

**VISVESVARAYA TECHNOLOGICAL
UNIVERSITY**

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LAB REPORT

on

Data Structures using C Lab

(23CS3PCDST)

Submitted by

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



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CERTIFICATE

This is to certify that the Lab work entitled “Data Structures using C Lab (23CS3PCDST)” carried out by **Spurthi Reddy P (1BM23CS338)**, 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. The Lab report has been approved as it satisfies the academic requirements in respect of Data Structures using C Lab (23CS3PCDST) work prescribed for the said degree.

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Github Link: <https://github.com/Spurthi-338/spurthi.c>

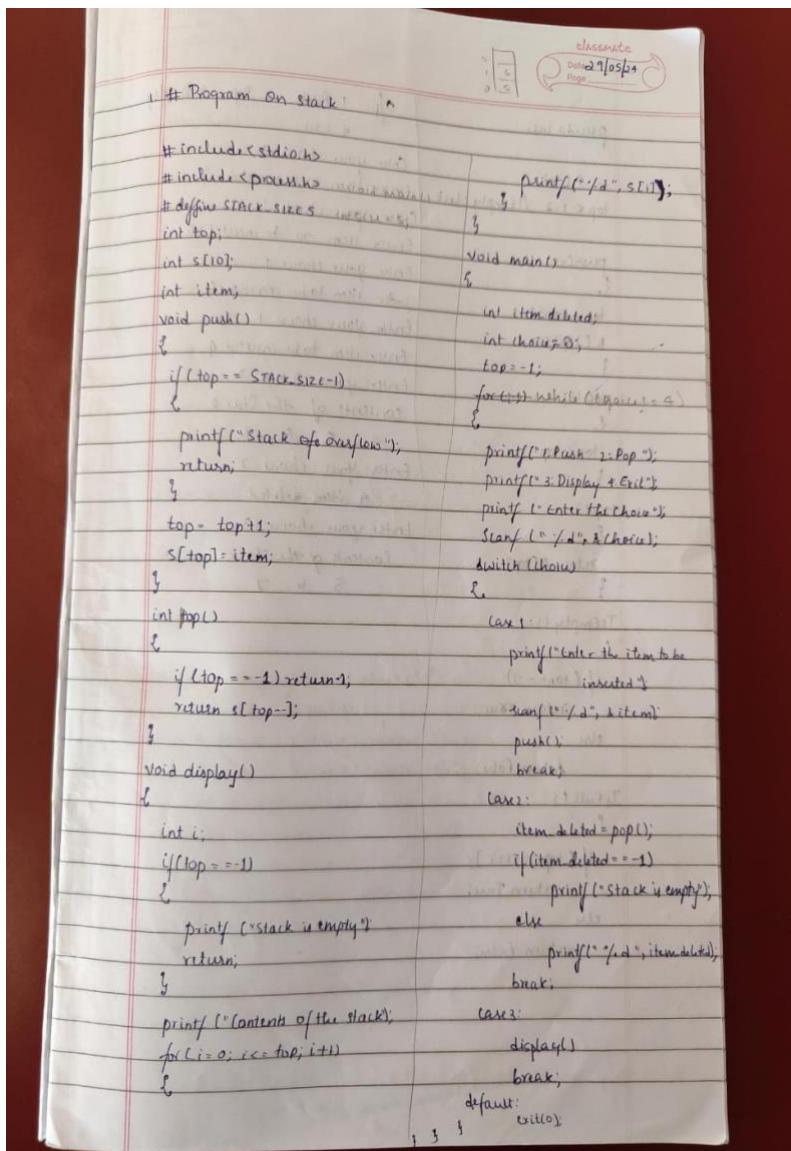
Lab Programs:

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



pseudo code | o/p - 1. Push 2. Pop 3. Display
 4. Exit

```

int A[10];
top <-1-1 //empty stack
push(x)
{
  top <- top+1
  A[top] <- x
}
pop()
{
  top <- top-1
}
top()
{
  return A[top]
}
IsEmpty()
{
  if (top == -1)
    return True;
  else
    return False;
}
IsFull()
{
  if (top == size)
    return True;
  else
    return False;
}
  
```

```

#include<stdio.h>
#include<stdlib.h>
#define size 3

int top=-1;
int stack[size];
int item;

void push(){
  if(top==size-1){
    printf("Stack Overload\n");
  }
  else{
    top+=1;
  }
}
  
```

```

        stack[top]=item;
    }
}

int pop() {
    if(top===-1) {
        printf("Stack Underflow\n");
    }
    else{
        return stack[top--];
    }
}

void display(){
    if(top===-1){
        printf("Stack is empty!");
    }
    else{
        printf("Content of the stacks:");
        for(int i=0;i<=top;i++){
            printf("%d ",stack[i]);
        }printf("\n");
    }
}

void main(){
    int choice;
    while(1) {
        printf("Enter your options:\n");
        printf("1.Push\n2.Pop\n3.Display\n4.Exit\n");
        printf("Enter your choice:");
        scanf("%d",&choice);
        switch(choice){
            case 1:printf("Enter the element to be pushed
in:");scanf("%d",&item);push();break;
            case 2:if(top===-1){
                printf("stack is empty!\n");
            }else{
                printf("%d popped from stack\n", stack[top]);
            }
            pop();
        }
    }
}

```

```
        break;
    case 3:display();
        break;
    case 4:exit(0);
}
}
}

Enter your options:
1.Push
2.Pop
3.Display
4.Exit
Enter your choice:1
Enter the element to be pushed in:1
Enter your options:
1.Push
2.Pop
3.Display
4.Exit
Enter your choice:1
Enter the element to be pushed in:2
Enter your options:
1.Push
2.Pop
3.Display
4.Exit
Enter your choice:1
Enter the element to be pushed in:3
Enter your options:
1.Push
2.Pop
3.Display
4.Exit
Enter your choice:1
Enter the element to be pushed in:4
Stack Overload
Enter your options:
1.Push
2.Pop
3.Display
4.Exit
Enter your choice:3
Content of the stacks:1 2 3
Enter your options:
1.Push
2.Pop
3.Display
4.Exit
```

```
Enter your choice:2
3 popped from stack
Enter your options:
1.Push
2.Pop
3.Display
4.Exit
Enter your choice:2
2 popped from stack
Enter your options:
1.Push
2.Pop
3.Display
4.Exit
Enter your choice:2
1 popped from stack
Enter your options:
1.Push
2.Pop
3.Display
4.Exit
Enter your choice:2
stack is empty!
Stack Underflow
Enter your options:
1.Push
2.Pop
3.Display
4.Exit
Enter your choice:3
Stack is empty!Enter your options:
1.Push
2.Pop
3.Display
4.Exit
Enter your choice:4
PS C:\Users\Spandana\OneDrive\Documents\dsa programs\output>
```

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>
#include <stdlib.h>
#include <string.h>
int prec(char c) {
    if (c == '^')
        return 3;
    else if (c == '*' || c == '/')
        return 2;
    else if (c == '+' || c == '-')
        return 1;
    else
        return 0;
}
char associativity(char c) {
    if (c == '^')
        return 'R';
    return 'L';
}
```

```
void infix_to_postfix(const char *s) {
    int len = strlen(s);
    char * result = (char *) malloc (len+1);
    char * stack = (char *) malloc (len);
    int resultIndex = 0;
    int stackIndex = -1;
    if (!result || !stack) {
        printf("memory allocation failed!\n");
        return;
    }
    for (int i=0; i<len; i++) {
        char c = s[i];
        if ((c >='a' && c <='z') || (c >='A' && c <='Z') ||
            (c >='0' && c <='9')) {
            result[resultIndex] = c;
            resultIndex++;
        } else if (c == '^') {
            stack[stackIndex+1] = c;
            stackIndex++;
        } else if (c == '(') {
            stack[stackIndex+1] = c;
            stackIndex++;
        } else if (c == ')') {
            while (stack[stackIndex] != '(')
                result[resultIndex] = stack[stackIndex], resultIndex++;
            stackIndex--;
        } else {
            if (prec(c) > prec(stack[stackIndex])) {
                stack[stackIndex+1] = c;
                stackIndex++;
            } else {
                result[resultIndex] = stack[stackIndex];
                resultIndex++;
                stackIndex--;
            }
        }
    }
    result[resultIndex] = '\0';
    printf("%s\n", result);
}
```

```

        result[resultIndex + 1] = c;
    }

    else if (c == '(') {
        stack[++stackIndex] = c;
    }

    else if (c == ')') {
        while (stackIndex >= 0 && stack[stackIndex] != '(') {
            result[resultIndex + 1] = stack[stackIndex];
            stackIndex--;
        }
        stackIndex--;
    }

    else {
        while (stackIndex >= 0 && prec(c) < prec(stack[stackIndex])
               && (prec(c) == prec(stack[stackIndex]) &&
                   associativity(c) == '<=')) {
            result[resultIndex + 1] = stack[stackIndex - 1];
            stackIndex--;
        }
        stack[++stackIndex] = c;
    }

    result[resultIndex + 1] = stack[stackIndex - 1];
}

result[resultIndex] = '\0';
printf ("%s\n", result);
free(result);
free(stack);
}

int main() {
    char exp[] = "a+b*c*(d-e)*(f+g*h)-i";
    infix_to_postfix(exp);
    return 0;
}

```

dp seen
C/C++
calculator

O/p: abed^e=fg*h^*+^*+i-

```

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

#define MAX 5

char stack[MAX];
int top = -1;

```

```

void push(char c) {
    if (top < MAX - 1) {
        stack[++top] = c;
    }
}

char pop() {
    if (top >= 0) {
        return stack[top--];
    }
    return '\0';
}

char peek() {
    if (top >= 0) {
        return stack[top];
    }
    return '\0';
}

int precedence(char c) {
    switch (c) {
        case '+': return 1;
        case '-': return 1;
        case '*': return 2;
        case '/': return 2;
        case '^': return 3;
        default: return 0;
    }
}

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

```

```

void infixToPostfix(const char *infix, char *postfix) {
    int i = 0, j = 0;
    while (infix[i]) {
        if (isalnum(infix[i])) {
            postfix[j++] = infix[i];
        } else if (infix[i] == '(') {
            push(infix[i]);
        } else if (infix[i] == ')') {
            while (top != -1 && peek() != '(') {
                postfix[j++] = pop();
            }
            pop();
        } else if (isOperator(infix[i])) {
            while (top != -1 && precedence(peek()) >= precedence(infix[i])) {
                postfix[j++] = pop();
            }
            push(infix[i]);
        }
        i++;
    }
    while (top != -1) {
        postfix[j++] = pop();
    }
    postfix[j] = '\0';
}

