VISVESVARAYA TECHNOLOGICAL UNIVERSITY

"JnanaSangama", Belgaum -590014, Karnataka.

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

B.M.S. COLLEGE OF ENGINEERING
(Autonomous Institution under VTU)

BENGALURU-560019
Sep-2024 to Jan-2025

B.M.S. College of Engineering,
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Department of Computer Science and Engineering

CERTIFICATE

This is to certify that the Lab work entitled "Data Structures using C Lab (23CS3PCDST)"carried out by **Spandana M R(1BM23CS337),** who is bonafide student of **B.M.S.College of Engineering.** It is in partial fulfillment for the award of **Bachelor of Engineering inComputer 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.

Prasad G R Assistant Professor Department of CSE, BMSCE	Dr. Kavitha Sooda Professor & HOD Department of CSE, BMSCE

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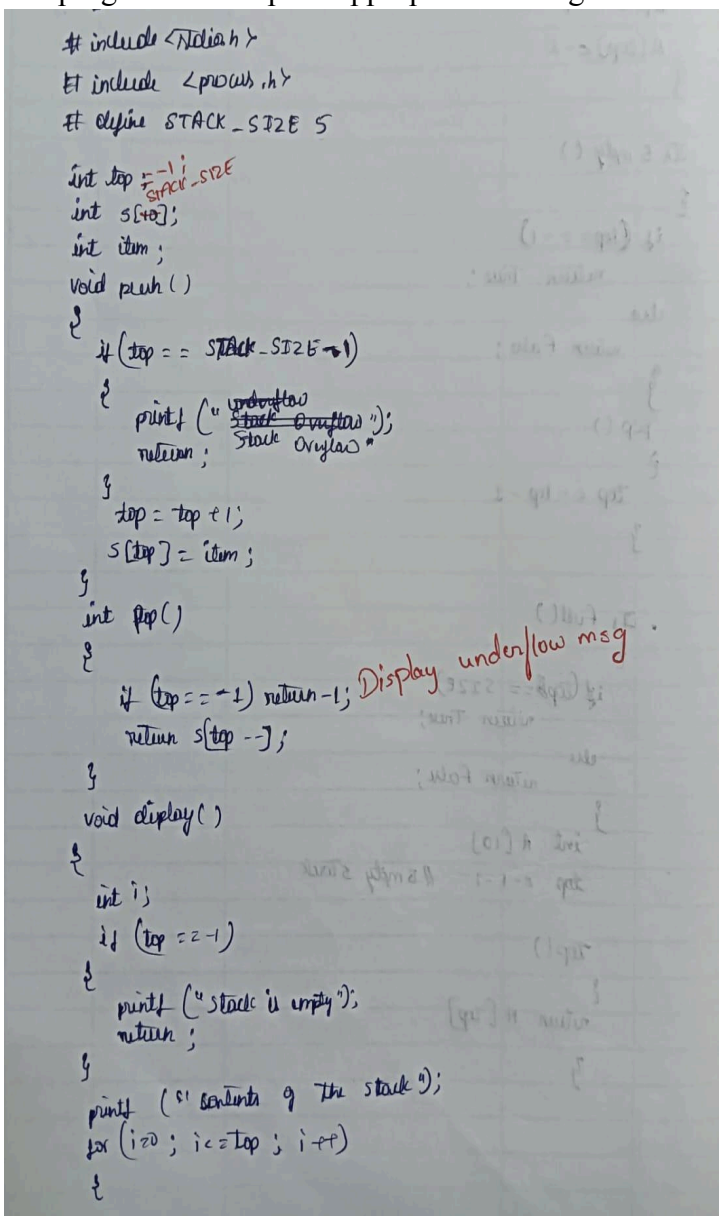
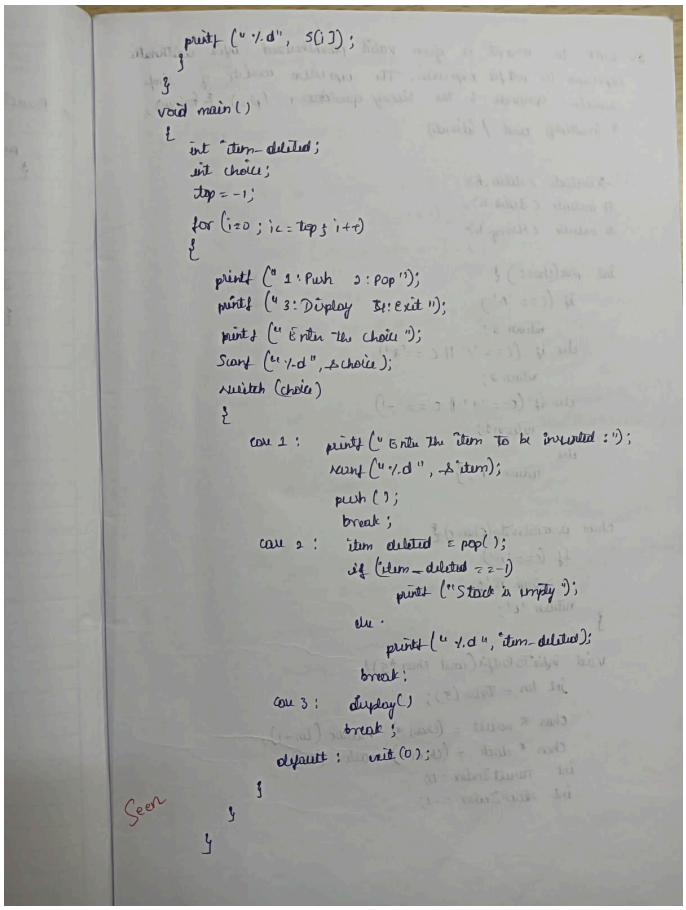
Github Link:
https://github.com/Spandana-mr/DS.C

