VISVESVARAYA TECHNOLOGICAL UNIVERSITY

"JnanaSangama", Belgaum -590014, Karnataka.

LAB REPORT
On

DATA STRUCTURES (23CS3PCDST)

Submitted by

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(1BM23CS177)

in partial fulfillment for the award of the degree of
BACHELOR OF ENGINEERING
in
COMPUTER SCIENCE AND ENGINEERING

B.M.S. COLLEGE OF ENGINEERING
(Autonomous Institution under VTU)
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Bull Temple Road, Bangalore 560019
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Department of Computer Science and Engineering

This is to certify that the Lab work entitled **"DATA STRUCTURES"** carried out by **MAKADIA RISHIT DILIPBHAI (1BM23CS177)**, who is bonafide student of **B. M. S. College of Engineering**. It is in partial fulfillment for the award of **Bachelor of Engineering in Computer Science and Engineering** of the Visvesvaraya Technological University, Belgaum during the year 2024-25. The Lab report has been approved as it satisfies the academic requirements in respect of Data structures Lab - **(23CS3PCDST)**work prescribed for the said degree.

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Index Sheet

Course outcomes:

CO1	Apply the concept of linear and nonlinear data structures.
CO2	Analyze data structure operations for a given problem
CO3	Design and develop solutions using the operations of linear and nonlinear data structure for a given specification.
CO4	Conduct practical experiments for demonstrating the operations of different data structures.

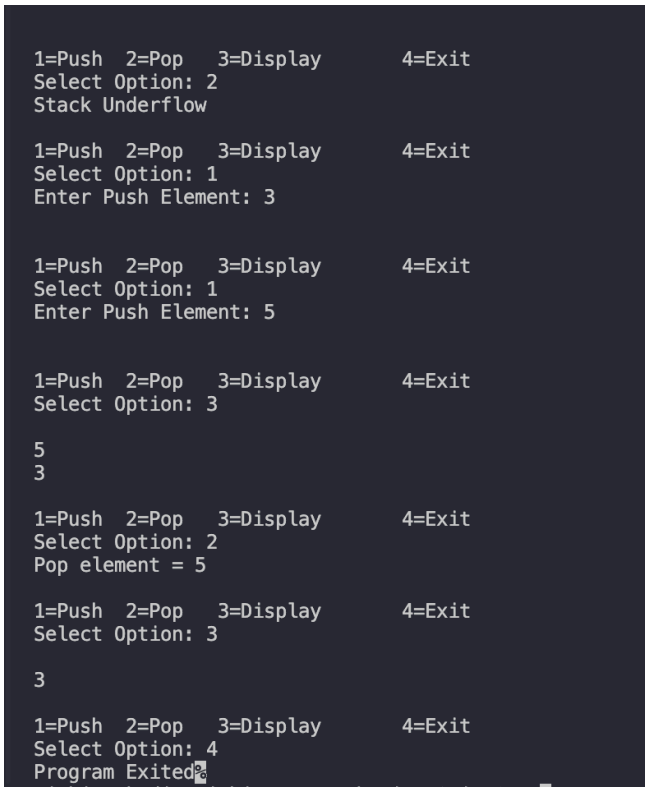
Lab program 1:

Write a program to simulate the working of stack using an array with the following:
a) Push
b) Pop
c) Display
The program should print appropriate messages for stack overflow, stack underflow.

```
#include <stdio.h>

#define MAX 5
int stack[MAX];
int top = -1;

void push(int ele)
{
   if (top==(MAX-1))
      printf("Stack Overflow");
   else
   {
      top = top + 1;
      stack[top] = ele;
   }
}

void pop()
{
   if (top==-1)
      printf("Stack Underflow ");
   else
   {
      int popele = stack[top];
      printf("Pop element = %d", popele);
      top--;
   }
}

void display()
{
   if (top==-1)
      printf("Stack is empty");
   else
   {
      for (int i = top; i >= 0; i--)
      {
         printf("\n%d", stack[i]);
```

```
        }
    }
}

int main()
{
    int opt, in;
    while (1)
    {
        printf("\n\n1=Push\t2=Pop\t3=Display\t4=Exit");
        printf("\nSelect Option: ");
        scanf("%d", &opt);

        switch(opt)
        {
            case 1:
            {
                printf("Enter Push Element: ");
                scanf("%d", &in);
                push(in);
                break;
            }
            case 2:
            {
                pop();
                break;
            }
            case 3:
            {
                display();
                break;
            }
            case 4:
            {
                printf("Program Exited");
                return 0;
            }
            default:
                printf("Invalid Operations");
        }
    }
    return 0;
}
```

Output:


1=Push 2=Pop 3=Display 4=Exit
Select Option: 2
Stack Underflow
1=Push 2=Pop 3=Display 4=Exit
Select Option: 1
Enter Push Element: 3
1=Push 2=Pop 3=Display 4=Exit
Select Option: 1
Enter Push Element: 5
1=Push 2=Pop 3=Display 4=Exit
Select Option: 3
5
3
1=Push 2=Pop 3=Display 4=Exit
Select Option: 2
Pop element = 5
1=Push 2=Pop 3=Display 4=Exit
Select Option: 3
3
1=Push 2=Pop 3=Display 4=Exit
Select Option: 4
Program Exited%

Lab program 2:

WAP to convert a given valid parenthesized infix arithmetic expression to postfix expression. The expression consists of single character operands and the binary operators + (plus), - (minus), * (multiply) and / (divide)

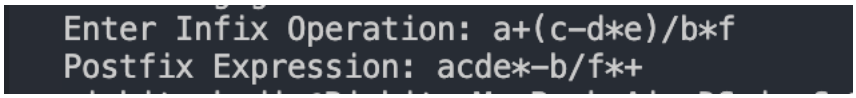
```
#include <stdio.h>
#define MAX 100
int stack[MAX];
int top = -1;

void push(char ele)
{
   if (top==(MAX-1))
      printf("Stack Overflow");
   else
   {
      top = top + 1;
      stack[top] = ele;
   }
}

char pop() //fu'n need to be char
{
   if (top==-1)
      printf("Stack Underflow ");
   else
   {
      int popele = stack[top];
```

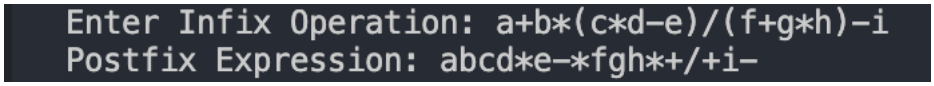
```
        // printf("Pop element = %d", popele);
        top--;
        return popele;
    }
}

int prece(char ch)
{
    if (ch=='*' || ch=='/')
        return 2;
    else if (ch=='+' || ch=='-')
        return 1;
    else
        return 0;
}

int operand(char op)
{
    if ((op>='a' && op<='z') || (op>='A' && op<='Z'))
        return op;
    return '\0';
}

void inToPos (char ifix[], char pfix[])
{
    int i = 0, j = 0;
    char ch;
    while (ifix[i]!='\0')
```

