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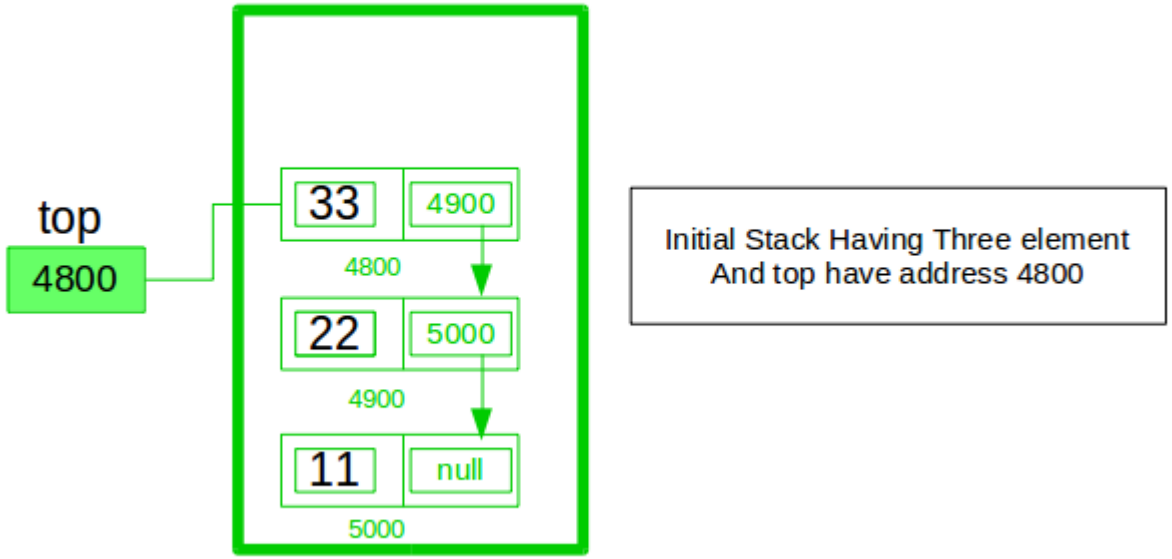
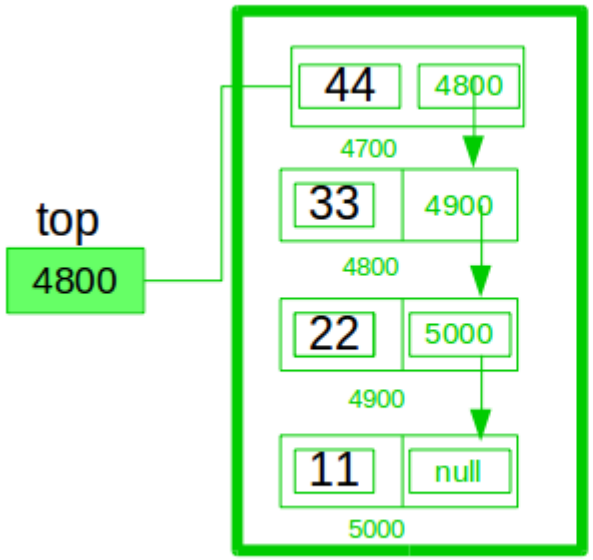
Linked List implementation of Stack

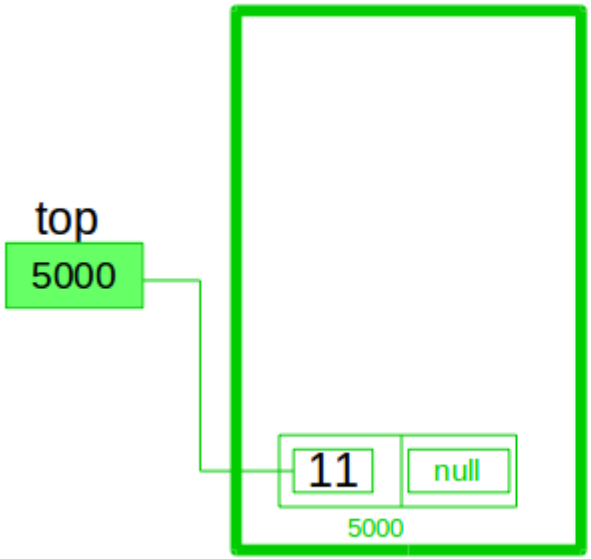
To implement a stack using the singly linked list concept, all the singly linked list operations should be performed based on Stack operations LIFO(last in first out) and with the help of that knowledge, we are going to implement a stack using a singly linked list.