Lab Programs:

1.Write a program to simulate the working of stack using an

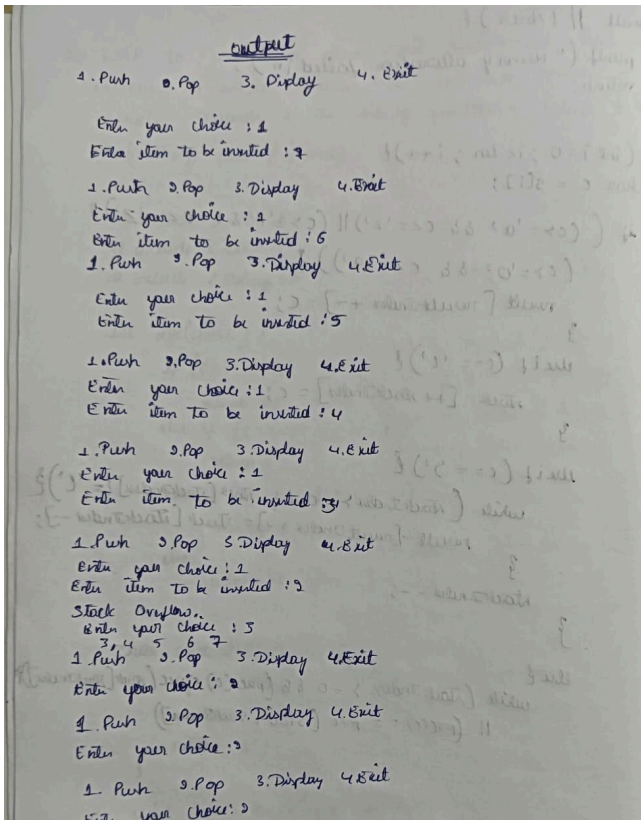
array with the following:
a) Push
b) Pop
c) Display
The program should print appropriate messages for stack overflow, stack underflow





```
        printf ("%d", S[i]);
    }
}
void main()
{
    int item_deleted;
    int choice;
    top = -1;
    for (i=0; i<=top; i++)
    {
        printf ("1:Push 2:Pop");
        printf ("3:Display 4:Exit");
        printf ("Enter the choice");
        scanf ("%d", &choice);
        switch (choice)
        {
            case 1: printf ("Enter the item to be inserted:");
                    scanf ("%d", &item);
                    push();
                    break;
            case 2: item_deleted = pop();
                    if (item_deleted == -1)
                        printf ("Stack is empty");
                    else
                        printf ("%d", item_deleted);
                    break;
            case 3: display()
                    break;
            default: exit(0);
        }
    }
}
```