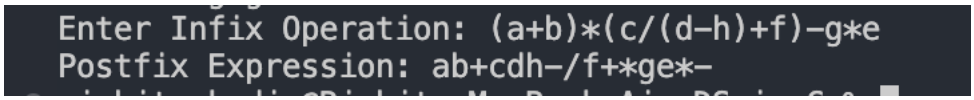
```
{
    ch = ifix[i];
    if (operand(ch))
        pfix[j++] = ch;
    else if (ch =='(')
        push(ch);
    else if (ch ==')')
    {
        while (stack[top]!='(')
        {
            pfix[j++] = pop();
        }
        pop(); //To remove (
    }
    else
    {
        // Very IMP
        while (top != -1 && prece(stack[top])>=prece(ch))
        {
            pfix[j++] = pop();
        }
        push(ch);
    }
    i++;
}
while(top!=-1)
{
    pfix[j++] = pop();
```

```
    }
    pfix[j] = '\0'; //to end the postfix string
}

int main()
{
    char infix[MAX], postfix[MAX];
    printf("Enter Infix Operation: ");
    // gets(infix);
    fgets(infix, MAX, stdin);
    // scanf("%s", infix);
    inToPos(infix, postfix);
    printf("Postfix Expression: %s", postfix);
}
```

Output:







Lab program 3(a):

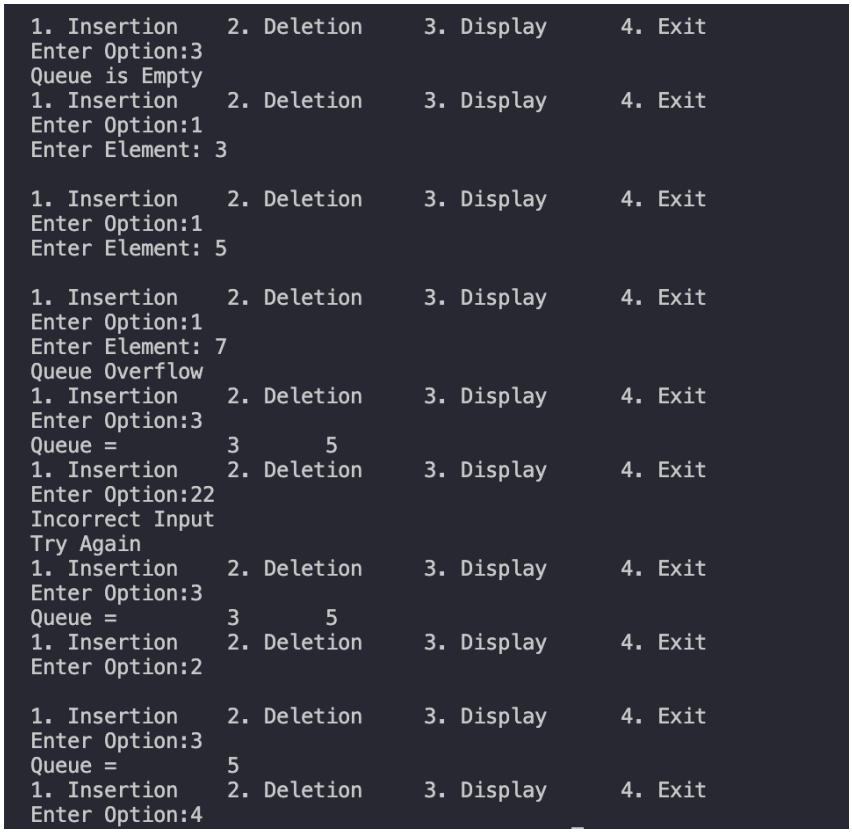
WAP to simulate the working of a queue of integers using an array. Provide the following operations: Insert, Delete, Display The program should print appropriate messages for queue empty and queue overflow conditions

```
#include <stdio.h>
#define MAX 2

int queue[MAX];
int front=-1, rear=-1;

void insertion(int ele)
{
   if (rear == MAX-1)
      printf("Queue Overflow");
   else
   {
      queue[++rear]=ele;
   }
}
void deletion()
{
   int del;
   if (rear == -1)
      printf("Queue is Empty");
   else
      del=queue[++front];
}
void display()
{
   int i = front;
   if (rear == -1)
      printf("Queue is Empty");
   else
```

```
    {
        printf("Queue = ");
        while (i != rear)
        {
            printf("\t%d", queue[++i]);
        }
    }
}

int main()
{
    int opt, no;
    while (1)
    {
        printf("\n1. Insertion\t2. Deletion\t3. Display\t4. Exit\nEnter Option:");
        scanf("%d", &opt);
        switch (opt)
        {
            case 1:
                printf("Enter Element: ");
                scanf("%d", &no);
                insertion(no);
                break;
            case 2:
                deletion();
                break;
            case 3:
                display();
                break;
            case 4:
                return 0;
            default:
                printf("Incorrect Input\nTry Again");
```

```
    }
  }
}
```

Output:


1. Insertion 2. Deletion 3. Display 4. Exit
Enter Option:3
Queue is Empty
1. Insertion 2. Deletion 3. Display 4. Exit
Enter Option:1
Enter Element: 3
1. Insertion 2. Deletion 3. Display 4. Exit
Enter Option:1
Enter Element: 5
1. Insertion 2. Deletion 3. Display 4. Exit
Enter Option:1
Enter Element: 7
Queue Overflow
1. Insertion 2. Deletion 3. Display 4. Exit
Enter Option:3
Queue = 3 5
1. Insertion 2. Deletion 3. Display 4. Exit
Enter Option:22
Incorrect Input
Try Again
1. Insertion 2. Deletion 3. Display 4. Exit
Enter Option:3
Queue = 3 5
1. Insertion 2. Deletion 3. Display 4. Exit
Enter Option:2
1. Insertion 2. Deletion 3. Display 4. Exit
Enter Option:3
Queue = 5
1. Insertion 2. Deletion 3. Display 4. Exit
Enter Option:4

Lab program 3(b):

WAP to simulate the working of a circular queue of integers using an array. Provide the following operations: Insert, Delete & Display The program should print appropriate messages for queue empty and queue overflow conditions

```
#include <stdio.h>


void insert(int *queue, int *front ,int *rear, int value, int MAX)
{
   if ((*front == 0 && *rear == (MAX -1)) || (*rear == *front -1))
   // if ((*rear + 1) % MAX == *front)
   {
      printf("Queue Overflow");
      return ;
   }
   else if (*front == -1){
      *front = *rear = 0;
      // queue[*rear]=value;
   }
   else if ((*rear == MAX -1 && *front != 0)){
      *rear =0;
      // queue[*rear]=value;
   }
   else{
      (*rear)++;
      // queue[*rear]=value;
   }
   queue[*rear]=value;
}
void delete (int *queue, int *front ,int *rear, int MAX){
   if (*front ==-1){
      printf("Queue Underflow");
```

```
    }
    else if (*front == *rear){
        *front = *rear=-1;
    }
    else if (*front == MAX-1){
        *front=0;
    }
    else{
        (*front)++;
    }
}
void display (int *queue, int front ,int rear, int MAX){
    if (front == -1){
        printf("Queue Underflow");
        return;
    }
    printf("Queue = ");
    if (rear >= front){
        for (int i=front; i<=rear;i++){
            printf("%d\t", queue[i]);
        }
    }
    else{
        for (int j=front; j<MAX; j++){
            printf("%d\t", queue[j]);
        }
        for (int k=0; k<=rear; k++){
            printf("%d\t", queue[k]);
        }
    }
}
```

```
int main()
{
   int MAX = 2;
   int queue[MAX];
   int fr=-1, re=-1;
   int opt, no;
   while (1)
   {
      printf("\n1. Insertion\t2. Deletion\t3. Display\t4. Exit\nEnter Option:");
      scanf("%d", &opt);
      switch (opt)
      {
         case 1:
         {
            printf("Enter Element: ");
            scanf("%d", &no);
            insert(queue, &fr, &re, no, MAX);
            break;
         }
         case 2:
         {
            delete(queue, &fr, &re, MAX);
            break;
         }
         case 3:
         {
            display(queue, fr, re, MAX);
            break;
         }
         case 4:
            return 0;
         default:
```

```
            printf("Incorrect Input\nTry Again");
        }
    }
}
```