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

    printf("Enter an infix expression: ");
    scanf("%s", infix);

    infixToPostfix(infix, postfix);
    printf("Postfix expression: %s\n", postfix);

    return 0;
}

```

```
Enter an infix expression: a+b*(c^d-e)^(f+g^h)-i  
Postfix expression: abcd^e-fgh^i^*+j-  
PS C:\Users\Spandana\OneDrive\Documents\dsa programs\output> |
```

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_size 10  
int front = -1, rear = -1, queue[Max_size];  
void insert(int value){  
    if (rear == Max_size - 1)  
        printf("Queue Overflow! Cannot insert\n");  
    else  
        if (front == -1)  
            front = 0;  
        rear++;  
        queue[rear] = value;  
        printf("Inserted %d into the queue\n", value);  
}  
void delete(){  
    if (front == -1 || front > rear)  
        printf("Queue underflow! Cannot delete\n");  
    else  
        printf("Deleted %d from the queue\n", queue[front]);  
    front++;  
}
```

```

void display()
{
    if (front == -1 || front > rear)
        printf ("Queue is Empty\n");
    else {
        printf ("Queue elements : ");
        for (int i = front; i <= rear; i++)
            printf ("%d ", queue[i]);
        printf ("\n");
    }
}

int main ()
{
    int choice, value;
    while (1) {
        printf ("\n 1. Insert\n");
        printf (" 2. Delete\n");
        printf (" 3. Display\n");
        printf (" 4. Exit\n");
        printf (" Enter your choice");
        scanf ("%d", &choice);
        switch (choice) {
            case 1: printf ("Enter value to insert : ");
                      scanf ("%d", &value);
                      insert (value);
                      break;
            case 2: delete();
                      break;
            case 3: display();
                      break;
            case 4: return 0;
            default: printf ("Invalid choice! Please enter again\n");
        }
    }
}

```

OB Seen
14/10/24

D/p:
 1 Insert
 2 Delete
 3. Display
 4 Exit
 Enter Y
 Enter Va
 Enter You
 Enter V
 Enter Y
 Enter V
 Enter I
 Enter E
 Enter Q
 Enter D
 Enter I
 Enter Enter

D/P:-

1. Insert
2. Delete
3. Display
4. Exit

Enter your choice: 1

Enter value to insert: 7

Enter your choice: 1

Enter Value to input: 8

Enter your choice: 1

Enter Value to insert: 9

Enter your choice: 2

Enter Deleted 7 from queue.

Enter Your choice: 3

Queue Elements:

8 9

Enter your choice: 3

Deleted 8 from queue

Enter your choice: 3

Deleted 9 from queue

Enter your choice: 3

Queue Underflow! Cannot delete

```
#include<stdio.h>
#include <stdlib.h>
#define size 3

int queue[size];
int front=-1;
int rear=-1;

void insert(int value) {
```

```

        if(rear==size-1){
            printf("Queue Overflow!\n");
        }
        else{
            front=0;
            rear++;
            queue[rear]=value;
            printf("%d is inserted into queue\n",value);
        }
    }

void delete(){
    if(front==-1 || front>rear){
        printf("Queue Underflow!\n");
    }
    else{
        printf("%d is deleted from the queue\n",queue[front]);
        front++;
    }
}

void display(){
    if(front==-1 || front>rear){
        printf("Queue is Empty\n");
    }
    else{
        printf("Queue elements are:");
        for(int i=front;i<=rear;i++){
            printf("%d ",queue[i]);
        }printf("\n");
    }
}

void main(){
    int value;
    int choice;
    while(1){
        printf("1.Insert\n2.Delete\n3.Display\n4.Exit\n");
        printf("Enter your choice:");
        scanf("%d",&choice);
        switch(choice){

```

```

        case 1:printf("Enter a value to insert:");
        scanf("%d",&value);
        insert(value);
        break;
    case 2:delete();
    break;
    case 3:display();
    break;
    case 4:exit(0);
    default:printf("Invalid choice!Please enter again");
}
}

1.Insert
2.Delete
3.Display
4.Exit
Enter your choice:1
Enter a value to insert:2
2 is inserted into queue
1.Insert
2.Delete
3.Display
4.Exit
Enter your choice:1
Enter a value to insert:4
4 is inserted into queue
1.Insert
2.Delete
3.Display
4.Exit
Enter your choice:1
Enter a value to insert:6
6 is inserted into queue
1.Insert
2.Delete
3.Display
4.Exit
Enter your choice:1
Enter a value to insert:8
Queue Overflow!
1.Insert
2.Delete
3.Display
4.Exit
Enter your choice:3
Queue elements are:2 4 6
1.Insert
2.Delete
3.Display
4.Exit

```

```
Enter your choice:2
2 is deleted from the queue
1.Insert
2.Delete
3.Display
4.Exit
Enter your choice:2
4 is deleted from the queue
1.Insert
2.Delete
3.Display
4.Exit
Enter your choice:2
6 is deleted from the queue
1.Insert
2.Delete
3.Display
4.Exit
Enter your choice:2
Queue Underflow!
1.Insert
2.Delete
3.Display
4.Exit
Enter your choice:3
Queue is Empty
1.Insert
2.Delete
3.Display
4.Exit
Enter your choice:4
PS C:\Users\Spandana\OneDrive\Documents\dsa programs\output> █
```

3b) 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

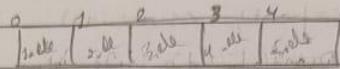
Lab Program - 4

WAP in C to show working of circular queue of integers using an array. Provide foll. operations

(a) Insert

(b) Delete

(c) Display



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

```
#define SIZE 5
```

```
int queue[SIZE], front = -1, rear = -1;
```

```
void insert(int ele)
```

```
{
```

```
    if ((front == 0 && rear == SIZE - 1) || (rear == (front - 1) %
```

(SIZE - 1))

```
)
```

printf ("Queue overflow");

```
    return;
```

```
}
```

```
else if (front == -1)
```

```
{
```

```
    front = rear = 0;
```

```
    queue[rear] = ele;
```

```
}
```

```
else if ((rear == SIZE - 1) && (front != 0))
```

```
{
```

```
    rear = 0;
```

```
    queue[rear] = ele;
```

```
}
```

```
else if (rear == SIZE - 1 && front != 0)
```

```
{
```

```
    rear = 0;
```

```
    queue[rear] = ele;
```

```
}
```

Ele se add kry

front = 0

rear = 1

queue[0] = 1

queue[1] = 2

queue[2] = 3

queue[3] = 4

queue[4] = 5

```

Date _____
Page _____
else
{
    rear++;
    queue[rear] = ele;
}
printf("Element %d has been inserted\n", ele);

void delete()
{
    if (front == -1)
    {
        printf("Queue Underflow!\n");
        return;
    }
    int temp = queue[front];
    printf("Element %d has been deleted\n", temp);
    if (front == rear)
    {
        front = rear = -1;
    }
    else
    {
        front++;
    }
}

void display()
{
    if (front == -1)
    {
        printf("Queue is Empty\n");
        return;
    }
    printf("Elements of queue are: ");
}

```

```

if (rear >= front)
{
    for (int i = front; i <= rear; i++)
    {
        printf("%d", queue[i]);
    }
}
else
{
    for (int i = 0; i <= rear; i++)
    {
        printf("%d", queue[i]);
    }
    printf("\n");
}

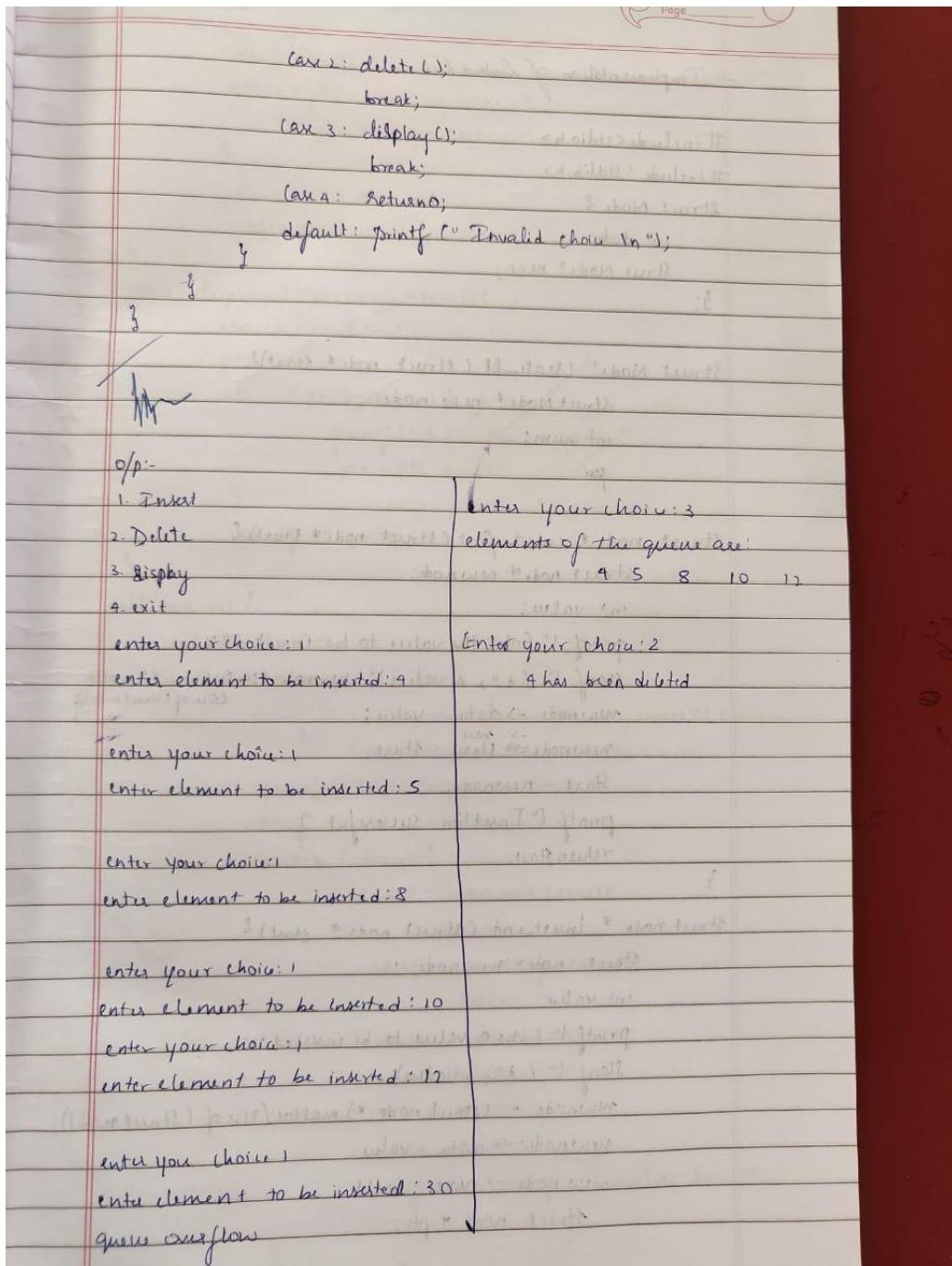
int main()
{
    int choice, ele;
    while (1)
    {
        printf("In Circular Queue Operators: \n");
        printf("1. Insert \n 2. Delete \n 3. Display \n 4. Exit \n");
        printf("Enter Your choice: ");
        scanf("%d", &choice);
        switch (choice)
        {
            case 1: printf("Enter elements to be inserted: ");
            scanf("%d", &ele);
            insert(ele);
            break;
        }
    }
}

