Here are the names and purposes of four open-source software:

Linux Operating System:

- **Purpose:** Linux is a widely used open-source operating system kernel that serves as the foundation for various Linux distributions (distros). It is designed to provide a free, customizable, and highly reliable operating system for a wide range of devices, including desktops, servers, embedded systems, and IoT devices.

Apache HTTP Server:

- **Purpose:** Apache HTTP Server, commonly known as Apache, is an open-source web server software widely used for hosting websites and serving web content. It provides a robust, scalable, and feature-rich platform for delivering web applications and managing HTTP requests in a secure and efficient manner.

Mozilla Firefox:

- **Purpose:** Mozilla Firefox is an open-source web browser developed by the Mozilla Foundation. It aims to provide users with a fast, secure, and customizable browsing experience while promoting privacy and user empowerment. Firefox is known for its extensive add-ons ecosystem and commitment to open standards and web compatibility.

LibreOffice:

- **Purpose:** LibreOffice is a free and open-source office productivity suite that includes applications for word processing, spreadsheets, presentations, and more. It is compatible with Microsoft Office file formats and offers powerful features for creating, editing, and sharing documents, spreadsheets, and presentations. LibreOffice aims to provide a free alternative to proprietary office software while promoting interoperability and user freedom.

(c) Define the following in the context of an Operating System :

(i) Batch Processing

(ii) Graphical User Interface

(iii) Multiprogramming

(iv) Time-Sharing System

In the context of an operating system:

(i) Batch Processing:

Batch processing is a method of executing computer programs in which a sequence or "batch" of jobs is collected and processed together without manual intervention. In batch processing, users submit their jobs to the system in advance, specifying input data and program instructions. The operating system then collects these jobs into batches and executes them one

after another, typically without user interaction. Batch processing is commonly used for tasks such as running large-scale data processing jobs, batch file processing, and automated system tasks.

(ii) Graphical User Interface (GUI):

A Graphical User Interface (GUI) is a type of user interface that allows users to interact with a computer system using graphical elements such as windows, icons, menus, and buttons, as opposed to text-based interfaces. GUIs provide a visually intuitive and user-friendly way to interact with applications and operating systems. Users can perform tasks by clicking on graphical elements using a pointing device such as a mouse or touchpad. GUIs are widely used in modern operating systems to provide a visual representation of the system's resources, applications, and user interface elements.

(iii) Multiprogramming:

Multiprogramming is a technique used by operating systems to maximize CPU utilization by running multiple programs concurrently on a single processor. In a multiprogramming environment, the operating system allocates CPU time to multiple processes, allowing them to execute simultaneously. The CPU switches rapidly between executing different processes, giving the illusion of parallelism to users. Multiprogramming increases system throughput and responsiveness by keeping the CPU busy and reducing idle time. It is a fundamental concept in modern operating systems and forms the basis for multitasking, where multiple processes run concurrently on a computer system.

(iv) Time-Sharing System:

A Time-Sharing System is an operating system that allows multiple users to interact with a computer system simultaneously by sharing its resources, such as CPU time, memory, and peripherals. In a time-sharing system, the operating system rapidly switches between executing processes, giving each user the illusion of having exclusive access to the system. Each user is provided with a time slice or "time quantum" during which their programs are executed. Time-sharing systems enable interactive computing, where users can input commands, run programs, and receive immediate responses from the system. Time-sharing systems are commonly used in multi-user environments such as mainframe computers, servers, and cloud computing platforms.

(d) Given the values of three variables as x = 5, y = 8 and z = 13, what would be the output of the following expressions in C programming language?

(i) x = = y

(ii) (x + y) = = z

(iii) y < z

(iv) x ! = z

Here are the outputs of the given expressions in the C programming language:

Given: x = 5, y = 8, z = 13

(i) x == y:

This expression checks if the value of x is equal to the value of y.

Since x = 5 and y = 8, the expression evaluates to false (0), as 5 is not equal to 8.

(ii) (x + y) == z:

This expression adds the values of x and y, then checks if the result is equal to the value of z.

Since x = 5, y = 8, and z = 13, (x + y) = (5 + 8) = 13, and z = 13.

Therefore, the expression evaluates to true (1), as 13 is equal to 13.

