Experiment - 1

Student Name: Mandeep Kaur **UID:** 23BCS10854
Branch: BE-CSE **Section/Group:** KRG-2B
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Subject Name: Design and Analysis of Algorithms
Subject Code: 23CSH-301

1. **Aim:** To analyze if the stack is empty or full, and if elements are present, return the top element in the stack using templates. Also, perform push and pop operations on the stack.

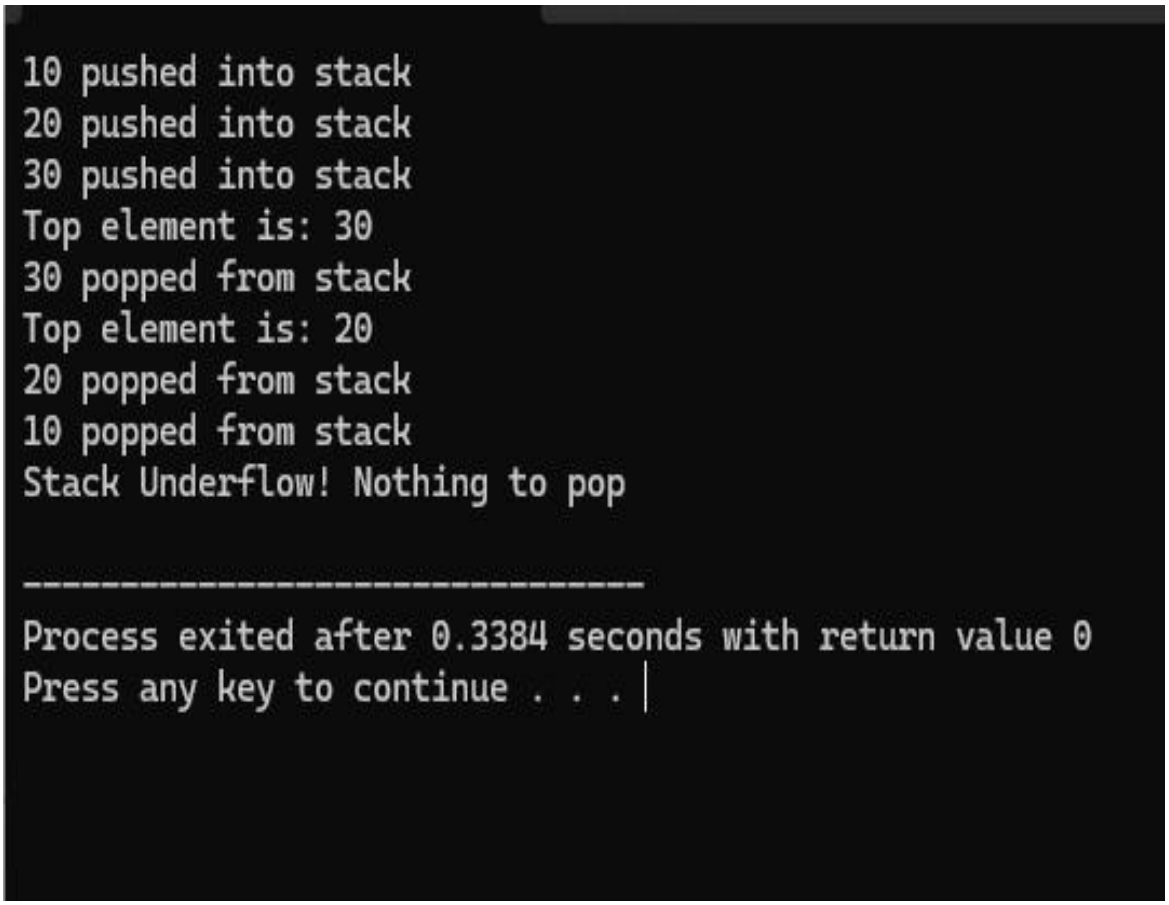
2. **Objective:** The main objective is to understand stack implementation concepts and basic operations that can be performed on a stack like push(), pop(), peek(), isempty(),etc using templates.

3. **Algorithm/Procedure:**
   1. Create stack using C++ template class.
   2. Initialise top = -1.
   3. For push() operation:
      - Check overflow if top == MAX -1.
      - Increment top and insert element.
   4. For pop() operation:
      - Check underflow if top == -1.
      - Remove element and decrement top.
   5. For peek() operation:
      - Return element at top.
   6. For isEmpty() and isFull() , check boundary conditions.
   7. Display results after performing push and pop operations.

4. Code and output:

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

const int MAX = 5;  // fixed size stack

// Template Stack Class
template <class T>
class Stack {
    T arr[MAX];
    int top;

public:
    Stack() { top = -1; }

    bool isEmpty() { return (top == -1); }
    bool isFull()  { return (top == MAX - 1); }

    void push(T x) {
        if (isFull()) {
            cout << "Stack Overflow! Cannot push " << x << endl;
            return;
        }
        arr[++top] = x;
        cout << x << " pushed into stack\n";
    }

    void pop() {
        if (isEmpty()) {
            cout << "Stack Underflow! Nothing to pop\n";
            return;
        }
```

```
        cout << arr[top--] << " popped from stack\n";
    }

    T peek() {
        if (isEmpty()) {
            cout << "Stack is empty!" << endl;
            return -1;
        }
        return arr[top];
    }
};

int main() {
    Stack<int> s;

    s.push(10);
    s.push(20);
    s.push(30);
    cout << "Top element is: " << s.peek() << endl;

    s.pop();
    cout << "Top element is: " << s.peek() << endl;

    s.pop();
    s.pop();
    s.pop(); // underflow check

    return 0;
}
```


10 pushed into stack
20 pushed into stack
30 pushed into stack
Top element is: 30
30 popped from stack
Top element is: 20
20 popped from stack
10 popped from stack
Stack Underflow! Nothing to pop

Process exited after 0.3384 seconds with return value 0
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