```

o/p:

- 1. Insert
- 2. Delete
- 3. Display
- 4. Exit

enter



```
#include<stdio.h>
#define size 3
int queue [size], front=-1, rear=-1;
void insert (int ele)
{
    if ((front== 0 && rear== size -1) || (rear == (front-1)%(size-1)))
    {
        printf("queue overflow\n");
    }
}
```

```

        return;
    }
    else if (front == -1)
    {
        front=rear=0;
        queue[rear]=ele;
    }
    else if ((rear == size-1 )&& (front!=0))
    {
        rear=0;
        queue [rear] =ele;
    }
    else
    {
        rear++;
        queue[rear]= ele;
    }
    printf(" %d has been inserted\n", ele);
}
void delete()
{
    if (front == -1)
    {
        printf("queue underflow\n");
        return;
    }
    int temp = queue[front];
    printf("%d has been deleted", temp);
    if (front== rear)
    {
        front= rear= -1;
    }
    else if (front== size-1)
    {
        front =0;
    }
    else
    {
        front++;
    }
}

```

```

}

void display()
{
    if (front===-1)
    {
        printf("queue is empty");
        return;
    }
    printf("elements of the queue are:");
    if(rear>=front)
    {
        for(int i= front; i<= rear;i++)
        {
            printf("%d ", queue[i]);
        }
    }
    else
    {
        for(int i= front; i< size; i++)
        {
            printf("%d ", queue[i]);
        }
        for(int i=0; i<= rear;i++)
        {
            printf("%d ", queue[i]);
        }
    }
    printf("\n");
}
int main()
{
    int choice,ele;
    while (1)
    {
        printf("\n circular queue operators:\n");
        printf("1.insert\n2.delete\n3.display\n4.exit\n");
        printf("Enter your choice:");
        scanf("%d", &choice);
        switch(choice)
        {
            case 1: printf("enter element to be inserted ");

```

```

        scanf("%d",&ele);
        insert (ele);
        break;
    case 2: delete ();
        break;
    case 3: display();
        break;
    case 4: return 0;
    default: printf("invalid choice");
}
}

circular queue operators:
1.insert
2.delete
3.display
4.exit
Enter your choice:1
enter element to be inserted 5
5 has been inserted

circular queue operators:
1.insert
2.delete
3.display
4.exit
Enter your choice:1
enter element to be inserted 6
6 has been inserted

circular queue operators:
1.insert
2.delete
3.display
4.exit
Enter your choice:1
enter element to be inserted 7
7 has been inserted

circular queue operators:
1.insert
2.delete
3.display
4.exit
Enter your choice:1
enter element to be inserted 8
queue overflow

```

```
circular queue operators:  
1.insert  
2.delete  
3.display  
4.exit  
Enter your choice:3  
elements of the queue are:5 6 7  
  
circular queue operators:  
1.insert  
2.delete  
3.display  
4.exit  
Enter your choice:2  
5 has been deleted  
circular queue operators:  
1.insert  
2.delete  
3.display  
4.exit  
Enter your choice:2  
6 has been deleted  
circular queue operators:  
1.insert  
2.delete  
3.display  
4.exit  
Enter your choice:2  
7 has been deleted  
circular queue operators:  
1.insert  
2.delete  
3.display  
4.exit  
Enter your choice:2  
queue underflow
```

4.WAP to Implement Singly Linked List with following operations

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

Display the contents of the linked list.

Date 28/10/24
Page

Implementation of linked list

```

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

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

struct Node* Create_ll (struct node * start),  

    struct Node* new_node,  

    int num;  

    for

struct node* insert_first (struct node * start) {  

    struct node* newnode;  

    int value;  

    printf ("Enter the value to be inserted");  

    scanf ("%d", &value); newnode = (struct node*) malloc  

        (size of (struct node));  

    newnode->data = value;  

    newnode->next = start;  

    start = newnode;  

    printf ("Insertion successful");  

    return start;
}

struct node* insert_end (struct node * start) {  

    struct node* newnode;  

    int value;  

    printf ("Enter a value to be inserted");  

    scanf ("%d", &value);  

    newnode = (struct node*) malloc (size of (struct node));  

    newnode->data = value;  

    newnode->next = NULL  

    struct node* ptr;
}

```

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```

ptr = start;
while (ptr->next != NULL) {
    ptr = ptr->next;
}
ptr->next = new_node;
return start;
}

Void display (struct node *start) {
    struct node *ptr;
    ptr = start;
    while (ptr != NULL) {
        printf ("%d", ptr->data);
        ptr = ptr->next;
    }
    printf ("\n");
}

void main() {
    int choice=0;
    while (choice!=4) {
        printf (" 1. insert at end \n 2. insert at start \n
            3. display \n 4. Exit\n");
        scanf ("%d", &choice);
        switch (choice) {
            case 1: insert_end (start);
            break;
            case 2: insert_begin (start);
            break;
            case 3: display (start);
            break;
            case 4: exit (0);
            break;
            default: printf (" Invalid choice ");
            break;
        }
    }
}

```

O/P:-

1. Insert at first

2. Insert at last

3. Display

4. Exit

Enter your choice:)

Enter the value to be inserted:2

Insertion successful

Enter your choice:1

Enter the value to be inserted :1

Insertion successful

Enter your choice:2

Enter the value to be inserted :3

Enter your choice:2

Enter the value to be inserted :4

Enter your choice:3

1 → 2 → 3 → 4 → NULL

Enter your choice:4

_____ * _____ *

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

```
struct node {
    int data;
    struct node *next;
};
```

```

struct node* insert_begin(struct node *start) {
    struct node *newnode;
    int value;
    printf("enter a value to be inserted: ");
    scanf("%d", &value);
    newnode = (struct node *)malloc(sizeof(struct node));
    newnode->data = value;
    newnode->next = start;
    start = newnode;
    return start;
}

struct node* insert_end(struct node *start) {
    struct node *newnode, *ptr;
    int value;
    printf("enter a value to be inserted: ");
    scanf("%d", &value);
    newnode = (struct node *)malloc(sizeof(struct node));
    newnode->data = value;
    newnode->next = NULL;
    ptr = start;
    while(ptr->next != NULL) {
        ptr = ptr->next;
    }
    ptr->next = newnode;
    return start;
}

void display(struct node *start) {
    struct node *ptr = start;
    printf("the contents of the linked list are: ");
    while(ptr->next != NULL) {
        printf("%d -> ", ptr->data);
        ptr=ptr->next;
    }
    printf("%d\n", ptr->data);
}

int main() {
    struct node *start;
    start = (struct node*)malloc(sizeof(struct node));

```

```
int value;
printf("enter a value to insert at the start: ");
scanf("%d",&value);
start->data = value;
start->next = NULL;
int choice=0;
while(choice!=4){
    printf("\n1.INSERT BACK\n2.INSERT FRONT\n3.DISPLAY\n4.EXIT\n");
    printf("enter an option: ");
    scanf("%d",&choice);
    switch(choice){
        case 1: start = insert_end(start);
        break;
        case 2: start = insert_begin(start);
        break;
        case 3: display(start);
        break;
        case 4: break;
        default: printf("enter a valid option!!\n");
    }
}
return 0;
}
```

```
enter a value to insert at the start: 6
1.INSERT BACK
2.INSERT FRONT
3.DISPLAY
4.EXIT
enter an option: 1
enter a value to be inserted: 2

1.INSERT BACK
2.INSERT FRONT
3.DISPLAY
4.EXIT
enter an option: 1
enter a value to be inserted: 4

1.INSERT BACK
2.INSERT FRONT
3.DISPLAY
4.EXIT
enter an option: 2
enter a value to be inserted: 5

1.INSERT BACK
2.INSERT FRONT
3.DISPLAY
4.EXIT
enter an option: 2
enter a value to be inserted: 7

1.INSERT BACK
2.INSERT FRONT
3.DISPLAY
4.EXIT
enter an option: 3
the contents of the linked list are: 7 -> 5 -> 6 -> 2 -> 4
```

5.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 <string.h>~~

bool is

5a. Write a program to implement singly linked list with following operations.

- Create a linked list
- Deletion of first element, specified element and last element in the list.
- Display the contents of the linked list.

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

struct Node {

int data;

struct Node * next;

};
Struct Node* createNode(int data);

Struct Node* newnode = (Struct Node*) malloc (sizeof
Struct Node));

newnode->data = data;

newnode->next = Null;

return newnode;

void insertAtFirst (Struct Node** head, int data) {

Struct Node* newnode = createNode(data);

newnode->next = * head;

* head = newnode;

```

void deleteFirst (struct Node** head) {
    if (*head == NULL) {
        printf ("The list is empty");
        return;
    }

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

void deleteElement (struct Node** head, int key) {
    if (*head == NULL) {
        printf ("The list is empty");
        return;
    }

    struct Node* temp = *head, *prev=NULL;
    if (temp != NULL && temp->data == key) {
        *head = temp->next;
        free (temp);
        return;
    }

    while (temp != NULL && temp->data != key) {
        prev = temp;
        temp = temp->next;
    }

    if (temp == NULL) {
        printf ("Element not found");
        return;
    }

    prev->next = temp->next;
    free (temp);
}

```

```

void deleteLast (struct Node * * head) {
    if (*head == NULL) {
        printf ("The list is empty");
        return;
    }

    struct Node * temp = *head, * prev = NULL;
    if (temp->next == NULL) {
        *head = NULL;
        free (temp);
        return;
    }

    while (temp->next != NULL) {
        prev = temp;
        temp = temp->next;
    }

    prev->next = NULL;
    free (temp);
}

void displayList (struct Node * head) {
    if (head == NULL) {
        printf ("The list is empty");
        return;
    }

