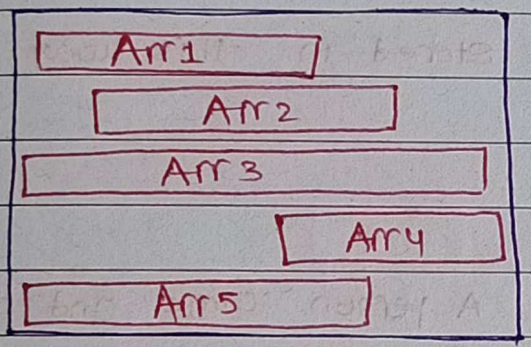
Lecture - 35

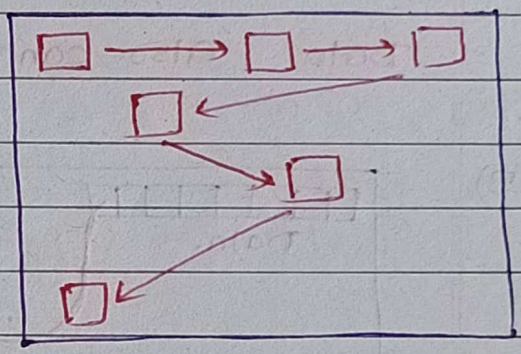
Stack

Till now, for data storage we can use either Array or Linked List.

For Array :



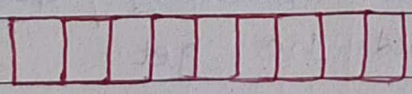
For linked list :



We have keep the data in two ways.
How to use this data ?

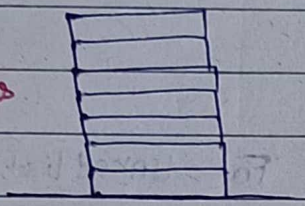
Let us understand with the help of real Example :

1) packet of Biscuit are arranged on a table -



If a person demand for biscuit, then he take either from front or back.

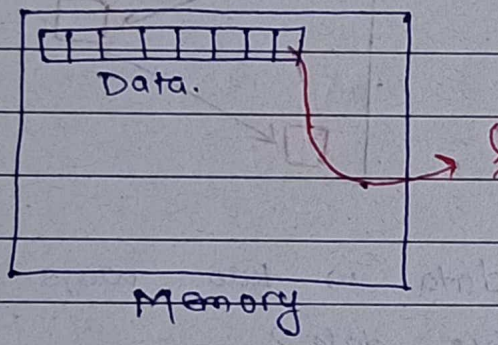
2) In a stationary shop, Copy is stored on table :-



A student demand for a copy then shopkeeper give you 2 copies from top.

Data also can be stored in this way.

3)



A person come and demand for some data. then from memory he get ~~from~~ from last.

If he demand more memory then the next memory he get.

What if he demand memory / data from Middle, then how he get.

Here, We assume that he only want data from last.

We can also see the case we he get from first or middle.

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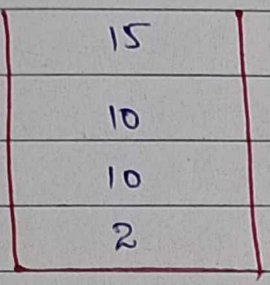
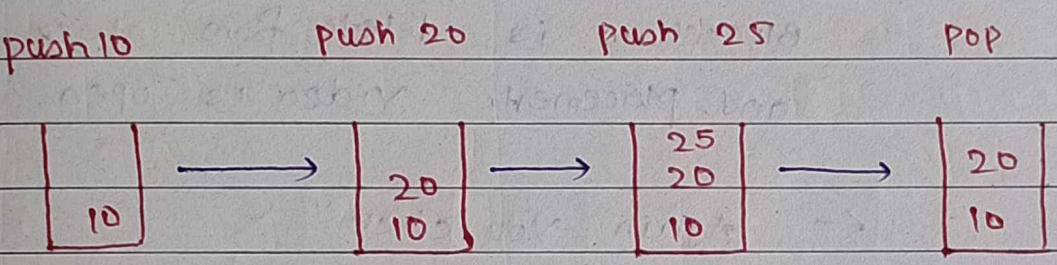
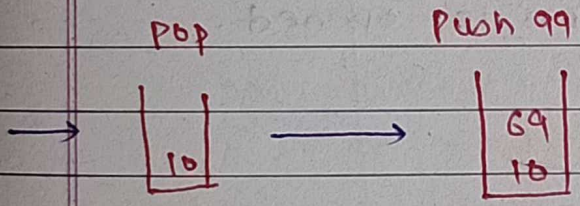
Stack (visual)



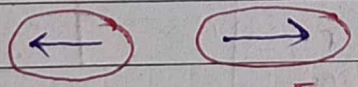
push : Insert an element
pop : Take the top element
top : Just Watch top element

How stack Mode?





