# Exercise 5: Task Management System

# 1.UNDERSTAND THE PROBLEM:

**o Explain the different types of linked lists (Singly Linked List, Doubly Linked List).**

**Singly Linked List:**

* **Structure:** Each node contains a data element and a reference to the next node in the list. It allows for efficient insertions and deletions at the beginning or middle of the list.
* **Operations:**
  + **Insert:** O(1) at the beginning, O(n) at the end or in the middle.
  + **Search:** O(n) – requires traversing the list.
  + **Delete:** O(1) if the node to be deleted is known, O(n) to find the node.

**Doubly Linked List:**

* **Structure:** Each node contains a data element, a reference to the next node, and a reference to the previous node. This allows for more efficient bidirectional traversal.
* **Operations:**
  + **Insert:** O(1) at both ends, O(n) in the middle.
  + **Search:** O(n) – requires traversing the list.
  + **Delete:** O(1) if the node is known, O(n) to find the node.

# 2. ANALYSIS:

**o Analyze the time complexity of each operation.**

**Time Complexity:**

* **Add:** O(1) – adding at the beginning, O(n) – adding at the end.
* **Search:** O(n) – requires traversing the list.
* **Traverse:** O(n) – visiting each node once.
* **Delete:** O(1) – if the node is known, O(n) – to find the node.

**o Discuss the advantages of linked lists over arrays for dynamic data.**

**Advantages of Linked Lists Over Arrays:**

* **Dynamic Size:** Linked lists can grow or shrink in size dynamically without needing to resize or reallocate.
* **Efficient Insertions/Deletions:** Insertions and deletions can be done efficiently (O(1)) if the node to be added or removed is known.

**When to Use Linked Lists:**

* Linked lists are ideal for scenarios where frequent insertions and deletions are required and the size of the data set can vary. They provide flexibility in managing dynamic data compared to arrays.