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

    printf ("NULL");
}

```

```

int main()
{
    struct Node * head = NULL;
    int choice, value;
    while(1)
    {
        printf("1. Insert element at first/n 2. Delete first element/n
        3. Delete specified element/n 4. Delete last element/n
        5. Display/n 6. Exit/n");
        printf("Enter your choice:");
        scanf("%d", &choice);

        switch(choice)
        {
            case 1: printf("Enter value to insert:");
                scanf("%d", &value);
                insertFirst(&head, value);
                break;
            case 2: deleteFirst(&head);
                break;
            case 3: printf("Enter value to delete:");
                scanf("%d", &value);
                deleteElement(&head, value);
                break;
            case 4: deleteLast(&head);
                break;
            case 5: displayList(head);
                break;
            case 6: exit(0);
            default: printf("Invalid choice");
        }
    }
    return 0;
}

```

1. Insert element at the ~~first~~
2. Delete first element
3. Delete Specified element
4. Delete last element
5. Display list
6. Exit

Enter your choice: 1
Enter value to insert: 5

Enter your choice: 1
Enter value to insert: 6

Enter your choice: 1
Enter value to insert: 7

Enter your choice: 2
Enter value to delete: 6

Enter your choice: 3
Enter value to delete: 6

Enter your choice: 5
7

Enter your choice: 1
Enter value to insert: 6

Enter your choice: 1
Enter value to insert: 5

Enter your choice: 4
Enter your choice: 5
Numbers are 5 6

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

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

```

struct Node* createNode(int data) {
    struct Node* newNode = (struct Node*)malloc(sizeof(struct Node));
    if (newNode == NULL) {
        printf("Memory allocation failed\n");
        return NULL;
    }
    newNode->data = data;
    newNode->next = NULL;
    return newNode;
}

void createList(struct Node** head) {
    int data;
    char choice;
    do {
        printf("Enter data for the new node: ");
        scanf("%d", &data);

        struct Node* newNode = createNode(data);

        if (*head == NULL) {
            *head = newNode;
        } else {
            struct Node* temp = *head;

            while (temp->next != NULL) {
                temp = temp->next;
            }
            temp->next = newNode;
        }

        printf("Do you want to add another node? (y/n): ");
        scanf(" %c", &choice);
    } while (choice == 'y' || choice == 'Y');
}

void displayList(struct Node* head) {
    if (head == NULL) {

```

```

        printf("The list is empty.\n");
        return;
    }

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

void deleteFirst(struct Node** head) {
    if (*head == NULL) {
        printf("The list is empty, cannot delete the first element.\n");
        return;
    }

    struct Node* temp = *head;
    *head = (*head)->next;
    free(temp);
    printf("First element deleted successfully.\n");
}

void deleteElement(struct Node** head, int data) {
    if (*head == NULL) {
        printf("The list is empty, cannot delete the element.\n");
        return;
    }

    struct Node* temp = *head;
    struct Node* prev = NULL;

    if (temp != NULL && temp->data == data) {
        *head = temp->next;
        free(temp);
        printf("Element %d deleted successfully.\n", data);
    }
}

```

```

        return;
    }

while (temp != NULL && temp->data != data) {
    prev = temp;
    temp = temp->next;
}

if (temp == NULL) {
    printf("Element %d not found in the list.\n", data);
    return;
}

prev->next = temp->next;
free(temp);
printf("Element %d deleted successfully.\n", data);
}

void deleteLast(struct Node** head) {
    if (*head == NULL) {
        printf("The list is empty, cannot delete the last element.\n");
        return;
    }

    if ((*head)->next == NULL) {
        free(*head);
        *head = NULL;
        printf("Last element deleted successfully.\n");
        return;
    }

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

```

```

        free(temp->next);
        temp->next = NULL;
        printf("Last element deleted successfully.\n");
    }

int main() {
    struct Node* head = NULL;
    int choice, element;

    do {
        printf("\nMenu:\n");
        printf("1. Create Linked List\n");
        printf("2. Display Linked List\n");
        printf("3. Delete First Element\n");
        printf("4. Delete Specified Element\n");
        printf("5. Delete Last Element\n");
        printf("6. Exit\n");
        printf("Enter your choice: ");
        scanf("%d", &choice);

        switch (choice) {
            case 1:
                createList(&head);
                break;
            case 2:
                displayList(head);
                break;
            case 3:
                deleteFirst(&head);
                break;
            case 4:
                printf("Enter the element to delete: ");
                scanf("%d", &element);
                deleteElement(&head, element);
                break;
            case 5:
                deleteLast(&head);
                break;
            case 6:
                printf("Exiting...\n");
                break;
        }
    } while (choice != 6);
}

```

```

        default:
            printf("Invalid choice. Please try again.\n");
    }

} while (choice != 6);

return 0;
}

Menu:
1. Create Linked List
2. Display Linked List
3. Delete First Element
4. Delete Specified Element
5. Delete Last Element
6. Exit
Enter your choice: 1
Enter data for the new node: 1
Do you want to add another node? (y/n): y
Enter data for the new node: 2
Do you want to add another node? (y/n): y
Enter data for the new node: 3
Do you want to add another node? (y/n): y
Enter data for the new node: 4
Do you want to add another node? (y/n): y
Enter data for the new node: 5
Do you want to add another node? (y/n): y
Enter data for the new node: 6
Do you want to add another node? (y/n): n

Menu:
1. Create Linked List
2. Display Linked List
3. Delete First Element
4. Delete Specified Element
5. Delete Last Element
6. Exit
Enter your choice: 2
Linked List: 1 -> 2 -> 3 -> 4 -> 5 -> 6 -> NULL

Menu:
1. Create Linked List
2. Display Linked List
3. Delete First Element
4. Delete Specified Element
5. Delete Last Element
6. Exit
Enter your choice: 3
First element deleted successfully.

```

```
Menu:  
1. Create Linked List  
2. Display Linked List  
3. Delete First Element  
4. Delete Specified Element  
5. Delete Last Element  
6. Exit  
Enter your choice: 4  
Enter the element to delete: 5  
Element 5 deleted successfully.
```

```
Menu:  
1. Create Linked List  
2. Display Linked List  
3. Delete First Element  
4. Delete Specified Element  
5. Delete Last Element  
6. Exit  
Enter your choice: 5  
Last element deleted successfully.
```

```
Menu:  
1. Create Linked List  
2. Display Linked List  
3. Delete First Element  
4. Delete Specified Element  
5. Delete Last Element  
6. Exit  
Enter your choice: 2  
Linked List: 2 -> 3 -> 4 -> NULL
```

```
Menu:  
1. Create Linked List  
2. Display Linked List  
3. Delete First Element  
4. Delete Specified Element  
5. Delete Last Element  
6. Exit  
Enter your choice: 6  
Exiting...
```

6.a) WAP to Implement Single Link List with following operations: Sortthelinkedlist, Reversethelinkedlist, Concatenation of two linked lists.

b) WAP to implement Singly linked list with foll. operations:
Sort the linked list.
Reverse the linked list.
Concatenation of 2 linked lists.

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

Struct Node {
    int data;
    Struct Node* next;
};

Struct Node* createNode (int data) {
    Struct Node* newNode = (Struct Node*) malloc (sizeof (Struct Node));
    newNode->data = data;
    newNode->next = NULL;
    return newNode;
}

void append (Struct Node** head, int data) {
    Struct Node* newNode = createNode (data);
    if (*head == NULL) {
        *head = newNode;
        return;
    }
    Struct Node* temp = *head;
    while (temp->next != NULL) {
        temp = temp->next;
    }
    temp->next = newNode;
}
```

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```

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

```

```

void sortList (struct Node ** head) {
    struct Node *i, *j;
    int temp;
    for (i = *head; i != NULL; i = i->next) {
        for (j = i->next; j != NULL; j = j->next) {
            if (i->data > j->data) {
                temp = i->data;
                i->data = j->data;
                j->data = temp;
            }
        }
    }
}

```

```

void reverseList (struct Node ** head) {
    struct Node *prev = NULL, *current = *head, *next = NULL;
    while (current != NULL) {
        next = current->next;
        current->next = prev;
        prev = current;
        current = next;
    }
    *head = prev;
}

```

```

struct Node* concatenate (struct Node* head1, struct Node* head2)
{
    if (head1 == NULL) return head2;
    if (head2 == NULL) return head1;

    struct Node* temp = head1;
    while ((temp->next != NULL) &
           temp->next != head2)
        temp = temp->next;
    temp->next = head2;
    return head1;
}

```

```

int main()
{
    struct Node* list1 = NULL;
    struct Node* list2 = NULL;
    int n1, n2, data, i;
    printf ("Enter the number of elements in list1 : ");
    scanf ("%d", &n1);
    printf ("Enter the elements of list1 : \n");
    for (i=0; i < n1, i++) {
        scanf ("%d", &data);
        append (&list1, data);
    }
    printf ("Enter the no. of elements in list2 : ");
    scanf ("%d", &n2);
    printf ("Enter the elements of list2 : \n");
    for (i=0; i < n2, i++) {
        scanf ("%d", &data);
        append (&list2, data);
    }
    printf ("List1 : ");
    display (list1);
    printf ("List2 : ");
    display (list2);
}

```

o/p:-

Enter the no. of elements in list1 : 4

Enter the elements of list1:

2
4
1
6

Enter the no. of elements in list2 : 3

Enter the elements of list2:

5
6
3

List1: 2 → 4 → 1 → 6 → NULL

List2: 5 → 6 → 3 → NULL

Sorted List1: 1 → 2 → 4 → 6 → NULL

Reversed List2: 6 → 4 → 2 → 1 → NULL

Concatenated List: 6 → 4 → 2 → 1 → 5 → 6 → 3 → NULL

✓ ✓ ✓

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

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

struct Node* createNode(int data) {
    struct Node* newNode = (struct Node*)malloc(sizeof(struct Node));
    newNode->data = data;
    newNode->next = NULL;
    return newNode;
}
```

```

newNode->data = data;
newNode->next = NULL;
return newNode;
}

void append(struct Node** head, int data) {
    struct Node* newNode = createNode(data);
    if (*head == NULL) {
        *head = newNode;
        return;
    }
    struct Node* temp = *head;
    while (temp->next != NULL) {
        temp = temp->next;
    }
    temp->next = newNode;
}

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

void sortList(struct Node** head) {
    struct Node* i, *j;
    int temp;
    for (i = *head; i != NULL; i = i->next) {
        for (j = i->next; j != NULL; j = j->next) {
            if (i->data > j->data) {
                temp = i->data;
                i->data = j->data;
                j->data = temp;
            }
        }
    }
}

```

```

    }

}

void reverseList(struct Node** head) {
    struct Node *prev = NULL, *current = *head, *next = NULL;
    while (current != NULL) {
        next = current->next;
        current->next = prev;
        prev = current;
        current = next;
    }
    *head = prev;
}

struct Node* concatenate(struct Node* head1, struct Node* head2) {
    if (head1 == NULL) return head2;
    if (head2 == NULL) return head1;

    struct Node* temp = head1;
    while (temp->next != NULL) {
        temp = temp->next;
    }
    temp->next = head2;
    return head1;
}

int main() {
    struct Node* list1 = NULL;
    struct Node* list2 = NULL;
    int n1, n2, data, i;

    printf("Enter the number of elements in List 1: ");
    scanf("%d", &n1);
    printf("Enter the elements of List 1:\n");
    for (i = 0; i < n1; i++) {
        scanf("%d", &data);
        append(&list1, data);
    }
}

