

Linked List: Single, Circular and Double Linked List

Presented by: Class 10 Computer Science Teacher

1. Introduction to Linked List

A linked list is a linear data structure where elements, called nodes, are linked using pointers. Each node contains two parts: Data and a Reference (link) to the next node. Unlike arrays, linked lists are not stored in contiguous memory, allowing dynamic memory allocation.

2. Advantages and Disadvantages

Advantages:

- Dynamic memory allocation.
- Easy insertion and deletion.
- Efficient use of memory.

Disadvantages:

- Extra memory required for pointers.
- Sequential access only (cannot access elements directly).
- Complex to implement compared to arrays.

3.1 Singly Linked List

A singly linked list connects nodes in one direction only — from head to tail. Each node contains data and a pointer to the next node. The last node points to NULL, marking the end of the list.

3.2 Doubly Linked List

In a doubly linked list, each node contains two pointers — one pointing to the next node and one to the previous node. This allows traversal in both directions.

3.3 Circular Linked List

In a circular linked list, the last node is linked back to the first node, forming a circular chain. It can be singly or doubly circular.

4. Comparison Table

Feature	Singly Linked List	Doubly Linked List	Circular Linked List
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Direction	Forward only	Forward & backward	Circular (forward/backward)
Links	1	2	1 or 2
Last Node	Points to NULL	NULL on both ends	Points to first node
Memory Usage	Less	More	Moderate

5. Applications of Linked Lists

Linked lists are used in various applications such as:

- Dynamic memory management.
- Implementation of stacks and queues.
- Undo/Redo functionality in text editors.
- Music playlist navigation.
- Browsing history management.

6. Real-Life Example

Think of a linked list as a chain of people holding hands. Each person represents a node — they hold some information and the hand of the next person. If the last person lets go, that represents NULL in a singly linked list.

7. Summary

Linked lists provide flexibility in memory usage and are essential in data structure learning. Understanding how they work helps in grasping advanced topics like stacks, queues, trees, and graphs.

8. Conclusion

Linked lists are the foundation of many dynamic data structures. From simple singly lists to complex doubly and circular types, they demonstrate how data can be connected efficiently.