**ANSWER**

**Exercise 5: Task Management System**

**Scenario:**

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

**Steps:**

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

**Singly Linked List:**

* Description: A linear collection of nodes where each node contains a data element and a reference (or link) to the next node in the sequence. The first node is called the head, and the last node points to null.
* Characteristics:
  + Simple to implement.
  + Efficient insertion and deletion from the beginning.
* Use Cases: Suitable for applications where the list is frequently modified, such as in queue implementations.

**Doubly Linked List:**

* Description: A linear collection of nodes where each node contains a data element, a reference to the next node, and a reference to the previous node. This allows traversal in both directions.
* Characteristics:
  + Allows for efficient insertion and deletion from both ends.
  + More complex to implement due to additional pointers.
* Use Cases: Suitable for applications requiring bidirectional traversal, such as in navigation systems and certain data structures like deques.

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

**Add Task**:

* Time Complexity: O(n)

**Search Task**:

* Time Complexity: O(n)

**Traverse Tasks**:

* Time Complexity: O(n)

**Delete Task**:

* Time Complexity: O(n)
  + **Discuss the advantages of linked lists over arrays for dynamic data.**

**Dynamic Size**: Linked lists can grow and shrink dynamically, making them more flexible for applications where the number of elements can change.

**Efficient Insertions/Deletions**: Insertions and deletions can be done in constant time (O(1)) if the position is known, without the need to shift elements as in arrays.

**Memory Utilization**: Linked lists use memory efficiently for dynamic data, avoiding the need for resizing arrays.