Seen



output

1. Push 2. Pop 3. Display 4. Exit

Enter your choice : 1
Enter item to be inserted : 7

1. Push 2. Pop 3. Display 4. Exit
Enter your choice : 1
Enter item to be inserted : 6
1. Push 2. Pop 3. Display 4. Exit

Enter your choice : 1
Enter item to be inserted : 5

1. Push 2. Pop 3. Display 4. Exit
Enter your choice : 1
Enter item to be inserted : 4

1. Push 2. Pop 3. Display 4. Exit
Enter your choice : 1
Enter item to be inserted : 3

1. Push 2. Pop 3. Display 4. Exit
Enter your choice : 1
Enter item to be inserted : 2
Stack Overflow..
Enter your choice : 3
3, 4 5 6 7
1. Push 2. Pop 3. Display 4. Exit
Enter your choice : 2
1. Push 2. Pop 3. Display 4. Exit
Enter your choice : 2

1. Push 2. Pop 3. Display 4. Exit
Enter your choice : 2

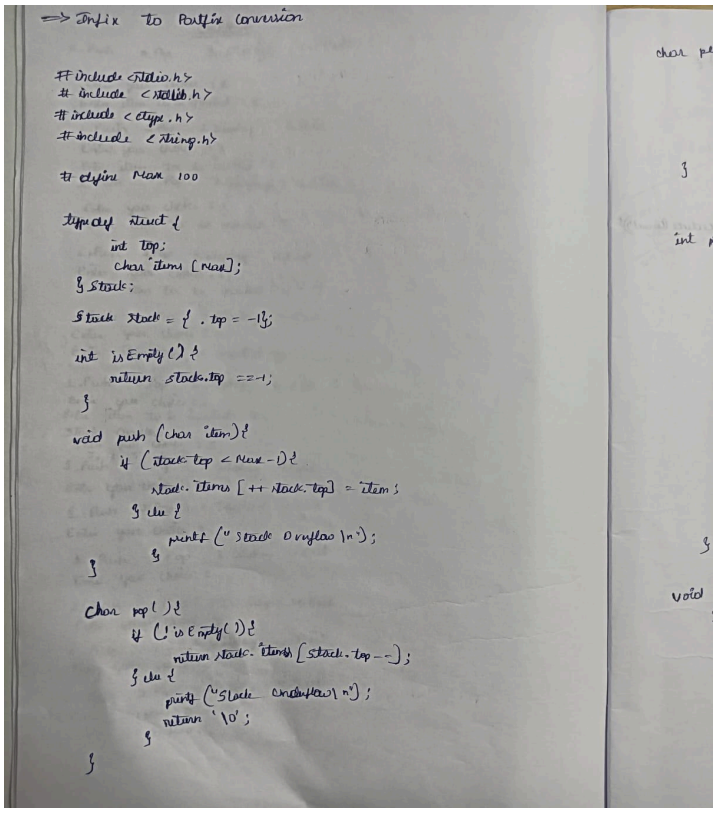
```c
#include<stdio.h>
#include<stdlib.h>
#define size 3

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);
        }
    }
}
```

