Subject Code: 24CT11RC01 **R-24** **Reg No:** | | | | | | | | | | | | |

GAYATRI VIDYA PARISHAD COLLEGE OF ENGINEERING FOR WOMEN
(AUTONOMOUS)
(Affiliated to Andhra University, Visakhapatnam)
I B.Tech. - I Semester Regular Examinations, December / January – 2025

Fundamentals of Computers

(Common to CSE, IT, CSE-AI&ML)

1. All questions carry equal marks
2. Must answer all parts of the question at one place

Time: 3Hrs. **Max Marks: 70**

Solutions

UNIT-I

1a.Discuss about various components of a computer with a neat diagram. 7M

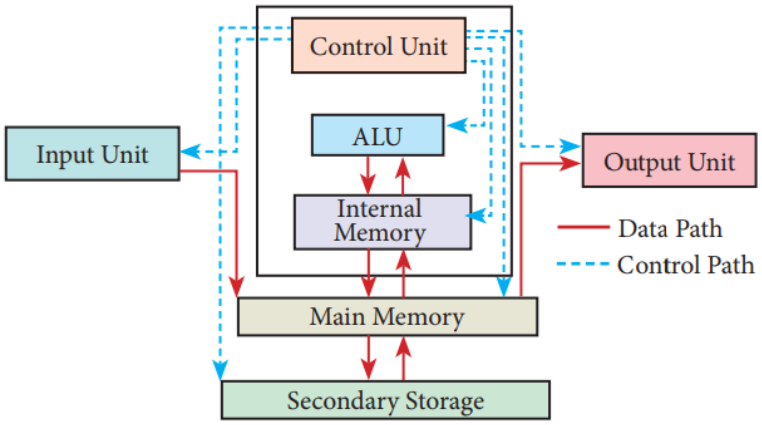


Figure 1.3 components of a computer

Input This is the process of entering data and instructions (also known as programs) into the computer system. The data and instructions can be entered by using different input devices such as keyboard, mouse, scanner, and trackball.

Storage Storage is the process of saving data and instructions permanently in the computer so that they can be used for processing. The computer storage space not only stores data and programs that operate on that data but also stores the intermediate results and the final results of processing.

A computer has two types of storage areas:

Primary storage Primary storage, also known as main memory, is the storage area that is directly accessible by the CPU at very high speeds. It is used to store data and parts of programs, the intermediate results of processing, and the recently generated results of jobs that are currently being worked on by the computer. Primary storage space is very expensive and therefore limited in capacity. Another drawback of main memory is that it is volatile in nature; that is, as soon as the computer is switched off, the information stored gets erased. Hence, it cannot be used as a permanent storage of useful data and programs for future use. Both random access memory (RAM) and read-only memory (ROM) are examples of primary storage.

Secondary storage Also known as auxiliary memory. this memory is just the opposite of primary memory. It overcomes all the drawbacks of the primary storage area. It is cheaper, non-volatile, and used to permanently

store data and programs of those jobs that are not being currently executed by the CPU. Secondary memory supplements the limited storage capacity of primary memory. An example is the magnetic disk used to store data, such as C and D drives, for future use.

Processing The process of performing operations on the data as per the instructions specified by a user (program) is called processing. Data and instructions are taken from the primary memory and transferred to the arithmetic logic unit (ALU), which performs all sorts of calculation. The intermediate results of processing may be stored in the main memory, as they might be required again. When the processing completes, the final result is then transferred to the main memory. Hence, the data may move from the main memory to the ALU multiple times before the processing is over.

Output Output is the process of giving the result of data processing to the outside world (external to the computer system). The results are given through output devices such as monitors and printers. Since the computer accepts data only in binary form and the result of processing is also in binary form, the result cannot be directly given to the user. The output devices, therefore, convert the results available in binary codes into a human-readable form before displaying it to the user.

Control The control unit (CU) is the central nervous system of the entire computer system. It manages and controls all the components of the computer system. It is the CU that decides the manner in which instructions will be executed and operations performed. It takes care of the step-by-step processing of all operations that are performed in the computer.

Note that the CPU is a combination of the ALU and the CU. The CPU is better known as the brain of the computer system because the entire processing of data is done in the ALU, and the CU activates and monitors the operations of other units (such as input, output, and storage) of the computer system.

1b.Difference between various Biometric Devices along with merits and demerits. **7M**

The word 'biometric' is derived from the Greek words 'bio' and 'metric', where bio means 'life' and metric means 'to measure'. Thus, biometric means identifying a person using his/her biological features (or measures). Correspondingly, any device which uses biometrics to identify a person is known as a biometric device. Biometric devices capture raw biometric samples in a form that can be digitized and stored in a database for matching the patterns for identification and authentication.

All modern smartphones come with fingerprint and face identification capability to provide access to the phone.

In this case, the smartphone is acting like a biometric device. We all know that as compared to a password, this type of identification system is more difficult to fake as biological features are unique to a person. Other commonly used techniques for biometric identification include identification by a person's hand geometry, iris, voice, and retina. Some banks have initiated using fingerprint readers for approval at ATMs.

Social networking sites such as Facebook use face recognition software to tag users in photographs.

Some commonly used biometric devices include:

Face scanner A face scanner identifies a person by taking measurements of his/her face. For example, the distance between the person's chin, eyes, nose, and mouth. For facial identification, a high-definition camera is used.

Hand scanner the palm of a person's hand is also unique to the person.

A biometric hand scanner identifies the person by the palm of his/her hand.

Advantages of Biometrics:

- More secure than traditional passwords as biological features are **unique** to individuals.

- Difficult to fake or replicate.

2 a. Explain the evolution and development of computers. 7M

Early computers were mainly designed for solving number- crunching problems.
These computers were punch-card based machines that took up entire rooms.
Today, our smartphones have much more computing power than that was available in those early computers. In this section, we will read about history of computers way back from the invention of abacus and take a look at the remarkable achievements in computing technology till the current time**.**
Timeline of Developments

Early Developments:

- **300 BC**: The **abacus**, used by Babylonians, became the first tool for aiding mathematical computations.
- **1822**: Charles Babbage designed a steam-driven calculating machine, laying the foundation for modern computers.
- **1890**: Herman Hollerith's punched card system for the U.S. census saved millions and led to the formation of IBM.
- **1936**: Alan Turing conceptualized the Turing machine, central to modern computing concepts.

1940s–1950s:

- **1941**: Atanasoff-Berry Computer (ABC) introduced memory storage.
- **1943-1944**: ENIAC became the first large-scale digital computer.
- **1947**: Transistor invention replaced vacuum tubes in computers.
- **1953**: Grace Hopper developed COBOL, the first programming language.

1960s–1970s:

- **1964**: Douglas Engelbart introduced a prototype with a mouse and GUI.
- **1969**: Unix OS was developed, becoming a foundation for modern systems.
- **1975-1977**: Microsoft and Apple were founded, initiating the PC revolution.

1980s–1990s:

- **1981**: IBM introduced the personal computer (PC).
- **1990**: Tim Berners-Lee invented the World Wide Web.
- **1996-1999**: Search engines (Google) and Wi-Fi gained prominence.

2000s–Present:

- **2001**: Mac OS X and Windows XP redefined operating systems.
- **2007**: Apple launched the iPhone, merging computing with smartphones.
- **2016**: Reprogrammable quantum computers emerged.

