**Exercise 5: Task Management System**

**Scenario:**

You are developing a task management system where tasks need to be added, deleted, and traversed efficiently.

1. **Understand Linked Lists:**
   * Explain the different types of linked lists (Singly Linked List, Doubly Linked List).

**Singly Linked List**: It is a type of linked list consisting of a sequence of nodes where each node contains data and a link to the next node. It is unidirectional and can be traversed from the first node, called the head, to the last node, called the tail.

[Data|Next] -> [Data|Next] -> [Data|Next] -> null

**Doubly Linked List**: It is a more complex type of linked list where each node contains a pointer to both the previous and the next nodes in the sequence. Consequently, a node in a doubly linked list has three components: the data, a pointer to the next node (next pointer), and a pointer to the previous node (previous pointer).

null <- [Prev|Data|Next] <-> [Prev|Data|Next] <-> [Prev|Data|Next] -> null

1. **Analysis:**
   * Analyse the time complexity of each operation.

Add: O(1) for insertion at the beginning or end; O(n) for insertion at a specific position.

Search: O(n) - requires traversing the list.

Traverse: O(n) - requires visiting each node.

Delete: O(1) if node is known; O(n) if searching for the node.

* + Discuss the advantages of linked lists over arrays for dynamic data.
* Dynamic Size: Unlike arrays, which have a fixed size and require reallocation and copying to resize, linked lists can grow and shrink dynamically without such overhead.
* Efficient Insertions/Deletions: Frequent insertions and deletions can be performed quickly by simply updating pointers, rather than shifting elements as in arrays.
* Memory Utilization: Linked lists do not require contiguous memory allocation, avoiding the issue of finding a large block of contiguous memory.
* No Wasted Memory: Linked lists allocate space for each element as needed, unlike arrays which often allocate extra space for potential future growth
* Data Storage Flexibility: Linked lists offer greater flexibility in data storage, allowing for elements of varying sizes and types, unlike arrays which require uniformity.