

# **Object Oriented Programming (OOPS)**

## **1. What do you mean by OOPS ?**

**Ans :** OOPS is a programming paradigm that deals with classes and object, in which the state and behavior of a object is wrapped inside a container commonly known as class

## **2. Why is OOPS used ?**

**Ans :** OOPS is used as it can break a very large codebase or program into small different parts which are more readable. And second it helps to attain the DRY principle that is do not repeat yourself, the same part of code can be reused in many places. OOPS programs can also be scaled.

## **3. What are different types of programming paradigms ?**

**Ans :** There are mainly four different types of programming paradigms

- **Procedural Programming** - ➤ In procedural programming there are sets of instructions which are given to a computer to execute step by step.
- **Logical Programming** - ➤ It is largely based on formal logic. Any program written in a logic programming language is a set of sentences in logical form, ex -> like SQL
- **Object Oriented Programming** - ➤ OOPS is a programming paradigm that deals with classes and object, in which the state and behavior of a object is wrapped inside a container commonly known as class
- **Functional programming** - ➤ Using functions to the best effect for creating clean and maintainable software.

#### **4. Tell me about declarative and imperative approaches ?**

**Ans :** **Declarative** programming, on the other hand, you write code that describes what you want, but not necessarily how to get it (declare your desired results, but not the step-by-step). With **Imperative** programming, you tell the compiler what you want to happen, step by step.

#### **5. What is operator overloading ?**

**Ans :** Operator Overloading is the method by which we can change the function of some specific operators to do some different task. Some operators can not be overloaded like.

- . operator
- :: scope resolution operator
- ?: ternary operator
- sizeof() operator

#### **6. What are 'this' and 'super' keywords ?**

**Ans :** this keyword is used for referring to the current class, it is a pointer to the current object, super keyword is only present in java, super keyword is used for referencing the immediate parent class. C++ do not have super keyword because in c++ there is a concept of multiple inheritance which can make the compiler confused.

#### **7. What are virtual functions ?**

**Ans :** Virtual functions are used to achieve runtime polymorphism. A virtual function is a member function which is defined in the base class but can be overridden in the derived class

## 8. What are the four pillars of OOPS ?

**Ans :** The four pillars of OOPS are APIE that is Abstraction, Polymorphism, Inheritance, Encapsulation.

- **Encapsulation** - > Binding the data members and the methods inside a capsule called class. Encapsulation can help to achieve security as no other class can access the data members and methods which are set private, thus protecting the access of an object by unwanted clients.
- **Abstraction** - > Encapsulation is used to attain abstraction that shows only what is necessary. The process of hiding the internal details of an application from the outer world. For example let's take a validate function which internally does many things using many different functions.
- **Inheritance** - > Inheritance is used for deriving some of the features from the parent class to child class to, it can derive the parent's class public and protected properties also the derived class can also have its own members and methods. For example Gold customer and Silver customer can be derived from customer.
- **Polymorphism** - > Poly means many, morphs means changing, that is the ability of an object to change its behavior under different conditions. There are two types of polymorphism
  - Static Polymorphism or Compile time polymorphism : In this type of polymorphism a function or an operator can be overloaded at the runtime, for example a function with the same name but different signature can be used to attain function overloading.
  - Dynamic polymorphism or Runtime Polymorphism : In this type of polymorphism if a child class has the same function with the same signature is present, the method when called will depend on the type of object that is created whether it is of type parent or type child. Runtime polymorphism with the help of features like **virtual functions**. Virtual functions take the shape of the functions based on the type of object in reference and are resolved at runtime

### **9. What are different types of inheritance ?**

**Ans :** There are 4 types of inheritance in C++

- **Single inheritance** - ➤ In which a child class is derived from the parent class.
- **Multilevel Inheritance** - ➤ In which a level of derived classes can be made.
- **Multiple inheritance** - ➤ In which two or more classes are derived from a parent class.
- **Hybrid inheritance** - ➤ Hybrid inheritance is a combination of multiple inheritance and multilevel inheritance.
- **Hierarchical Inheritance** - ➤ Tree structure inheritance.

### **10. What is the diamond problem and its solution ?**

**Ans :** The "diamond problem" (sometimes referred to as the "Deadly Diamond of Death") is an ambiguity that arises when two classes B and C inherit from A, and class D inherits from both B and C. Its solution is to use virtual keywords. The way of calling constructors are also different in the case of virtual inheritance.

### **11. What do you mean by abstraction ?**

**Ans :** Abstraction means hiding the underlying complexities of a software.

### **12. How much memory does a class occupy ?**

**Ans :** Classes do not consume any memory as they are only the blueprint of the objects. They consume memory when the objects are initialized.

### **13. What are constructor and destructors, and tell me about types of constructor ?**

**Ans :** Constructors are special methods of a class which have the same name and are used for initialization of objects. Destructors are special methods which are used for deleting an object and deallocating the memory used by objects destructors start with tilde sign followed by the same name as the class. There are by default constructors and destructors implemented.

There are three types of constructors: default constructors, copy constructors, parameterized constructors. Default constructor are by default present; they are invoked when an object is instantiated.

Parameterized constructor are used for initialization of an object with some data / parameter, A copy constructor is a member function that initializes an object using another object of the same class.