Output:

```
1. Insertion    2. Deletion     3. Display      4. Exit
Enter Option:2
Queue Underflow
1. Insertion    2. Deletion     3. Display      4. Exit
Enter Option:1
Enter Element: 3

1. Insertion    2. Deletion     3. Display      4. Exit
Enter Option:1
Enter Element: 5

1. Insertion    2. Deletion     3. Display      4. Exit
Enter Option:1
Enter Element: 7
Queue Overflow
1. Insertion    2. Deletion     3. Display      4. Exit
Enter Option:3
Queue = 3       5
1. Insertion    2. Deletion     3. Display      4. Exit
Enter Option:2

1. Insertion    2. Deletion     3. Display      4. Exit
Enter Option:1
Enter Element: 9

1. Insertion    2. Deletion     3. Display      4. Exit
Enter Option:3
Queue = 5       9
1. Insertion    2. Deletion     3. Display      4. Exit
Enter Option:4
```

Lab Program-4 (a):

WAP to Implement Singly Linked List with following operations

a) Create a linked list.

b) Insertion of a node at first position, at any position and at end of list.

c) Display the contents of the linked list.

AND

Lab Program-5 (a):

WAP to Implement Singly Linked List with following operations

a) Create a linked list.

b) Deletion of first element, specified element and last element in the list.

c) Display the contents of the linked list.

```
#include <stdio.h>
#include <stdlib.h>
struct Node {
    int data;
    struct Node *next;
};

void insertBeg(struct Node **head, int val){
    struct Node *new = (struct Node *) malloc(sizeof(struct Node));
    new->data=val;
    new->next=*head;
    *head = new;
}

void insertEnd(struct Node **head, int val){
    struct Node *new = (struct Node *) malloc(sizeof(struct Node));
    new->data=val;
    new->next=NULL;
    if (*head == NULL){
        *head=new;
```

```
        return;
    }
    struct Node *temp = *head;
    while (temp->next!=NULL){
        temp = temp->next;
    }
    temp->next=new;
}

void insertPos(struct Node **head, int val, int pos){
    struct Node *new = (struct Node *) malloc(sizeof(struct Node));
    new->data=val;
    if (pos==0){
        new->next=*head;
        *head = new;
        return;
    }
    struct Node *temp = *head;
    for (int i=0; temp->next!=NULL && i < pos-1; i++){
        temp = temp->next;
    }
    if (temp == NULL){
        printf("Out of Range");
        return;
    }
    new->next=temp->next;
    temp->next = new;
}

void deleteBeg(struct Node **head){
    if (*head == NULL){
        printf("Empty LL");
```

```
        return;
    }
    struct Node *temp = *head;
    *head = temp->next;
    free(temp);
}

void deleteEnd(struct Node **head){
    if (*head == NULL){
        printf("Empty LL");
        return;
    }
    struct Node *temp = *head;
    if(temp->next == NULL){
        free(temp);
        *head = NULL;
        return;
    }
    while (temp->next->next!=NULL){
        temp = temp->next;
    }
    free(temp->next);
    temp->next=NULL;
}

void deleteVal(struct Node **head, int val){
    if (*head == NULL){
        printf("Empty LL");
        return;
    }
    struct Node *temp = *head;
    if (temp->data == val){
```

```
        *head = temp->next;
        free(temp);
        return;
    }
    while (temp->next->data!=val){
        temp = temp->next;
    }
    if(temp->next == NULL){
        printf("Value not present in LL");
        free(temp);
        // return;
    }
    struct Node *toDelete = temp->next;
    temp->next = toDelete->next; // Bypass the node to be deleted
    free(toDelete);
}

void display(struct Node **head){
    struct Node *temp = *head;
    if (*head == NULL){
        printf("Empty LL");
        return;
    }
    printf("Queue = ");
    while (temp!=NULL){
        printf("\t%d", temp->data);
        temp = temp->next;
    }

}

int main(){
```

```
    struct Node *head = NULL;
    int choice, data, pos;
    printf("\n1. Insert at beginning\t2. Insert at end\t3. Insert at position\n4. Delete from beginning\t5. Delete from end\t6. Delete by Value\n7. Display\t8. Exit");
    while (1) {
        printf("\nEnter your choice: ");
        scanf("%d", &choice);

        switch (choice) {
            case 1:
                printf("Enter value: ");
                scanf("%d", &data);
                insertBeg(&head, data);
                break;
            case 2:
                printf("Enter value: ");
                scanf("%d", &data);
                insertEnd(&head, data);
                break;
            case 3:
                printf("Enter value & position: ");
                scanf("%d %d", &data, &pos);
                insertPos(&head, data, pos);
                break;
            case 4:
                deleteBeg(&head);
                break;
            case 5:
                deleteEnd(&head);
                break;
            case 6:
                printf("Enter value to delete: ");
```

```
            scanf("%d", &pos);
            deleteVal(&head, pos);
            break;
        case 7:
            display(&head);
            break;
        case 8:
            return 0;
        default:
            printf("Invalid choice!\n");
      }
   }
   return 0;
}
```

Output:

```
1. Insert at beginning  2. Insert at end        3. Insert at position
4. Delete from beginning        5. Delete from end      6. Delete by Value
7. Display      8. Exit
Enter your choice: 4
Empty LL
Enter your choice: 1
Enter value: 3

Enter your choice: 2
Enter value: 5

Enter your choice: 3
Enter value & position: 7 1

Enter your choice: 7
Queue =         3       7       5
Enter your choice: 5

Enter your choice: 6
Enter value to delete: 3

Enter your choice: 7
Queue =         7
Enter your choice: 8
```

