Assignment 6

Dated Jan 13th, 2025

Problem Statement

A program in C to evaluate postfix expression of a math expression given by the user.

Algorithm

Input

initStack() is used here to take input from the user as a string and convert it to a stack.

Output

evaluatePostfix() is used to evaluate the necessary postfix expression and the result is stored in a character array which will further be displayed in the main function.

Algorithm for createNode()

Step 1: Start.
Step 2: Input an integer data for the new node.
Step 3: Allocate memory for a new node of type Node.
Step 4: If memory allocation fails, display an error message and terminate the program.
Step 5: Assign data to the data field of the new node.
Step 6: Set the next pointer of the new node to NULL.
Step 7: Return the newly created node.
Step 8: Stop.
Step 9: [End of function createNode defined at Step 1.]

Algorithm for push()
Step 10: Start.
Step 11: Input a pointer to the top of the stack (top) and an integer data.
Step 12: Call createNode(data) to create a new node and store the result in newNode.
Step 13: Set newNode->next to the current *top.
Step 14: Update *top to point to newNode.
Step 15: Display a message indicating that data has been pushed onto the stack.
Step 16: Stop.
Step 17: [End of function push defined at Step 10.]

Algorithm for isEmpty()

Step 18: Start.

Step 19: Input a pointer to the top of the stack (top).

Step 20: If top == NULL, return 1 (stack is empty). Otherwise, return 0 (stack is not empty).

Step 21: Stop.

Step 22: [End of function isEmpty defined at Step 18.]

Algorithm for pop()

Step 23: Start.

Step 24: Input a pointer to the top of the stack (top).

Step 25: Call isEmpty(*top). If the result is 1, display an underflow message and return -1.

Step 26: Declare a temporary pointer temp and set it to *top.

Step 27: Update *top to point to (*top)->next.

Step 28: Store the data value of temp in a variable popped.

Step 29: Free the memory allocated for temp.

Step 30: Display a message indicating the popped value.

Step 31: Return popped.

Step 32: Stop.

Step 33: [End of function pop defined at Step 23.]

Algorithm for peek()

Step 34: Start.

Step 35: Input a pointer to the top of the stack (top).

Step 36: Call isEmpty(top). If the result is 1, display an empty stack message and return -1.

Step 37: Return top->data.

Step 38: Stop.

Step 39: [End of function peek defined at Step 34.]

Algorithm for display()

Step 40: Start.

Step 41: Input a pointer to the top of the stack (top).

Step 42: Call isEmpty(top). If the result is 1, display an empty stack message and stop.

Step 43: Declare a pointer temp and set it to top.
Step 44: Display a message "Stack elements:".
Step 45: While temp != NULL, perform the following:

- **Step 45.1:** Print temp->data.
- **Step 45.2:** Update temp to temp->next.

Step 46: Print a newline.
Step 47: Stop.
Step 48: [End of function display defined at Step 40.]

Algorithm for displayMenu()
Step 49: Start.
Step 50: Display the available stack operations.
Step 51: Display a prompt for user choice.
Step 52: Stop.
Step 53: [End of function displayMenu defined at Step 49.]

Algorithm for main()
Step 54: Start.
Step 55: Declare a pointer stack and initialize it to NULL.
Step 56: Declare integers choice and value.
Step 57: Enter an infinite loop to handle user input:

- **Step 57.1:** Call displayMenu().
- **Step 57.2:** Input the user choice and store it in choice.
- **Step 57.3:** Perform actions based on the value of choice:

Case 1: Call push(&stack, value) after prompting the user for value.
Case 2: Call pop(&stack).
Case 3: Display the result of peek(stack).
Case 4: Call display(stack).
Case 5: Display an exit message and break the loop using goto end.
Default Case: Display an invalid choice message.

Step 58: Label end to exit the loop and display a final thank-you message.
Step 59: Stop.
Step 60: [End of function main defined at Step 54.]