### **14. Difference between structure and class ?**

**Ans :** No, class and structure are not the same. Though they appear to be similar, they have differences that make them apart. For example, the structure is saved in the stack memory, whereas the class is saved in the heap memory. Also, Data Abstraction cannot be achieved with the help of structure, but with class, Abstraction is majorly used.

### **15. Limitations of inheritance ?**

**Ans :** Inheritance is a very useful feature but implementation of inheritance is very complex as the base class and child class are tightly coupled together. There is a need for nested changes in different classes. So if they are not correctly implemented it can lead to incorrect outputs.

### **16. Difference between overloading and overriding ?**

**Ans :** Overloading is compile time polymorphism in which the function acts differently when their signatures are different. Function overriding means runtime polymorphism in which function behaves differently while execution.

**17. What are abstract classes ?**

**Ans :** Abstract classes are half defined parent classes in which functions are only declared and not defined. The child class of this abstract class has the implementation of the methods which are declared. It is compulsory to define the methods of the child class of an abstract parent class. Abstract methods are virtual only.

**18. Difference between abstract class and simple class ?**

**Ans :** Difference between abstract class and simple class is abstract class and is purely half defined whereas in simple class, if we want to make a simple class half defined we have to make tricky logic / throw exceptions other things which will be very hectic.

**19. Can we create objects of abstract classes ?**

**Ans :** We cannot create objects of an abstract class. To implement features of an abstract class, we inherit subclasses from it and create objects of the subclass. A subclass must override all abstract methods of an abstract class.

	<b>Customer</b>	
	<b>getDisc()</b>	
<b>goldMember</b>		<b>silverMember</b>
<b>getDisc()</b>		<b>getDisc()</b>

**20. What do you mean by interface ?**

**Ans :** It is used to achieve total abstraction. Since java does not support multiple inheritances in the case of class, by using an interface it can achieve multiple inheritances

**21. What do you mean by pure virtual function ?**

**Ans :** A pure virtual function is a function that must be overridden in a derived class and need not be defined

**22. What do you mean by friend function ?**

**Ans :** A friend function is a special function in C++ which in spite of not being member function of a class has privilege to access private and protected data of a class. The friend function in C++ is defined outside the scope of the class. It has the authority to access all protected members and private members of the class.

**23. What do you mean by exception ?**

**Ans :** An exception can be considered as a special event, which is raised during the execution of a program at runtime, that brings the execution to a halt. The reason for the exception is mainly due to a position in the program, where the user wants to do something for which the program is not specified, like undesirable input.

**24. What do you mean by exception handling ?**

**Ans :** No one wants its software to fail or crash. Exceptions are the major reason for software failure. The exceptions can be handled in the program beforehand and prevent the execution from stopping. This is known as exception handling. So exception handling is the mechanism for identifying the undesirable states that the program can reach and specifying the desirable outcomes of such states. Try-catch is the most common method used for handling exceptions in the program

**25. What is garbage collection ?**

**Ans :** Garbage collection (GC) is a memory recovery feature built into programming languages such as C# and Java. A garbage collection-enabled programming language automatically frees up memory space that has been allocated to objects no longer needed by the program.

**26. Requirements for an abstract class in C++ ?**

**Ans :** An abstract class contains at least one *pure virtual function*. You declare a pure virtual function by using a *pure specifier* (= 0) in the declaration of a virtual member function in the class declaration.

**27. What do you mean by static keyword ?**

**Ans :** As the variables declared as static are initialized only once as they are allocated space in separate static storage, the static variables in a class are shared by the objects. There can not be multiple copies of the same static variables for different objects. Also because of this reason static variables can not be initialized using constructors.

**28. What do you mean by the final keyword ?**

**Ans :** Use of final specifier in C++ 11: Sometimes you don't want to allow derived classes to override the base class' virtual function. C++ allows built-in facilities to prevent overriding of virtual functions using final specifiers.



# **Computer Networks (CN)**

## **1. What are different types of networks ?**

**Ans :** Different types of network includes : -

- LAN (Wireless and Wired) - > Lab, Company
- WAN - > Large geographical area Country / Continent
- MAN - > TV cable over a city
- PAN -> Bluetooth
- GAN - > Connects the globe

## **2. What does VPN mean and mention its advantages ?**

**Ans :** VPN means virtual private network, it creates an encrypted secure tunnel for your data and it hides your IP address over a network. VPN client first validates your request then encapsulates it in a wrapper, encrypts it then the data is transferred, then it is decrypted at your side. It creates a private WAN. By using the VPN, a client can connect to the organization's network remotely. The below diagram shows an organizational WAN network over Australia created using VPN:

- VPN is used to connect very far geographical locations offices at lower cost.
- It is used for secure transactions.
- Encrypts internet traffic and disguise the identity.

## **3. What are nodes and links ?**

**Ans :** Any communicating device in a network is called a Node. Node is the point of intersection in a network. It can send/receive data and information within a network. And links are any edge b/w nodes used for transmission of data.

## **4. What does network topology mean ?**

**Ans :** Network topology is the arrangement of networks and cables in different forms such as star, bus, mesh, ring and tree etc.

### 5. What is an IPv4 address, and what are its different classes ?

**Ans :** IPv4 addresses are 32 bit numbers, which are divided into 4 segments of 8 bits. With each number value upto 255. There are total A, B, C, D, E classes of IPv4. 0 - 127, 128 - 191, 192 - 223, 224 - 239, 240 - 255.