In Web browser, you see :



back
undo

Forward
redo

Example:

on youtube you watch videos :

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Open Rohit Negi channel

4	Blockchain
3	placement
2	IIT Madras
1	Gate video

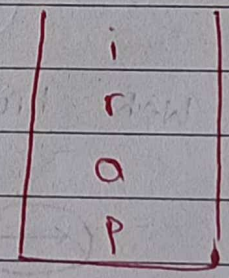
When you click this ←

Blockchain is delete from stack and placement video is open.

← Again you click placement video is deleted and IIT Madras is opened.

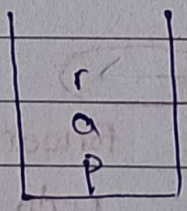
* undo operation (ctrl + z)

Write : Pari



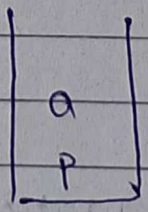
type ctrl + z

i deleted



type ctrl + z

r deleted



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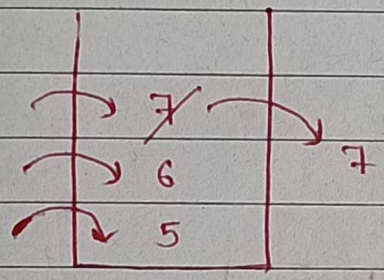
* How to create a stack :

Push ()
Pop ()

LIFO (Last in first out)
↳ used in stack.



We can create a stack in two ways :

1) Creation by Array
2) Creation by Linked list

1) Creation By Array :

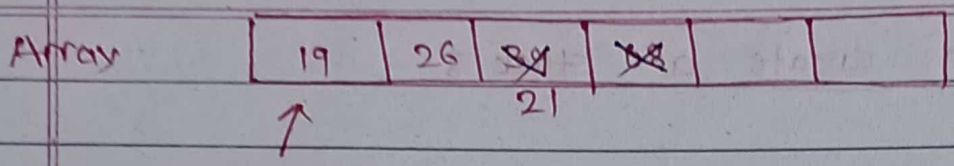
2	3	7	11	19	23

DrawBack :

Size is fixed. If we want to store more data, then it is not possible.

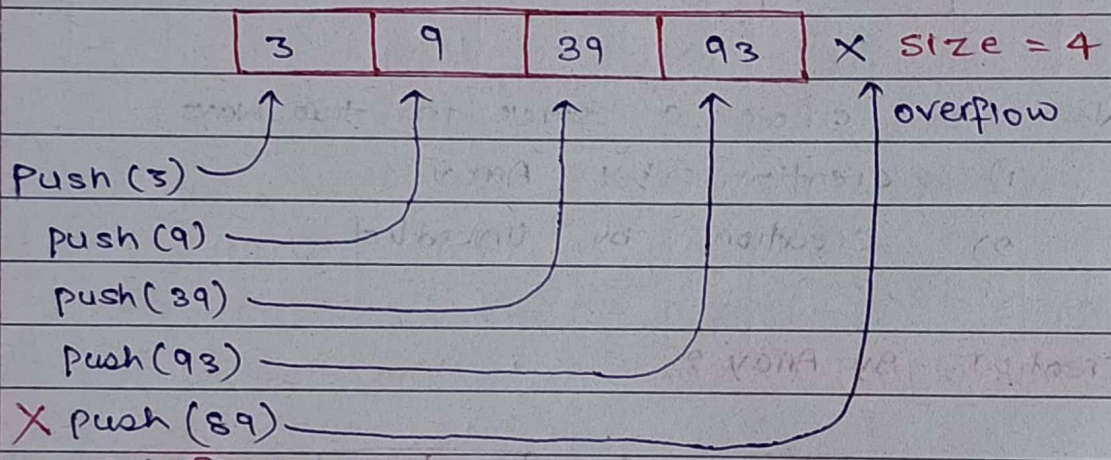
Array size = 6

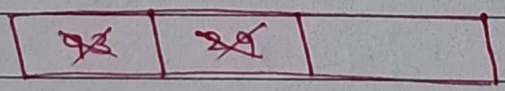
Let Make an array of size = 6



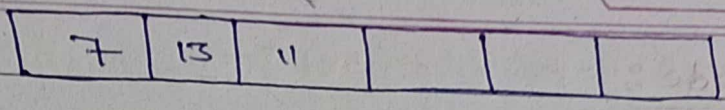
push (19)
push (26).
push (39)
push (08)
pop → delete 08
pop → delete 39
push (21)

