

# Task Management System

## 1. Explain the different types of linked lists (Singly Linked List, Doubly Linked List).

Singly Linked List:

- Each node has a data field and a reference to the next node.
- Memory-efficient (less pointer space).
- Only forward traversal.

Doubly Linked List:

- Each node has a data field, a next pointer, and a previous pointer.
- Supports bidirectional traversal.
- Uses more memory per node.

## 2. Analyze the time complexity of each operation.

Add :  $O(n)$  – we have to traverse to end

Search :  $O(n)$  – linear scan

Delete :  $O(n)$  - Traverse to locate node

Traverse :  $O(n)$  - Visit each node

## 3. Discuss the advantages of linked lists over arrays for dynamic data

Arrays have a fixed size, while linked lists have a dynamic size that can grow or shrink during runtime.

Insertion and deletion in arrays are costly operations with time complexity  $O(n)$ , whereas linked lists allow efficient insertions and deletions, especially at the beginning, with  $O(1)$  or  $O(n)$  depending on the position.

Arrays require a contiguous block of memory, but linked lists can use scattered memory blocks through pointers.

Arrays provide fast random access to elements in  $O(1)$  time, while linked lists offer slower access with  $O(n)$  time since traversal is required.