

Task Management System

Understand Linked Lists:

Q1: Explain the different types of linked lists (Singly Linked List, Doubly Linked List).

Ans:

Singly Linked List: Nodes have a reference to the next node only, allowing one-way traversal. Simple but limited to forward navigation.

Doubly Linked List: Nodes have references to both next and previous nodes, allowing bidirectional traversal. More complex but facilitates easier navigation and operations at both ends.

Analysis:

Q1: Analyze the time complexity of each operation.

Ans:

Singly Linked List

- Add (to head): $O(1)$
- Add (to tail): $O(n)$ ($O(1)$ if tail reference is maintained)
- Search: $O(n)$
- Delete: $O(n)$

Doubly Linked List

- Add (to head): $O(1)$
- Add (to tail): $O(1)$
- Search: $O(n)$
- Delete: $O(n)$ ($O(1)$ if node reference is known)

Doubly Linked Lists generally provide faster operations at both ends and bidirectional traversal, while Singly Linked Lists are simpler but limited to one-way operations.

Q2: Discuss the advantages of linked lists over arrays for dynamic data.

Ans:

Advantages of Linked Lists over Arrays for Dynamic Data:

- **Dynamic Size:** Linked lists can grow or shrink in size dynamically without requiring reallocation, unlike arrays which have a fixed size or costly resizing operations.
- **Efficient Insertions/Deletions:** Insertions and deletions can be done efficiently, especially at the beginning or middle, without shifting elements as required in arrays.
- **Memory Utilization:** Linked lists use memory only as needed for the number of elements, avoiding wasted space unlike arrays which may allocate excess capacity.
- **Flexible Data Management:** Linked lists handle varying data sizes and frequent changes more effectively due to their dynamic nature.