* Overflow & underflow :

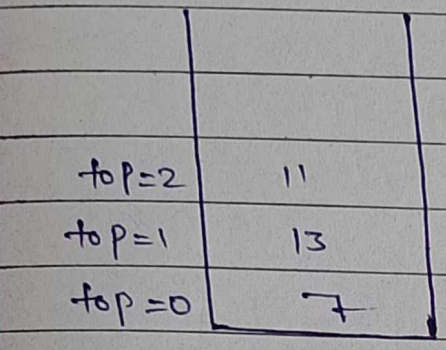




Push (93)
Push (29)
pop → delete 29
pop → delete 93
pop → underflow because No element present.

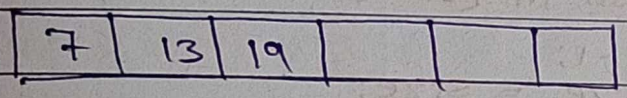
Arr → 

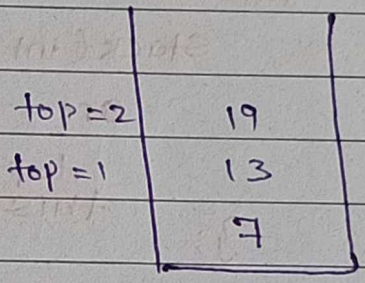
Initially top = -1



top = -1

① push 7 top++
② push 13 top++
③ push 11 top++
④ pop top--





⑤ push 19

* Condition for overflow & underflow :

(top == arr.size())
Stack overflow // push not possible

(top == -1)
Stack underflow // pop not possible.

S.top() → from this we can print the top element.

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Code :

```
#include <iostream>
using namespace std;

class stack {
    int top;
    int * arr;
    int size;
  public:
    stack(int size) {
        arr = new int [size];
        top = -1;
        this->size = size;
    };

    void push( int data) {
        if (top == size-1) {
            cout << " stack overflow \n";
            return;
        }
        top++;
        arr[top] = data;
    }

    void pop() {
        if (top == -1) {
            cout << " underflow \n";
            return;
        }
        top--;
        return;
    }
```

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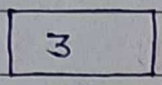
```
int peak () {
    if (top == -1) {
        Cout << " stack underflow";
        return -1;
    }
    return arr[top];
}

bool empty () {
    return top == -1;
}

int main () {
    Stack S(4);
    S.push(4);
    S.push(19);
    S.push(413);
    Cout << S.peek();
    return 0;
}
```

Output : 413

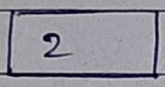
* Stack by Unicedlist :-

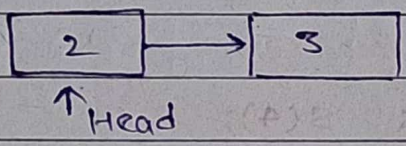
Push (3)



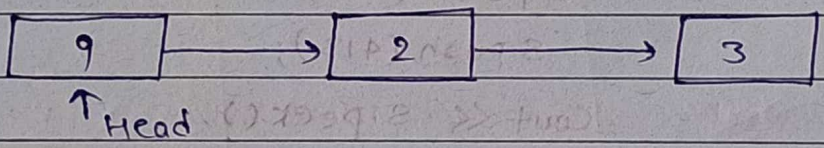
New Element आते जाएगा उसको Head बनाते जाएंगे।

push (2)

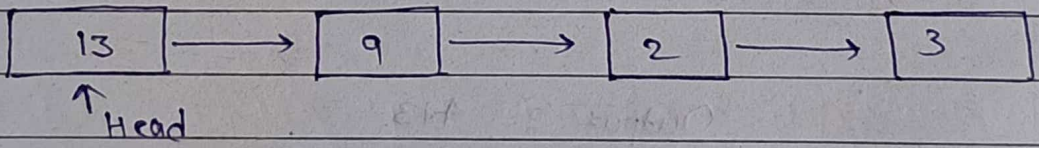




push (9)