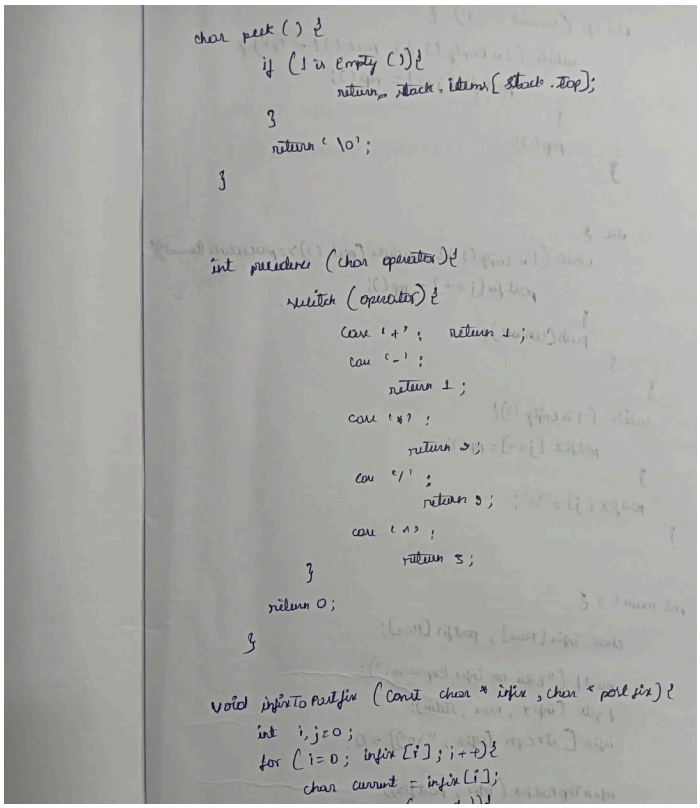
```
Enter your options:
1.Push
2.Pop
3.Display
4.Exit
Enter your choice:1
Enter the element to be pushed in:1
Enter your options:
1.Push
2.Pop
3.Display
4.Exit
Enter your choice:1
Enter the element to be pushed in:2
Enter your options:
1.Push
2.Pop
3.Display
4.Exit
Enter your choice:1
Enter the element 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>
```

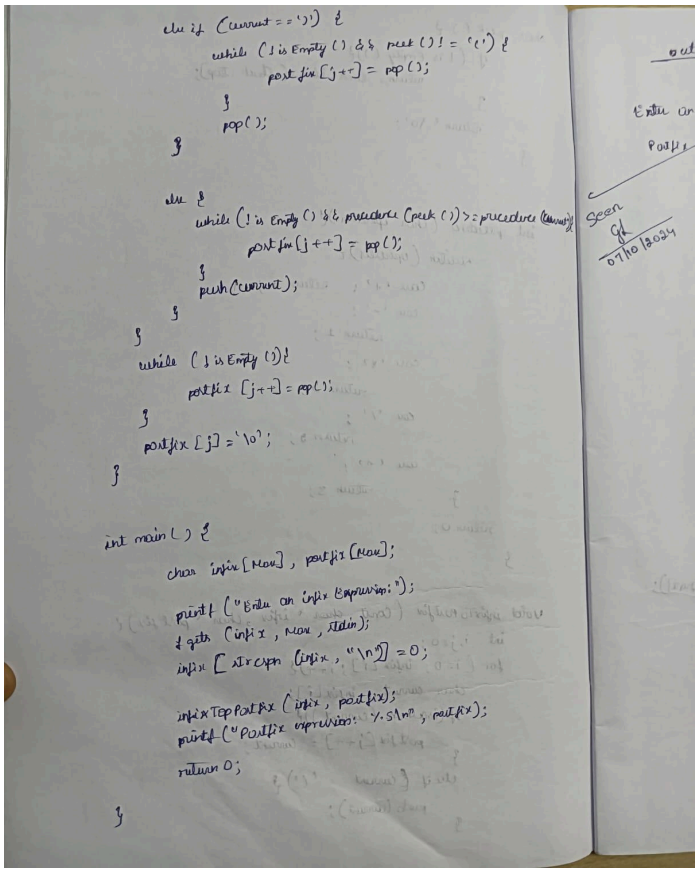
2.WAP to convert a given valid parenthesized infix arithmetic expression to postfix expression. The expression consists of single character operands and the binary operators + (plus),- (minus), * (multiply) and / (divide)



```
==> Infix to Postfix conversion

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

#define Max 100

typedef struct {
    int top;
    char items[Max];
} Stack;

Stack stack = { .top = -1 };

int isEmpty() {
    return stack.top == -1;
}

void push(char item) {
    if (stack.top < Max - 1) {
        stack.items[++stack.top] = item;
    } else {
        printf("Stack Overflow\n");
    }
}

char pop() {
    if (!isEmpty()) {
        return stack.items[stack.top--];
    } else {
        printf("Stack Underflow\n");
        return '\0';
    }
}
```