Generations of Computers:

1. **First Generation (1942–1955):**
   - Vacuum tubes; large, unreliable, and costly.
   - Used for scientific applications.
2. **Second Generation (1955–1964):**
   - Transistors; more reliable and efficient than vacuum tubes.
   - Suitable for commercial and scientific use.
3. **Third Generation (1964–1975):**
   - Integrated Circuits (ICs); introduced miniaturization and reduced heat.
   - Supported high-level programming languages and online applications.
4. **Fourth Generation (1975–1989):**
   - Large-scale ICs; introduction of PCs, GUI-based OS, and networking.
   - Significant advancements in ease of use and affordability.
5. **Fifth Generation (1989–Present):**
   - Ultra Large Scale ICs (ULSI); widespread use of the Internet, portable devices, and smartphones.
   - Advancements include parallel processing and molecular informatics.

2 b. Summerize the merits and demerits of Voice Response Systems. 7M

A voice response system in simple terms is a computer Interface which responds to voice commands, instead of responding to inputs from a mouse or a keyboard. This system has a limited vocabulary and organizes sentences by combining pre-recorded words saved in a database. As VRS promotes voice-activated data entry, operators have to no longer enter data manually.

Uses of VRS:

- VRS is best suited for visually impaired people. Since they cannot use a mouse or a keyboard, they can use voice response systems to instruct a computer.
- VRS is used to provide customer service. It is an automated telephony system that interacts with callers, gathers information, and routes calls to the appropriate recipients.
- A user gives input by a combination of voice telephone input and touch. tone keypad selection and gets the output in the form of voice, fax, callback, e-mail, and other contact methods.
- With the help of a VRS system, users can use their voices to activate and operate software applications. For example, turning on/off lights and fans, closing and opening a garage door, etc.
- Public transport (bus/train/airplane/metro) uses VRS to notify passengers of next destination, schedule, or other vital information.
- VRS enables customers to fill out sales order forms with a phone keypad. The completed form is then forwarded to a salesperson.

Advantages

- Saves time and money as VRS can replace humans to answer frequently asked questions (FAQs). Saves cost of a telephone operator who would be appointed just to answer users' commonly asked queries.

- Greater customer satisfaction as VRS eliminates wait time by responding to a caller immediately. Businesses use VRS to enhance their customer satisfaction by ensuring that their customers are heard and guided instantly.

- VRS is available 24x7 so that uninterrupted service is provided to the callers whenever they need it.

Disadvantages

- VRS can recognize only those words that are in its vocabulary.

- When VRS is used to handle calls, it does not permit responses outside the parameters programmed in the software. So many a times, customers get frustrated. Installing the VRS comes with an initial cost.

- However, as with all technology, the VRS is evolving and improving with time to address these limitations.

UNIT-II

3 a. Differentiate between primary memory and Secondary Memory. 7M

Primary memory	Secondary memory
It is more expensive.	It is cheaper.
It is faster and more efficient than the secondary memory.	It is slower and less efficient than the primary memory.
It is directly accessed by the CPU.	It is cannot be accessed directly by the CPU.
It is volatile in nature.	It is non-volatile in nature.
Storage capacity is limited.	It has storage capacity.
It has no moving parts.	It has moving parts.
The memory is power-dependent.	The memory is power independent.
Memory is integrated, circuit based.	Memory is magnetic or optical-based.
It consumes less power.	It consumes more power.
It stores data temporarily.	It stores data permanently.

Memory is an internal storage area in a computer, which is used to store data and programs either temporarily or permanently. Computer memory can be broadly divided into two groups primary memory and secondary memory.

While the primary or main memory holds instructions and data when a program is executing, the secondary or auxiliary memory holds data and programs that are not currently in use and provides long-term storage.

To execute a program, all the instructions and data that have to be used by the CPU are loaded into the main memory. However, the primary memory is volatile and it can retain data only when the power is on. Moreover, it is very expensive and therefore limited in capacity.

On the contrary, the secondary memory stores data and instructions permanently, even when the power is turned off. It is cheaper and can store large volumes of data.

Moreover, data stored in the auxiliary memory is highly portable, as users can easily move it from one computer to another. The only drawback of the secondary memory is that data can be accessed from it at very low speeds as compared with the data access speed of the primary memory.

3 b. Explain different types of memory organization with examples. 7M

MEMORY ORGANIZATION

The internal structure of the main memory is made of storage units which can store a binary digit (either 0 or 1).

This smallest unit of data is known as a bit (short for binary digit). A group of four bits is called a nibble, and a group of eight bits is called a byte.

The main memory can be best considered as a matrix of words, where a word is the smallest unit of memory that has an independent address. The number of bits in a word depends on the processor design. Most modern processors have a word size of 8, 16, 24, 32, or 64 bits. Memory could be either byte- addressable or word-addressable. In a byte-addressable memory unit, every addressable unit (or location) can store a byte (or 8 bits). Similarly, in a word-addressable memory unit, every addressable unit can store a word (16 bits). This means that every 16 bits have a unique address. Present-day computers, however, use double-word (32 bit) or quad-word (64 bit) addressable memory units.

Address 8-bit

Every cell stores a bit and every row stores a byte (or a group of 8 bits).

In a byte- addressable memory, 8 bits can be read or written simultaneously. Similarly, in a 64-bit (quad-word) memory organization, 64 bits can be read or written simultaneously. This clearly indicates that more the number of bits in each 0 1 2 3 4 5 6 7

4 a. Define Processor Registers. Explain Cache Memory in detail. 7M

Processor registers:

Processor registers are located inside the processor and are therefore directly accessed by the CPU. Each register stores a word of data (which is either 32 or 64 bits in present-day computers). CPU instructions instruct the arithmetic and logic unit (ALU) to perform various calculations or other operations on the data. Registers are the fastest among all types of computer data storage.

Cache memory:

Cache memory is an intermediate form of storage between the ultra-fast CPU registers and the primary memory. The CPU uses cache memory to store instructions and data that are repeatedly required to execute programs, thereby improving the overall system speed and increasing the performance of the computer.

Cache memory is widely used for memory caching. It is a portion of memory made of high-speed static RAM (SRAM) instead of the slower and cheaper dynamic RAM (DRAM) which is used for main memory. Maintaining frequently accessed data and instructions in the cache helps in avoiding the need to access the slower DRAM repeatedly.

Some memory caches are in-built in the architecture of microprocessors. For example, the Intel 80486 microprocessor has an 8K memory cache, and the Pentium E2160 has a 1 MB cache. Such internal caches are often called level 1 (L1) caches. However, modern PCs also come with external cache memory, called level 2 (L2) caches, which are built onto the motherboard outside the CPU. Although L2 caches are composed of SRAM, they are much larger in size than Ll caches. Another type of cache, called level 3 (L3), is an extra cache that has a much larger size than L1 and L2 caches, but is slower than them (but faster than RAM).

When a program is being executed and the CPU wants to read data or instructions, the following steps are performed:

The CPU first checks whether the data or instruction is available in the cache memory. If it is not present there, the CPU reads the data or instructions from the main memory into the processor registers and also copies it into the cache memory. When the same piece of data/instruction is needed again, the CPU reads it from the cache memory instead of the main memory.

4 b. Outline the difference between sequential and Random Access memory. 7M

Memory devices can be accessed either randomly or sequentially.

The method of access has a great impact on application efficiency in terms of disk usage. Therefore, we must understand the differences between these two access methods which are listed in Table.

Sequential access	**Random access**
Data is read sequentially in a specified order.	Data is read in an arbitrary manner.
If the 99th record is desired after the 1st one, then all the records have to be traversed to reach the desired one. Therefore, the time required to return data varies depending on the position of the record.	Random access always returns data in constant time.
Sequential access devices can store a large number of records at a very low cost.	Random access devices are expensive than sequential access devices.
Magnetic tapes support sequential access.	RAM supports random access.
Sequential access is faster if records are to be accessed in the same order.	Random access is faster if records are to be accessed in random order.