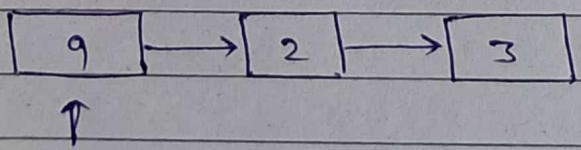


Push (13)



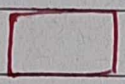
pop ()

Delete 13



push() → O(1) ✓
pop() → O(1) ✓
top() → O(1) ✓

Empty : Condition



If Head → NULL
then Empty

Where we use stack :
→ On Browser
→ For undo operation. ←
→ for Redo operation. →

Youtube → channel (Rohit Negi) → placement → 2 crore
→ Data → IIT Madras → Blockchain

Blockchain
IIT Madras
Gate
2 Crore
Placement

After this, if we press
← ↳ Delete the Blockchain
← ↳ Delete the IIT Madras
→ ↳ Again come IIT Madras.

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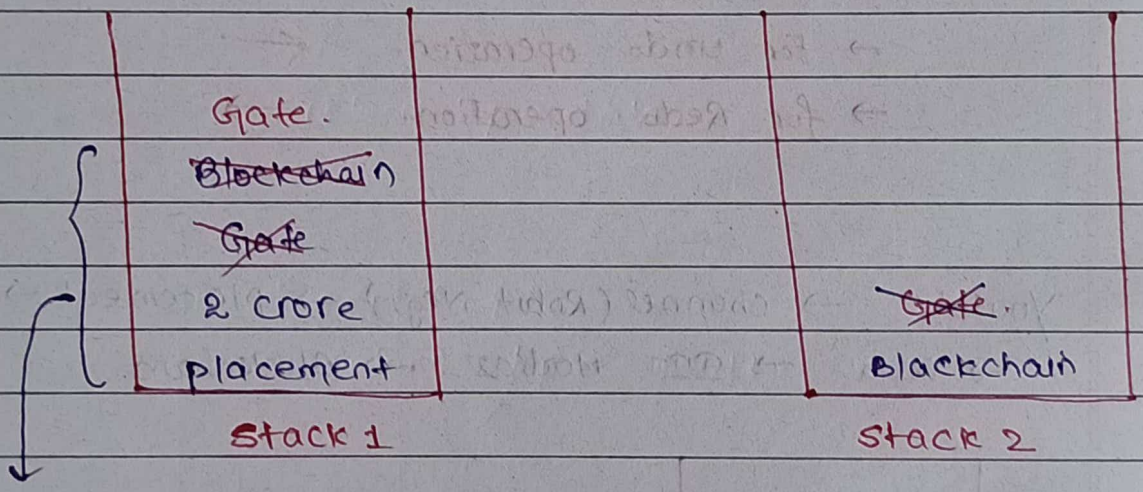
After deleting How it Comes again by clicking this (→)

By the help of 2 stack.

When we undo (←) it is deleted from one stack and stored in another stack.

And, When we do Redo (→) it is again Come is 1st stack and deleted in 2nd stack.



After this if we put undo (←) it is deleted from stack 1 and stored in stack 2.

← (undo) Again we put undo, it delete Gate from stack 1 and stored in stack 2;

→ (Redo) If we put Redo, it delete from stack 2 and again Come to stack 1.

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Code :

```
#include <iostream>
#include <stack>
using namespace std;

class Node {
    public :
        int data;
        Node * next;
        Node (int data) {
            this -> data = data;
            next = NULL;
        }
};

class Stack {
        Node * top;
        public :
            Stack () {
                top = NULL;
            }

    Void push (int data) {
            Node * temp = new Node (data);
            if (!temp) {
                Cout << "stack overflow \n";
                return;
            }
            temp -> next = top;
            top = temp;
        }
```

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```
Void pop() {
    if (! top) {
        Cout << " stack underflow \n";
            return;
        }
        Node * temp = top;
        top = top → next;
        delete temp;
    }

int peek() {
    if (!top) {
        Cout << " Stack is empty \n" ;
        };
        return top → data;
    };

    bool empty() {
        return top == NULL;
    };
};

int main() {
    Stack s;
    s.push(10);
    s.push(20);
    Cout << s.empty();
    return 0;
}
```

Teacher's Signature.....

Problem : 1

Stack : function call

* Stack with help of STL