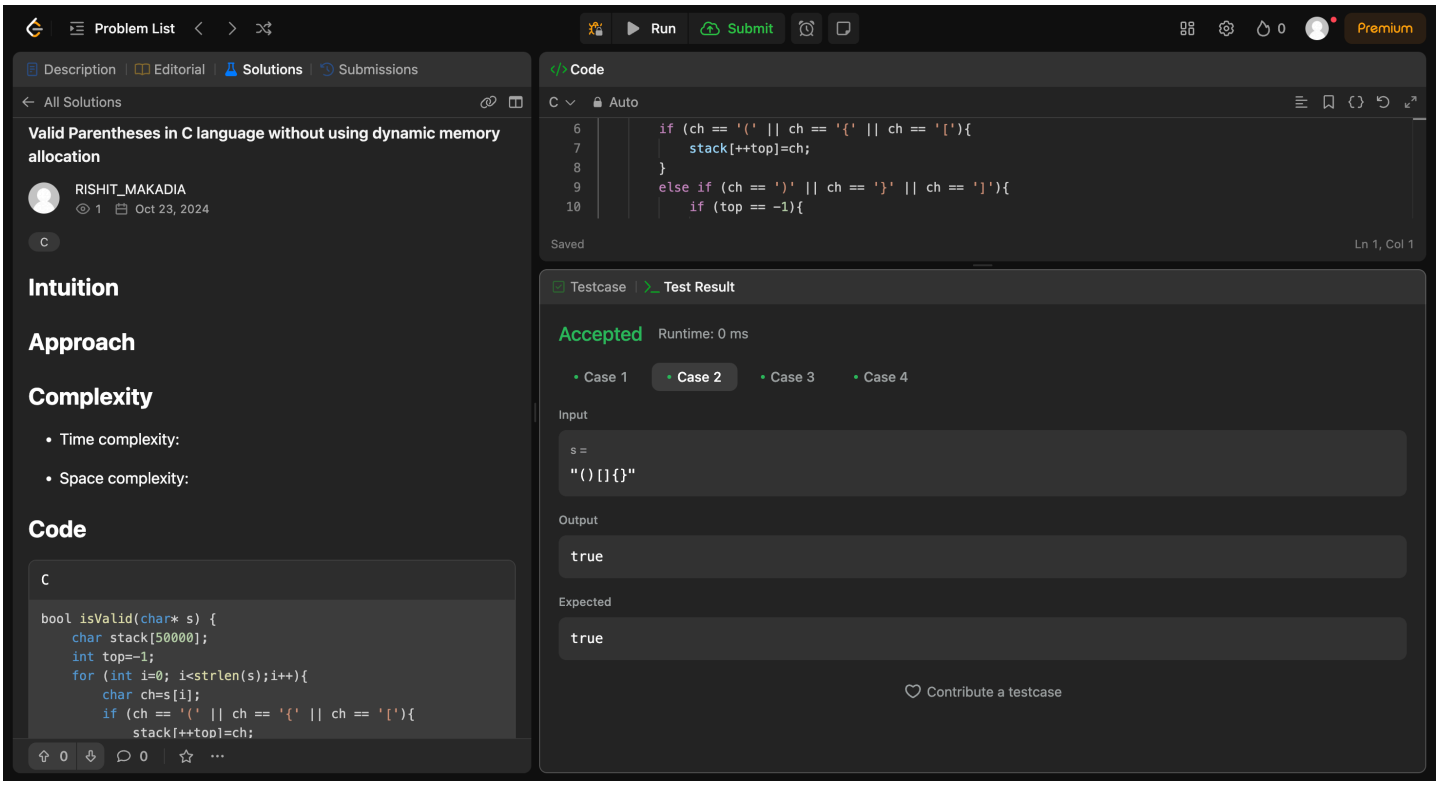
Lab Program-4(b):

Program - Leetcode platform
Valid Parantheses

```
bool isValid(char* s) {
    char stack[50000];
    int top=-1;
    for (int i=0; i<strlen(s);i++){
        char ch=s[i];
        if (ch == '(' || ch == '{' || ch == '['){
            stack[++top]=ch;
        }
        else if (ch == ')' || ch == '}' || ch == ']'){
            if (top == -1){
                return 0;
            }
            char val = stack[top];
            if ((ch == ')' && val == '(') || (ch == '}' && val == '{') || (ch == ']' && val == '[')){
                top--;
            }
            else{
                return 0;
            }
        }
        else{
            return 0;
        }
    }
    if (top != -1){
        return 0;
    }
```

```
    else{
        top = -1;
        return 1;
    }
}
```

Output:



Lab Program-5(b):

Program - Leetcode platform

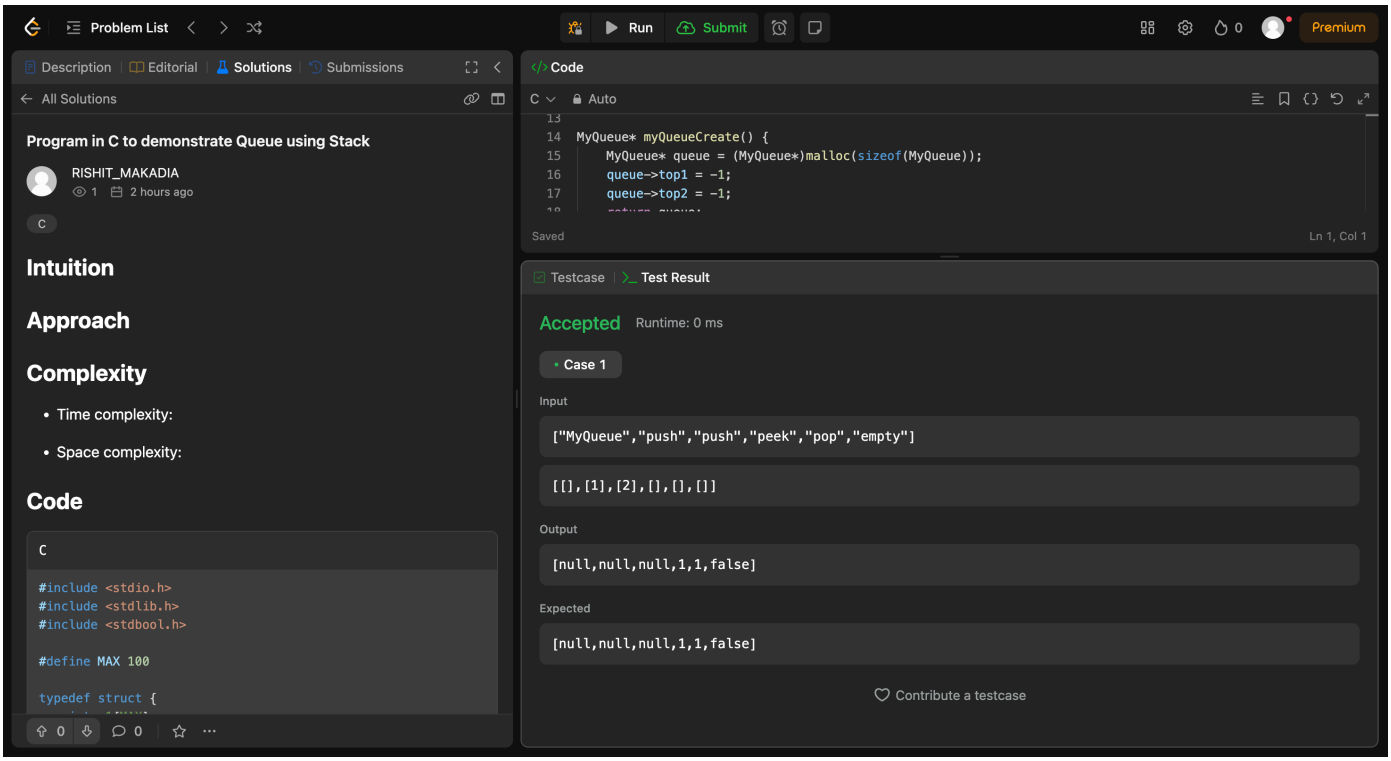
Queue using Stack

```
#include <stdio.h>
#include <stdlib.h>
#include <stdbool.h>

#define MAX 100

typedef struct {
    int s1[MAX];
    int s2[MAX];
    int top1;
    int top2;
} MyQueue;

MyQueue* myQueueCreate() {
    MyQueue* queue = (MyQueue*)malloc(sizeof(MyQueue));
    queue->top1 = -1;
    queue->top2 = -1;
    return queue;
}

void myQueuePush(MyQueue* obj, int x) {
    if (obj->top1 == MAX - 1) {
        printf("Queue is full\n");
        return;
    }
    obj->s1[++(obj->top1)] = x;
}
```

```
int myQueuePop(MyQueue* obj) {
    if (obj->top2 == -1) {
        while (obj->top1 != -1) {
            obj->s2[++(obj->top2)] = obj->s1[(obj->top1)--];
        }
    }
    if (obj->top2 == -1) {
        printf("Queue is empty\n");
        return -1;
    }
    return obj->s2[(obj->top2)--];
}

int myQueuePeek(MyQueue* obj) {
    if (obj->top2 == -1) {
        while (obj->top1 != -1) {
            obj->s2[++(obj->top2)] = obj->s1[(obj->top1)--];
        }
    }
    if (obj->top2 == -1) {
        printf("Queue is empty\n");
        return -1;
    }
    return obj->s2[obj->top2];
}

bool myQueueEmpty(MyQueue* obj) {
    return obj->top1 == -1 && obj->top2 == -1;
}

void myQueueFree(MyQueue* obj) {
    free(obj);
```

```
}

/**
 * Your MyQueue struct will be instantiated and called as such:
 * MyQueue* obj = myQueueCreate();
 * myQueuePush(obj, x);
 * int param_2 = myQueuePop(obj);
 * int param_3 = myQueuePeek(obj);
 * bool param_4 = myQueueEmpty(obj);
 * myQueueFree(obj);
 */
```