```

```

printf("Enter the number of elements in List 2: ");
scanf("%d", &n2);
printf("Enter the elements of List 2:\n");
for (i = 0; i < n2; i++) {
    scanf("%d", &data);
    append(&list2, data);
}

printf("List 1: ");
display(list1);

printf("List 2: ");
display(list2);

sortList(&list1);
printf("Sorted List 1: ");
display(list1);

reverseList(&list1);
printf("Reversed List 1: ");
display(list1);

struct Node* mergedList = concatenate(list1, list2);
printf("Concatenated List: ");
display(mergedList);

return 0;
}

```

```

Enter the number of elements in List 1: 3
Enter the elements of List 1:
5
4
7
Enter the number of elements in List 2: 3
Enter the elements of List 2:
8
9
10
List 1: 5 -> 4 -> 7 -> NULL
List 2: 8 -> 9 -> 10 -> NULL
Sorted List 1: 4 -> 5 -> 7 -> NULL
Reversed List 1: 7 -> 5 -> 4 -> NULL
Concatenated List: 7 -> 5 -> 4 -> 8 -> 9 -> 10 -> NULL

```

6b) WAP to Implement Single Link List to simulate Stack & Queue Operations.

sk) WAP to implement Singly Link List to simulate stack and Queue operations.

```

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

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

struct Node * createNode(int data) {
    struct Node * next;
    struct Node * newNode = (struct Node *) malloc(sizeof(struct Node));
    newNode->data = data;
    newNode->next = NULL;
    return newNode;
}

void push (struct Node ** top, int data) {
    struct Node * newNode = createNode(data);
    newNode->next = *top;
    *top = newNode;
}

int pop (struct Node ** top) {
    if (*top == NULL) {
        printf ("Stack Underflow \n");
        return -1;
    }
}

```

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```

int data = (*top) -> data;
Struct node *temp = *top;
*top = (*top) -> next;
free (temp);
return data;
}

void enqueue (struct node *front, struct node *rear, int
data) {
    Struct Node *newNode = NewNode (data);
    if (*rear == NULL) {
        *front = *rear = newNode;
        return;
    }
    (*rear) -> next = newNode;
    *rear = newNode;
}

int dequeue (struct Node **front) {
    if (*front == NULL) {
        printf ("Queue underflow\n");
        return 1;
    }
    int data = (*front) -> data;
    Struct node *temp = *front;
    *front = (*front) -> next;
    free (temp);
    return data;
}

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

```

```

int main() {
    struct node * stack = NULL;
    struct node * front = NULL, * rear = NULL;
    int choice, data;
    while (1) {
        printf (" 1. Push (Stack) In, 2. Pop (Stack) In,
               3. Display Stack In 4. Enqueue (Queue) In
               5. Dequeue (Queue) In 6. Display Queue
               7. Exit (n)");
        printf ("Enter Your Choice : ");
        scanf ("%d", &choice);
        switch (choice) {
            case 1: printf ("Enter Value to Push : ");
                      scanf ("%d", &data);
                      push (&stack, data);
                      break;
            case 2: printf ("Popped : %d \n", pop (&stack));
                      break;
            case 3: printf ("Stack");
                      display (stack);
                      break;
            case 4: printf ("Enter Value to Enqueue : ");
                      scanf ("%d", &data);
                      enqueue (&front, &rear, data);
                      break;
            case 5: printf ("Dequeue : %d \n", dequeue (front));
                      break;
            case 6: printf ("Queue");
                      display (front);
                      break;
            case 7: exit (0);
            default: printf ("Invalid Choice In");
        }
    }
}

```

o/p:- 1. Push (stack) 2. Pop (stack) 3. Display Stack 4. Enqueue (Queue) 5. Dequeue (Queue) 6. Display Queue 7. Exit.	
Enter Your choice: 1 Enter value to push: 5	Enter your choice: 4 Enter value to enqueue: 6
Enter your choice: 1 Enter value to push: 6	Enter Your choice: 4 Enter value to enqueue: 7
Enter your choice: 1 Enter value to push: 7	Enter your choice: 5 Enter value to Dequeue: 5
Enter Your choice: 2 popped: 7	Enter Your choice: 6 Queue: 6 → 7 → NULL
Enter Your choice: 3 Stack: 6 → 5 → NULL	Enter Your choice: 7
Enter Your choice: 4 Enter Value to enqueue: 5	

```

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

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

struct Node* createNode(int data) {
    struct Node* newNode = (struct Node*)malloc(sizeof(struct Node));
    newNode->data = data;
    newNode->next = NULL;
    return newNode;
}

int main() {
    struct Node* head = NULL;
    struct Node* current = NULL;
    struct Node* previous = NULL;
    int choice, value;
    while (choice != 7) {
        printf("Enter Your choice: ");
        scanf("%d", &choice);
        switch (choice) {
            case 1:
                printf("Enter value to push: ");
                scanf("%d", &value);
                current = createNode(value);
                if (head == NULL) {
                    head = current;
                } else {
                    previous->next = current;
                }
                previous = current;
                break;
            case 2:
                if (head == NULL) {
                    printf("Stack is empty\n");
                } else {
                    previous = head;
                    head = head->next;
                    free(previous);
                }
                break;
            case 3:
                if (head == NULL) {
                    printf("Stack is empty\n");
                } else {
                    current = head;
                    head = head->next;
                    free(current);
                }
                break;
            case 4:
                printf("Enter value to enqueue: ");
                scanf("%d", &value);
                current = createNode(value);
                if (head == NULL) {
                    head = current;
                } else {
                    current->next = head;
                    head = current;
                }
                break;
            case 5:
                if (head == NULL) {
                    printf("Queue is empty\n");
                } else {
                    current = head;
                    head = head->next;
                    free(current);
                }
                break;
            case 6:
                if (head == NULL) {
                    printf("Queue is empty\n");
                } else {
                    current = head;
                    head = head->next;
                    free(current);
                }
                break;
            case 7:
                printf("Exiting...\n");
                break;
            default:
                printf("Invalid choice\n");
        }
    }
    return 0;
}

```

```

newNode->data = data;
newNode->next = NULL;
return newNode;
}

void push(struct Node** top, int data) {
    struct Node* newNode = createNode(data);
    newNode->next = *top;
    *top = newNode;
}

int pop(struct Node** top) {
    if (*top == NULL) {
        printf("Stack Underflow\n");
        return -1;
    }
    int data = (*top)->data;
    struct Node* temp = *top;
    *top = (*top)->next;
    free(temp);
    return data;
}

void enqueue(struct Node** front, struct Node** rear, int data) {
    struct Node* newNode = createNode(data);
    if (*rear == NULL) {
        *front = *rear = newNode;
        return;
    }
    (*rear)->next = newNode;
    *rear = newNode;
}

int dequeue(struct Node** front) {
    if (*front == NULL) {
        printf("Queue Underflow\n");
        return -1;
    }
    int data = (*front)->data;

```

```

        struct Node* temp = *front;
        *front = (*front)->next;
        free(temp);
        return data;
    }

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

int main() {
    struct Node* stack = NULL;
    struct Node *front = NULL, *rear = NULL;

    int choice, data;

    while (1) {
        printf("\nMenu:\n");
        printf("1. Push (Stack)\n");
        printf("2. Pop (Stack)\n");
        printf("3. Display Stack\n");
        printf("4. Enqueue (Queue)\n");
        printf("5. Dequeue (Queue)\n");
        printf("6. Display Queue\n");
        printf("7. Exit\n");
        printf("Enter your choice: ");
        scanf("%d", &choice);

        switch (choice) {
            case 1:
                printf("Enter value to push: ");
                scanf("%d", &data);
                push(&stack, data);
                break;
        }
    }
}

```

```

    case 2:
        printf("Popped: %d\n", pop(&stack));
        break;

    case 3:
        printf("Stack: ");
        display(stack);
        break;

    case 4:
        printf("Enter value to enqueue: ");
        scanf("%d", &data);
        enqueue(&front, &rear, data);
        break;

    case 5:
        printf("Dequeued: %d\n", dequeue(&front));
        break;

    case 6:
        printf("Queue: ");
        display(front);
        break;

    case 7:
        exit(0);

    default:
        printf("Invalid choice!\n");
    }
}
return 0;
}

```

```
Menu:  
1. Push (Stack)  
2. Pop (Stack)  
3. Display Stack  
4. Enqueue (Queue)  
5. Dequeue (Queue)  
6. Display Queue  
7. Exit  
Enter your choice: 1  
Enter value to push: 1  
  
Menu:  
1. Push (Stack)  
2. Pop (Stack)  
3. Display Stack  
4. Enqueue (Queue)  
5. Dequeue (Queue)  
6. Display Queue  
7. Exit  
Enter your choice: 1  
Enter value to push: 2  
  
Menu:  
1. Push (Stack)  
2. Pop (Stack)  
3. Display Stack  
4. Enqueue (Queue)  
5. Dequeue (Queue)  
6. Display Queue  
7. Exit  
Enter your choice: 1  
Enter value to push: 3  
  
Menu:  
1. Push (Stack)  
2. Pop (Stack)  
3. Display Stack  
4. Enqueue (Queue)  
5. Dequeue (Queue)  
6. Display Queue  
7. Exit  
Enter your choice: 3  
Stack: 3 -> 2 -> 1 -> NULL  
Menu:  
1. Push (Stack)  
2. Pop (Stack)  
3. Display Stack  
4. Enqueue (Queue)  
5. Dequeue (Queue)  
6. Display Queue  
7. Exit  
Enter your choice: 2  
Popped: 3  
  
Menu:  
1. Push (Stack)  
2. Pop (Stack)  
3. Display Stack  
4. Enqueue (Queue)  
5. Dequeue (Queue)  
6. Display Queue  
7. Exit  
Enter your choice: 4  
Enter value to enqueue: 1  
  
Menu:  
1. Push (Stack)  
2. Pop (Stack)  
3. Display Stack  
4. Enqueue (Queue)  
5. Dequeue (Queue)  
6. Display Queue  
7. Exit  
Enter your choice: 4  
Enter value to enqueue: 2  
  
Menu:  
1. Push (Stack)  
2. Pop (Stack)  
3. Display Stack  
4. Enqueue (Queue)  
5. Dequeue (Queue)  
6. Display Queue  
7. Exit  
Enter your choice: 4  
Enter value to enqueue: 3
```

```
Menu:  
1. Push (Stack)  
2. Pop (Stack)  
3. Display Stack  
4. Enqueue (Queue)  
5. Dequeue (Queue)  
6. Display Queue  
7. Exit  
Enter your choice: 6  
Queue: 1 -> 2 -> 3 -> NULL  
  
Menu:  
1. Push (Stack)  
2. Pop (Stack)  
3. Display Stack  
4. Enqueue (Queue)  
5. Dequeue (Queue)  
6. Display Queue  
7. Exit  
Enter your choice: 5  
Dequeued: 1  
  
Menu:  
1. Push (Stack)  
2. Pop (Stack)  
3. Display Stack  
4. Enqueue (Queue)  
5. Dequeue (Queue)  
6. Display Queue  
7. Exit  
Enter your choice: 7  
PS C:\Users\Spandana\OneDrive\Documents\dsa programs\output>
```

7.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

- 7] WAP to implement doubly linked list with primitive operations.
- 1] Create a doubly linked list.
 - 2] Insert a new node at the beginning.
 - 3] Insert the node based on a specific location.
 - 4] Insert a new node at the end.
 - 5] Display the contents of the list.