(iii) y < z:

This expression checks if the value of y is less than the value of z.

Since y = 8 and z = 13, 8 is indeed less than 13.

Therefore, the expression evaluates to true (1).

(iv) x != z:

This expression checks if the value of x is not equal to the value of z.

Since x = 5 and z = 13, 5 is indeed not equal to 13.

Therefore, the expression evaluates to true (1).

4. (a) Explain the terms in the context of Computer Network:

(i) Half Duplex

(ii) Channel

(iii) Packet Switching

(iv) Bandwidth

In the context of computer networks:

(i) Half Duplex:

- Half duplex communication refers to a mode of communication where data can be transmitted and received, but not simultaneously on the same communication channel.
- In a half-duplex system, devices take turns transmitting and receiving data. When one device is transmitting, the other device must wait until the transmission is complete before it can transmit its own data.
- Walkie-talkies and traditional two-way radios are examples of devices that typically use half-duplex communication.

(ii) Channel:

- In computer networking, a channel refers to a communication path or medium through which data is transmitted between devices.
- Channels can be physical, such as copper wires, fiber optic cables, or wireless radio frequencies, or logical, such as virtual connections established over a network.
- Channels can also be classified based on their characteristics, such as bandwidth, latency, and reliability.

(iii) Packet Switching:

- Packet switching is a method of transmitting data in computer networks where data is divided into small, discrete units called packets.
- Each packet contains a portion of the data being transmitted, along with header information containing source and destination addresses, sequencing information, and error checking codes.
- In packet switching networks, packets are independently routed through the network from source to destination, often along different paths, based on routing algorithms and network conditions.

- Packet switching allows for efficient and flexible use of network resources, supports multiple simultaneous connections, and provides resilience to network failures.

(iv) Bandwidth:

- Bandwidth refers to the maximum data transfer rate of a communication channel or network link, typically measured in bits per second (bps), kilobits per second (kbps), megabits per second (Mbps), or gigabits per second (Gbps).
- It represents the capacity or throughput of the channel, indicating how much data can be transmitted over the channel in a given amount of time.
- Higher bandwidth channels can transmit more data per unit of time, enabling faster data transfer rates and supporting the transmission of larger files, higher-resolution multimedia content, and real-time streaming applications.
- Bandwidth is a critical factor in determining the performance and efficiency of computer networks, influencing factors such as network latency, response times, and overall user experience.

(b) Explain the characteristics of Local Area Networks. How are LANs different from WANs?

Local Area Networks (LANs) are computer networks that cover a relatively small geographical area, typically within a single building or campus. LANs are characterized by several key features:

- **Limited Geographic Area**: LANs typically cover a small geographic area, such as a single building, office, or campus. This localized coverage allows for high-speed data transfer and low latency, as devices within the LAN are in close proximity to each other.
- **High Data Transfer Rates**: LANs provide high-speed data transfer rates, often ranging from 10 Mbps (Ethernet) to multiple Gbps (Gigabit Ethernet or faster technologies). This high bandwidth facilitates the rapid exchange of data between devices connected to the LAN.
- **Ownership and Control**: LANs are typically owned, operated, and controlled by a single organization or entity, such as a business, educational institution, or government agency. This centralized control allows the organization to manage and secure the network according to its specific requirements and policies.
- **Shared Resources**: LANs allow connected devices to share resources such as files, printers, applications, and internet connectivity. This sharing of resources promotes collaboration, efficiency, and productivity among users within the LAN.

- **Low Cost:** LAN infrastructure components, such as Ethernet switches, network cables, and network interface cards (NICs), are relatively inexpensive compared to wide area network (WAN) technologies. This affordability makes LANs an attractive option for organizations of all sizes.
- **High Reliability:** LANs are often designed with redundancy and fault tolerance mechanisms to ensure high availability and reliability. Redundant network paths, backup power supplies, and failover mechanisms help minimize downtime and ensure continuous operation of critical network services.