Output:



Lab Program-6(a):

WAP to Implement Single Link List with following operations: Sort the linked list, Reverse the linked list, Concatenation of two linked lists.

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

typedef struct Node {
   int data;
   struct Node *next;
}Node;

Node *create(int val)
{
    Node *newN = (struct Node *) malloc(sizeof(Node));
    newN->data=val;
    newN->next=NULL;
    return newN;
}
Node *insertBeg(Node *head,int val)
{
   Node *new=create(val);
   new->next=head;
   head=new;
   return head;
}

Node *concate(Node *head1, Node *head2)
{
   Node *temp=head1;
   while (temp->next != NULL)
      temp=temp->next;
```

```
    temp->next=head2;
    return head1;
}

Node *sort(Node *head)
{
    int t;
    Node *temp, *curr;
    curr=head;
    while (curr!=NULL)
    {
        temp=head;
        while(temp->next!=NULL)
        {
            if ((temp->data) > (temp->next->data))
            {
                t=temp->data;
                temp->data = temp->next->data;
                temp->next->data = t;
            }
            temp=temp->next;
        }
        curr=curr->next;
    }
    return head;
}

Node *reverse(Node *head)
{
    Node *temp, *new, *prev=NULL;
    temp = head;
    while (temp!=NULL)
```

```
    {
        new=temp->next;
        temp->next=prev;
        prev=temp;
        temp=new;
    }
    return prev;
}

void display(Node *head)
{
    struct Node *temp=head;
    while(temp!=NULL){
        printf("%d ", temp->data);
        temp=temp->next;
    }
    printf("\n");
}

int main()
{
    Node *l1 = NULL;
    Node *l2 = NULL;

    l1 = insertBeg(l1, 5);
    l1 = insertBeg(l1, 3);
    l1 = insertBeg(l1, 7);

    l2 = insertBeg(l2, 4);
    l2 = insertBeg(l2, 8);
    l2 = insertBeg(l2, 6);
```

```
    printf("List 1 = ");
    display(l1);
    printf("List 2 = ");
    display(l2);

    l1 = sort(l1);
    l2 = sort(l2);

    l2 = reverse(l2);

    printf("Sorted List 1 = ");
    display(l1);
    printf("Sorted and then Reversed List 2 = ");
    display(l2);

    printf("List 1 + List 2 = ");
    l1=concate(l1, l2);
    display(l1);
}
```

Output:

```
List 1 = 7 3 5
List 2 = 6 8 4
Sorted List 1 = 3 5 7
Sorted and then Reversed List 2 = 8 6 4
List 1 + List 2 = 3 5 7 8 6 4
```

Lab Program-6(b):

WAP to Implement Single Link List to simulate Stack & Queue Operations.

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

struct Node {
    int data;
    struct Node *next;
};
struct Node *top=NULL, *front=NULL, *rear=NULL;

void push(int val)
{
    struct Node *new = (struct Node *) malloc(sizeof(struct Node));
    new->data=val;
    new->next=top;
    top=new;
}
void pop()
{
    struct Node *temp;
    if (top==NULL)
        printf("Stack Underflow ");
    else
    {
        temp=top;
        top=top->next;
        free(temp);
    }
}
void displayStack()
```

```
{
   struct Node *temp=top;
   while(temp!=NULL){
      printf("%d ", temp->data);
      temp=temp->next;
   }
}

void enQueue(int val)
{
   struct Node *new = (struct Node *) malloc(sizeof(struct Node));
   new->data=val;
   new->next=NULL;
   if (rear==NULL && front==NULL)
      rear=front=new;
   else
   {
      rear->next=new;
      rear=new;
   }
}
void deQueue()
{
   struct Node *temp;
   if (front==NULL)
      printf("Queue Underflow\n ");
   else
   {
      temp=front;
      front=front->next;
      if (front==NULL)
         rear=NULL;
```

```
        free(temp);
    }
}
void displayQueue()
{
    struct Node *temp=front;
    while(temp!=NULL){
        printf("%d ", temp->data);
        temp=temp->next;
    }
}


int main()
{
 int choice, data;
    printf("\n1. Stack PUSH\t2. Stack POP\t3. Display Stack\n4. Queue Insertion\t5. Queue Deletion\t6. Display Queue\n7. Exit");
    while (1) {
        printf("\nEnter your choice: ");
        scanf("%d", &choice);


        switch (choice) {
            case 1:
                printf("Enter value: ");
                scanf("%d", &data);
                push(data);
                break;
            case 2:
                pop();
                break;
            case 3:
                displayStack();
```

```
            break;
        case 4:
            printf("Enter value: ");
            scanf("%d", &data);
            enQueue(data);
            break;
        case 5:
            deQueue();
            break;
        case 6:
            displayQueue();
            break;
        case 7:
            return 0;
        default:
            printf("Invalid choice!\n");
      }
   }
   return 0;
}
```

Output:

```
1. Stack PUSH   2. Stack POP    3. Display Stack
4. Queue Insertion      5. Queue Deletion       6. Display Queue
7. Exit
Enter your choice: 2
Stack Underflow
Enter your choice: 1
Enter value: 3

Enter your choice: 1
Enter value: 5

Enter your choice: 1
Enter value: 7

Enter your choice: 2

Enter your choice: 3
5 3
Enter your choice: 5
Queue Underflow

Enter your choice: 4
Enter value: 2

Enter your choice: 4
Enter value: 4

Enter your choice: 4
Enter value: 6

Enter your choice: 5

Enter your choice: 6
4 6
Enter your choice: 7
```

Lab program-7 (a):

WAP to Implement doubly link list with primitive operations

a) Create a doubly linked list.

b) Insert a new node to the left of the node.

