**Questions:**

**1. What is Singleton application in java and its cons and pros.**

**2. Non primitive SJF leads to which of the following Aging, Starvation, Thrashing, pooling**

**3. Explain Comparator interface and its adv and dis-adv.**

**4.Which of the following is a shortest path algo: Dijkstra, Kruskal, Prims**

1..

A **Singleton** is a design pattern in Java that ensures a class has only **one instance** and provides a global point of access to that instance.

**Pros:**

**Controlled Instance**: Ensures only one instance of the class exists.

**Lazy Initialization**: Can be initialized only when needed.

**Efficient Resource Management**: Suitable for managing shared resources like database connections.

**Global Access Point**: Provides a centralized way to access an instance.

**Cons:**

**Global State Issues**: Can lead to unintended modifications due to a shared instance.

**Difficult to Unit Test**: Hard to mock since it's tightly coupled.

**Multi-threading Challenges**:

Requires synchronization for thread safety, which can impact performance.

**Breaks SOLID Principles**:

Specifically, violates the **Single Responsibility Principle (SRP)** and **Dependency Inversion Principle (DIP)**.

3..

The **Comparator** interface in Java is used to define **custom sorting logic** for objects.

**Advantages:**

**Custom Sorting Order**: Allows sorting objects based on multiple fields.

**Multiple Sorting Criteria**: Unlike Comparable, a class can have **multiple comparators**.

**Decoupling from Class**: Sorting logic is external, keeping the original class clean.

**Disadvantages:**

**Boilerplate Code**: Requires extra code compared to Comparable.

**Increased Complexity**: Managing multiple comparators can make code difficult to maintain.

**Performance Overhead**: External logic adds slight overhead during sorting.

2..

**Non-preemptive SJF leads to which of the following?**

**Starvation** (Correct Answer)

In **Non-Preemptive Shortest Job First (SJF)** scheduling, long processes may have to wait indefinitely if shorter jobs keep arriving. This leads to **starvation** of longer jobs.

**Aging**:

Aging is a solution to **prevent starvation** by gradually increasing the priority of waiting processes. SJF does **not** inherently include aging.

**Thrashing**:

Thrashing occurs in memory management (paging), not CPU scheduling. It happens when excessive page swapping reduces CPU efficiency.

**Pooling**:

Pooling refers to managing a set of resources (like thread pool, connection pool) for efficiency, and it is **unrelated** to CPU scheduling.

4..

**Dijkstra’s Algorithm** (Correct Answer)

Dijkstra's algorithm finds the shortest path from a **single source node** to all other nodes in a **weighted** graph (non-negative weights).

**Kruskal’s Algorithm**

KA is **not** a shortest path algorithm.

It is used for finding the **Minimum Spanning Tree (MST)** of a graph, which connects all nodes with the minimum total edge weight.

**Prim’s Algorithm**

Prim’s algorithm is also used for finding the **Minimum Spanning Tree (MST)**.

Like Kruskal’s, it does **not** compute the shortest path between nodes but rather constructs a tree with minimal edge weight.