LANs differ from Wide Area Networks (WANs) in several ways:

- **Geographic Coverage**: LANs cover a small, localized area, such as a single building or campus, while WANs span larger geographic areas, often encompassing multiple cities, regions, or countries.
- **Data Transfer Rates:** LANs typically offer higher data transfer rates compared to WANs. WANs may have lower bandwidth and higher latency due to the longer distances and multiple network hops involved in data transmission.
- **Ownership and Control:** LANs are owned and operated by a single organization or entity, while WANs may involve multiple organizations, service providers, and regulatory authorities. WANs often require cooperation and coordination among multiple stakeholders.
- **Cost and Complexity:** WAN infrastructure, such as leased lines, routers, and WAN optimization devices, tends to be more expensive and complex compared to LAN technologies. WAN deployment and maintenance may require specialized expertise and resources.
- **Security and Privacy:** LANs are typically easier to secure and monitor compared to WANs, as they are contained within a single organization's premises. WANs may be more susceptible to security threats and privacy concerns due to the involvement of multiple entities and the use of public communication links.

Overall, while LANs provide high-speed connectivity and shared resources within a localized area, WANs enable communication and data exchange over larger distances, connecting remote offices, branches, and users across the globe.

(c) What is a URL in the context of Internet? Explain with the help of an example. Also explain the role of DNS with the help of an example.

In the context of the Internet, a URL (Uniform Resource Locator) is a reference or address used to locate and access resources on the World Wide Web. A URL specifies the protocol used to access the resource, the domain name or IP address of the server hosting the resource, and the specific location of the resource on the server. URLs are commonly used to access web pages, files, images, videos, and other online resources.

Here's an example of a URL:

URL: https://www.example.com/index.html

- **Protocol:** "https://" specifies the Hypertext Transfer Protocol Secure (HTTPS) for secure communication.
- **Domain Name**: "www.example.com" is the domain name of the server hosting the resource.
- **Path:** "/index.html" specifies the location of the resource on the server, in this case, the "index.html" file located at the root directory of the website.

Now, let's explain the role of DNS (Domain Name System) with an example:

DNS is a hierarchical and distributed system that translates human-readable domain names into IP addresses, which are numerical identifiers used to locate devices and services on a network. DNS plays a crucial role in the Internet's operation by enabling users to access websites and other online resources using memorable domain names instead of numeric IP addresses.

Example:

Suppose a user wants to visit the website "www.example.com" in their web browser. Here's how DNS resolves the domain name to an IP address:

- The user's web browser sends a DNS query to a DNS resolver, typically provided by the Internet service provider (ISP) or configured on the user's network.
- The DNS resolver checks its local cache to see if it already has the IP address associated with the domain name "www.example.com." If the IP address is found in the cache and is still valid (not expired), the resolver returns the IP address to the browser, and the browser can initiate a connection to the web server.
- If the IP address is not found in the resolver's cache or has expired, the resolver sends a recursive DNS query to the root DNS servers, asking for the IP address associated with the domain name "www.example.com."
- The root DNS servers respond to the resolver with the IP addresses of the top-level domain (TLD) servers responsible for the ".com" domain.

- The resolver sends another recursive query to the TLD servers, asking for the IP address of the authoritative DNS servers responsible for the "example.com" domain.
- The authoritative DNS servers for "example.com" respond to the resolver with the IP address of the web server hosting the website "www.example.com."
- Finally, the resolver returns the IP address to the user's web browser, which can then initiate a connection to the web server and retrieve the requested web page.

In summary, DNS translates domain names into IP addresses, allowing users to access websites and other online resources using human-readable names. DNS resolution involves multiple steps of querying DNS servers hierarchically until the IP address associated with the domain name is successfully resolved.

(d) Explain the characteristics of the following:

(i) WIKI

(ii) Social Networking

Certainly! Here are the characteristics of WIKI and Social Networking:

(i) WIKI:

- **Collaborative Editing:** WIKI platforms allow multiple users to collaboratively create, edit, and update content. Users can contribute new information, edit existing content, and improve the accuracy and completeness of articles.
- **Open Access:** WIKI content is typically freely accessible to anyone with an internet connection. Users can view, read, and contribute to WIKI articles without requiring authentication or membership.
- **Version History:** WIKI platforms maintain a version history for each article, documenting all changes made by users over time. This allows users to track revisions, revert to previous versions, and review the evolution of content.
- **Community-driven:** WIKI platforms are community-driven, with users collectively responsible for maintaining and improving content quality. Users can discuss articles, provide feedback, and resolve disputes through collaborative consensus-building.
- **Structured Information:** WIKI articles are organized into structured formats, with headings, sections, hyperlinks, and categories facilitating navigation and information retrieval. This structured approach enhances readability and usability for users.