c) Delete the node based on a specific value

d) Display the contents of the list

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

struct Node
{
   int data;
   struct Node *next;
   struct Node *prev;
};
struct Node *create(int val)
{
   struct Node *new = (struct Node *)malloc(sizeof(struct Node));
   new->data = val;
   new->next = NULL;
   new->prev = NULL;
   return new;
}

void createList(struct Node **head, int val){
   *head=create(val);
}

void insertLeft (struct Node **head, int find, int val){
   if ((*head)==NULL){
```

```
        printf("No LL Exist");
        return;
    }
    struct Node *temp=*head;
    struct Node *new=create(val);
    while(temp!=NULL && temp->data!=find){
        temp=temp->next;
    }
    if (temp==NULL){
        printf("No Node found with value %d", find);
        return;
    }
    new->next=temp;
    new->prev=temp->prev;
    if (temp->prev!=NULL)
        temp->prev->next=new;
    else
        (*head)=new;
    temp->prev=new;
}

void deleteVal (struct Node **head, int del){
    if ((*head)==NULL){
        printf("LL doesn't exist");
        return;
    }
    struct Node *temp=*head;
    while(temp!=NULL && temp->data!=del){
        temp=temp->next;
    }
    if (temp==NULL){
        printf("No Node found with value %d", del);
```

```
        return;
    }
    if (temp->prev!=NULL)
        temp->prev->next=temp->next;
    else
        (*head)=temp->next;
    if (temp->next!=NULL)
        temp->next->prev=temp->prev;
    free(temp);
}

void display(struct Node *head){
    struct Node *temp=head;
    while(temp!=NULL){
        printf("%d\t", temp->data);
        temp=temp->next;
    }
}

int main(){
    struct Node *head = NULL;
    int choice, data, pos;
    printf("\n1. Create a new LL\t2. Insert Left to\t3. Delete by value\t4. Display\t5. Exit\t\n");
    while (1) {
        printf("\nEnter your choice: ");
        scanf("%d", &choice);

        switch (choice)
        {
            case 1:
                printf("Enter value: ");
                scanf("%d", &data);
```

```
            createList(&head, data);
            break;
        case 2:
            printf("Enter value: ");
            scanf("%d", &data);
            printf("Enter to the left of value: ");
            scanf("%d", &pos);
            insertLeft(&head, pos, data);
            break;
        case 3:
            printf("Enter value to delete: ");
            scanf("%d", &data);
            deleteVal(&head, data);
            break;
        case 4:
            display(head);
            break;
        case 5:
            return 0;
        default:
            printf("Invalid choice!\n");
      }
   }
}
```

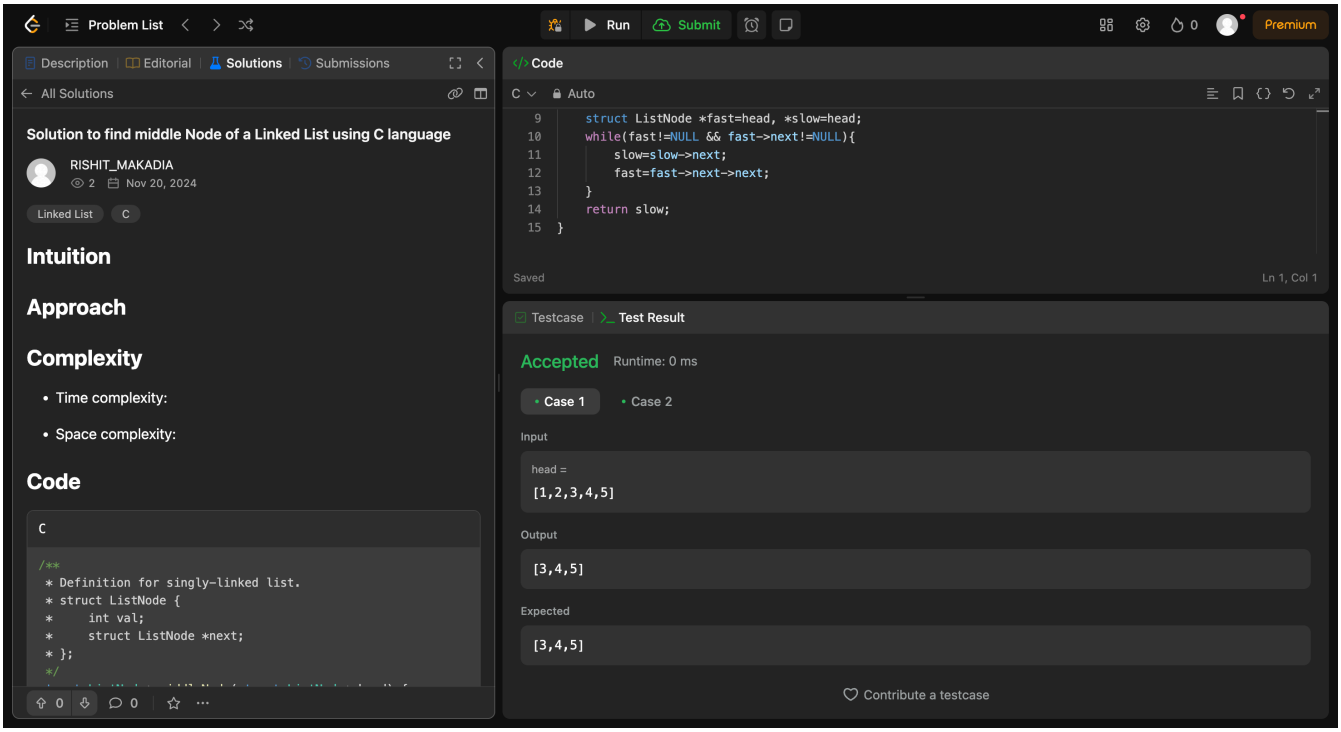
Output:

```
1. Create a new LL      2. Insert Left to       3. Delete by value      4. Display      5. Exit

Enter your choice: 3
Enter value to delete: 7
LL doesn't exist
Enter your choice: 1
Enter value: 3

Enter your choice: 2
Enter value: 5
Enter to the left of value: 3

Enter your choice: 4
5       3
Enter your choice: 3
Enter value to delete: 3

Enter your choice: 4
5
Enter your choice: 5
```

Lab Program-7(b):
Program - Leetcode platform
Middle element of the Linked List

```
/**
 * Definition for singly-linked list.
 * struct ListNode {
 *     int val;
 *     struct ListNode *next;
 * };
 */
struct ListNode* middleNode(struct ListNode* head) {
    struct ListNode *fast=head, *slow=head;
    while(fast!=NULL && fast->next!=NULL){
        slow=slow->next;
        fast=fast->next->next;
    }
    return slow;
}
```

Output:



Lab program-8 (a):

Write a program

a) To construct a binary Search tree.

b) To traverse the tree using all the methods i.e., in-order, preorder and post order.

c) To display the elements in the tree.

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

typedef struct Node
{
   int data;
   struct Node *left;
   struct Node *right;
}Node;

Node *create(Node* root, int val){
   Node *new = (Node *)malloc(sizeof(Node));
   new->data = val;
   new->left = NULL;
   new->right = NULL;
   return new;
}

Node *insert(Node* root, int val){
   if (root == NULL)
      return create(root, val);
   else if (val<(root->data))
      root->left = insert(root->left, val);
   else if (val>(root->data))
```

```
        root->right = insert(root->right, val);
    return root;
}

void preOrder(Node *root){
    if (root!=NULL){
        printf(" %d", root->data);
        preOrder(root->left);
        preOrder(root->right);
    }
}
void inOrder(Node *root){
    if (root!=NULL){
        inOrder(root->left);
        printf(" %d", root->data);
        inOrder(root->right);
    }
}
void postOrder(Node *root){
    if (root!=NULL){
        postOrder(root->left);
        postOrder(root->right);
        printf(" %d", root->data);
    }
}

int main()
{
    Node *root = NULL;
    int data, no;
    printf("Enter a new Binary Search Tree\n");
    printf("Enter No. of Nodes: ");
```

```
    scanf("%d", &no);
    printf("Enter value: ");
    for(int i=0; i<no;i++){
        scanf("%d", &data);
        if (i==0)
            root=create(root, data);
        else
            insert(root, data);
    }
    printf("\nPre-Order : ");
    preOrder(root);
    printf("\nIn-Order : ");
    inOrder(root);
    printf("\nPost-Order : ");
    postOrder(root);
}
```