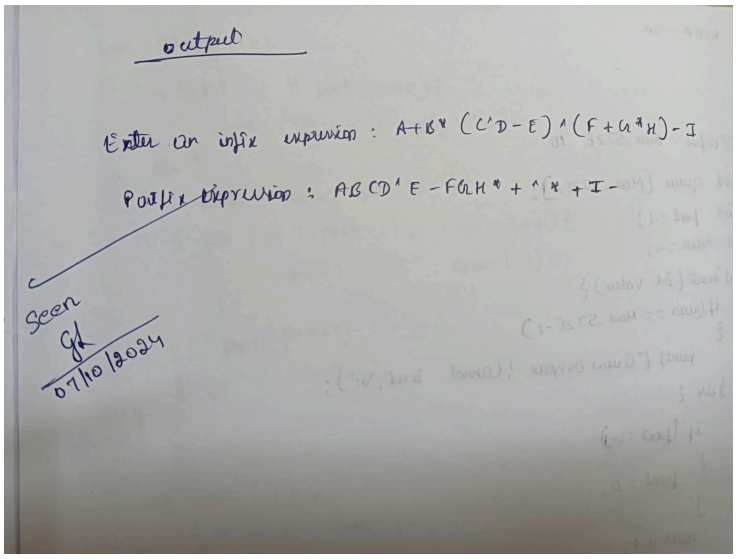
```
char peek() {
    if (!isEmpty()) {
        return stack.items[stack.top];
    }
    return '\0';
}

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

void infixToPostfix(const char *infix, char *postfix) {
    int i, j=0;
    for (i=0; infix[i]; i++) {
        char current = infix[i];
```



```
    else if (current == ')') {
        while (!isEmpty() && peek() != '(') {
            postfix[j++] = pop();
        }
        pop();
    }

    else {
        while (!isEmpty() && precedence(peek()) >= precedence(current)) {
            postfix[j++] = pop();
        }
        push(current);
    }
}
while (!isEmpty()) {
    postfix[j++] = pop();
}
postfix[j] = '\0';
}

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

    printf("Enter an infix expression: ");
    fgets(infix, MAX, stdin);
    infix[strcspn(infix, "\n")] = 0;

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

    return 0;
}
```

Enter an
Postfix

Seen
07/10/2024



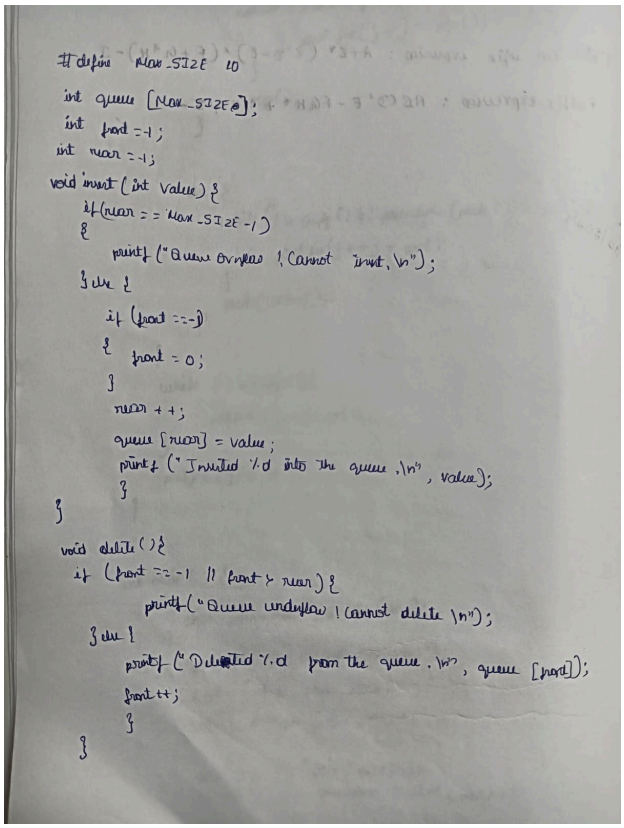

```c
#include <stdio.h>
#include <stdlib.h>
#include <ctype.h>
#include <string.h>

#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++;
```