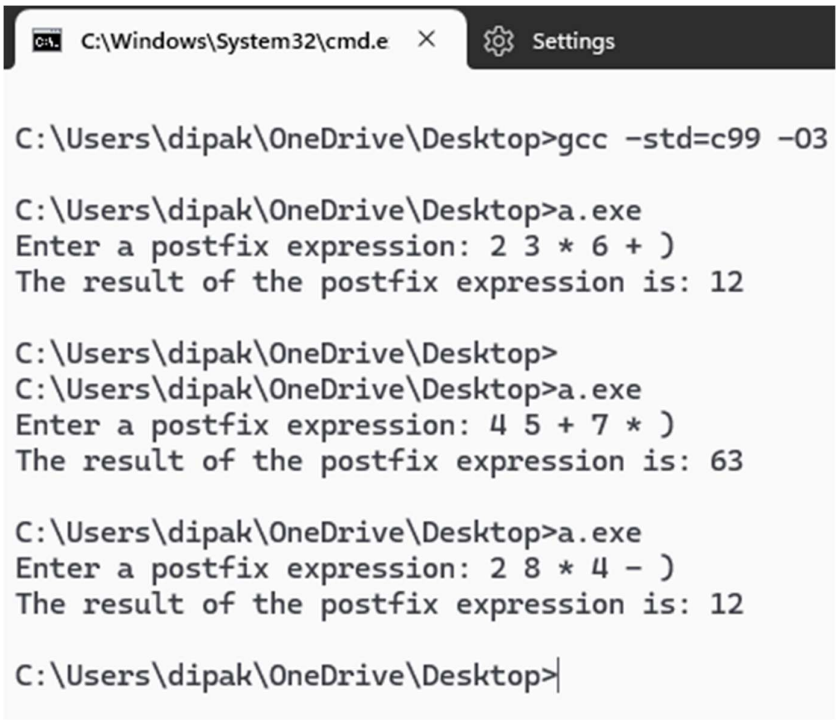
Source Code

```
#include <ctype.h>
#include <stdio.h>
#include <stdlib.h>
#include <string.h>

#define MAX 8192

// Stack structure definition
typedef struct {
    int data[MAX];
    int top;
} Stack;

// Function to initialize the stack
void initStack(Stack* s)
{
    s->top = -1;
}

// Function to check if the stack is empty
int isEmpty(Stack* s)
{
    return s->top == -1;
}

// Function to push an element onto the stack
void push(Stack* s, int value)
{
    if (s->top == MAX - 1) {
        printf("Stack overflow\n");
        return;
    }
    s->data[++s->top] = value;
}

// Function to pop an element from the stack
int pop(Stack* s)
{
    if (isEmpty(s)) {
        printf("Stack underflow\n");
        exit(1);
    }
    return s->data[s->top--];
}

// Function to evaluate a postfix expression
int evaluatePostfix(char* seq)
{
    Stack stack;
```

```
    initStack(&stack);

    for (int i = 0; i < strlen(seq); i++) {
        char ch = seq[i];

        // If the character is a digit, push it onto the stack
        if (isdigit(ch)) {
            push(&stack, ch - '0');
        }

        // If the character is an operator, pop two elements, apply the operator,
and push the result
        else if (ch == '+' || ch == '-' || ch == '*' || ch == '/') {
            int a = pop(&stack);
            int b = pop(&stack);

            // Handling division by zero
            if (a == 0) {
                printf("error: Divide by zero is impossible.\n");
                exit(1);
            }

            switch (ch) {
            case '+':
                push(&stack, b + a);
                break;
            case '-':
                push(&stack, b - a);
                break;
            case '*':
                push(&stack, b * a);
                break;
            case '/':
                push(&stack, b / a);
                break;
            }
        }
    }

    // The final result is the only element left in the stack
    return pop(&stack);
}
int main()
{
    char expression[MAX];

    printf("Enter a postfix expression: ");
    fgets(expression, MAX, stdin);

    // Remove newline character from input
```

```
    expression[strcspn(expression, "\n")] = '\0';

    int result = evaluatePostfix(expression);
    printf("The result of the postfix expression is: %d\n", result);
    return 0;
}
```

Output



Discussion

Global variables should be used to the least. However, it has been applied here to reduce the complexity of using pointers and tricky lines.

Teacher's signature