(ii) Social Networking:

- **User Profiles:** Social networking platforms allow users to create personalized profiles, providing information about themselves, their interests, and their activities. Profiles may include photos, biographical details, contact information, and links to other users or content.
- **Social Connections:** Social networking platforms facilitate connections and interactions between users, enabling them to connect with friends, family, colleagues, and acquaintances. Users can send messages, share updates, comment on posts, and engage in real-time communication.
- **Content Sharing**: Social networking platforms allow users to share various types of content, including text posts, photos, videos, links, and multimedia content. Users can share updates, news, opinions, and personal experiences with their social network.
- **Privacy Controls:** Social networking platforms offer privacy controls and settings that allow users to manage their online visibility, control who can view their content, and restrict access to their profile and personal information. Users can customize privacy settings to suit their preferences and comfort levels.
- **Networking Features:** Social networking platforms often include networking features such as groups, events, communities, and forums, allowing users with similar interests to connect, interact, and engage in discussions. These features facilitate networking, collaboration, and community-building among users.
- **Discovery and Recommendations:** Social networking platforms may provide algorithms and features for content discovery, recommendations, and personalized feeds. These features help users discover new connections, interests, and content based on their preferences, behavior, and social network activity.

5. Explain any five of the following with the help of an example or a diagram, wherever required:

(a) Security Threats on Internet

(b) TCP/IP Model

(c) Object-Oriented Programming Language

(d) Perverse Software

(e) Subroutine and Functions

(f) Memory Hierarchy

(g) Classification of Printers

(h) Features of Spreadsheet Software

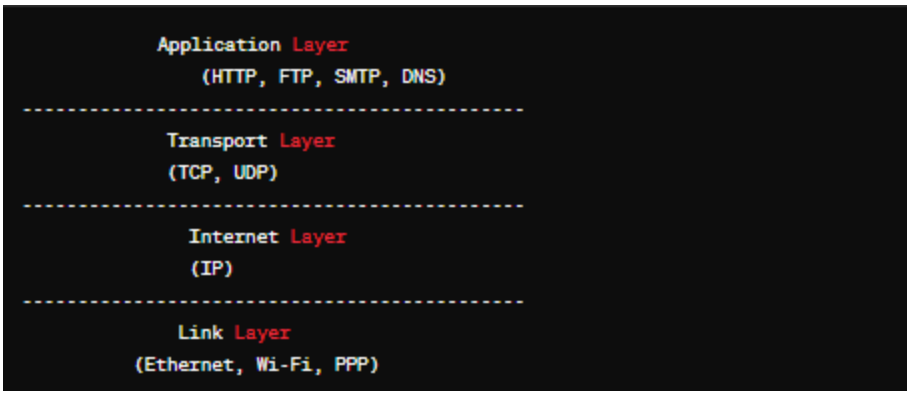
Sure, here are explanations for five of the topics:

(b) TCP/IP Model:

The TCP/IP model is a conceptual framework used for understanding and implementing network communication protocols. It stands for Transmission Control Protocol/Internet Protocol. The TCP/IP model consists of four layers, each responsible for different aspects of network communication:

- **Application Layer:** The Application layer is the topmost layer of the TCP/IP model. It provides network services to applications and end-users, such as web browsers, email clients, and file transfer utilities. Protocols at this layer include HTTP, SMTP, FTP, and DNS.
- **Transport Layer**: The Transport layer is responsible for end-to-end communication between devices across a network. It ensures reliable and error-free data transmission by providing services such as segmentation, reassembly, flow control, and error detection. Protocols at this layer include TCP (Transmission Control Protocol) and UDP (User Datagram Protocol).
- **Internet Layer**: The Internet layer is responsible for routing packets across different networks to reach their destination. It handles the addressing, encapsulation, and routing of data packets between source and destination hosts. The primary protocol at this layer is IP (Internet Protocol).
- **Link Layer:** The Link layer, also known as the Network Interface layer, is responsible for the physical transmission of data between devices on the same network segment. It handles protocols specific to the underlying network technology, such as Ethernet, Wi-Fi, or PPP (Point-to-Point Protocol).