Output:

```
Enter a new Binary Search Tree
Enter No. of Nodes: 9
Enter value: 5 4 1 7 11 8 2 3 10

Pre-Order :  5 4 1 2 3 7 11 8 10
In-Order :  1 2 3 4 5 7 8 10 11
Post-Order :  3 2 1 4 10 8 11 7 5
```

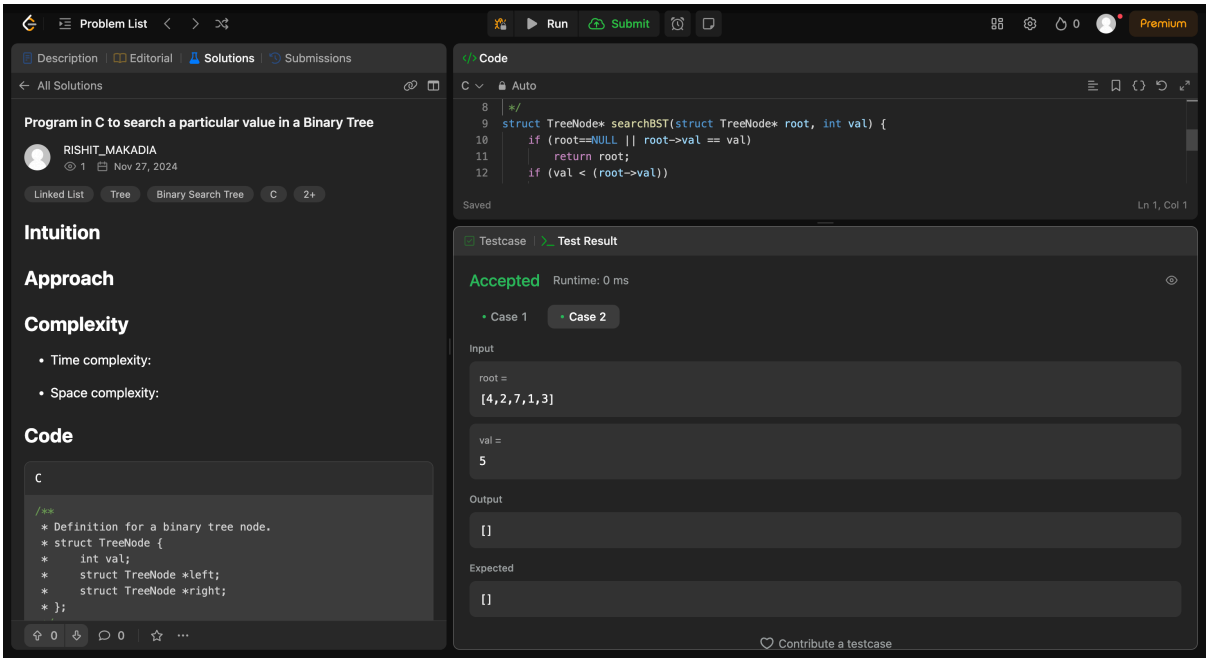
Lab Program-8(b):

Program - Leetcode platform

Search in Binary Search Tree

```
/**
 * Definition for a binary tree node.
 * struct TreeNode {
 *     int val;
 *     struct TreeNode *left;
 *     struct TreeNode *right;
 * };
 */
struct TreeNode* searchBST(struct TreeNode* root, int val) {
    if (root==NULL || root->val == val)
        return root;
    if (val < (root->val))
        return searchBST(root->left, val);
    else
        return searchBST(root->right, val);
}
```

Output:


Problem List
Run
Submit
Premium
Description
Editorial
Solutions
Submissions
All Solutions
Program in C to search a particular value in a Binary Tree
RISHIT_MAKADIA
1
Nov 27, 2024
Linked List
Tree
Binary Search Tree
C
2+
Intuition
Approach
Complexity
Time complexity:
Space complexity:
Code
C
/**
* Definition for a binary tree node.
* struct TreeNode {
*   int val;
*   struct TreeNode *left;
*   struct TreeNode *right;
* };
Code
C
Auto
*/
struct TreeNode* searchBST(struct TreeNode* root, int val) {
if (root==NULL || root->val == val)
return root;
if (val < (root->val))
Saved
Ln 1, Col 1
Testcase
Test Result
Accepted
Runtime: 0 ms
Case 1
Case 2
Input
root =
[4,2,7,1,3]
val =
5
Output
[]
Expected
[]
Contribute a testcase

Lab Program-9 (a):

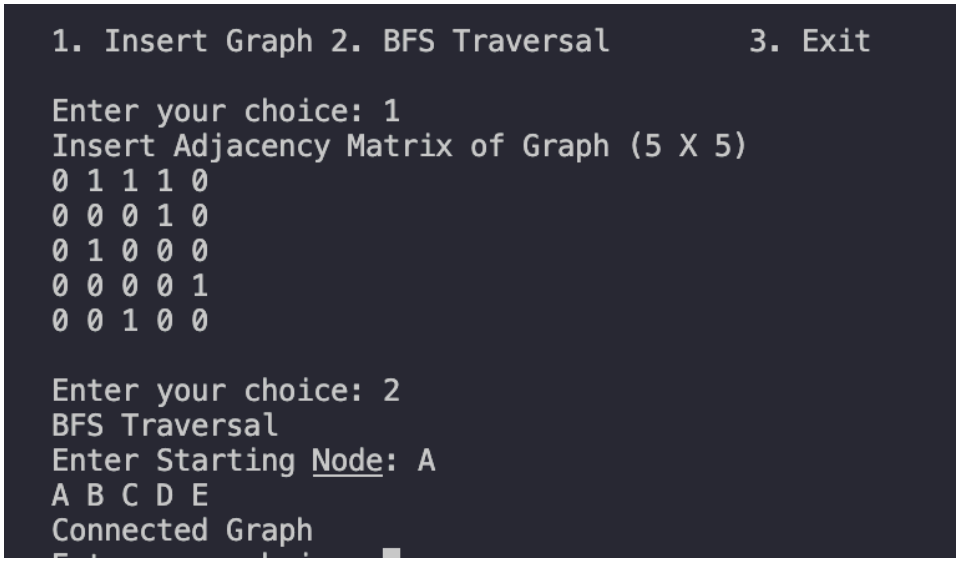
Write a program to traverse a graph using BFS method.

```
#include <stdio.h>
#define MAX 5

void bfs(int adjM[MAX][MAX], int visited[MAX], int start)
{
   int queue[MAX], rear = -1, front = -1, count=1;
   for (int i = 0; i < MAX; i++)
   {
      visited[i] = 0;
   }
   queue[++rear] = start;
   front++;
   visited[start] = 1;
   while (rear >= front)
   {
      start = queue[front++];
      printf("%c ", (start + 65));
      for (int k = 0; k < MAX; k++)
      {
         if (adjM[start][k] == 1 && visited[k] == 0)
         {
            queue[++rear] = k;
            visited[k] = 1;
            count++;
         }
      }
   }
   if(count==MAX)
```

```
        printf("\nConnected Graph");
    else
        printf("\nNot-Connected Graph");
}

int main(){
    int visited[MAX]={0}, adj[MAX][MAX];
    int choice;
    char ch;
    printf("\n1. Insert Graph\t2. BFS Traversal\t3. Exit\t\n");
    while (1) {
        printf("\nEnter your choice: ");
        scanf("%d", &choice);
        switch (choice){
            case 1:
                printf("Insert Adjacency Matrix of Graph (5 X 5)\n");
                for(int i=0; i<MAX; i++){
                    for(int j=0; j<MAX; j++){
                        scanf("%d", &adj[i][j]);
                    }
                }
                break;
            case 2:
                printf("BFS Traversal\n");
                printf("Enter Starting Node: ");
                scanf(" %c", &ch);
                bfs(adj, visited, (ch-65));
                break;
            case 3:
                return 0;
                break;
            default:
```

```
            printf("Invalid Option");
        }
    }
}
```