UNIT-III

5 a. Distinguish between different types of computer software 7M

Computer software can be broadly classified into two groups:

application software and system software.

Application software:

This software is designed to solve a particular problem for users. In general, it is what we mean by the term computer programs. Examples of application software include spreadsheets, database systems, desktop publishing systems, program development software, games, web browsers, and so on. Simply put, application software represents programs that allow users to do something besides simply run the hardware.

System software:

This software provides a general programming environment in which programmers can create specific applications to suit their needs. This environment provides new functions that are not available at the hardware level and performs tasks related to executing application programs. System software represents programs that allow the hardware to run properly. It is transparent to users and acts as an interface between the hardware of the computer and the application software that the users need to run on the computer.

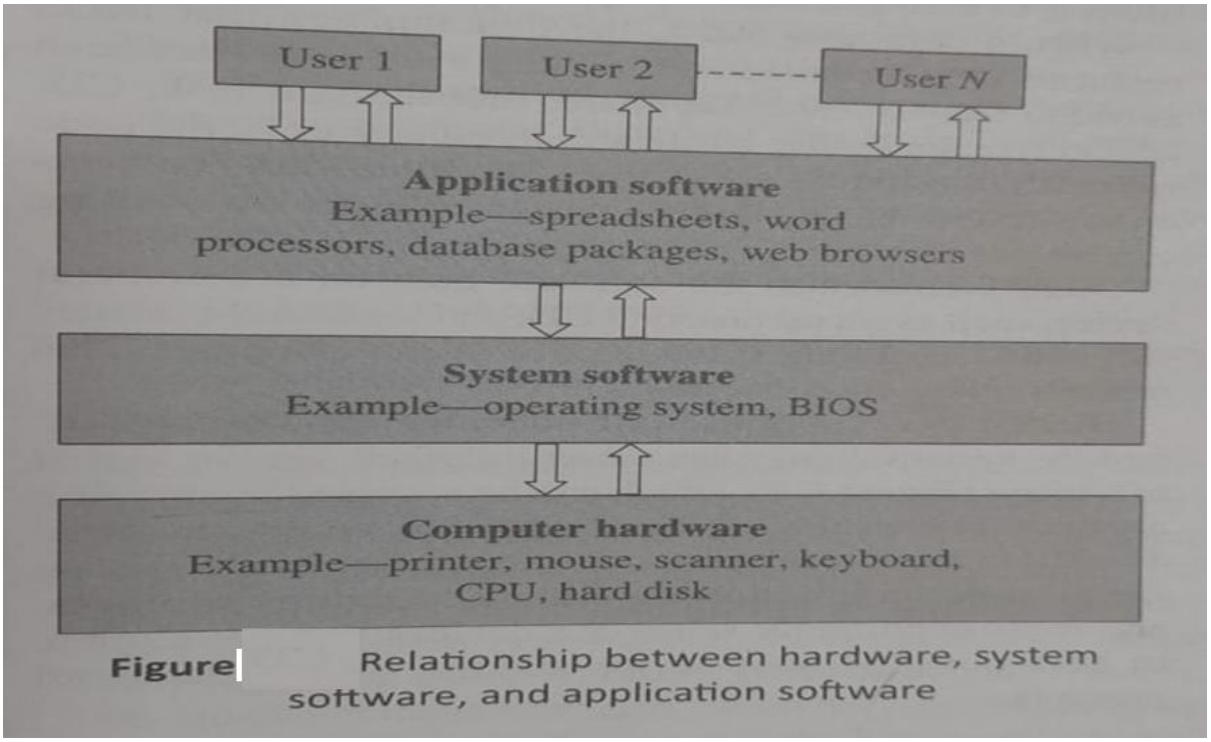


Figure Relationship between hardware, system software, and application software

5 b. What are the different phases of program development life cycle. 7M

Requirements Analysis:

- Gather user expectations to determine why the software is needed.
- Analyze and document requirements to define the scope and objective.
- Evaluate hardware and software needs for functionality, capability, and performance.

Design:

- Use documented requirements to create a detailed plan of action.
- Break down the software into modules and specify solutions via algorithms or flowcharts.
- Define the core structure of the software.

Implementation:

- Convert algorithms into program code using high-level programming languages.
- Ensure code correctness and compatibility with specified hardware and software.
- This phase is also known as construction or code generation.

Testing:

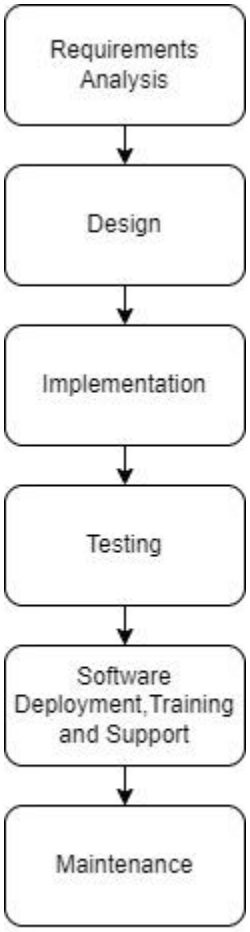
- Test individual modules and the integrated system to ensure functionality as per requirements.
- Use varied test data to identify and resolve any bugs.

Deployment, Training, and Support:

- Install the tested software in the production environment.
- Provide training to users to ensure proper adoption and usage.
- Address resistance to change and unfamiliarity among users.

Maintenance:

- Address new problems or requirements through ongoing updates and enhancements.
- Monitor maintenance costs; if they exceed 25% of prior phase costs, consider re-building parts of the software.



Fig

6 a. What are the different generations of programming Languages. 7M

First Generation: Machine Language

- Low-level language, directly understood by computers (0s and 1s).
- Fast execution, but hard to learn, debug, and non-portable.

Second Generation: Assembly Language

- Symbolic programming using mnemonics (e.g., ADD, SUB).
- Requires an assembler to convert to machine language.
- Efficient but not portable between different machines.

Third Generation: High-level Languages (3GL)

- More abstract, user-friendly languages (e.g., FORTRAN, C, Java).
- Code is portable and easier to write and debug.
- Requires compilers or interpreters to translate to machine language.

Fourth Generation: Very High-level Languages (4GL)

- Non-procedural and closer to natural language (e.g., SQL).
- Focus on "what" rather than "how."
- Faster development with fewer lines of code, but less efficient resource usage.

Fifth Generation: Constraint-based Languages (5GL)

- Focus on problem-solving through constraints (e.g., Prolog).
- Used in AI and logic programming.
- Allows the machine to solve problems based on specified conditions rather than predefined algorithms.

6 b Define software. Explain briefly and different Database Management Software. 7M

Database management software or DBMS is a collection of programs which helps users to store, edit, and extract data from a database. Today, different types of DBMS, such as Microsoft Access, MySQL, DB2, SQL Server, and Oracle, are available in the market. Some types of DBMS can run on PCs, whereas others run on huge systems such as mainframes.

The use of DBMS has become so common that it has now become a part of our everyday life. DBMS is used in computerized library systems, automated teller machines (ATMs), flight reservation systems, computerized inventory systems, and so on. All these applications call for the creation of a series of rights or privileges that can be associated with a specific user. This means that it is possible to designate one or more database administrators who control each function as well as provide other users with various levels of administration rights.

From a technical point of view, DBMS can differ widely based on the way the underlying data is organized in the database. A DBMS can be relational, network, flat, or hierarchical. The internal organization of the data can affect the speed and flexibility with which information can be extracted. Information from a database is extracted in the form of a query, which is a stylized question. Consider the following query:

SELECT ALL FROM STUDENTS WHERE MARKS > 90

The query requests from the table STUDENTS all records that have marks greater than 90. The set of rules for constructing queries is known as a query language. The most commonly used query language is structured query language (SQL).

The information from a database can be presented to users in a variety of formats. For example, many DBMS include a report writer program, which outputs the data in the form of a report. Many DBMS also include a graphics component to display the information in the form of graphs and charts.

Thus, DBMS facilitates its users to control data access, enforce data integrity, manage concurrency, and restore the database from backups.

UNIT IV

7 a. Classify different Network Topologies and also mention the applications of each. 7M

NETWORK TOPOLOGIES

Network topology refers to the schematic description of the arrangement of a network. That is, network topology refers to the actual geometric layout of computers and other devices connected to a network. There are different network topologies each suited to specific tasks and having its own advantages and disadvantages. Some of these topologies are explained in this section.

Bus Topology:

In bus topology , each computer or server is connected to a single cable. Hence, all the nodes (computers and other devices) share the same communication channel. When a node wants to send a message to another node, it creates a message and adds the address of the recipient to it. Then it checks whether the line is free or not. If the line is free, it places the message on the line (transmission channel); else, it waits until the channel becomes available.

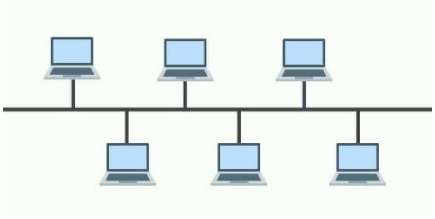


Fig. Bus Topology

When the message is placed on the line, each and every node connected to it checks the destination address mentioned on it. If the node's address does not match the intended address, it ignores the message. The message is picked up and opened only by the addressee. The receiving device also sends an acknowledgement to the sending device before it frees the line.

Advantages

* Easy to install and to connect a new device to the network
* Requires less cable length than other topologies
* Inexpensive as only one cable is required
* Failure of a single node does not affect the network

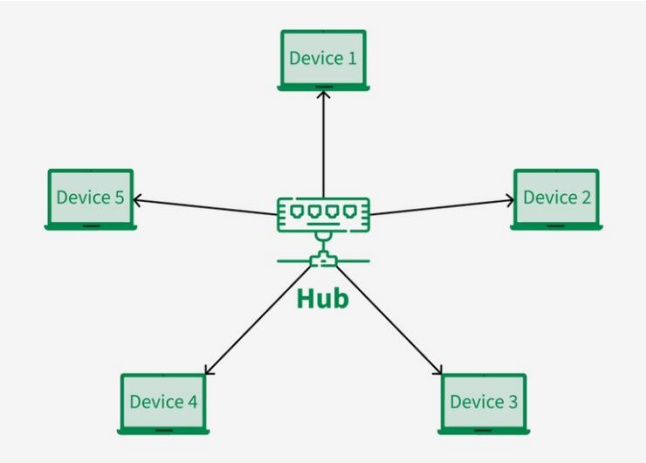
Disadvantages

* Damage in the cable results in shutting down entire network

In case of network shutdown, it becomes very diff of the to identify the problem

Star Topology:

Star topology is considered the asses topology to design and implement. In this topology, ach node is connected to a central hub (or server) with a poin to-point connection. All traffic that traverses the network passes through the central hub.



The hub acts as a signal repeater. When a node hast send a message to another node connected to the networ it will first send that message to the hub. The hub will regenerate the message (since signals become weak due noise) and then send it to the destination node.

Advantages

Easy to install
New nodes can be connected easily
Network does not get disturbed when a device is added or removed from it
Easy to detect faults
Failure of any other node (except the hub) does affect the network

Disadvantages

- Requires more cable length than bus topology
- If the central hub fails, the entire network is shut dows
- More expensive than bus topology because of the cost of hubs, cables, etc.

Ring Topology

In ring topology , all the nodes are connected to each other in the shape of a closed loop, so that every node is connected directly to two other nodes, one on either side of it. In ring network, messages travel through the ning in a circular fashion in the same direction (either clockwise brecounter-clockwise). A failure in any cable or device breaks the loop and can cause the network to shut down.

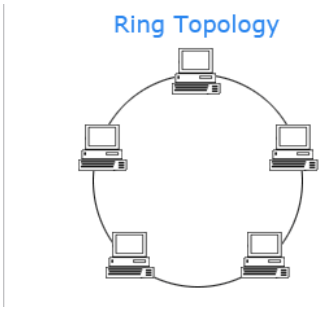


Fig: Ring Topology

Advantages

- Best suited for nerworks that do not have a buy
- More reliablend on a single hay as the does not depend on a hub
- Easy to install
- Can span over larger distances
- Every node has equal chance to transmit data

Disadvantages

- causes delay in communication which is directly proportional to the number of nodes in the network. adding new nodes will just increase the delay caused
- In case of network failure, it is difficult to diagnone the
- If one node fails, the entire network is shut down because the ring is not complete
- It is difficult to add or remove nodes from the network

Mesh Topology

In mesh network , also known as completely connected network, every node is connected to every other sode on the network using a separate physical link. Mesh topology involves the concept of routes. Unlike other topologies, in mesh network, a message can take any of the several possible paths from the source to the destination, For example, if a message has to be sent from A to B via C, then if node C fails, then the message can be sent to B via any other node in the network.

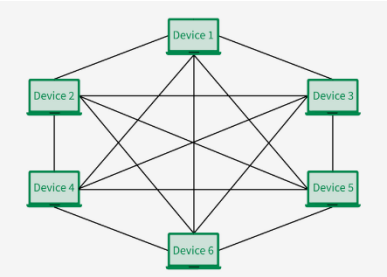


Fig: Mesh Topology

Advantages

- Failure of a node does not affect the entire network, only the communication with that particular node is affected
- Communication is fast as there is a direct link between the nodes
- Each connection can have its own data load, so the traffic problem is eliminated
- It ensures security of data because every message travels along a dedicated link
- It is easy to detect network errors

Disadvantages

- It is the most expensive network as for n nodes. nx (n-1)/2 physical links (cables) are required
- It is difficult to install

Hybrid Topology

We have discussed the star, ring, bus, and mesh topologies. Each of these has its own advantages and disadvantages. But in the real world, a pure star, pure ring, or pure bus topology is rarely used. Rather, a combination of two or more topologies is preferred.

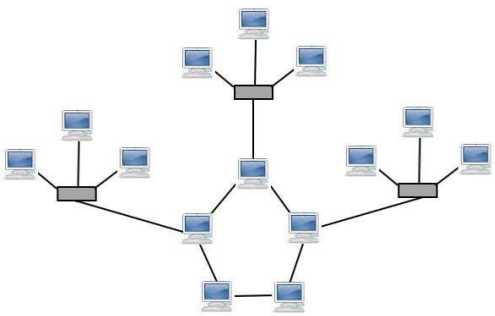


Fig: Hybrid topology

Consider an example of a hybrid network: an organization has two departments where one department has connected its computers using bus topology and the other department is using ring topology. Now, the networks of the two departments can be connected by a central hub, thereby using star topology.

7 b. Illustrate Three Schema Architecture in Database Systems 7M

THREE-SCHEMA ARCHITECTURE

A database schema is a layout of the database or a blueprint that outlines the manner in which the data is stored in the database. It describes the structure of the database in a formal language supported by the DBMS. For example,

Corresponding to the three levels of abstraction, there are three levels of database schema. This is called a three-level schema architecture or simply three-schema architecture. In the three-tier architecture, the levels of schema are as follows:

Physical schema :The physical schema describes the design of the database at the physical level. It incorporates the lowest level details that are hidden below the logical schema and describes the physical storage structure of the database. The physical schema can be easily implemented without affecting the application programs that are using the data. This schema is managed by the operating system under the direction of the DBMS.

Logical schema: Logical schema describes the database design at the logical level. This schema is often used by the application developers and programmers to develop applications. It is considered to be the most important schema in terms of its effect on application programs.

External schema It describes a part of the database as per the user requirements and hides the rest of the database from that user.

In the three-schema architecture, each user group has its own external view. When a user or a user group request to generate a new external view, the DBMS transforms the specified request at the external level into a request at the logical level, and then into a request at the physical level. When the user tries to access data from the database, the data is first extracted and then presented in a format specified by the user. This process of transforming the requests and results between the three levels of schema architecture is called mapping.

The three-schema architecture ensures data independence, which is the main advantage of using this architecture. Data independence is the ability to modify the database schema at one level without affecting or without changing the schema at the other levels. It is of two types- logical data independence and physical data independence.

Logical data independence is the ability to change the logical schema of the database without affecting its external schemas or application programs. The logical schema may be changed due to any of the following reasons:

- Addition of new field(s)
- Deletion of existing field(s)
- Addition of constraints
- Removal of constraints

Physical data independence is the ability to change the internal schema without affecting the logical or external schema. The internal or physical schema of the database may be changed due to the following reasons:

- Creating additional access structure
- Changing the storage structure

8 a. Define Operating System what are the different types of Operating Systems 7M

An operating system (OS) is a program that manages a computer's hardware and software resources, and acts as an intermediary between the user and the device.

Batch Processing Operating System

Batch processing systems operating allow very limited or no interaction between the users and the processors during the execution of work. Data and programs that need to be processed are bundled and collected as a 'batch' and executed together

Batch processing operating systems perform very well when a large amount of data has to be processed and either the data or the process is similar in nature. Batch processing is performed automatically without user intervention. For example, organizations use batt processing to automate their payroll. The process wal identify each employee, calculate his/her monthly salary (with tax deductions), and print the corresponding pays Batch processing is useful for this purpose since the sas procedure is repeated for each employee every month batch operating systems, users had to prepare their job on an offline device such as a punch card and submit to the computer operator. To speed up processing, the computer operator would group the jobs with similar features to form a batch, which were then executed by the computer. The results of execution and errors (if any) were mcorded on the punched cards and then given to the user of the job. The following were the typical problems with batch operating systems:

- There was little or no interaction between the user and the jo
- The CPU remained idle most of the times as the speed of the I/O devices was far slower than that he
- the CPU Assigning priorities to jobs was difficult.

Single-user Single-tasking Operating System

As the name indicated single-user single-tasking operating systems allowed only one program to be executed at a time. They were designed to enable a single user to do a single job effectively at any point of ume. The Palm OS for palm handheld computers is an example of a modern single-user single-task operating system.

Multiprogramming Operating System

In the batch processing system, only one job was stored in the memory and executed by the CPU. The next job would be loaded for execution only after the first job was completely executed. Thus, the entire main memory and CPU time were exclusively reserved for a single job (Figure 8.4(a)). However, a job does not need the CPU all the time during its execution. For some time, it needs the CPU for processing, and at other times, it requires an I/O device for performing an I/O operation.

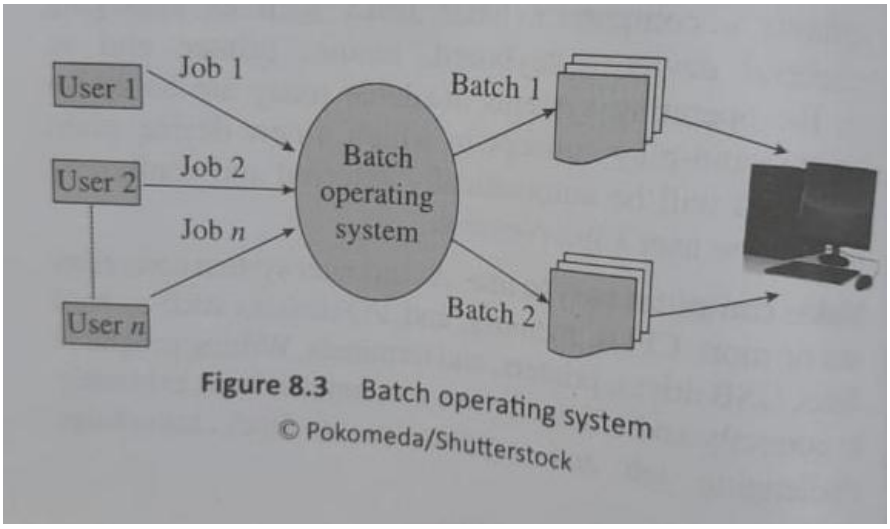
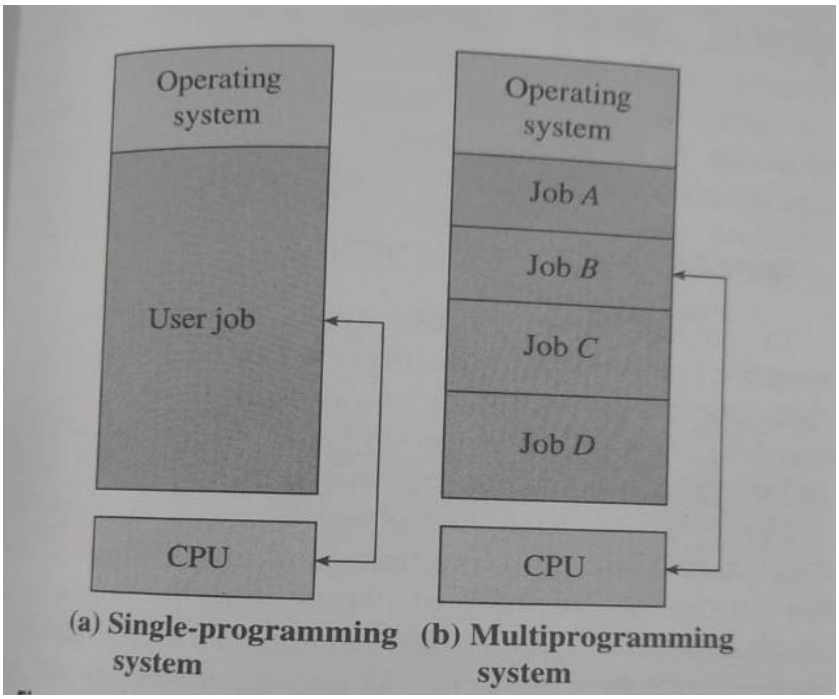


Figure 8.3 Batch operating system



Hence, the CPU remains idle when the job has to do an I/O operation. The idle time of the CPU can be significant if the job has to do 80-90 per cent of I/O operations and only 10-20 per cent of processing. To reduce the idle time of the CPU, multiprogramming was introduced for interleaved execution of multiple jobs by the same CPU.

Single-user Multitasking Operating System

A single-user multitasking operating system (a form of multiprogramming) allows a single user to simultaneously perform several tasks. This is the operating system normally used in our desktops and laptops. The single-user multitasking operating system enhances the productivity of users, as they can complete more than one job at the same time.

Multi-user Multitasking Operating System

A multi-user operating system enables multiple users on different computers to access a single system (with one operating system), In simple terms, it allows more than one user to connect to the main computer (which has only one CPU and one operating system) to perform more than one job at a time. Hence, users on multiple terminals can access the same data and application programs that are stored on the main computer.

Time-sharing Operating System

Time sharing is a logical extension of multiprogramming and enables multiple users to simultaneously share the CPU's time. Time-sharing systems were developed to provide an interactive use of computer systems by several users. In such a system, the CPU switches between multiple jobs so frequently that every user receives an immediate response (in a few seconds).

Multiprocessing Operating System

Multiprocessing means using two or more processors coordinated processing of programs by more than one processor. In multiprocessing systems, a complex program can be divided into smaller parts and then be executed concurrently by multiple processors.

Real-time Operating System

A real-time operating system (RTOS) is a data processing system in which the time interval required to process and respond to inputs is very small and highly critical.

Virtual Machine Operating System

A virtual machine operating system enables several users of a computer to use it as if they are using it individually. When using a virtual machine operating system, several operating system environments can coexist on the same computer. For example, Figure 8.9 shows three operating system environments existing on the same computer. These operating systems are Windows, Linux, and Solaris.

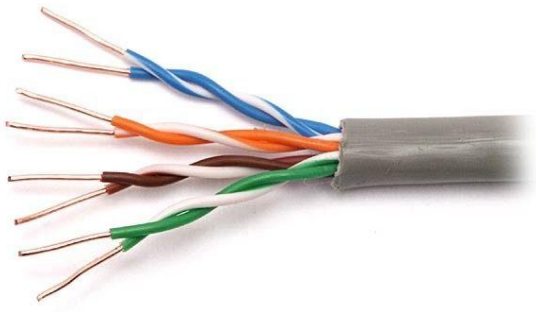
8b.What are the Physical Components of Computer Networks Give examples 7M

Following are the Physical Components of Computer Networks:WIRED MEDIA

Computers and other computing devices can be connected by different kinds of media such as twisted-pair cables, coaxial cables, and optical fibres.

Twisted-pair Wires

Twisted-pair wires, which consist of copper wires that are twisted into pairs, are the most widely used medium for telecommunication. Figure 10.14 shows a bunch of twisted-pair cables enclosed in plastic insulation. While ordinary telephone wires consist of two insulated copper wires twisted into pairs, computer networking cables, on the other hand, consist of four pairs of copper cables that can be utilized for both voice and data transmission.

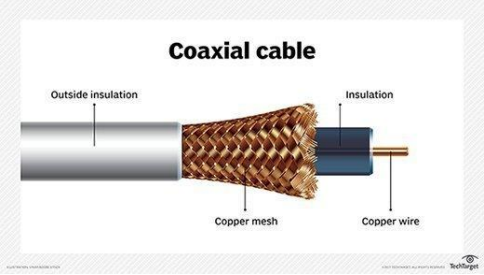


Twisted-pair cable

The twisted wires help to reduce crosstalk and electromagnetic induction. The transmission speed of twisted-pair cable varies from two million bits per second (bps) to 100 million bps. They are inexpensive and easy to install and use. However, these cables easily pick up noise signals, and thus become prone to error when their length extends beyond 100 metres.

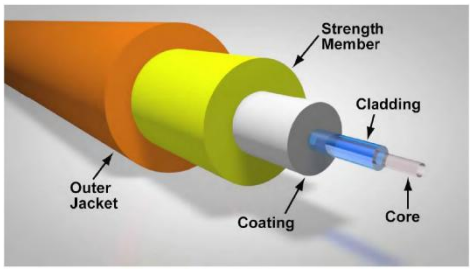
Coaxial Cables

Coaxial cables are a highly preferred connecting medium for cable television systems and for connecting the computers within an office building or within short distances to form a network.



Optical Fibre Cables

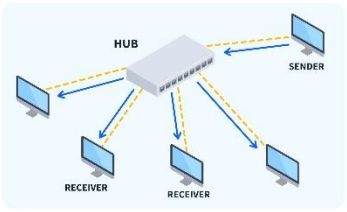
An optical fiber cable, also known as a fiber-optic cable, is a bundle of glass or plastic strands that transmit data as light



NETWORKING DEVICES

Computer networking devices are communication devices that enable users to create a network. These devices are also known as network equipment, intermediate systems (IS), or interworking unit (IWU). In this section, we will read about the commonly used networking devices.

Hub

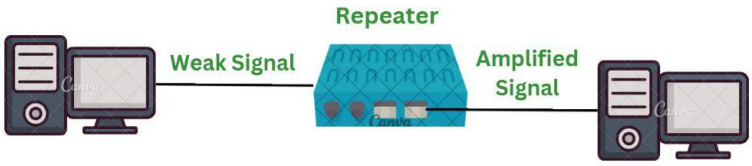


A hub is a device to which different devices are connected so that they can communicate with each other. Every computer on the network is directly connected with the hub. When data packets arrive at the hub, it broadcasts them to all the devices connected to it. Hence, every device picks the message but only the destined device processes the packet and all the other computers just discard it

A hub is not an intelligent device; its main function is to amplify the signals and broadcast them to all the devices connected to it.

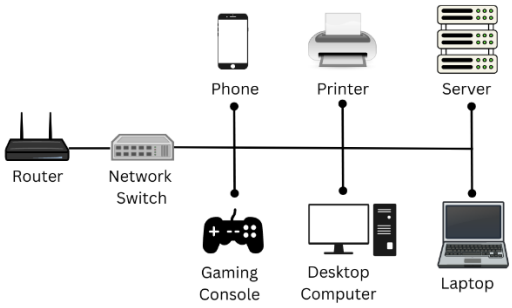
Repeater

Network repeaters are electronic devices that regenerate incoming electrical, wireless, or optical signals. Without a repeater, the data can only span a limited distance before the quality of the signal degrades. Repeaters attempt to preserve signal integrity by removing unwanted noise from the incoming signal, restoring the weak/distorted signal, thereby extending the distance over which the data can safely travel.



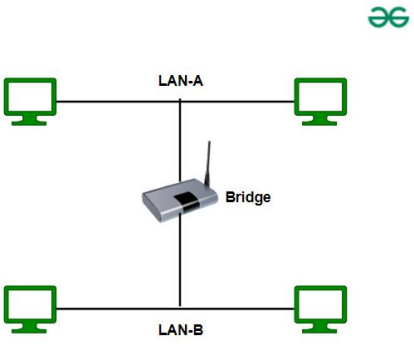
Switch

A switch is a device that can be used in all places where a hub is used However, it is much better than the hub because it has a switching table within it. The switching table stores the address of every computer or device connected to it and sends the data only to the destined device rather than broadcast the data to all the devices connected to it. Therefore, the switch is considered to be an intelligent device as it selects the destined device among many devices connected to it to forward the data.



Bridge

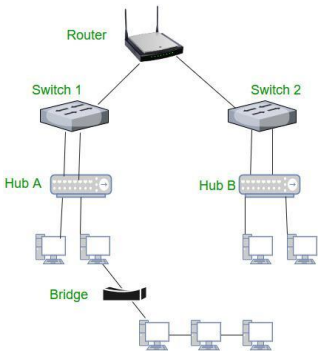
A bridge is a device that connects two or more LANS. When a bridge receives data from one LAN to forward it to another LAN, it first regenerates (or amplifies) the signals and then forwards the data to the other LAN. Amplification ensures that the devices on the network receive accurate information. Otherwise, the signals become weaker as they travel, and a 1 sent by the transmitting device may be interpreted as a 0 by the receiving device.