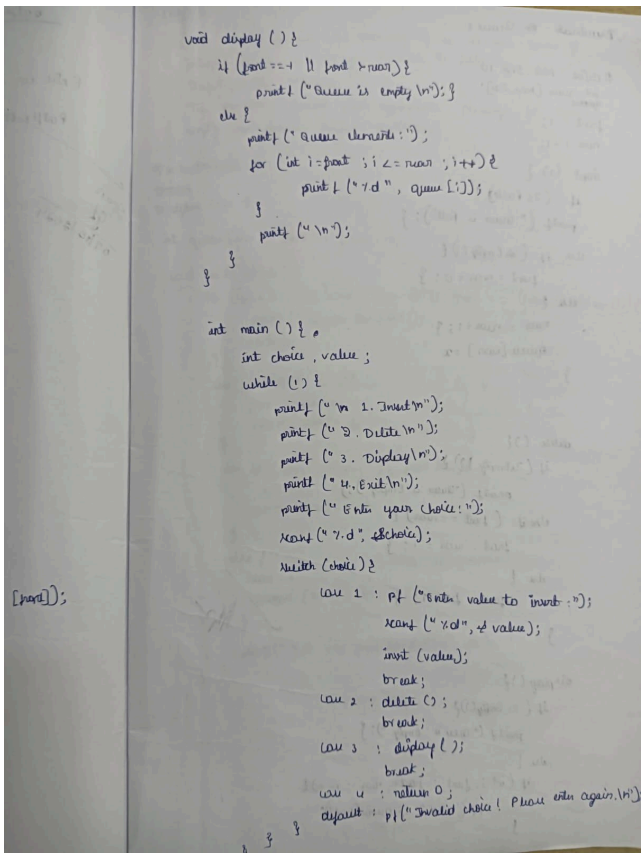
```
    }
    while (top != -1) {
        postfix[j++] = pop();
    }
    postfix[j] = '\0';
}

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-
PS C:\Users\Spandana\OneDrive\Documents\dsa programs\output>
```

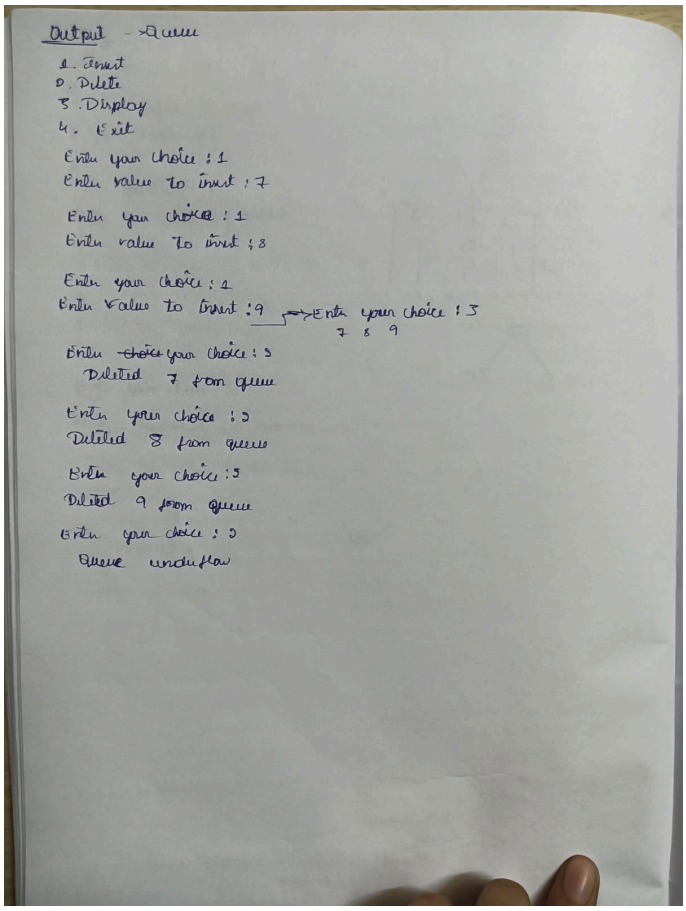
3.3a) WAP to simulate the working of a queue of integers using an array. Provide the following operations: Insert,Delete, Display The program should print appropriate messages for queue empty and queue overflow conditions



```
#define MAX_SIZE 10
int queue[MAX_SIZE];
int front = -1;
int rear = -1;
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) {
[front]);
            case 1: pf("Enter value to insert:");
                    scanf("%d", &value);
                    insert(value);
                    break;
            case 2: delete();
                    break;
            case 3: display();
                    break;
            case 4: return 0;
            default: pf("Invalid choice! Please enter again.\n");
        }
    }
```




```c
#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);
    }
}
```

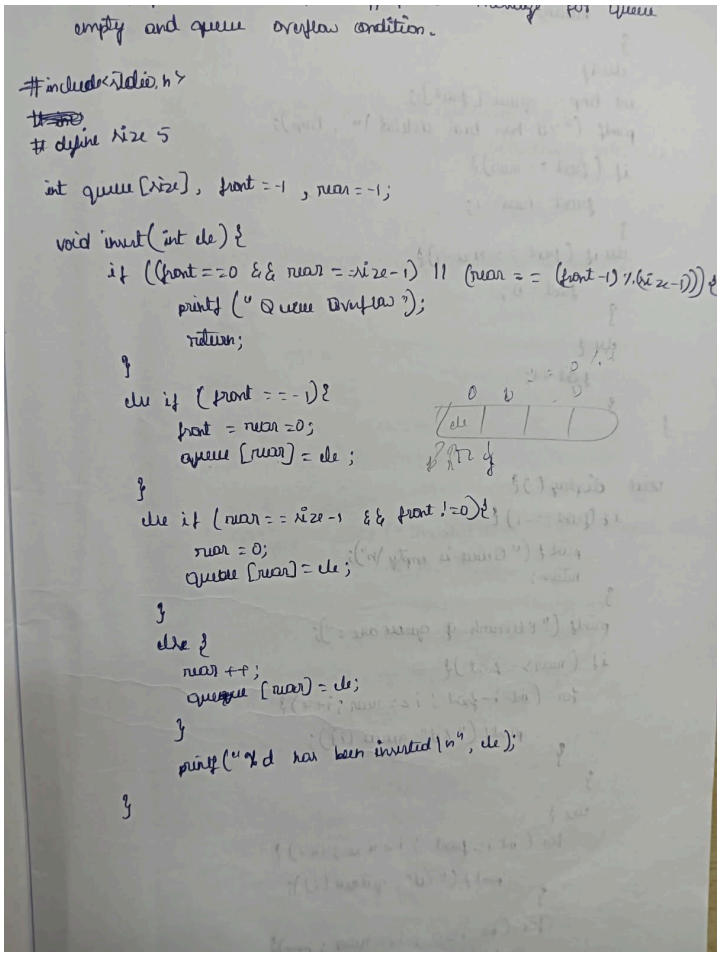
```
void delete(){
    if(front==-1||front>rear){
        printf("Queue Underflow!\n");
    }
    else{
        printf("%d is deleted from the queue\n",queue[front]);
        front++;
    }
}

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");
```

```
            }

        }

}
```