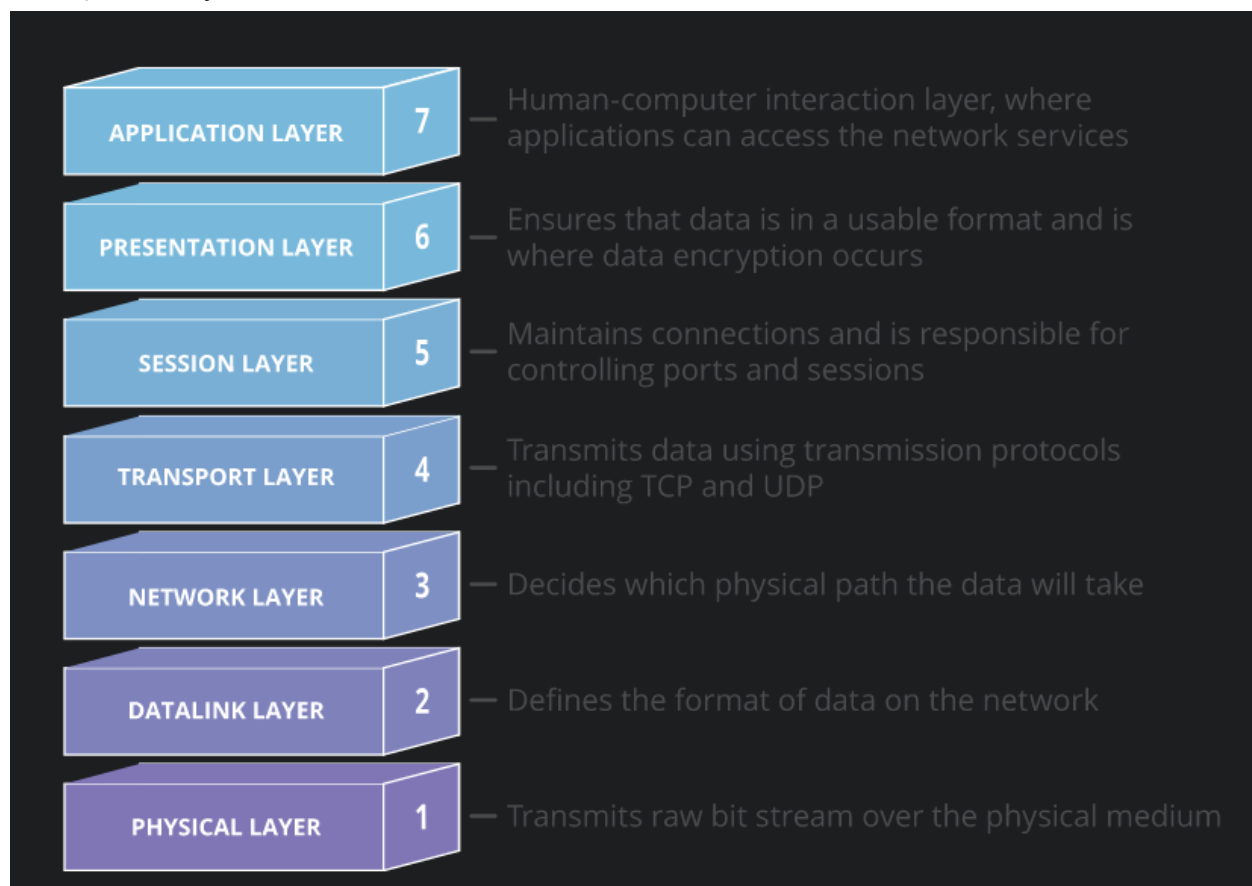
### 6. What are private and special IP addresses ?

**Ans : Private IP addresses :** Are reserved for private use only. These IP addresses can not be used for routing.

**Special Address:** IP Range from 127.0.0.1 to 127.255.255.255 are network testing addresses also known as loopback addresses are the special IP address

### 7. Define OSI model ?

**Ans :** The OSI (open system interface) provides a standard for different computer systems to be able to communicate with each other.



- **Physical Layer** - > Hub is present here, Deals with the raw bit stream over physical medium. Transmission types simplex, half duplex, full duplex. Unit - Bit.
- **Data Link Layer** - > Hub is present here, **hop to hop delivery**, **Flow control** -> STOP AND WAIT, GO BACK N, SELECTIVE REPEAT. **Error Control** -> Parity check, Checksum, CRC, **Access Control**, physical address MAC, framing, CSMA/C/A, Unit - Frames.
- **Network Layer** - > **Host to host delivery**, Logical address (IP), routing, congestion control, router works here, Unit - Packets.
- **Transport Layer** - > **End to End delivery**, TCP / UDP, **Transmission Control Protocol** (TCP) : Connection Oriented, No loss data, Inorder, **User Datagram Protocol** (UDP) is a communications protocol that is primarily used to establish low-latency and loss-tolerating connections between applications on the internet.
- **Session Layer** - > The session layer allows users on different machines to establish sessions between them, authentication, session restoration, synchronization.
- **Presentation Layer** - > Ensures the data is in usable format and data encryption occurs here.
- **Application Layer** - > Human computer interaction where applications can access the network services.