Here's a simplified diagram illustrating the TCP/IP model:



(d) Perverse Software:

Perverse software refers to malicious or harmful programs designed to disrupt, damage, or compromise computer systems, networks, or data. These programs are created with malicious intent and can cause various forms of harm, including data theft, system corruption, financial loss, and privacy violations. Examples of perverse software include viruses, worms, Trojans, ransomware, spyware, adware, and rootkits. Perverse software may spread through infected email attachments, malicious websites, compromised software downloads, or unauthorized access to systems. Once installed on a system, perverse software can perform actions such as stealing sensitive information, encrypting files for ransom, hijacking system resources, monitoring user activities, and remotely controlling infected devices. To protect against perverse software, users and organizations should employ security best practices, such as using antivirus software, keeping systems and software up-to-date, practicing safe browsing habits, and implementing security measures such as firewalls, intrusion detection systems, and access controls.

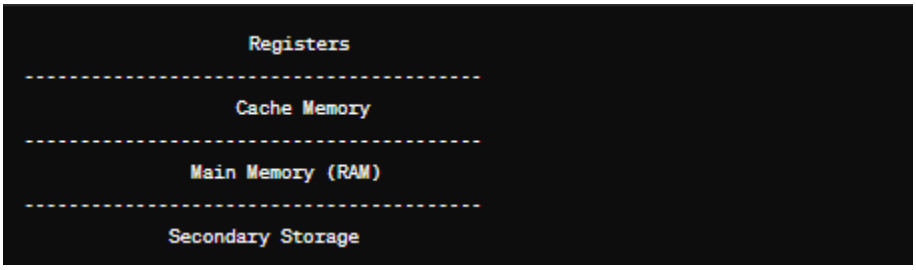
(f) Memory Hierarchy:

Memory hierarchy refers to the organization of different types of memory in a computer system, arranged in a hierarchy based on characteristics such as speed, capacity, cost, and volatility. The memory hierarchy consists of multiple levels, each with varying access times, storage capacities, and costs. The primary goal of the memory hierarchy is to optimize performance by providing fast access to frequently accessed data while minimizing costs and maximizing storage capacity. The memory hierarchy typically includes the following levels:

- **Registers:** Registers are the fastest and smallest type of memory located within the CPU (Central Processing Unit). They hold data and instructions that are currently being processed by the CPU. Registers have the fastest access times but limited storage capacity.

- **Cache Memory:** Cache memory is a small, high-speed memory located between the CPU and main memory (RAM). It stores frequently accessed data and instructions to reduce access times and improve CPU performance. Cache memory is divided into multiple levels (L1, L2, L3) based on proximity to the CPU and size.
- **Main Memory (RAM):** Main memory, also known as RAM (Random Access Memory), is the primary volatile memory used by the CPU to store data and instructions during program execution. RAM provides fast access times but is more expensive and has limited capacity compared to secondary storage devices.
- **Secondary Storage:** Secondary storage devices, such as hard disk drives (HDDs) and solid-state drives (SSDs), provide non-volatile storage for long-term data retention. They offer larger storage capacities but slower access times compared to main memory. Secondary storage is used for storing operating system files, application software, user data, and virtual memory.

Here's a simplified diagram illustrating the memory hierarchy:



(g) Classification of Printers:

Printers can be classified into different categories based on various factors such as printing technology, printing method, and intended use. Some common classifications of printers include:

- **Inkjet Printers**: Inkjet printers use liquid ink droplets sprayed onto paper to create text and images. They are popular for home and office use due to their low cost, high-quality color output, and versatility in handling different paper types and sizes.
- **Laser Printers**: Laser printers use toner cartridges and a laser beam to create text and images on paper. They are known for their fast printing speeds, high-quality text output, and low cost per page. Laser printers are commonly used in offices and businesses for high-volume printing tasks.
- **Dot Matrix Printers**: Dot matrix printers use a matrix of small pins.