```
struct Node {
```

```
    int data;
```

```
    struct Node * prev;
```

```
    struct Node * next;
```

```
};
```

```
struct Node * head, * tail;
```

```
}
```

```
void insertBeg (int x)
```

```
{
```

```
    struct Node * newnode;
```

```
    newnode = (struct Node *) malloc (sizeof (struct Node));
```

```
    newnode-> data = x;
```

```
    newnode-> prev = NULL;
```

```
    if (head == NULL)
```

```
    {
```

```
        head = tail = newnode;
```

```
        newnode-> head = NULL;
```

```
}
```

```
else
```

```
{
```

```
    newnode-> next = head;
```

```
    head-> prev = newnode;
```

```
    head = newnode;
```

```
}
```

```
createNode (* createdlist (int data))
```

```
struct Node * newnode;
```

```
struct Node * SmallerOrEqual (Node * head,
```

```
    Node * now);
```

```
newnode-> data = data;
```

```
newnode-> next = NULL;
```

```
newnode-> prev = NULL;
```

```
initial otherwise true
```

```

void insertEnd(int x)
{
    struct node * newnode;
    newnode = (struct node *) malloc (sizeof (struct node));
    newnode->next = NULL;
    if (head == NULL)
    {
        head = tail = newnode;
        newnode->prev = NULL;
    }
    else
    {
        newnode->prev = tail;
        tail->next = newnode;
        tail = newnode;
    }
}

void insertPos (int x)
{
    struct node * newnode, *temp;
    int pos;
    printf ("Enter the position");
    scanf ("%d", &pos);
    if (pos == 1)
    {
        void insertBeg (x);
    }
    else
    {
        newnode = (struct node *) malloc (sizeof (struct node));
        newnode->data = x;
        newnode->next = NULL;
        newnode->prev = NULL;
        temp = head;
    }
}

```

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```

for (int i=1; i<pos-1; i++)
{
    temp = temp->next;
    if (temp == tail->next)
        {
            printf ("There are less than %d nodes", pos);
            return;
        }
    newnode->prev = temp;
    newnode->next = temp->node;
    temp->next = newnode;
    newnode->next->prev = newnode;
}
    
```

Void display () {

```

struct node *temp;
if (head == NULL)
{
    printf ("list is empty");
}
else
{
    temp = head;
    while (temp != NULL)
    {
        printf ("%d", temp->data);
        temp = temp->next;
    }
}
    
```

```

int main()
{
    int choice, data;
    struct node* head = NULL;

    while(1)
    {
        printf("1. Create doubly linked list\n");
        printf("2. Insert at beginning\n");
        printf("3. Insert at end & Print\n");
        printf("4. Display\n");
        printf("Enter your choice: ");
        scanf("%d", &choice);

        switch(choice)
        {
            case 1:
                printf("Enter 1st node value: ");
                scanf("%d", &data);
                head = createlist(data);
                break;
            case 2:
                printf("Enter the data: ");
                scanf("%d", &data);
                insertBeg(data);
                break;
            case 3:
                printf("Enter the data: ");
                scanf("%d", &data);
                insertEnd(data);
                break;
            case 4:
                printf("Enter the data: ");
                scanf("%d", &data);
                insertAtPos(data);
                break;
            case 5:
                display();
                break;
            case 6:
                exit(0);
            default:
                printf("Invalid choice\n");
                break;
        }
    }
}

```

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o/p:- 1. Create linked list
 2. Insert at Beginning
 3. Insert at End
 4. Insert at position.
 5. Display
 6. Exit
 Enter your choice: 1
 Enter 1st node value: 8
 Enter your choice: 2
 Enter the data: 5
 Enter your choice: 3
 Enter the data: 4
 Enter your choice: 4
 Enter the data: 3
 Enter your choice: 5
 Enter the data: 6
 Enter your choice: 5
 3 → 4 → 5 → 8 → 6
 Enter your choice: 4
 Enter your data: 7
 Enter your pos: 3
 Enter your choice: 5
 3 → 4 → 7 → 5 → 8 → 6

~~MR~~

```
#include <stdio.h>
#include <stdlib.h>
struct Node{
  int data;
  struct Node* next;
  struct Node* prev;
}; struct node *head, *tail;
```

```

struct Node* createList(int data) {
    struct Node* newNode = (struct Node*)malloc(sizeof(struct Node));
    newNode->data = data;
    newNode->next = NULL;
    newNode->prev = NULL;
    return newNode;
}

void insertAtBeginning(struct Node** head, int data) {
    struct Node* newNode = (struct Node*)malloc(sizeof(struct Node));
    newNode->data = data;
    newNode->next = *head;
    newNode->prev = NULL;

    if (*head != NULL) {
        (*head)->prev = newNode;
    }
    *head = newNode;
    printf("Inserted %d at the beginning.\n", data);
}

void insertAtPosition(struct Node** head, int data, int position) {
    struct Node* newNode = (struct Node*)malloc(sizeof(struct Node));
    struct Node* temp = *head;
    int count = 1;

    newNode->data = data;

    if (position == 1) {
        newNode->next = *head;
        newNode->prev = NULL;
        if (*head != NULL) {
            (*head)->prev = newNode;
        }
        *head = newNode;
        printf("Inserted %d at position %d.\n", data, position);
        return;
    }

    while (temp != NULL && count < position - 1) {

```

```

        temp = temp->next;
        count++;
    }

    if (temp == NULL) {
        printf("Position out of bounds.\n");
        return;
    }

    newNode->next = temp->next;
    newNode->prev = temp;

    if (temp->next != NULL) {
        temp->next->prev = newNode;
    }
    temp->next = newNode;
    printf("Inserted %d at position %d.\n", data, position);
}

void insertAtEnd(struct Node** head, int data) {
    struct Node* newNode = (struct Node*)malloc(sizeof(struct Node));
    struct Node* temp = *head;
    newNode->data = data;
    newNode->next = NULL;

    if (*head == NULL) {
        newNode->prev = NULL;
        *head = newNode;
        printf("List was empty. Inserted %d as the first node.\n", data);
        return;
    }

    while (temp->next != NULL) {
        temp = temp->next;
    }

    temp->next = newNode;
    newNode->prev = temp;
    printf("Inserted %d at the end.\n", data);
}

```

```

void displayList(struct Node* head) {
    struct Node* temp = head;
    if (head == NULL) {
        printf("The list is empty.\n");
        return;
    }

    printf("Doubly Linked List contents:\n");
    while (temp != NULL) {
        printf("%d <=> ", temp->data);
        temp = temp->next;
    }
    printf("NULL\n");
}

int main() {
    struct Node* head = NULL;
    int choice, data, position;

    while(1) {
        printf("\nMenu:\n");
        printf("1. Create the doubly linked list\n");
        printf("2. Insert a new node at the beginning\n");
        printf("3. Insert a new node at a specific position\n");
        printf("4. Insert a new node at the end\n");
        printf("5. Display the contents of the list\n");
        printf("6. Exit\n");

        printf("Enter your choice: ");
        scanf("%d", &choice);

        switch (choice) {
            case 1:
                printf("Enter the first node's value: ");
                scanf("%d", &data);
                head = createList(data);
                printf("List created with first node having value: %d\n",
data);
                break;

            case 2:

```

```

        printf("Enter the value to insert at the beginning: ");
        scanf("%d", &data);
        insertAtBeginning(&head, data);
        break;

    case 3:
        printf("Enter the value to insert: ");
        scanf("%d", &data);
        printf("Enter the position: ");
        scanf("%d", &position);
        insertAtPosition(&head, data, position);
        break;

    case 4:
        printf("Enter the value to insert at the end: ");
        scanf("%d", &data);
        insertAtEnd(&head, data);
        break;

    case 5:
        displayList(head);
        break;

    case 6:
        exit(0);

default:
    printf("Invalid choice. Please try again.\n");
}

}

return 0;
}

```

```
Menu:  
1. Create the doubly linked list  
2. Insert a new node at the beginning  
3. Insert a new node at a specific position  
4. Insert a new node at the end  
5. Display the contents of the list  
6. Exit  
Enter your choice: 1  
Enter the first node's value: 2  
List created with first node having value: 2
```

```
Menu:  
1. Create the doubly linked list  
2. Insert a new node at the beginning  
3. Insert a new node at a specific position  
4. Insert a new node at the end  
5. Display the contents of the list  
6. Exit  
Enter your choice: 1  
Enter the first node's value: 5  
List created with first node having value: 5
```

```
Menu:  
1. Create the doubly linked list  
2. Insert a new node at the beginning  
3. Insert a new node at a specific position  
4. Insert a new node at the end  
5. Display the contents of the list  
6. Exit  
Enter your choice: 1  
Enter the first node's value: 9  
List created with first node having value: 9
```

```
Menu:  
1. Create the doubly linked list  
2. Insert a new node at the beginning  
3. Insert a new node at a specific position  
4. Insert a new node at the end  
5. Display the contents of the list  
6. Exit  
Enter your choice: 1  
Enter the first node's value: 14  
List created with first node having value: 14  
Menu:  
1. Create the doubly linked list  
2. Insert a new node at the beginning  
3. Insert a new node at a specific position  
4. Insert a new node at the end  
5. Display the contents of the list  
6. Exit  
Enter your choice: 2  
Enter the value to insert at the beginning: 3  
Inserted 3 at the beginning.
```

```
Menu:  
1. Create the doubly linked list  
2. Insert a new node at the beginning  
3. Insert a new node at a specific position  
4. Insert a new node at the end  
5. Display the contents of the list  
6. Exit  
Enter your choice: 3  
Enter the value to insert: 7  
Enter the position: 4  
Position out of bounds.
```

```
Menu:  
1. Create the doubly linked list  
2. Insert a new node at the beginning  
3. Insert a new node at a specific position  
4. Insert a new node at the end  
5. Display the contents of the list  
6. Exit  
Enter your choice: 4  
Enter the value to insert at the end: 18  
Inserted 18 at the end.
```

```
Menu:  
1. Create the doubly linked list  
2. Insert a new node at the beginning  
3. Insert a new node at a specific position  
4. Insert a new node at the end  
5. Display the contents of the list  
6. Exit  
Enter your choice: 5  
Doubly Linked List contents:  
3 <=> 14 <=> 18 <=> NULL  
  
Menu:  
1. Create the doubly linked list  
2. Insert a new node at the beginning  
3. Insert a new node at a specific position  
4. Insert a new node at the end  
5. Display the contents of the list  
6. Exit  
Enter your choice: 6
```

8. 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.