## 8. What is the TCP / IP model ?

**Ans :** It is a compressed form of OSI model which has only 4 layers -> **Application, Transport, Network, and Link layers.**

## 9. HTTP and HTTPS protocol ?

**Ans :** HTTP protocol is a set of rules which are used for transferring data over the network WWW uses port 80. HTTPS enables secure transactions by encrypting the communication and also helps identify network servers securely. It uses port 443 by default

### 10. SMTP ?

**Ans :** SMTP is the Simple Mail Transfer Protocol. SMTP sets the rule for communication between servers. This set of rules helps the software to transmit emails over the internet. It supports both End-to-End and Store-and-Forward methods. It is in **always-listening mode** on **port 25**.

### 11.DNS ?

**Ans :** It is considered as the devices/services directory of the Internet. It is a decentralized and hierarchical naming system for devices/services connected to the Internet. It translates the domain names to their corresponding IPs. For e.g. interviewbit.com to 172.217.166.36. It uses **port 53** by default

### 12.Router and Gateway ?

**Ans :** The **router** is a networking device used for connecting two or more network segments. It directs the traffic in the network. It transfers information and data like web pages, emails, images, videos, etc. from source to destination in the form of packets. It operates at the network layer. The **gateways** are also used to route and regulate the network traffic but, they can also **send data between two dissimilar networks** while a router can only send data to similar networks

### 13.TCP ?

**Ans :** TCP or TCP/IP is the Transmission Control Protocol/Internet Protocol. It is a set of rules that decides how a computer connects to the Internet and how to transmit the data over the network. It creates a virtual network when more than one computer is connected to the network and **uses the three ways handshake model** to establish the connection which makes it more reliable

#### 14. UDP ?

**Ans :** UDP is the User Datagram Protocol and is based on Datagrams. Mainly, it is used for multicasting and broadcasting. Its functionality is almost the same as TCP/IP Protocol **except for the three ways of handshaking and error checking**. It uses a simple transmission without any hand-shaking which makes it less reliable.

TCP/IP	UDP
Connection-Oriented Protocol	Connectionless Protocol
More Reliable	Less Reliable
Slower Transmission	Faster Transmission
Packets order can be preserved or can be rearranged	Packets order is not fixed and packets are independent of each other
Uses three ways handshake model for connection	No handshake for establishing the connection
TCP packets are heavy-weight	UDP packets are light-weight
Offers error checking mechanism	No error checking mechanism
Protocols like HTTP, FTP, Telnet, SMTP, HTTPS, etc use TCP at the transport layer	Protocols like DNS, RIP, SNMP, RTP, BOOTP, TFTP, NIP, etc use UDP at the transport layer

#### 15.DHCP ?

**Ans :** It is an application layer protocol used to auto-configure devices on IP networks enabling them to use the TCP and UDP-based protocols. The DHCP servers **auto-assign the IPs** and other network configurations to the devices individually which enables them to communicate over the IP network.

#### 16. ARP ?

**Ans :** ARP is Address Resolution Protocol. It is a network-level protocol used to convert the logical address i.e. IP address to the device's physical address i.e. MAC address. It can also be used to get the MAC address of devices when they are trying to communicate over the local network.

### **17. MAC and NIC ?**

**Ans :** MAC address is the Media Access Control address. It is a 48-bit or 64-bit unique identifier of devices in the network. It is also called the physical address embedded with a Network Interface Card (NIC) used at the Data Link Layer. NIC is a hardware component in the networking device using which a device can connect to the network

### **18. Subnetting ?**

**Ans :** A subnet is a network inside a network achieved by the process called subnetting which helps divide a network into subnets. It is used for getting a higher routing efficiency and enhances the security of the network. It reduces the time to extract the host address from the routing table.

### **19. Firewall ?**

**Ans :** The firewall is a network security system that is used to monitor the incoming and outgoing traffic and blocks the same based on the firewall security policies. It acts as a wall between the internet (public network) and the networking devices (a private network).

## **20. What happens when you search for google.com ?**

**Ans :**

- Check the browser cache first if the content is fresh and present in the cache display the same.
- If not, the browser checks if the IP of the URL is present in the cache (browser and OS) if not then requests the OS to do a DNS lookup using UDP to get the corresponding IP address of the URL from the DNS server to establish a new TCP connection.
- A new TCP connection is set between the browser and the server using three-way handshaking.
- An HTTP request is sent to the server using the TCP connection.
- The web servers running on the Servers handle the incoming HTTP request and send the HTTP response.
- The browser processes the HTTP response sent by the server and may close the TCP connection or reuse the same for future requests.
- If the response data is cacheable then browsers cache the same.
- Browser decodes the response and renders the content.

# **Database Management System (DBMS)**

## **1. Explain ACID properties of DBMS ?**

**Ans :**

- **Atomicity** : Atomic operations are allowed, either the transaction is successful or not.
- **Consistency** : Data must be consistent, it must not change after transaction for example the sum of amount before and after the transaction.
- **Isolation** : No other transaction/process should interrupt in between an ongoing transaction.
- **Durability** : The changes made must be persistent or durable.

## **2. Data warehousing ?**

**Ans :** Data warehousing means collection of data from various sources for operational purposes, also for data warehousing is used for data engineering.

## **3. Three levels of data abstraction ?**

**Ans :**

- **Physical Level** : It is the lowest level of a database where the data is actually stored.
- **Conceptual level / Logical** : It describes how the database will look to the users, it shows the relationship between various tables, it is the blueprint of the table schema.
- **External Level / View Level** : It shows the data to the user at a broader view in the form of views.

## **4. What do you understand about the ER model ?**

**Ans :** ER model stands for Entity relationship model which is prepared before designing of a database, it helps the database designer to design a database, in ER model we show the relationship between the different entities.



## 5. Define different types of keys in DBMS ?

**Ans :**

- **Primary Key** : It is used to uniquely identify tuples, must be unique and not null.
- **Candidate Key** : It can be null, it can be a primary key, it can be more than one.
- **Superkey** : It is formed by the composition of the primary key.
- **Foreign Key** : Foreign key is used for referencing a primary key in another table. It is used for linking two tables.

## 6. What do you mean by normalization ?

**Ans :** It improves the integrity of the data by reducing redundancy, it also decreases the disk usage by the database.

1NF, 2NF, 3NF, BCNF are many forms which are used for achieving normalization.

## 7. What do you mean by data integrity ?

**Ans :** Data integrity is the overall accuracy, completeness, and consistency of data. Data consistency refers to whether the same data kept at different places do or do not match.

**SQL Queries** **TODO**

# Operating System (OS)

## 1. What do you mean by OS ?

**Ans :** Operating system is an interface between user and computer through which user can easily interact with computer also it acts as a resource manager for the system it manages the resources according to the need of the application and processes.

## 2. Different types of OS ?

**Ans :** There are many types of operating system :

- **Single Process OS** - Processes a single process at a time
  - Example - MSDOS
- **Batch processing OS** - Process a batch of processes
  - Example - ATLAS
- **Multi - Programming OS** - There is **context switching** in multiprogramming OS, it only have one CPU
  - Example - THE
- **Multi - Tasking OS** - There is **context switching and time sharing** in this type of OS.
  - Example - CTSS
- **Multi - Processing OS** - There is context switching, **time sharing and CPU > 1.**
  - Example - Windows
- **Distributed OS** - Loosely coupled CPU / Memory used in online judges.
  - Example - AIX
- **RTOS** - Real Time OS, used for air traffic control.
  - Example - RT Linux

## 3. Components of OS ?

**Ans : User Space** - Application runs here

**Kernel Space** - Access to underlying hardware

#### 4. What do you mean by kernel and define its functions ?

**Ans :** Kernel is the heart of the OS, it is the first layer above the computer hardware, it is solely **responsible** for interaction of the application with the hardware of the computer.

**There are 4 functions / modules performed by a kernel :**

- ⇒ Process Management
- ⇒ File Management
- ⇒ Memory Management
- ⇒ IO Management

#### 5. Different types of kernel ?

**Ans :** The different types of kernel are:

- **Monolithic Kernel** - All 4 modules of kernel are present in kernel space. **Linux.**
- **Micro Kernel** - File and IO management modules are in the user space, rest memory and process management modules are in the kernel space. **Symbian OS.**
- **Hybrid Kernel** - File Management in user space rest in kernel space. **Windows.**
- **Nano Kernel and Exokernel**

#### 6. How does KS and US communicate ?

**Ans :** They communicate with each other through IPC inter process communication -

- Use shared Memory or
- Message passing through communication pipe.

## 7. Multithreading vs Multitasking vs Multiprogramming ?

**Ans :**

- **Multithreading** : More than 1 threads, No isolation and memory protection, threads are scheduled, threads are context switched.
- **Multiprogramming** : Single CPU, Context switching, No time sharing.
- **Multitasking** : Single CPU, Context switching, time sharing.
- **Multiprocessing** : > 1 CPU, Context switching, time sharing.

## 8. Goal of an OS ?

**Ans :**

- Isolation and memory protection.
- Maximum CPU utilization.
- No process starvation.
- High priority job execution.

## 9. What does context switching mean ?

**Ans :** Context switching involves storing the current state or context of the process in the PCB such that other processes which are in the ready state can be executed.

## 10. How do apps interact with the kernel ? System calls define it ?

**Ans :** Apps interact with the kernel by system calls. A system call is a mechanism using which a user program can request a service from the kernel for which it does not have permission to perform.

Typically the user does not have access to access modules like IO/ File that's why the user uses system calls that interact with the kernel and does the work for us.

### 11. How does the OS boot ?

**Ans :**

- **Power On** : Power to every unit of computer through power supply.
- **CPU** : The CPU loads the BIOS, bios is Basic I/O system software which initializes everything in the computer.
- **BIOS / UEFI** : .Unified Extensible Firmware Interface ( Faster newer version) connects the hardware of the computer to the operating system after performing the POST test power on self test.
- **BIOS / UEFI hands off to the boot drive** : After initialization bios / uefi starts to boot using the boot drive using the boot loader program.
- **Boot Loader** : Boot loader can be found at 0th index of disk in MBR systems and a boot disk in EFI systems. Finally the OS is loaded and the computer is started.

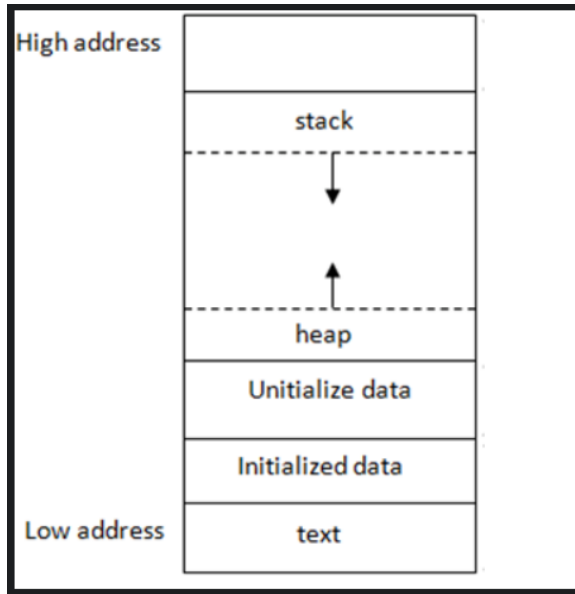
### 12. 32 Bit vs 64 Bit processor ?

**Ans :** In a 32 bit process the register size is 32 bit, a total of  $2^{32}$  addresses can be stored at once meaning 4GB of ram at max. In a 64 bit processor we can do more operations in the same cycle. Hence 64 bit processors are faster and support more RAM also.

### 13. How does the OS create a Process ?

Ans :

- Loads the static data to memory
- Allocate runtime stack
- Allocate Heap
- I/O tasks
- OS hands off control to main



### 14. What is PCB ? Define some of its entries ?

**Ans :** A process control block (PCB) is a data structure used by computer operating systems to store all the information about a process these are stored in memory . OS uses Process table to access PCB of a process , **process table** is a table that contains **Process ID** and the reference to the corresponding **PCB** in memory.

⇒ Process ID

⇒ Program Counter

⇒ Process State

⇒ Priority

⇒ Registers

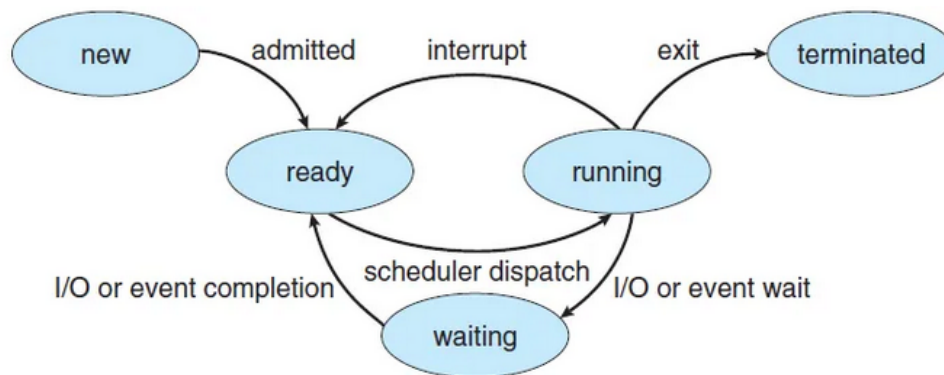
⇒ Open File List

⇒ Open Device List

### 15. Define process life cycle, state of process ?

**Ans :** Some of the process state are :

- ⇒ New State
- ⇒ Ready State
- ⇒ Running State
- ⇒ Waiting State
- ⇒ Terminated State



### 16. Define various queues ?

**Ans :**

- **Ready Queue** -> CPU Scheduler, **Short Term scheduler**, depending on the algorithm and priority CPU is dispatched to a process.  
**Ready -> running**
- **Job Queue** -> Job Scheduler, **Long term scheduler**, new - > ready

### 17. Define CPU dispatcher ?

**Ans :** Depending on the algorithm and priority CPU is dispatched and the module for it is called dispatcher. From ready queue to running state.

**18. Why is the Job Scheduler known as LTS ?**

**Ans :** Job scheduler is known as LTS because it has a very low frequency, longer idle time.

**19. Define MTS, LTS, STS ?**

**Ans :**

Long term scheduler	Medium term scheduler	Short term scheduler
Long term scheduler is a job scheduler.	Medium term is a process of swapping schedulers.	Short term scheduler is called a CPU scheduler.
The speed of long term is lesser than the short term.	The speed of medium term is in between short and long term scheduler.	The speed of short term is fastest among the other two.
Long term controls the degree of multiprogramming.	Medium term reduces the degree of multiprogramming.	The short term provides lesser control over the degree of multiprogramming.
The long term is almost nil or minimal in the time sharing system.	The medium term is a part of the time sharing system.	Short term is also a minimal time sharing system.
The long term selects the processes from the pool and loads them into memory for execution.	Medium term can reintroduce the process into memory and execution can be continued.	Short term selects those processes that are ready to execute.

**20. Define zombie and orphan processes ?**

**Ans :**

- **Zombie Process** : A process whose execution is completed but it still has an entry in the process table. Zombie process usually occurs for child processes as the parent process **still needs to read its child exit status**.
- Once the exit status of a process is read using the **wait system call**, the zombie process is eliminated from the process table. This is known as **reaping**.
- **Orphan Process** : A process whose parent process no more exists i.e. either finished or terminated without waiting for its child process to terminate. It is adopted by init process PID = 1.



## **21. Define process scheduling and different process scheduling algorithms ?**

**Ans :** Process Scheduling handles the selection of a process for the processor on the basis of a scheduling algorithm and also the removal of a process from the processor.

### **Goals of process scheduling : -**

- ⇒ Maximum CPU utilization
- ⇒ Minimum Turnaround Time
- ⇒ Minimum Waiting Time
- ⇒ Minimum Response Time

### **CPU Algorithms : -**

- ⇒ FCFS
- ⇒ SJF
- ⇒ Priority Scheduling
- ⇒ Round Robin (Preemptive Version of FCFS)
- ⇒ MLQ (Multilevel Queue)
  - > Sys, Interactive, Batch Process
- ⇒ MLFQ (Multilevel Feedback Queue)

## **22. What is concurrency in OS ?**

**Ans :** It occurs when multiple threads of a process execute the same block of instructions at the same time concurrently. These threads can interact with one another via shared memory or message passing. Concurrency results in resource sharing, which causes issues like deadlocks and resource scarcity.

## **23. What does Critical Section mean ?**

**Ans :** A critical section of code means a part of code where processes and threads access shared resources such as common variables and files and perform write operations which can result in conflicting data.

#### **24. What does Race condition mean ?**

**Ans :** Race condition occurs when two or more threads can access shared data and then try to change it at the same time. It results in the change in data dependent on thread scheduling algorithms. Both threads are racing to access the critical section.

#### **25. Give some solution to critical section / race conditions ?**

**Ans :**

- **Atomic Operation or variable**
- **Mutual Exclusion (Mutex / Lock)**
  - A mutual exclusion (mutex) is a program object that prevents simultaneous access to a shared resource. The atomic type is implemented using mutex locks. If one thread acquires the mutex lock, then no other thread can acquire it until it is released by that particular thread.
- **Semaphores**
  - An integer which is equal to the number of resources, multiple threads can execute CS concurrently. It is a variable which is used to control access to a common resource. Example : You don't want 2 tasks sending to the printer at once, so you create a binary semaphore to control printer access.

#### **26. What are semaphores ? Define binary and counting semaphores ?**

**Ans :** An integer which is equal to the number of resources, multiple threads can execute CS concurrently. It is a variable which is used to control access to a common resource. Example : You don't want 2 tasks sending to the printer at once, so you create a binary semaphore to control printer access.

- Binary Semaphore is a semaphore whose integer value ranges over 0 and 1.
- Counting semaphore is a semaphore that has multiple values of the counter.

### **27. What are locks ?**

**Ans :** Locks are used for solving the problem of race condition and it is used for achieving synchronization. It limits the access of resources when there are many threads of execution.

### **28. Producer consumer problem ?**

**Ans :**

- The producer consumer problem is a synchronization problem. There is a fixed size buffer and the producer produces items and enters them into the buffer. The consumer removes the items from the buffer and consumes them.
- A producer should not produce items into the buffer when the consumer is consuming an item from the buffer and vice versa. So the buffer should only be accessed by the producer or consumer at a time.
- The producer consumer problem can be resolved using semaphores.
- The producer should produce data only when the buffer is not full. In case it is found that the buffer is full, the producer is not allowed to store any data into the memory buffer. Data can only be consumed by the consumer if and only if the memory buffer is not empty. In case it is found that the buffer is empty, the consumer is not allowed to use any data from the memory buffer. Accessing memory buffer should not be allowed to producer and consumer at the same time.

**CODE TODO**

## 29. Reader writer problem ?

**Ans :**

- If two or more than two readers want to access the file at the same point in time there will be no problem. However, in other situations like when two writers or one reader and one writer wants to access the file at the same point of time, there may occur some problems, hence the task is to design the code in such a manner that if one reader is reading then no writer is allowed to update at the same point of time, similarly, if one writer is writing no reader is allowed to read the file at that point of time and if one writer is updating a file other writers should not be allowed to update the file at the same point of time. However, multiple readers can access the object at the same time.

Case	Process 1	Process 2	Allowed / Not Allowed
Case 1	Writing	Writing	Not Allowed
Case 2	Reading	Writing	Not Allowed
Case 3	Writing	Reading	Not Allowed
Case 4	Reading	Reading	Allowed

**CODE TODO**

### **30. Dining Philosophers problem ?**

**Ans :** The dining philosopher's problem is the classical problem of synchronization which says that Five philosophers are sitting around a circular table and their job is to think and eat alternatively. A bowl of noodles is placed at the center of the table along with five chopsticks for each of the philosophers. To eat a philosopher needs both their right and a left chopstick. A philosopher can only eat if both immediate left and right chopsticks of the philosopher are available. In case if both immediate left and right chopsticks of the philosopher are not available then the philosopher puts down their (either left or right) chopstick and starts thinking again.

## **CODE TODO**

### **31. What is Deadlock ?**

**Ans :** Deadlock is a bug generated when we are trying to solve the problem of concurrency. Two or more processes are waiting on some resources availability, which will never be available as it is also busy with some other process.

### **32. Necessary Conditions for Deadlock ?**

**Ans :**

- No Preemption
- Circular Wait
- Hold And Wait
- Mutual Exclusion : Only one process at a time can use the resource

### **33. Methods to handle DL ?**

**Ans :**

- Deadlock prevention / avoidance ( BankersAlgorithm )
- Allow System to go in DL (Detect -> Recover)
- Deadlock ignorance ( Ostrich ALgorithm ) App will handle DL

### 34. Define Banker's Algorithm ?

**Ans :** Banker's Algorithm is a deadlock avoidance algorithm that tests the safety of a system by precomputation of resource allocation, if there is a safe sequence available only then it proceeds. It uses max Allocated, max Needed, and available resources as a factor.

### 35. What is logical and physical address space ?

**Ans :**

- **Logical Address :**
  - Address generated by CPU.
  - Address of an instance or data.
  - Users have indirect access to physical addresses through logical addresses.
- **Physical address :**
  - Real addresses of the registers of the RAM.
  - Users can never access physical addresses directly.
  - It can be accessed by using a logical address.
  - Computed by memory management unity (MMU), it does the runtime mapping.

### 36. Define internal and external fragmentation ?

**Ans :**

- **Internal fragmentation** happens when the memory is split into mounted-sized blocks. Whenever a method is requested for the memory, the mounted-sized block is allotted to the method. In the case where the memory allocated to the method is somewhat larger than the memory requested, then the difference between allotted and requested memory is called internal fragmentation.
- **External fragmentation** happens when there's a sufficient quantity of area within the memory to satisfy the memory request of a method. However, the process's memory request cannot be fulfilled because the memory offered is in a non-contiguous manner

### 37. Different allocation methods on physical memory ?

**Ans :** There are two types of memory allocation on physical memory. Contiguous and Noncontiguous memory allocation.

- **Contiguous Memory Allocation :** Allocating memory to process in a contiguous manner.
  - **Fixed Partitioning**
    - The size of the partition or the memory allocation is fixed for all processes.
  - **Dynamic Partitioning**
    - Partition size is not declared initially, declared at the time of process loading.
- Limitation of CMA / Fixed Partitioning
  - Internal Fragmentation
  - External Fragmentation
  - Limitation on process size
  - Low degree of multiprogramming
- Limitation of CMA / Dynamic Partitioning
  - External Fragmentation
- Advantages of Dynamic Partitioning
  - No internal fragmentation
  - No limitation of size of process.
  - Better degree of multiprogramming
- **Non Contiguous Memory Allocation :**
  - In this type of memory allocation the logical address space of the process is divided into pages and the physical address space is divided into frames where size of frame equals size of pages. Then the pages are allocated to the main memory. In non-contiguous memory allocation, **different parts of a process are allocated to different places in Main Memory**

**38. How does the OS manage free space ?**

**Ans :** OS manages free space by defragmentation in which free partition are merged which can now be allocated according to the need of new process.

**39. How to process the allocated space in Contiguous memory allocation ?**

**Ans :**

- **First Fit** -> Allocate the first hole which is big enough.
- **Next Fit** - > Enhancement of first fit, starts the search always from last allocated holes.
- **Best Fit** -> Allocate smallest hole, less internal fragmentation but higher external fragmentation.

**40. Define Paging, Page Table, TLB ?**

**Ans :**

- **Paging** : Memory paging is a memory management scheme by which a computer stores and retrieves data from secondary storage for use in main memory. In this scheme, the operating system retrieves data from secondary storage in same-size blocks called pages. Internal fragmentation is present in paging, external fragmentation is less.
- **Page Table** : Page table (Data Structure) is located inside memory and each process has its own page table which has the reference of a process to its PCB which has its details.
- **TLB** : TLB is a memory cache that stores the recent transaction of virtual memory to physical memory to reduce the time taken to access a memory location.



#### 41. Define paging briefly ?

**Ans :** Paging is a memory management technique in which process address space is broken into blocks of the same size called pages . The size of the process is measured in the number of pages. Similarly, main memory is divided into small fixed-sized blocks of (physical) memory called frames and the size of a frame is kept the same as that of a page to have optimum utilization of the main memory and to avoid external fragmentation. Similarly, main memory is divided into small fixed-sized blocks of (physical) memory called frames and the size of a frame is kept the same as that of a page to have optimum utilization of the main memory and to avoid external fragmentation.

#### 42. Define segmentation ?

**Ans :** Segmentation is a memory management technique in which each job is divided into several segments of different sizes, one for each module that contains pieces that perform related functions. Each segment is actually a different logical address space of the program. When a process is to be executed, its corresponding segmentation is loaded into non-contiguous memory though every segment is loaded into a contiguous block of available memory. **Segmentation memory management works very similar to paging but here segments are of variable-length whereas in paging pages are of fixed size.**

#### 43. Define Virtual Memory ? Define Demand Paging ?

**Ans :**

- **Virtual memory** is a technique that allows the execution of processes that are not completely in the memory. It provides the user with a very big main memory. This is done by treating a part of secondary memory as main memory (swap space).
- **Demand paging** means demanding the pages of a process which are in the virtual memory or swap space, Demand paging is a technique used in virtual memory systems where the pages are brought in the main memory only when required or demanded by the CPU

**44. Define Page faults ? Page Replacement Algorithms ? Belady's Anomaly ?**

**Ans :**

- **Page faults :** A page fault occurs when a program attempts to access data or code that is in its address space, but is not currently located in the system RAM.
- **Page Replacement Algorithms :**
  - **FIFO**
  - **Optimal Page Replacement Algorithm**
  - **Least Recently Used (LRU) \*\***
- **Belady's Anomaly :** The phenomenon in which **increasing the number of page frames** results in an **increase in the number of page faults** for certain memory access patterns.

**45. Define thrashing ? Methods to handle thrashing ? Locality of reference ?**

**Ans :**

- **Thrashing :** A system is said to be thrashing when it spends more time servicing the page faults than executing the process. CPU utilization decreases in thrashing.
- **Methods to handle thrashing :**
  - Replace the pages by taking in the related pages of the process.
  - Controlling page fault rate can prevent thrashing
- **Locality of reference :**
  - A phenomenon in which a computer program tends to access the same set of memory locations for a particular time period. In other words, Locality of Reference refers to the tendency of the computer program to access instructions whose addresses are near one another