Q1. Explain the merge sort algorithm and derive its time complexity? (Marks 10)

Merge Sort follows the rule of **Divide and Conquer** to sort a given set of numbers/elements, recursively, hence consuming less time.

Before moving forward with Merge Sort, check these topics out first:

* Selection Sort
* Insertion Sort
* Space Complexity of Algorithms
* Time Complexity of Algorithms

In the last two tutorials, we learned about Selection Sort and Insertion Sort, both of which have a worst-case running time of O(n2). As the size of input grows, insertion and selection sort can take a long time to run.

Merge sort, on the other hand, runs in O(n\*log n) time in all the cases.

Q2. Explain DNS servers, with example. (10 marks)  
The Domain Name System ([DNS](https://www.cloudflare.com/learning/dns/what-is-dns/)) is the phonebook of the Internet. When users type domain names such as ‘google.com’ or ‘nytimes.com’ into web browsers, DNS is responsible for finding the correct IP address for those sites. Browsers then use those addresses to communicate with origin servers or CDN edge servers to access website information. This all happens thanks to DNS servers: machines dedicated to answering DNS queries.   
**The Different Types of DNS Server**

Once a DNS query is entered, it passes through a few different servers before resolution, without any end user interaction.

1. DNS recursor

This is a server designed specifically to receive queries from client machines. It tracks down the DNS record and makes additional requests to meet the DNS queries from the client. The number of requests can be decreased with DNS caching, when the requested resources are returned to the recursor early on in the lookup process.

1. Root name server

This server does the job of translating the human-friendly host names into computer-friendly IP addresses. The root server accepts the recursor’s query and sends it to the TLD nameservers in the next stage, depending on the domain name seen in the query.

1. Top Level Domain (TLD) nameserver

The TLD nameservers are responsible for maintaining the information about the domain names. For example, they could contain information about websites ending in “.com” or “.org” or country level domains like “www.example.com.uk”, “www.example.com.us” and others. The TLD nameserver will take the query from the root server and point it to the authoritative DNS nameserver associated with the query’s particular domain.

1. Authoritative nameserver

 In the last step, the authoritative DNS nameserver will return the IP address back to the DNS recursor that can relay it to the client. This authoritative DNS nameserver is the one at the bottom of the lookup process that holds the DNS records. Think of these as the last stop or the final authoritative source of truth in the process.

Q3. Which traversal of BST gives sorted output and why?(10 marks) Note: You would need to explain all the steps.  
 Inorder traversal of a BST outputs data in sorted order.

Q4. Explain all disc scheduling algorithms. (10 marks)

**Disk scheduling**is done by operating systems to schedule I/O requests arriving for the disk. Disk scheduling is also known as I/O scheduling.

Disk scheduling is important because:

* Multiple I/O requests may arrive by different processes and only one I/O request can be served at a time by the disk controller. Thus other I/O requests need to wait in the waiting queue and need to be scheduled.
* Two or more request may be far from each other so can result in greater disk arm movement.
* Hard drives are one of the slowest parts of the computer system and thus need to be accessed in an efficient manner.

There are many Disk Scheduling Algorithms but before discussing them let’s have a quick look at some of the important terms:

* **Seek Time:**Seek time is the time taken to locate the disk arm to a specified track where the data is to be read or write. So the disk scheduling algorithm that gives minimum average seek time is better.
* **Rotational Latency:** Rotational Latency is the time taken by the desired sector of disk to rotate into a position so that it can access the read/write heads. So the disk scheduling algorithm that gives minimum rotational latency is better.
* **Transfer Time:** Transfer time is the time to transfer the data. It depends on the rotating speed of the disk and number of bytes to be transferred.
* **Disk Access Time:** Disk Access Time is:
* **Disk Response Time:**Response Time is the average of time spent by a request waiting to perform its I/O operation. *Average Response time*is the response time of the all requests. *Variance Response Time*is measure of how individual request are serviced with respect to average response time. So the disk scheduling algorithm that gives minimum variance response time is better.

**Disk Scheduling Algorithms** 

1. **FCFS:**FCFS is the simplest of all the Disk Scheduling Algorithms. In FCFS, the requests are addressed in the order they arrive in the disk queue.

Advantages: 

* Every request gets a fair chance
* No indefinite postponement

Disadvantages: 

* Does not try to optimize seek time
* May not provide the best possible service

Q5. Explain swap memory. (5 marks)

Memory swapping is a memory reclamation method wherein memory contents not currently in use are swapped to a disk to make the memory available for other applications or processes. The exact state or "page" of memory is copied to the disk to make the data contiguous and easy to restore later.  
Memory swapping is done by the OS kernel or, in the case of virtualized environments, by the hypervisor. It is actually an "expensive" process in regard to its overall impact on the system performance since moving data to and from the disk has considerable overhead. The more applications requiring the system to do memory swapping, the slower the performance becomes due to the increased overhead. In this case, increasing the amount of physical RAM would be the best course of action rather than allowing the system to do constant data juggling between the disk and the memory.

Q6. List range of private IP addresses. (5 marks)

The Internet Assigned Numbers Authority (IANA) has assigned several address ranges to be used by private networks.

Address ranges to be use by private networks are:

* Class A: 10.0.0.0 to 10.255.255.255
* Class B: 172.16.0.0 to 172.31.255.255
* Class C: 192.168.0.0 to 192.168.255.255

An IP address within these ranges is therefore considered non-routable, as it is not unique. Any private network that needs to use IP addresses internally can use any address within these ranges without any coordination with IANA or an Internet registry. Addresses within this private address space are only unique within a given private network.

All addresses outside these ranges are considered public.