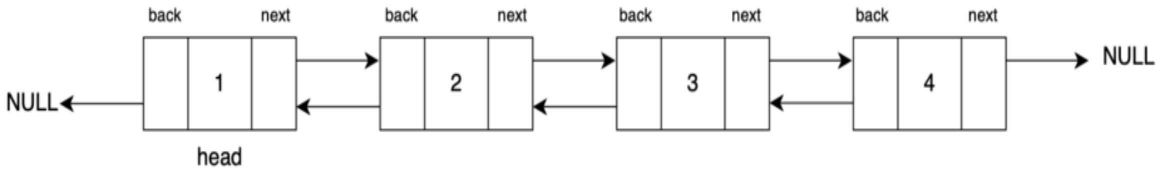
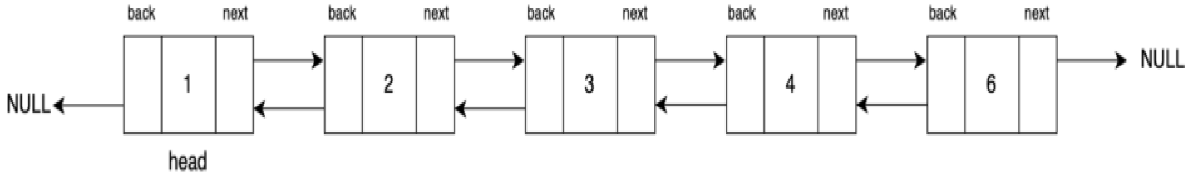
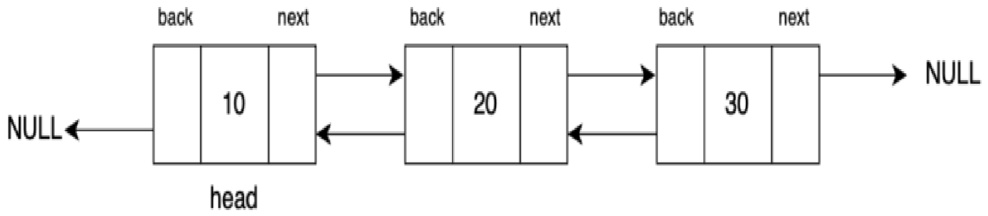
Insert at end of Doubly Linked List

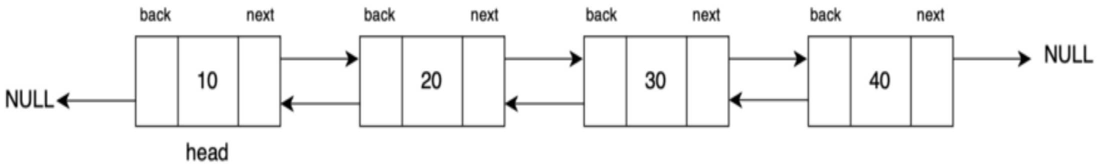
Problem Statement: Given a doubly linked list, and a value **‘k’**, insert a node having value **‘k’** at the end of the doubly linked list.

Examples







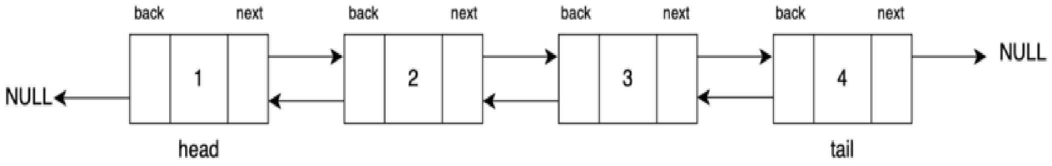


Solution

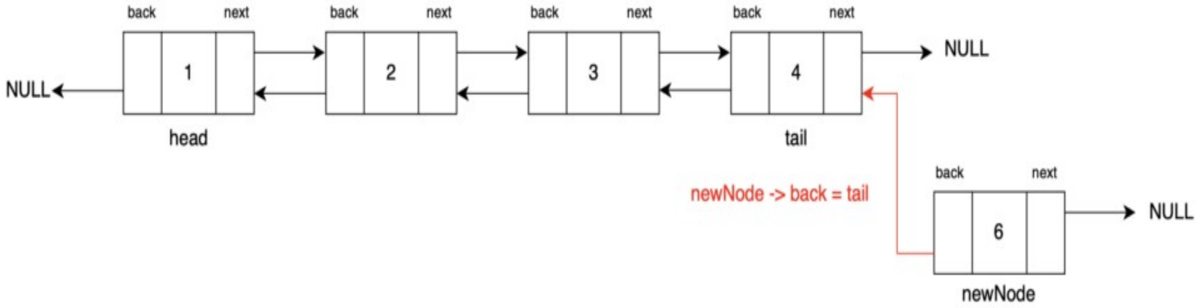
Approach:

To insert before a given node, begin by identifying its **previous node**. This step is assured since the provided node is never the head. Create a **new node** with the specified value and set its **back** and **next** pointers to the **previous node** and the **given node**, respectively. To seamlessly integrate the new node into the doubly linked list, set the previous node's **next** pointer and the given node's **back** pointer to the **new node**.