```
stack<int> s;
stack<char> s;
s.push(4);
s.pop();
s.push(9);
```

```
#include <iostream>
#include <stack>
using namespace std;

int main() {
    stack<int> s;
    s.push(14);
    s.push(19);
    s.pop();
    cout << s.empty();
    return 0;
}
```

s.size()

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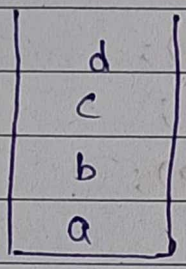
* problem - 1 : (Not from GFG)

String : "abcd"

Reverse this by stack

put string in stack



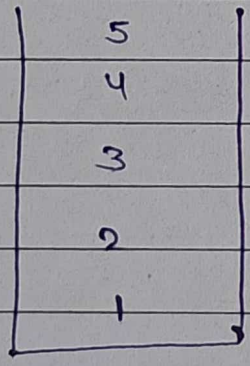
Now pop one by one and print

"dcba"

result.

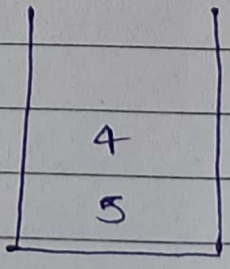
* problem - 2 :- (delete Middle element of a stack)

GFG



Delete Mid element

① Copy n/2 element in another stack



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(2) pop next element

→ 3

(3) Then, return the element from stack 2

5.
4
2
1

O(N)

If length = even

then put n/2 element in another stack.

If length = odd

then put n/2 element in another stack.

Code:

```
Void deleteMid ( Stack <int> &s, int size) {
        Stack <int> temp;
        int Count = size / 2;
        While ( Count --) {
            temp.push ( s.top());
            s.pop();
        };
        s.pop();
        While(temp.size()) {
            s.push (temp.top());
            temp.pop();
        }
}
```

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GfG Problem : 3 (parenthesis checker 2744)

Given Expression string x.

String can consists only
{ } [ ] ( )

Check that parenthesis is correctly placed or not.

[( )] → balanced

{ } → balanced

([) → Not balanced / invalid.

How to check :

[( ) ( )] → valid

If we met an open, then we find for closed, if closed found then valid otherwise invalid.

If we met an close before open
↳ then it is invalid..

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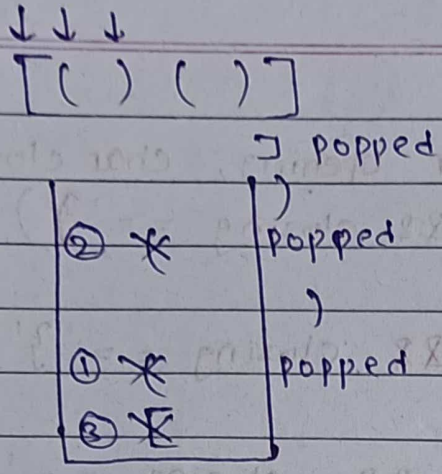
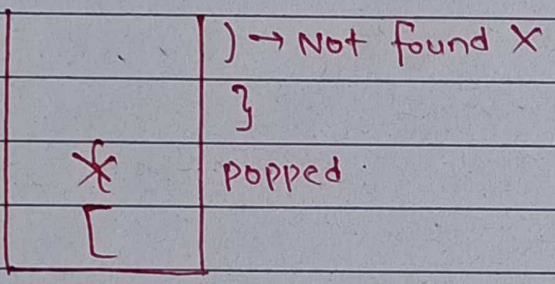


[{ })



Invalid

Code :

```
bool ispar (string exp) {
    stack <char> s;
    for (int i = 0; i<exp.length(); i++) {
        if (exp[i]=='(' || exp[i]=='{' || exp[i]=='[')
            s.push(exp[i]);
        else if(exp[i]==')' || exp[i]=='}' || exp[i]==']')
        {
            if (s.empty() || !isMatchingpair(s.top(), exp[i])
                return false;
            else
                s.pop();
        }
    }
    return s.empty();
}
```

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~~bool is M~~

```
bool isMatchingpair(char opening, char closing){
    if(opening == '(' && closing == ')')
        return true;
    else if(opening == '{' && closing == '}')
        return true;
    else if(opening == '[' && closing == ']')
        return true;
    return false;
}
```

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