```cpp
 /*
                        ASSIGNMENT NO. 4

NAME- ABRAR SHAIKH                              ROLL NO. - 23570
                        TOPIC- Stack using linked-list
*/
#include <iostream>
using namespace std;


// Node class for the linked list
class Node {
public:
    int data;
    Node* next;

    Node(int data) {
        this->data = data;
        this->next = NULL;
    }
};


// Stack ADT using singly linked list
class Stack {
private:
    Node* top; // Pointer to the top of the stack

public:
    Stack() {
        top = NULL;
    }
```

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// Push an element to the stack
void push(int value) {
    Node* newNode = new Node(value);
    if (top == NULL) {
        top = newNode;
    } else {
        newNode->next = top;
        top = newNode;
    }
}


// Pop an element from the stack
int pop() {
    if (top == NULL) {
        cout << "Stack Underflow!" << endl;
        return -1;  // returning an error value
    } else {
        Node* temp = top;
        top = top->next;
        int poppedValue = temp->data;
        delete temp;
        return poppedValue;
    }
}


// Peek at the top element of the stack
int peek() {
    if (top == NULL) {
        cout << "Stack is empty!" << endl;
        return -1;
```

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        }

        return top->data;

    }


    // Check if the stack is empty

    bool isEmpty() {

        return top == NULL;

    }

};


// Function to check if the character is an operator

bool isOperator(char c) {

    return (c == '+' || c == '-' || c == '*' || c == '/' || c ==
'^');

}


// Function to get precedence of operators

int precedence(char c) {

    if (c == '^')

        return 3;

    else if (c == '*' || c == '/')

        return 2;

    else if (c == '+' || c == '-')

        return 1;

    else

        return -1;

}


// Function to convert infix expression to postfix

void infixToPostfix(char infix[], char postfix[]) {
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    Stack s;

    int j = 0;


    for (int i = 0; infix[i] != '\0'; i++) {

        char c = infix[i];


        // If the character is an operand, add it to the output

        if (c >= '0' && c <= '9') {

            postfix[j++] = c;

        }

        // If the character is '(', push it to the stack

        else if (c == '(') {

            s.push(c);

        }

        // If the character is ')', pop and output until '(' is
encountered

        else if (c == ')') {

            while (s.peek() != '(') {

                postfix[j++] = s.pop();

            }

            s.pop(); // Remove '(' from stack

        }

        // If the character is an operator

        else if (isOperator(c)) {

            while (!s.isEmpty() && precedence(c) <=
precedence(s.peek())) {

                postfix[j++] = s.pop();

            }

            s.push(c);

        }

    }
```

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    // Pop all the operators from the stack
    while (!s.isEmpty()) {
        postfix[j++] = s.pop();
    }


    postfix[j] = '\0'; // Null terminate the postfix expression
}


// Function to convert infix expression to prefix
void infixToPrefix(char infix[], char prefix[]) {
    Stack s;
    char reversedInfix[100], reversedPostfix[100];


    // Reverse the infix expression
    int length = 0;
    for (int i = 0; infix[i] != '\0'; i++) {
        length++;
    }


    for (int i = 0; i < length; i++) {
        if (infix[length - i - 1] == '(')
            reversedInfix[i] = ')';
        else if (infix[length - i - 1] == ')')
            reversedInfix[i] = '(';
        else
            reversedInfix[i] = infix[length - i - 1];
    }
    reversedInfix[length] = '\0';
```

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    // Convert the reversed infix to postfix
    infixToPostfix(reversedInfix, reversedPostfix);


    // Reverse the postfix to get the prefix
    for (int i = 0; reversedPostfix[i] != '\0'; i++) {
        prefix[i] = reversedPostfix[length - i - 1];
    }
    prefix[length] = '\0'; // Null terminate the prefix expression
}


// Function to evaluate a postfix expression
int evaluatePostfix(char postfix[]) {
    Stack s;


    for (int i = 0; postfix[i] != '\0'; i++) {
        char c = postfix[i];


        // If the character is an operand, push it to the stack
        if (c >= '0' && c <= '9') {
            s.push(c - '0');
        }
        // If the character is an operator
        else if (isOperator(c)) {
            int val1 = s.pop();
            int val2 = s.pop();


            switch (c) {
                case '+': s.push(val2 + val1); break;
                case '-': s.push(val2 - val1); break;
                case '*': s.push(val2 * val1); break;
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                    case '/': s.push(val2 / val1); break;
            }
        }
    }


    return s.pop();
}


//function for prefix evaluation
int evaluatePrefix(char prefix[]) {
    Stack s;
    int length = 0;


    // Find the length of the prefix expression
    for (int i = 0; prefix[i] != '\0'; i++) {
        length++;
    }


    // Traverse the prefix expression from right to left
    for (int i = length - 1; i >= 0; i--) {
        char c = prefix[i];


        // If the character is an operand, push it to the stack
        if (c >= '0' && c <= '9') {
            s.push(c - '0');  // Convert char to int
        }
        // If the character is an operator
        else if (isOperator(c)) {
            int val1 = s.pop();
            int val2 = s.pop();
```

```cpp
            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;
            }
        }
    }

    // The final result will be the only element left in the stack
    return s.pop();
}


int main() {
    char infix[100], postfix[100], prefix[100];

    cout << "Enter an infix expression: ";
    cin >> infix;

    infixToPostfix(infix, postfix);
    infixToPrefix(infix, prefix);

    cout << "Postfix Expression: " << postfix << endl;
    cout << "Prefix Expression: " << prefix << endl;

    char postfixEval[100];
    cout << "Enter a postfix expression for evaluation: ";
    cin >> postfixEval;
```
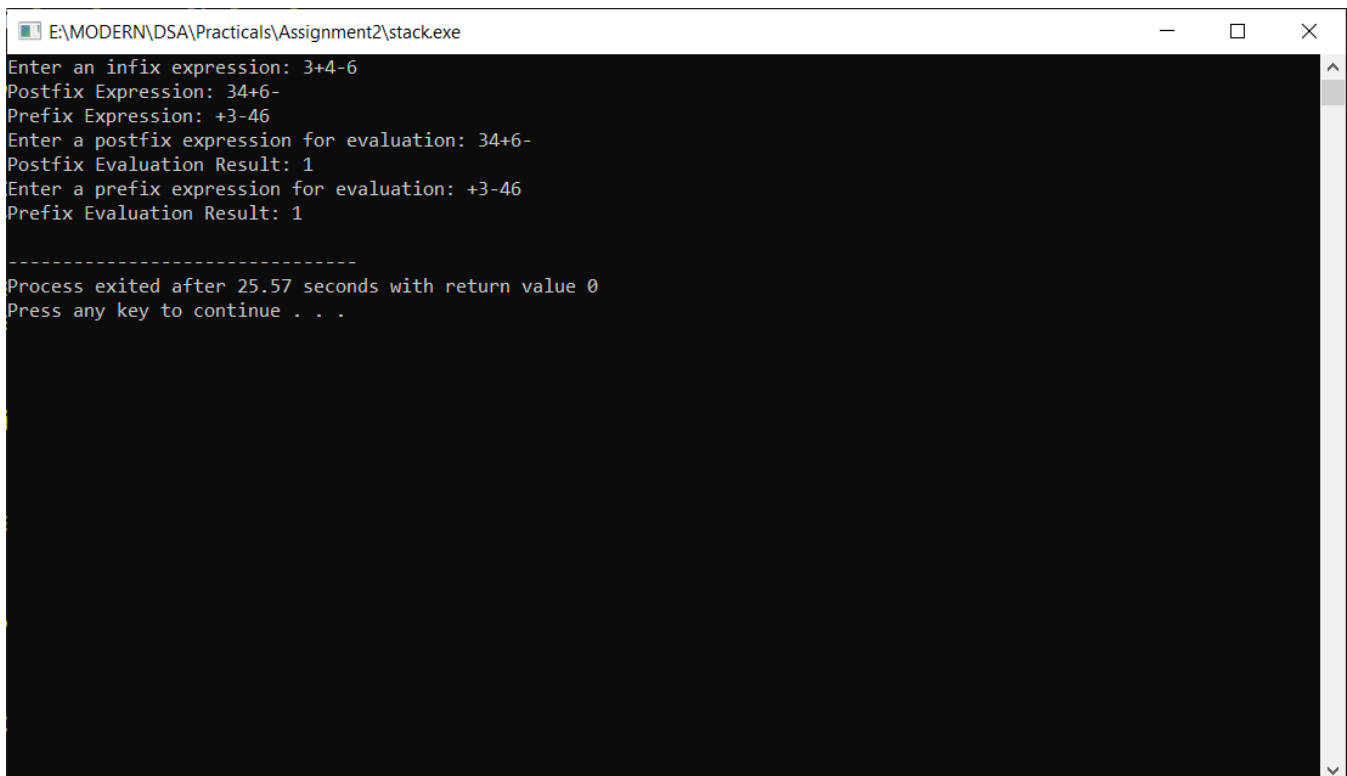
```
    cout << "Postfix Evaluation Result: " <<
evaluatePostfix(postfixEval) << endl;


    char prefixEval[100];

    cout << "Enter a prefix expression for evaluation: ";

    cin >> prefixEval;


    cout << "Prefix Evaluation Result: " <<
evaluatePrefix(prefixEval) << endl;


    return 0;

}
```

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E:\MODERN\DSA\Practicals\Assignment2\stack.exe                        —    □    ×

Enter an infix expression: 3+4-6
Postfix Expression: 34+6-
Prefix Expression: +3-46
Enter a postfix expression for evaluation: 34+6-
Postfix Evaluation Result: 1
Enter a prefix expression for evaluation: +3-46
Prefix Evaluation Result: 1


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Process exited after 25.57 seconds with return value 0
Press any key to continue . . .
```

Github Repository - https://github.com/abssha/DSA.git