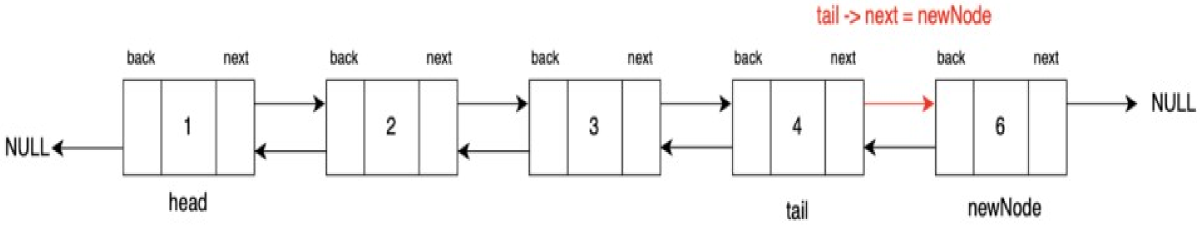
Step 1: Traverse through the list, and reach the tail of the DLL. Let's use a node **tail** traverse from the head.



Step 2: Create a **new node** with its **data as k** and back **pointer pointing to tail** and next pointer pointing to null as the new tail will point to null**.**



Step 3: Update the **next pointer** of the current **tail node** to point to the newly created node which will be our new tail post this. Then, **return the head** of the updated doubly linked list.



Code:

```
 public class DLinkedList {
    public static class Node {
        // Data stored in the node
        public int data;
        // Reference to the next node in the list (forward direction)
        public Node next;
        // Reference to the previous node in the list (backward direction)
        public Node back;

        // Constructor for a Node with both data, a reference to the next node,
and a reference to the previous node
        public Node(int data1, Node next1, Node back1) {
            data = data1;
            next = next1;
            back = back1;
        }

        // Constructor for a Node with data, and no references to the next and
previous nodes (end of the list)
        public Node(int data1) {
            data = data1;
            next = null;
            back = null;
        }
    }

    private static Node convertArr2DLL(int[] arr) {
        // Create the head node with the first element of the array
        Node head = new Node(arr[0]);
        // Initialize 'prev' to the head node
        Node prev = head;

        for (int i = 1; i < arr.length; i++) {
            // Create a new node with data from the array and set its 'back'
pointer to the previous node
            Node temp = new Node(arr[i], null, prev);
            // Update the 'next' pointer of the previous node to point to the
new node
            prev.next = temp;
            // Move 'prev' to the newly created node for the next iteration
            prev = temp;
        }
        // Return the head of the doubly linked list
        return head;
    }

    private static void print(Node head) {
        while (head != null) {
            // Print the data in the current node
            System.out.print(head.data + " ");
            // Move to the next node
            head = head.next; // Move to the next node
        }
        System.out.println();
    }

    // Function to insert a new node with value 'k' at the end of the doubly
linked list
    private static Node insertAtTail(Node head, int k) {
        // Create a new node with data 'k'
        Node newNode = new Node(k);
        // If the doubly linked list is empty, set 'head' to the new node
        if (head == null) {
            return newNode;
        }

        // Traverse to the end of the doubly linked list
        Node current = head;
        while (current.next != null) {
            current = current.next;
        }

        // Connect the new node to the last node in the list
        current.next = newNode;
        newNode.back = current;

        return head;
        }



    public static void main(String[] args) {
        int[] arr = {12, 5, 6, 8, 4};
        // Convert the array to a doubly linked list
        Node head = convertArr2DLL(arr);

        // Print the doubly linked list
         System.out.println("Doubly Linked List Initially: ");
        print(head);

        System.out.println("Doubly Linked List After Inserting before the node
with value 8:");

        head = insertAtTail(head, 10); // Insert a node with value 10 at the end
        print(head);

    }
}
```

Output:

```
Doubly Linked List Initially:
12 5 8 7 4
Doubly Linked List After Inserting at the tail with value 10:
12 5 8 7 4 10
```

Time Complexity: O(N) The time complexity of this insertion operation is O(N) because we have to **traverse** the entire list to reach its tail. The complexity would be O(1) if we were given the tail node directly.

Space Complexity: O(1) The space complexity is also O(1) because we are **notusing** any **extradatastructures** to do the operations apart from creating a single new node.