- 8) WAP a) To construct a binary tree search
b) To traverse the tree using all-the methods i.e., in-order, pre-order and post-order, display all traversal.

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

struct Node* createNode(int data){
    struct Node *newNode = (struct Node*) malloc (sizeof(struct Node));
    newNode->data = data;
    newNode->left = NULL;
    newNode->right = NULL;
    return newNode;
}

struct Node* insert (struct Node* root, int data) {
    if (root == NULL) {
        root = createNode (data);
    }
    else if (data < root->data) {
        root->left = insert (root->left, data);
    }
    else if (data > root->data) {
        root->right = insert (root->right, data);
    }
    return root;
}
```

```

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```

```

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

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

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

int main() {
    struct Node* root = NULL;
    int choice, value;
    printf ("1. Insert a node\n, 2. In-order Traversal\n");
    printf ("3. Preorder Traversal\n, 4. Postorder Traversal\n, 5. Exit\n");
    while (1) {
        printf ("Enter your choice:");
        scanf ("%d", &choice);
    }
}

```

```

Switch(choice) {
    case 1: printf ("Enter the value to insert: ");
    scanf ("%d", &value);
    root = insert (root, value);
    break;
    case 2: preInOrderTraversal (root);
    break;
    case 3: preOrderTraversal (root);
    break;
    case 4: postOrderTraversal (root);
    break;
    case 5: exit (0);
    default: printf ("Invalid choice");
}

```

Op:-

Enter

1. Insert a node
2. In-order Traversal
3. Pre-order Traversal
4. Post-order Traversal

5. Exit

Enter Your choice: 1

Enter value to insert: 6

Enter Your choice: 1

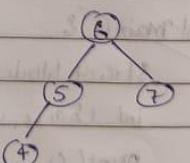
Enter value to insert: 5

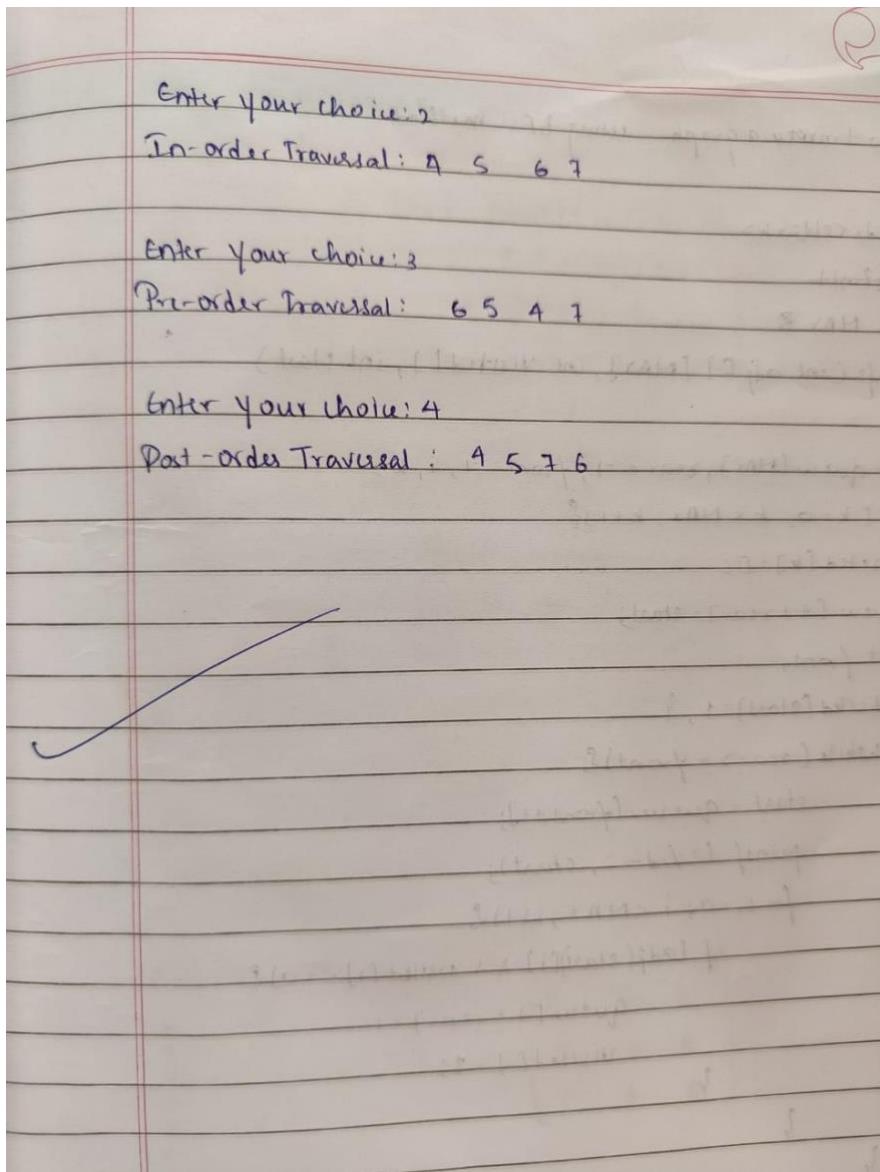
Enter Your choice: 1

Enter value to insert: 7

Enter Your choice: 1

Enter value to insert: 4





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

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

struct Node* createNode(int data) {
    struct Node* newNode = (struct Node*)malloc(sizeof(struct Node));
    newNode->data = data;
    newNode->left = NULL;
    newNode->right = NULL;
    return newNode;
}
```

```

newNode->data = data;
newNode->left = NULL;
newNode->right = NULL;
return newNode;
}

struct Node* insert(struct Node* root, int data) {
    if (root == NULL) {
        root = createNode(data);
    } else if (data < root->data) {
        root->left = insert(root->left, data);
    } else {
        root->right = insert(root->right, data);
    }
    return root;
}

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

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

void postOrderTraversal(struct Node* root) {
    if (root != NULL) {
        postOrderTraversal(root->left);
        postOrderTraversal(root->right);
    }
}

```

```

        printf("%d ", root->data);
    }
}

int main() {
    struct Node* root = NULL;
    int choice, value;

    printf("Binary Search Tree Operations\n");
    printf("1. Insert a node\n");
    printf("2. In-order Traversal\n");
    printf("3. Pre-order Traversal\n");
    printf("4. Post-order Traversal\n");
    printf("5. Exit\n");

    while (1) {
        printf("\nEnter your choice: ");
        scanf("%d", &choice);

        switch (choice) {
            case 1:
                printf("Enter the value to insert: ");
                scanf("%d", &value);
                root = insert(root, value);
                break;
            case 2:
                printf("In-order Traversal: ");
                inOrderTraversal(root);
                printf("\n");
                break;
            case 3:
                printf("Pre-order Traversal: ");
                preOrderTraversal(root);
                printf("\n");
                break;
            case 4:
                printf("Post-order Traversal: ");
                postOrderTraversal(root);
                printf("\n");
                break;
        }
    }
}

```

```

        case 5:
            exit(0);
        default:
            printf("Invalid choice. Please try again.\n");
    }
}

return 0;
}

Binary Search Tree Operations
1. Insert a node
2. In-order Traversal
3. Pre-order Traversal
4. Post-order Traversal
5. Exit

Enter your choice: 1
Enter the value to insert: 67

Enter your choice: 1
Enter the value to insert: 45

Enter your choice: 1
Enter the value to insert: 90

Enter your choice: 1
Enter the value to insert: 50

Enter your choice: 1
Enter the value to insert: 72

Enter your choice: 2
In-order Traversal: 45 50 67 72 90

Enter your choice: 3
Pre-order Traversal: 67 45 50 90 72

Enter your choice: 4
Post-order Traversal: 50 45 72 90 67

Enter your choice: 5

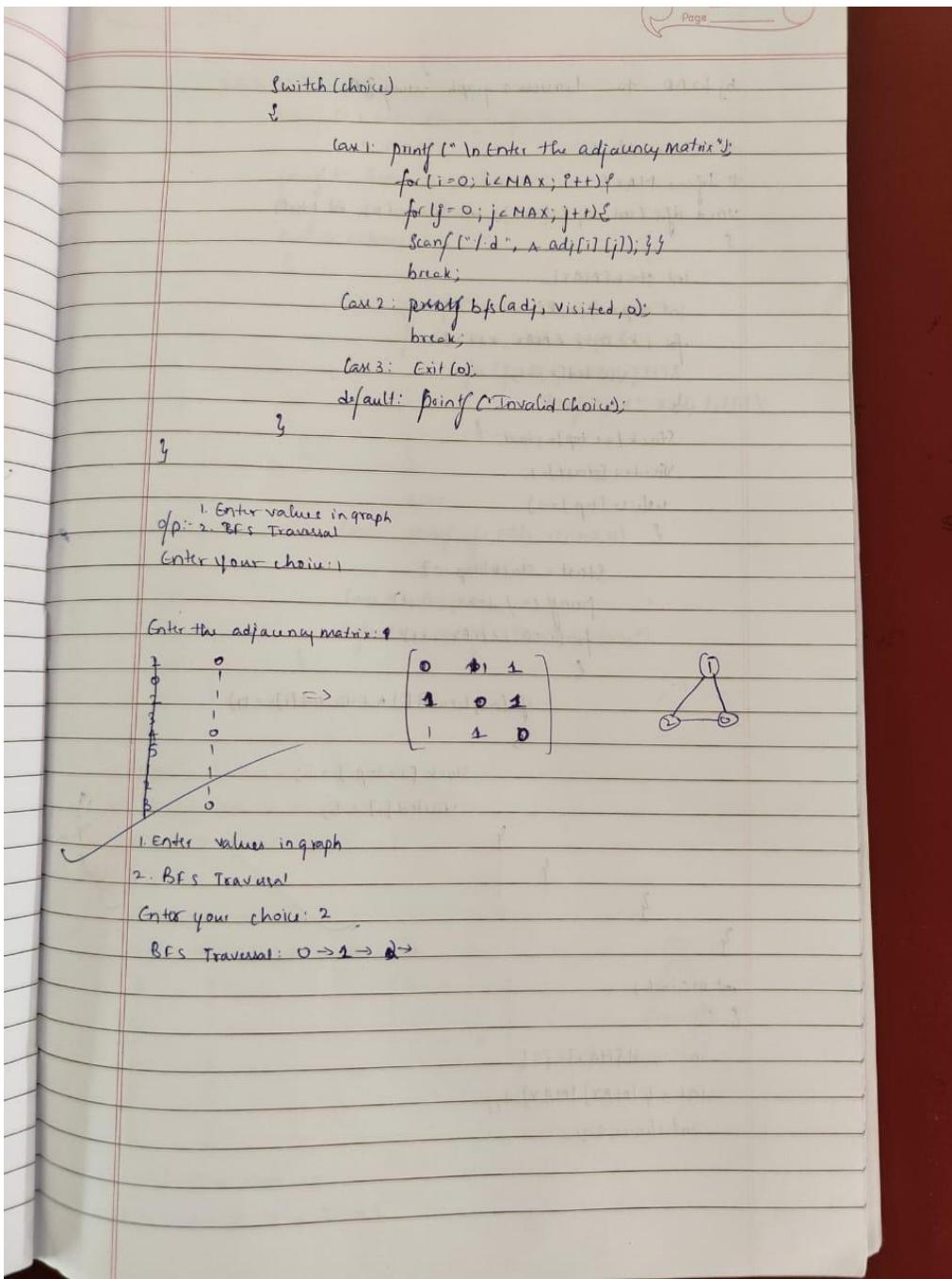
```

9.9a) Write a program to traverse a graph using BFS method.

9.a) WAP to traverse a graph using BFS method.

```
#include <stdio.h>
void bfs(int)
{
    #define MAX 3
    void bfs(int adj[MAX][MAX], int visited[], int start)
    {
        int queue[MAX], rear = -1, front = -1, i, k;
        for (k = 0; k < MAX; k++)
            visited[k] = 0;
        queue[++rear] = start;
        ++front;
        Visited[start] = 1;
        while (rear >= front)
        {
            start = queue[front++];
            printf("%d ", start);
            for (i = 0; i < MAX; i++)
                if ((adj[start][i] > 0) && (visited[i] == 0))
                    queue[++rear] = i;
            visited[i] = 1;
        }
    }
}
```

```
int main()
{
    int visited[MAX] = {0};
    int adj[MAX][MAX], i, j;
    int op;
    choice, size;
    while (1)
    {
        printf("1. Enter value in graph\n");
        printf("2. BFS Traversal\n");
        printf("Enter your choice:");
        scanf("%d", &choice);
    }
}
```



```
#include<stdio.h>
#define MAX 4
void bfs(int adj [] [MAX], int visited[], int start)
{
    int queue[MAX], rear=-1, front=-1, i, k;
    for (k=0; k<MAX; k++)
        visited[k]=0;
    queue[++rear]=start;
    ++front;
    visited[start]=1;
```

```

while(rear>=front)
{
    start=queue[front++];
    printf("%d->",start);
    for(i=0;i<MAX;i++)
    {
        if(adj[start][i]&&visited[i]==0)
        {
            queue[++rear]=i;
            visited[i]=1;
        }
    }
}

int main()
{
    int visited[MAX]={0};
    int adj[MAX][MAX],i,j;
    int option,size;
    do{
        printf("\n *****Main Menu*****\n");
        printf("\n 1. Enter values in graph ");
        printf("\n 2. BFS Traversal");

        printf("\n \n Enter your choice:");
        scanf("%d",&option);
        switch(option)
        {
            case 1: printf("\n Enter the adjacency matrix:\n");
                      for(i=0;i<MAX;i++) {
                          for(j=0;j<MAX;j++) {
                              scanf("%d",&adj[i][j]);
                          }
                      }
                      break;

            case 2: printf("BFS Traversal:");
        }
    }
}

```

```

        bfs(adj,visited,0);
        break;

    }
}while(option!=3);
return 0;
}

*****Main Menu*****
1. Enter values in graph
2. BFS Traversal

Enter your choice:1

Enter the adjacency matrix:
0
1
1
1
1
0
0
1
1
1
1
0
1
1
1
1
0

*****Main Menu*****
1. Enter values in graph
2. BFS Traversal

Enter your choice:2
BFS Traversal:0->1->2->3->

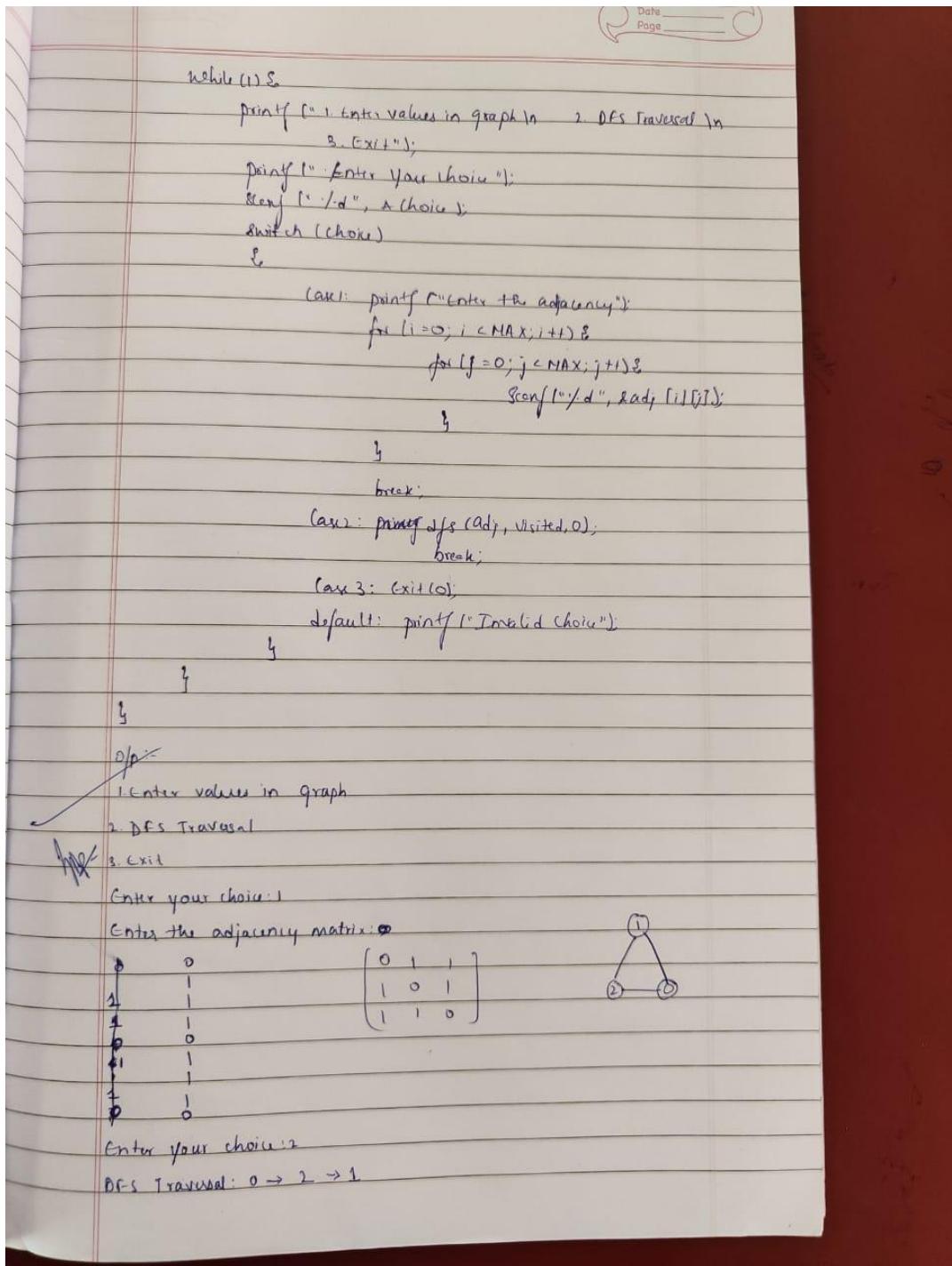
```

9b) Write a program to check whether given graph is connected or not using DFS method.

b] WAP to traverse a graph using DFS

```
#include <stdio.h>
#define MAX 5
void dfs(int adj[MAX][MAX], int Visited[], int start)
{
    int stack[MAX];
    int top = -1, i, k;
    for (k = 0; k < MAX; k++)
        Visited[k] = 0;
    stack[++top] = start;
    Visited[start] = 1;
    while (top != -1)
    {
        start = stack[top--];
        printf("-/-d->", start);
        for (i = 0; i < MAX; i++)
        {
            if (adj[start][i] && Visited[i] == 0)
            {
                stack[++top] = i;
                Visited[i] = 1;
            }
        }
    }
}

int main()
{
    int Visited[MAX] = {0};
    int adj[MAX][MAX], i, j;
    int choice, size;
```



```
#include<stdio.h>
#define MAX 3

void dfs(int adj[][MAX], int visited[], int start)
{
    int stack[MAX];
    int top = -1, i, k;
```

```

for(k = 0; k < MAX; k++) {
    visited[k] = 0;
}

stack[++top] = start;
visited[start] = 1;

while(top != -1)
{
    start = stack[top--];
    printf("%d -> ", start);

    for(i = 0; i < MAX; i++)
    {
        if(adj[start][i] && visited[i] == 0)
        {
            stack[++top] = i;
            visited[i] = 1;
        }
    }
}

int main()
{
    int visited[MAX] = {0};
    int adj[MAX][MAX], i, j;
    int option, size;

    do {

        printf("\n 1. Enter values in graph ");
        printf("\n 2. DFS Traversal");
        printf("\n 3. Exit");
        printf("\n \nEnter your choice: ");
        scanf("%d", &option);
    }
}

```

```

switch(option)
{
    case 1:
        printf("\n Enter the adjacency matrix:\n");
        for(i = 0; i < MAX; i++) {
            for(j = 0; j < MAX; j++) {
                scanf("%d", &adj[i][j]);
            }
        }
        break;

    case 2:
        printf("\n DFS Traversal: ");
        dfs(adj, visited, 0);
        printf("\n");
        break;

    case 3:
        printf("\n Exiting program.\n");
        break;

    default:
        printf("\n Invalid option. Please try again.\n");
}
} while(option != 3);

return 0;
}

```

```
1. Enter values in graph  
2. DFS Traversal  
3. Exit
```

Enter your choice: 1

Enter the adjacency matrix:

```
0  
1  
1  
1  
0  
1  
1  
1  
0
```

```
1. Enter values in graph  
2. DFS Traversal  
3. Exit
```

Enter your choice: 2

DFS Traversal: 0 -> 2 -> 1 ->

```
1. Enter values in graph  
2. DFS Traversal  
3. Exit
```

Enter your choice: 3

Exiting program.