Output:



Lab Program-9 (b):

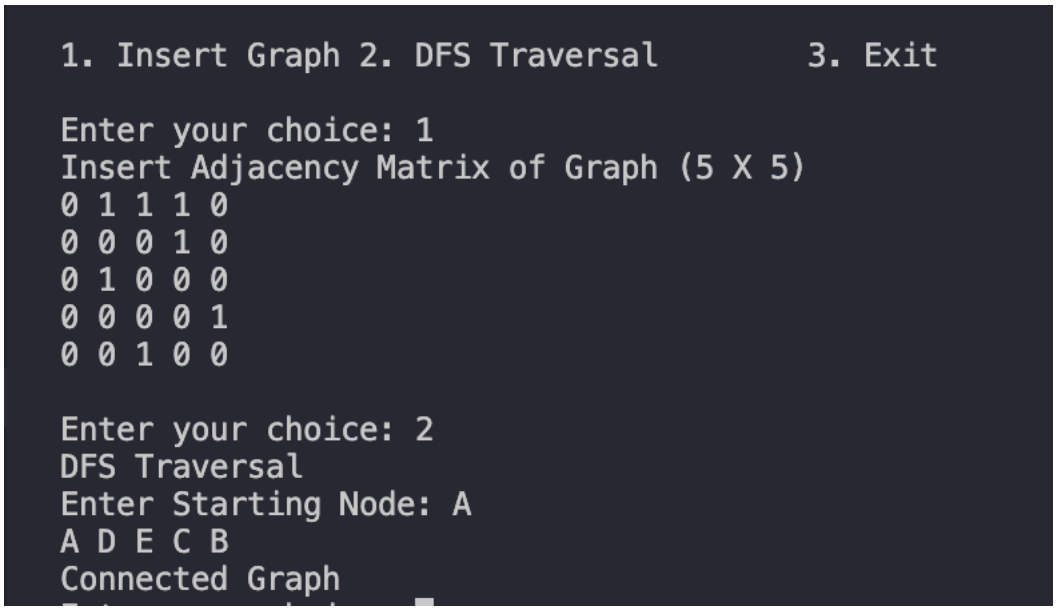
Write a program to check whether given graph is connected or not using DFS method.

```
#include <stdio.h>
#define MAX 5

void dfs(int adjM[MAX][MAX], int visited[MAX], int start)
{
   int stack[MAX], top = -1, count=1;
   for (int i = 0; i < MAX; i++)
   {
      visited[i] = 0;
   }
   stack[++top] = start;
   visited[start] = 1;
   while (top != -1)
   {
      start = stack[top--];
      printf("%c ", (start + 65));
      for (int k = 0; k < MAX; k++)
      {
         if (adjM[start][k] == 1 && visited[k] == 0)
         {
            stack[++top] = k;
            visited[k] = 1;
            count++;
         }
      }
   }
   if(count==MAX)
      printf("\nConnected Graph");
```

```
    else
        printf("\nNot-Connected Graph");
}
int main(){
    int visited[MAX]={0}, adj[MAX][MAX];
    int choice;
    char ch;
    printf("\n1. Insert Graph\t2. DFS Traversal\t3. Exit\t\n");
    while (1) {
        printf("\nEnter your choice: ");
        scanf("%d", &choice);
        switch (choice){
            case 1:
                printf("Insert Adjacency Matrix of Graph (5 X 5)\n");
                for(int i=0; i<MAX; i++){
                    for(int j=0; j<MAX; j++){
                        scanf("%d", &adj[i][j]);
                    }
                }
                break;
            case 2:
                printf("DFS Traversal\n");
                printf("Enter Starting Node: ");
                scanf(" %c", &ch);
                dfs(adj, visited, (ch-65));
                break;
            case 3:
                return 0;
                break;
            default:
                printf("Invalid Option");
        }
```

```
    }
}
```

Output:


1. Insert Graph 2. DFS Traversal 3. Exit
Enter your choice: 1
Insert Adjacency Matrix of Graph (5 X 5)
0 1 1 1 0
0 0 0 1 0
0 1 0 0 0
0 0 0 0 1
0 0 1 0 0
Enter your choice: 2
DFS Traversal
Enter Starting Node: A
A D E C B
Connected Graph

Lab Program-10

Given a File of N employee records with a set K of Keys(4-digit)

which uniquely determine the records in file F. Assume that file F is maintained in memory by a Hash Table (HT) of m memory locations with L as the set of memory addresses (2-digit) of locations in HT. Let the keys in K and addresses in L are integers. Design and develop a Program in C that uses Hash function H: K-> L as H(K)=K mod m (remainder method), and implement hashing technique to map a given key K to the address space L. Resolve the collision (if any) using linear probing.

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

int key[20], n, m;
int *ht;
int count = 0;

void insert(int key) {
   int index = key % m;
   while (ht[index] != -1) {
      index = (index + 1) % m;
   }
   ht[index] = key;
   count++;
}

void display() {
   int i;
   if (count == 0) {
      printf("\nHash Table is empty\n");
      return;
   }
```

```
    printf("\nHash Table:\n");
    for (i = 0; i < m; i++) {
        printf("T[%d] = %d\n", i, ht[i]);
    }
}

int main() {
    int i;
    printf("Enter No. of Employee: ");
    scanf("%d", &n);

    printf("Enter Size of Hash Table: ");
    scanf("%d", &m);

    ht = (int *)calloc(m, sizeof(int));
    for (i = 0; i < m; i++)
        ht[i] = -1;

    printf("Enter 4-digit key values for %d Employee Records:\n", n);
    for (i = 0; i < n; i++) {
        scanf("%d", &key[i]);
    }

    for (i = 0; i < n; i++) {
        if (count == m) {
            printf("\nHash table is full");
            break;
        }
        insert(key[i]);
    }

    display();
```

```
    free(ht);
    return 0;
}
```

Output: