Data Structures & Algorithms
Lab Assignment 3
Stack

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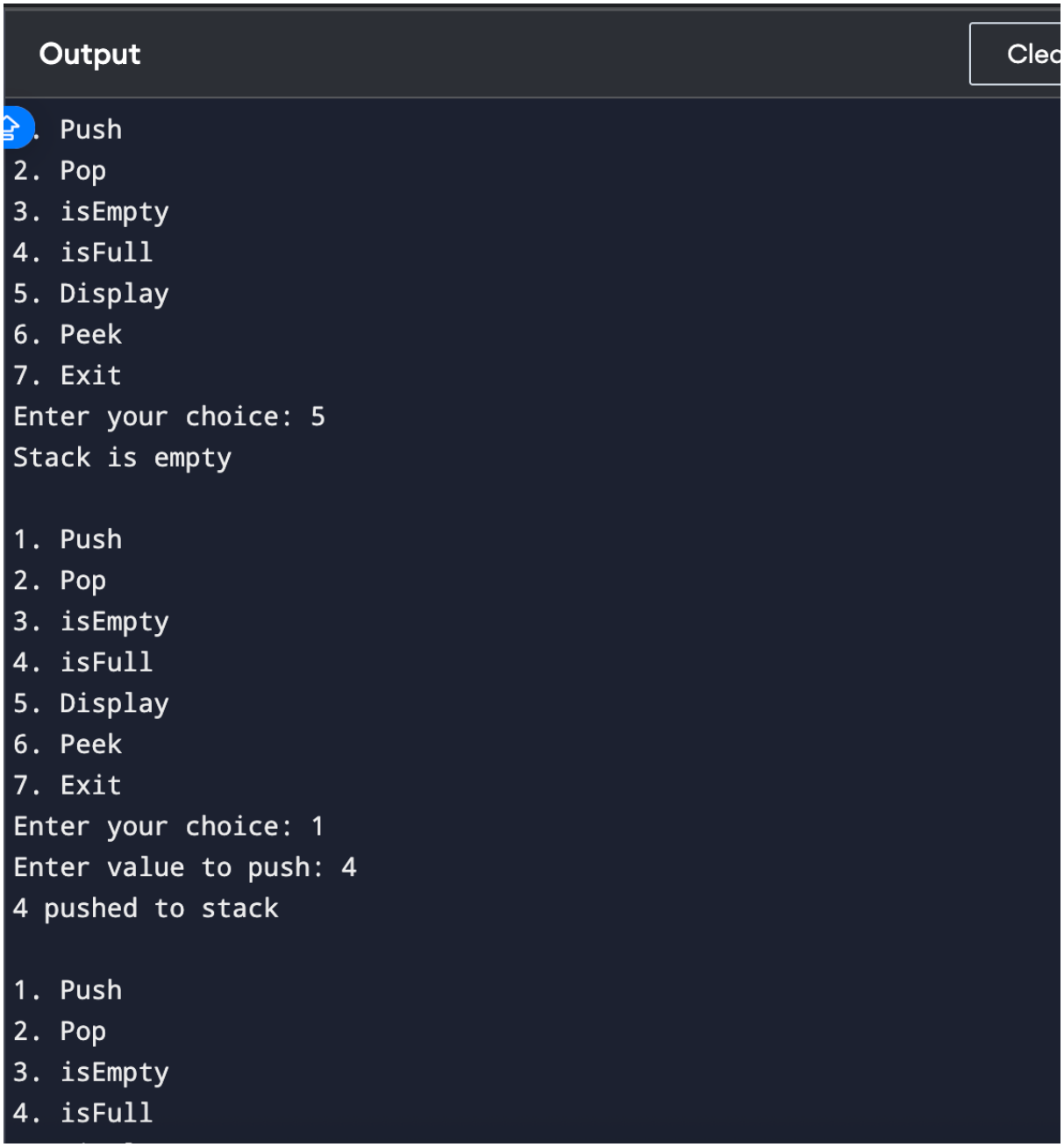
1. Develop a menu driven program demonstrating the following operations on a Stack using array: (i) push(), (ii) pop(), (iii) isEmpty(), (iv) isFull(), (v) display(), and (vi) peek().

A1)

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

#define MAX 100

class Stack {
   int arr[MAX];
   int top;

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

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

   void push(int x) {
      if (isFull()) {
         cout << "Stack Overflow\n";
         return;
      }
      arr[++top] = x;
      cout << x << " pushed to stack\n";
   }

   void pop() {
      if (isEmpty()) {
         cout << "Stack Underflow\n";
         return;
      }
      cout << arr[top--] << " popped from stack\n";
   }

   int peek() {
      if (isEmpty()) {
         cout << "Stack is empty\n";
         return -1;
      }
      return arr[top];
   }

   void display() {
      if (isEmpty()) {
         cout << "Stack is empty\n";
         return;
      }
      cout << "Stack elements: ";
      for (int i = top; i >= 0; i--)
         cout << arr[i] << " ";
      cout << "\n";
   }
```

```
};

int main() {
    Stack s;
    int choice, val;

    do {
        cout << "\n1. Push\n2. Pop\n3. isEmpty\n4. isFull\n5. Display\n6. Peek\n7. Exit\nEnter your choice: ";
        cin >> choice;

        switch (choice) {
            case 1:
                cout << "Enter value to push: ";
                cin >> val;
                s.push(val);
                break;
            case 2:
                s.pop();
                break;
            case 3:
                cout << (s.isEmpty() ? "Stack is empty\n" : "Stack is not empty\n");
                break;
            case 4:
                cout << (s.isFull() ? "Stack is full\n" : "Stack is not full\n");
                break;
            case 5:
                s.display();
                break;
            case 6:
                val = s.peek();
                if (val != -1)
                    cout << "Top element: " << val << "\n";
                break;
            case 7:
                cout << "Exiting...\n";
                break;
            default:
                cout << "Invalid choice\n";
        }
    } while (choice != 7);

    return 0;
}
```

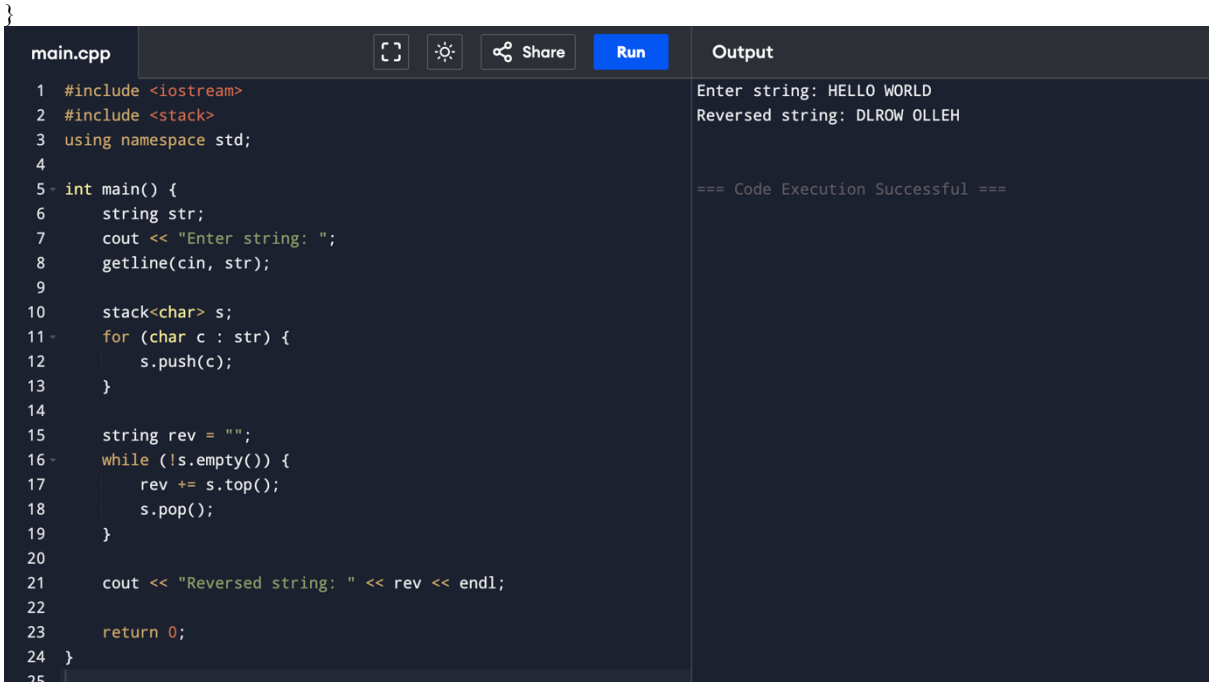


Q2. Given a string, reverse it using STACK. For example “DataStructure” should be output as “erutcurtSataD.”

A2)

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

int main() {
    string str;
    cout << "Enter string: ";
    getline(cin, str);

    stack<char> s;
    for (char c : str) {
        s.push(c);
    }
```

```
    string rev = "";
    while (!s.empty()) {
        rev += s.top();
        s.pop();
    }

    cout << "Reversed string: " << rev << endl;

    return 0;
}
```

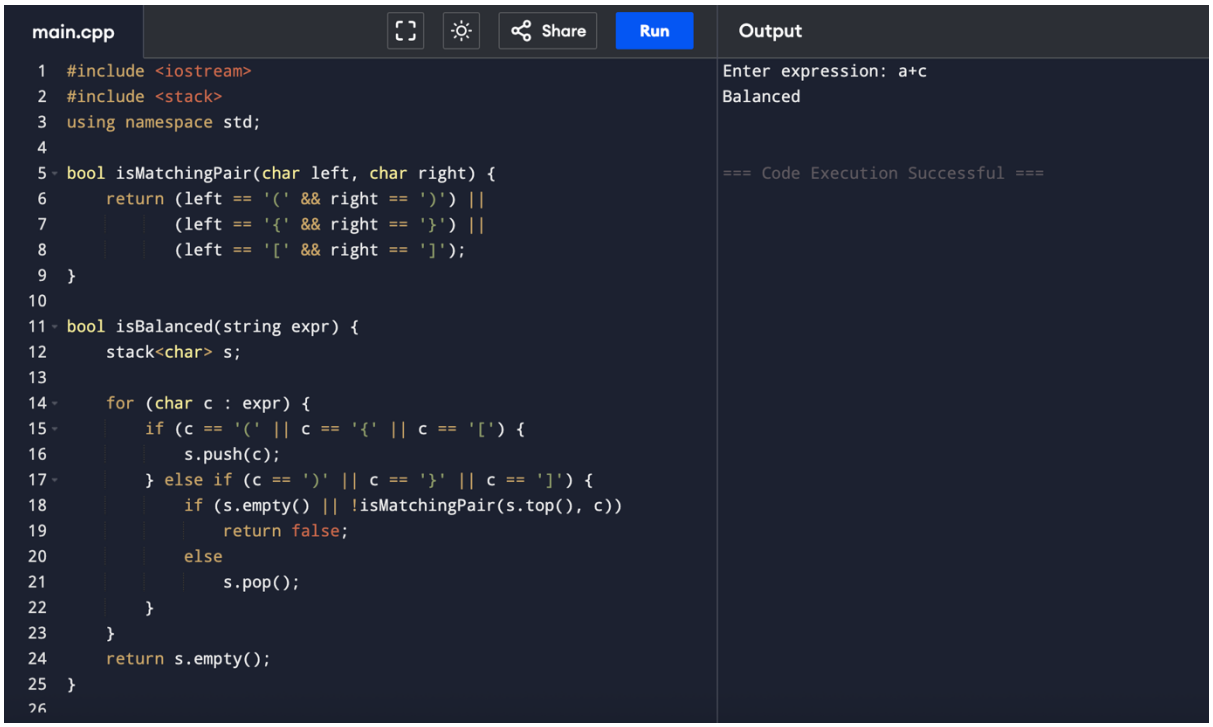


Q3. Write a program that checks if an expression has balanced parentheses.

A3)

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

bool isMatchingPair(char left, char right) {
    return (left == '(' && right == ')') ||
           (left == '{' && right == '}') ||
           (left == '[' && right == ']');
}

bool isBalanced(string expr) {
    stack<char> s;

    for (char c : expr) {
        if (c == '(' || c == '{' || c == '[') {
            s.push(c);
        } else if (c == ')' || c == '}' || c == ']') {
            if (s.empty() || !isMatchingPair(s.top(), c))
                return false;
            else
                s.pop();
        }
    }
    return s.empty();
}
```

```
int main() {
    string expr;
    cout << "Enter expression: ";
    getline(cin, expr);

    if (isBalanced(expr))
        cout << "Balanced\n";
    else
        cout << "Not balanced\n";

    return 0;
}
```

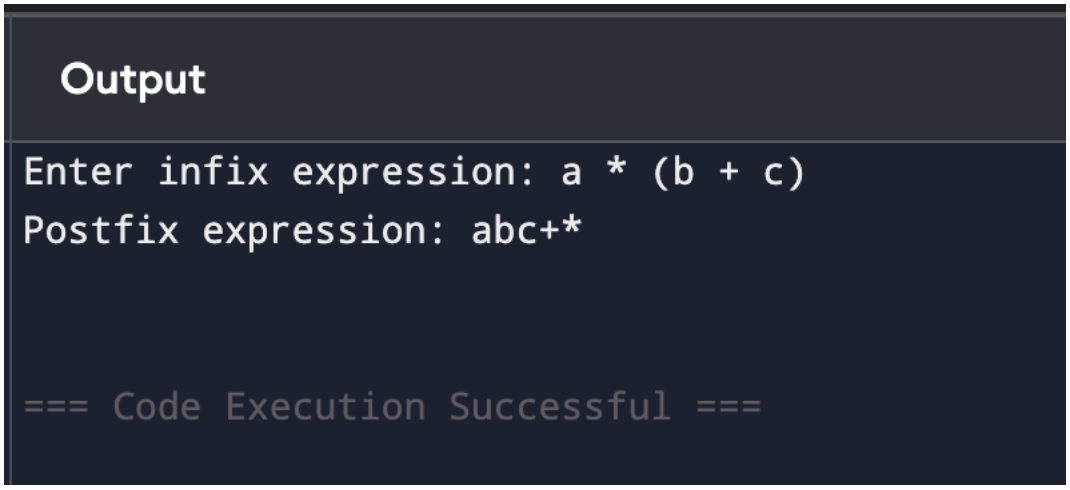


Q4. Write a program to convert an Infix expression into a Postfix expression.

A4)

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

int precedence(char op) {
    if (op == '+' || op == '-') return 1;
    if (op == '*' || op == '/') return 2;
    if (op == '^') return 3;
    return 0;
}

bool isOperator(char c) {
    return c == '+' || c == '-' || c == '*' || c == '/' || c == '^';
}

string infixToPostfix(string infix) {
    stack<char> s;
    string postfix = "";

    for (char c : infix) {
```

```
        if (isalnum(c)) {
            postfix += c;
        } else if (c == '(') {
            s.push(c);
        } else if (c == ')') {
            while (!s.empty() && s.top() != '(') {
                postfix += s.top();
                s.pop();
            }
            if (!s.empty()) s.pop();  // pop '('
        } else if (isOperator(c)) {
            while (!s.empty() && precedence(s.top()) >= precedence(c)) {
                if (c == '^' && s.top() == '^') // right associative
                    break;
                postfix += s.top();
                s.pop();
            }
            s.push(c);
        }
    }
    while (!s.empty()) {
        postfix += s.top();
        s.pop();
    }
    return postfix;
}

int main() {
    string infix;
    cout << "Enter infix expression: ";
    getline(cin, infix);

    cout << "Postfix expression: " << infixToPostfix(infix) << endl;

    return 0;
}
```



Q5. Write a program for the evaluation of a Postfix expression.

A5)

```
#include <iostream>

#include <stack>
```

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

int evaluatePostfix(string postfix) {
    stack<int> s;

    for (char c : postfix) {
        if (isdigit(c)) {
            s.push(c - '0');
        } else {
            int val2 = s.top(); s.pop();
            int val1 = s.top(); s.pop();

            switch (c) {
                case '+': s.push(val1 + val2); break;
                case '-': s.push(val1 - val2); break;
                case '*': s.push(val1 * val2); break;
                case '/': s.push(val1 / val2); break;
                case '^': {
                    int res = 1;
                    for (int i = 0; i < val2; i++) res *= val1;
                    s.push(res);
                    break;
                }
            }
        }
    }
    return s.top();
}

int main() {
    string postfix;
    cout << "Enter postfix expression (single digit operands): ";
    getline(cin, postfix);
```

```
    cout << "Evaluated result: " << evaluatePostfix(postfix) << endl;

    return 0;
}
```