So we need to follow a simple rule in the implementation of a stack which is **last in first out** and all the operations can be performed with the help of a top variable. Let us learn how to perform **Pop, Push, Peek, and Display** operations in the following article:





First create a temp node and assign 44
Into data field and top in link field
And in last assign temp assign into top



Pop three element
temp = top;
top = top->link;
temp->link = NULL;
free(temp);

In the stack Implementation, a stack contains a top pointer. which is the “head” of the stack where pushing and popping items happens at the head of the list. The first node has a null in the link field and second node-link has the first node address in the link field and so on and the last node address is in the “top” pointer.

The main advantage of using a linked list over arrays is that it is possible to implement a stack that can shrink or grow as much as needed. Using an array will put a restriction on the maximum capacity of the array which can lead to stack overflow. Here each new node will be dynamically allocated. so overflow is not possible.

Stack Operations:

- **push():** Insert a new element into the stack i.e just insert a new element at the beginning of the linked list.
- **pop():** Return the top element of the Stack i.e simply delete the first element from the linked list.
- **peek():** Return the top element.
- **display():** Print all elements in Stack.

Push Operation:

> - *Initialise a node*
> - *Update the value of that node by data i.e.* ***node->data = data***
> - *Now link this node to the top of the linked list*
> - *And update top pointer to the current node*

Pop Operation:

> - *First Check whether there is any node present in the linked list or not, if not then return*
> - *Otherwise make pointer let say* ***temp*** *to the top node and move forward the top node by 1 step*

- *Now free this temp node*

Peek Operation:

- *Check if there is any node present or not, if not then return.*
- *Otherwise return the value of top node of the linked list*

- *Take a **temp** node and initialize it with top pointer*
- *Now start traversing temp till it encounters NULL*
- *Simultaneously print the value of the temp node*

Below is the implementation of the above operations

C++ Java

```
// Java program to Implement a stack
// using singly linked list
// import package
import static java.lang.System.exit;

// Driver code
```

```
class GFG {
    public static void main(String[] args)
    {
        // create Object of Implementing class
        StackUsingLinkedlist obj
            = new StackUsingLinkedlist();
        // insert Stack value
        obj.push(11);
        obj.push(22);
        obj.push(33);
        obj.push(44);

        // print Stack elements
        obj.display();

        // print Top element of Stack
        System.out.printf("\nTop element is %d\n",
                          obj.peek());

        // Delete top element of Stack
        obj.pop();
        obj.pop();

        // print Stack elements
        obj.display();

        // print Top element of Stack
        System.out.printf("\nTop element is %d\n",
                          obj.peek());
```

```
    }
}

// Create Stack Using Linked list
class StackUsingLinkedlist {

    // A linked list node
    private class Node {

        int data; // integer data
        Node link; // reference variable Node type
    }
    // create global top reference variable global
    Node top;
    // Constructor
    StackUsingLinkedlist() { this.top = null; }

    // Utility function to add an element x in the stack
    public void push(int x) // insert at the beginning
    {
        // create new node temp and allocate memory
        Node temp = new Node();

        // check if stack (heap) is full. Then inserting an
        // element would lead to stack overflow
        if (temp == null) {
            System.out.print("\nHeap Overflow");
            return;
        }
```

```
        // initialize data into temp data field
        temp.data = x;

        // put top reference into temp link
        temp.link = top;

        // update top reference
        top = temp;
    }

    // Utility function to check if the stack is empty or
    // not
    public boolean isEmpty() { return top == null; }

    // Utility function to return top element in a stack
    public int peek()
    {
        // check for empty stack
        if (!isEmpty()) {
            return top.data;
        }
        else {
            System.out.println("Stack is empty");
            return -1;
        }
    }

    // Utility function to pop top element from the stack
```

```
public void pop() // remove at the beginning
{
    // check for stack underflow
    if (top == null) {
        System.out.print("\nStack Underflow");
        return;
    }

    // update the top pointer to point to the next node
    top = (top).link;
}

public void display()
{
    // check for stack underflow
    if (top == null) {
        System.out.printf("\nStack Underflow");
        exit(1);
    }
    else {
        Node temp = top;
        while (temp != null) {

            // print node data
            System.out.print(temp.data);

            // assign temp link to temp
            temp = temp.link;
            if(temp != null)
```

```
                    System.out.print(" -> ");
                }
            }
        }
    }
```


Output

```
44 -> 33 -> 22 -> 11
Top element is 44
22 -> 11
Top element is 22
```

Time Complexity: O(1), for all push(), pop(), and peek(), as we are not performing any kind of traversal over the list. We perform all the operations through the current pointer only.
Auxiliary Space: O(N), where N is the size of the stack

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