Router

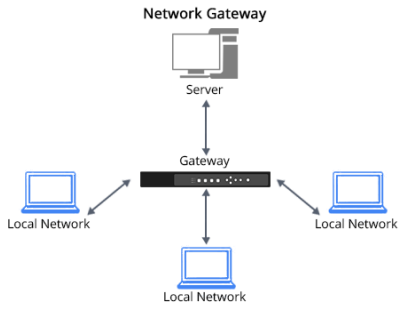
A router is an intelligent device that routes data to destination computers. It is used to connect two logically and physically different networks, two LANs, two WANs, and a LAN with a WAN.

Routers use special software known as routing table that stores the addresses of devices connected to the network. The major task of a router is to route the data packets between two networks on the best possible path for fast data transmission.



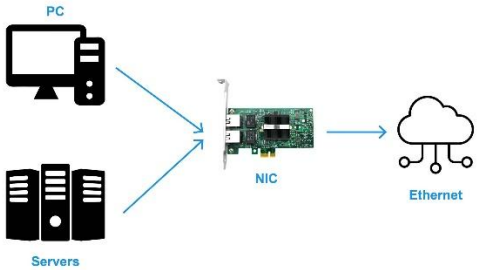
Gateway

A gateway is a very complicated networking device that is used to connect two or more dissimilar networks that use Entirely different protocols. For example, if we know only English but want to talk to a person who knows only French then we need a translator to facilitate communication The gateway acts as a translator between two dissimilar networks. It accepts data formatted by one network and converts it into a format that can be accepted by the other network.



Network Interface Card

One can use the network services through a network interface card (NIC), also known as a network adapter or LAN card. That is, no computer can communicate with other devices without a properly installed and configured LAN card .The communication cables that connect different devices to form a network are connected via this card.



Modem

A modem is a hardware device that allows a computer to send and receive data over a telephone line or a cable or satellite connection (see Figure 10.24). When data transmitted over analog telephone lines (which, the most popular way to modem converts data between analog and digital formats in real time to enable two-way network communication

UNIT V

9a. Differentiate between Artificial Intelligence, Machine Learning and Deep learning . 7M

Here are **key differences** between Artificial Intelligence (AI), Machine Learning (ML), and Deep Learning (DL):

Feature	Artificial Intelligence (AI)	Machine Learning (ML)	Deep Learning (DL)
Definition	Broad field focused on creating intelligent systems.	Subset of AI, enabling systems to learn from data.	Subset of ML using neural networks with many layers.
Purpose	Mimics human intelligence in tasks.	Focuses on pattern recognition and predictions.	Solves complex problems involving large, unstructured data.
Data Requirements	Can work with limited data (e.g., rule-based systems).	Requires significant amounts of labeled data.	Requires very large datasets and high computational power.
Complexity	Uses simpler or hybrid methods (rules, heuristics).	Focuses on algorithms like decision trees, SVMs.	Employs deep neural networks (e.g., CNNs, RNNs).
Hardware Dependency	May not need specialized hardware.	Often runs on standard hardware.	Requires GPUs/TPUs for efficient training.
Use Cases	Chatbots, expert systems, and robotics.	Spam detection, recommendation systems.	Image recognition, autonomous driving.
Learning Process	Can include non-learning methods (rule-based).	Learns from structured or semi-structured data.	Learns features automatically from raw data.

9b. Write about various applications of Artificial Intelligence in Agriculture. 7M

Applications of Artificial Intelligence in Agriculture

Artificial Intelligence (AI) is revolutionizing agriculture by enabling smarter, more efficient, and sustainable farming practices. Below are some key applications of AI in agriculture:

1. Precision Farming

- **Description**: AI helps optimize resource use (e.g., water, fertilizers, pesticides) by analyzing environmental and crop data.
- **Examples**:
    - Sensors and AI systems monitor soil moisture and nutrient levels.
    - AI-powered drones assess crop health and identify areas needing attention.

2. Crop Monitoring and Management

- **Description**: AI-based image processing and machine learning models help monitor crop conditions and detect diseases.
- **Examples**:
    - Computer vision systems identify pest infestations and diseases early.

- AI systems suggest remedial actions to minimize crop losses.

3. Yield Prediction

- **Description**: AI algorithms analyze historical data, weather patterns, and soil conditions to predict crop yields.
- **Examples**:
  - Farmers use predictions to make informed decisions about planting and harvesting.
  - Reduces uncertainties in farming practices.

4. Smart Irrigation Systems

- **Description**: AI integrates with IoT sensors to provide precise irrigation solutions.
- **Examples**:
  - AI systems schedule watering based on real-time weather and soil data.
  - Reduces water wastage and increases crop yield.

5. Weed and Pest Control

- **Description**: AI-powered robotics and drones can identify and remove weeds or apply pesticides only where needed.
- **Examples**:
  - Robots equipped with AI vision systems differentiate crops from weeds.
  - Targeted pesticide application minimizes chemical use and environmental impact.

6. Livestock Monitoring

- **Description**: AI is used to monitor livestock health and behavior for better management.
- **Examples**:
  - Wearable sensors track vital signs, detect illnesses, and optimize feeding.
  - AI systems analyze behavior to predict breeding times or stress levels.

7. Supply Chain Optimization

- **Description**: AI improves logistics, pricing, and distribution in the agricultural supply chain.
- **Examples**:
  - Predictive analytics help farmers choose the best time and market for selling produce.
  - AI reduces food wastage by matching supply with demand.

8. Weather Forecasting

- **Description**: AI models provide accurate weather predictions to help farmers plan their activities.
- **Examples**:
  - Farmers use AI tools to decide on planting, harvesting, and irrigation schedules.
  - Minimizes risks from adverse weather conditions.

9. Soil Health Monitoring

- **Description**: AI tools analyze soil samples to determine fertility and suitability for various crops.

- **Examples**:
    - AI systems recommend specific fertilizers or soil amendments.
    - Enhances sustainable farming practices.

10. Market Trend Analysis

- **Description**: AI provides insights into market trends, helping farmers make strategic decisions.
- **Examples**:
    - AI analyzes consumer demand and suggests profitable crops.
    - Helps farmers stay competitive in the market.

By integrating AI into agriculture, farmers can boost productivity, reduce costs, and achieve sustainability while addressing global challenges such as food security and climate change.

10 a. What is the significance of Data Model in Data Science? 7M

Significance of Data Models in Data Science

A **data model** plays a crucial role in data science as it serves as a blueprint for how data is organized, processed, and interpreted. It provides a structured way to represent relationships between different data elements, enabling efficient analysis and decision-making. The significance of data models in data science is highlighted below:

1. Data Organization and Structure

- Data models define how data is stored, categorized, and related.
- They provide a logical framework that ensures data is organized in a way that is meaningful and accessible.
- Examples include relational models, hierarchical models, and graph-based models.

2. Facilitates Analysis and Interpretation

- Data models simplify complex datasets by focusing on essential variables and their relationships.
- This abstraction enables data scientists to analyze trends and patterns more effectively.

3. Improved Decision-Making

- A well-designed data model ensures that the data is relevant and reliable.
- Accurate models provide actionable insights, aiding businesses and organizations in making informed decisions.

4. Enhances Data Quality

- Data models enforce rules and constraints to maintain data integrity, consistency, and accuracy.
- This ensures the data used in analytics or machine learning models is clean and reliable.

5. Efficient Data Processing

- Data models optimize data storage and retrieval, reducing computational overhead during analysis.
- This is particularly significant when working with large-scale data.

6. Enables Predictive Modeling

- Predictive models like regression, decision trees, or neural networks rely on structured data representations derived from data models.
- These models use historical data to make predictions about future trends.

7. Supports Scalability

- As data grows in volume and complexity, a robust data model ensures scalability, making it easier to accommodate new data without redesigning the system.

8. Communication Tool

- Data models serve as a shared language between data scientists, engineers, and stakeholders.
- They help explain complex data relationships in a simplified manner, improving collaboration.

In data science, the **data model is the foundation** upon which all data-driven processes are built. It ensures that data is usable, interpretable, and aligned with the objectives of the analysis, making it an indispensable part of any data science project.

10b. Discuss any Data Science application with use case diagram.

Data Science is a broad field with many potential applications. It's not just about analyzing data and modeling algorithms, but it also reinvents the way businesses operate and how different departments interact. Data scientists solve complex problems every day, leveraging a variety of Data Science solutions to tackle issues like processing unstructured data, finding patterns in large datasets, and building recommendation engines using advanced statistical methods, artificial intelligence, and machine learning techniques.

The widespread benefits of Data Science for businesses are felt across the spectrum of organizational functions. Organizations are using Data Science to transform data into competitive advantages, fine-tuning products and services and identifying customer churn through analytics collected by the call centers so that marketing can act to keep them. Marketers are targeting customers using machine learning and product recommendation systems, which take into account socioeconomic data points to inform how to market to customers.

Data Science helps analyze and extract patterns from corporate data, so these patterns can be organized to guide corporate decisions. Data analysis using Data Science techniques helps companies to figure out which trends are the best fit for businesses during various parts of the year.

Through data patterns, Data Science professionals can use tools and techniques to forecast future customer needs toward a specific product or service. Data Science and businesses can work together closely in understanding consumer preferences across a wide range of items and running better marketing campaigns.

To enhance the scope of predictive analytics, Data Science now employs other advanced technologies such as machine learning and deep learning to improve decision-making and create better models for predicting financial risks, customer behaviors, or market trends.

Data Science helps with making future-proofing decisions, supply chain predictions, understanding market trends, planning better pricing for products, consideration of automation for various data-driven tasks, and so on.

For example, in **sales and marketing**, Data Science is mainly used to predict markets, determine new customer segments, optimize pricing structures, and analyze the customer portfolio. Businesses frequently use sentiment analysis and behavior analytics to determine purchase and usage patterns, and to understand how people view products and services. Some businesses like Lowes, Home Depot, or Netflix use "hyper-personalization" techniques to match offers to customers accurately via their recommendation engines.

E-commerce companies use recommendation engines, pricing algorithms, customer predictive segmentation, personalized product image searching, and artificially intelligent chat bots to offer transformational customer experience.

10b.Discuss any Data Science with use case diagram 7M

Data Science Application: Player Performance Analysis in Cricket

Overview: Data science is used in cricket to analyze player performance, team strategies, and match outcomes. By leveraging historical data and advanced analytics, teams can make data-driven decisions to improve their chances of success.

Use Case Description

Actors:

1. **Player**: Provides performance data (e.g., runs scored, wickets taken).
2. **Data Analyst**: Analyzes historical and real-time data for insights.
3. **Coach/Team Management**: Uses insights for strategic planning.
4. **Cricket Fans**: Access insights through apps and broadcasts.

Process:

1. Player performance data (e.g., batting average, strike rate) is collected during matches.
2. Data analysts process and analyze this data to identify patterns.
3. Insights are presented to coaches and management for decision-making, such as team selection or match strategies.
4. Fans access player statistics and predictions via cricket apps or websites.

Use Case Diagram

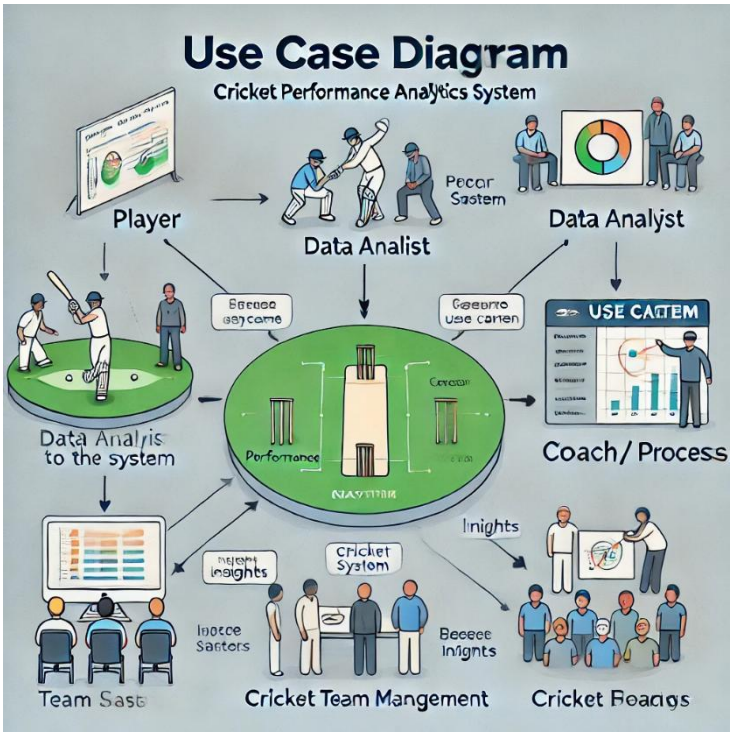
Here's a textual description of the diagram structure:

- **Actors**: Player, Data Analyst, Coach/Team Management, Cricket Fans.
- **System**: Cricket Performance Analytics System.

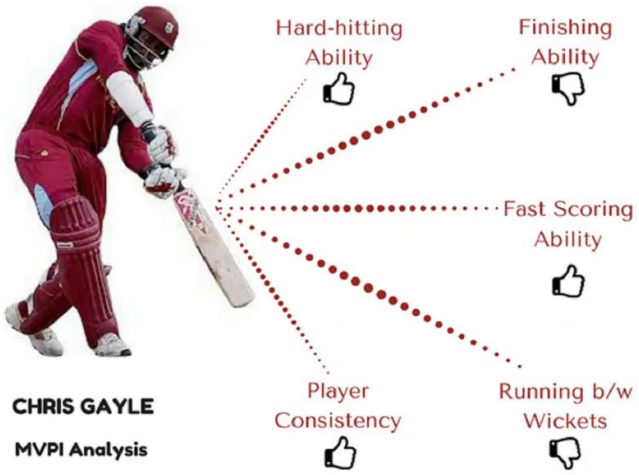
Interactions:

- Player → Provides data → Cricket Performance Analytics System.
- Data Analyst → Analyzes data → Cricket Performance Analytics System.
- Coach/Team Management → Receives insights → Cricket Performance Analytics System.
- Cricket Fans → Access data insights → Cricket Performance Analytics System.

Use Case Diagram for this cricket application.



Here is a use case diagram illustrating the Cricket Performance Analytics System. It highlights the interactions between players, data analysts, team management, and cricket fans. Let me know if you'd like further explanations or adjustments!



Data science can accurately evaluate athletes' performance, and weather conditions, and analyze teams' recent wins/losses.

Prepared by

Dr.V.Lakshmana Rao

Associate Professor

Dept of Computer Science