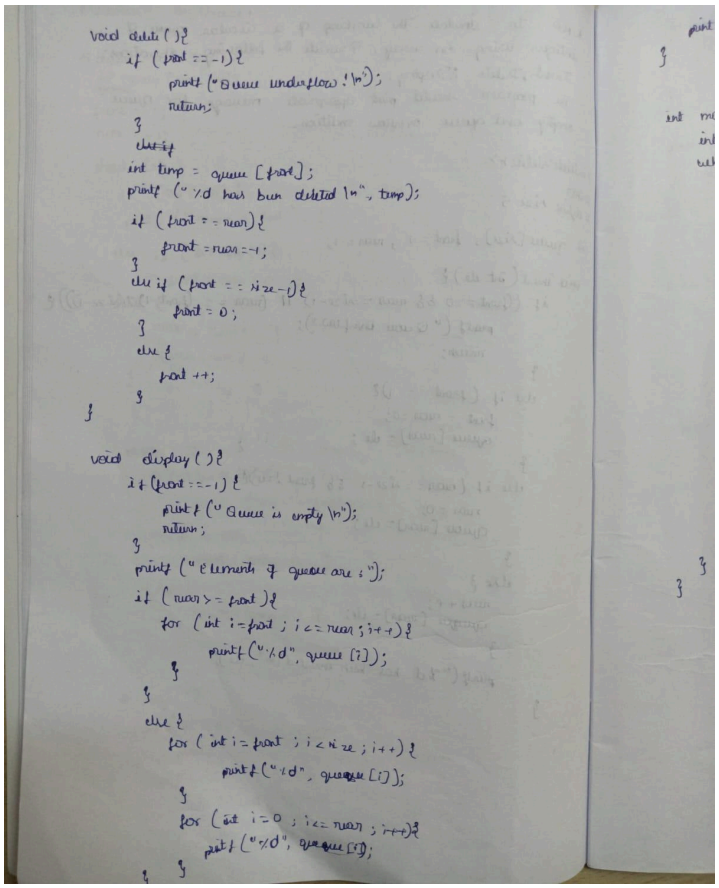
```
1.Insert
2.Delete
3.Display
4.Exit
Enter your choice:1
Enter a value to insert:2
2 is inserted into queue
1.Insert
2.Delete
3.Display
4.Exit
Enter your choice:1
Enter a value to insert:4
4 is inserted into queue
1.Insert
2.Delete
3.Display
4.Exit
Enter your choice:1
Enter a value to insert:6
6 is 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>
```

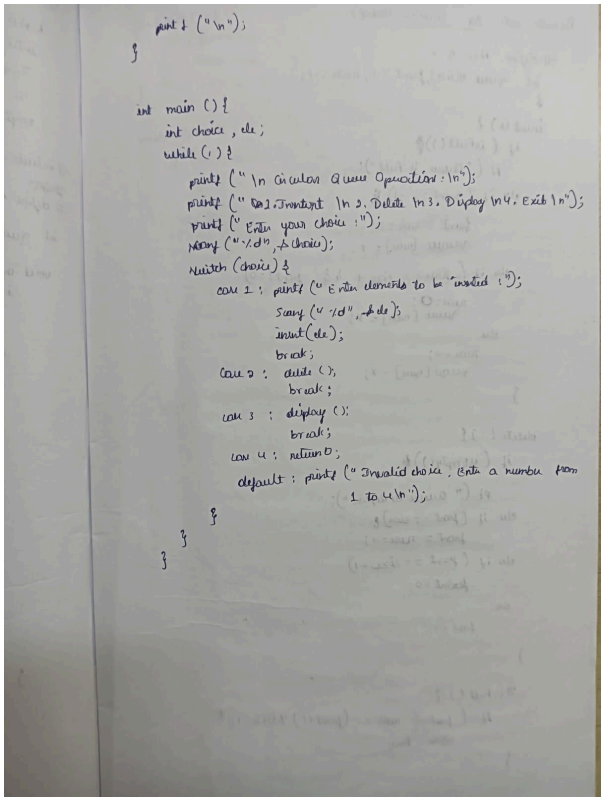
3b) WAP to simulate the working of a circular queue of integers using an array. Provide the following operations:Insert, Delete & Display The program should print appropriate messages for queue empty and queue overflow conditions



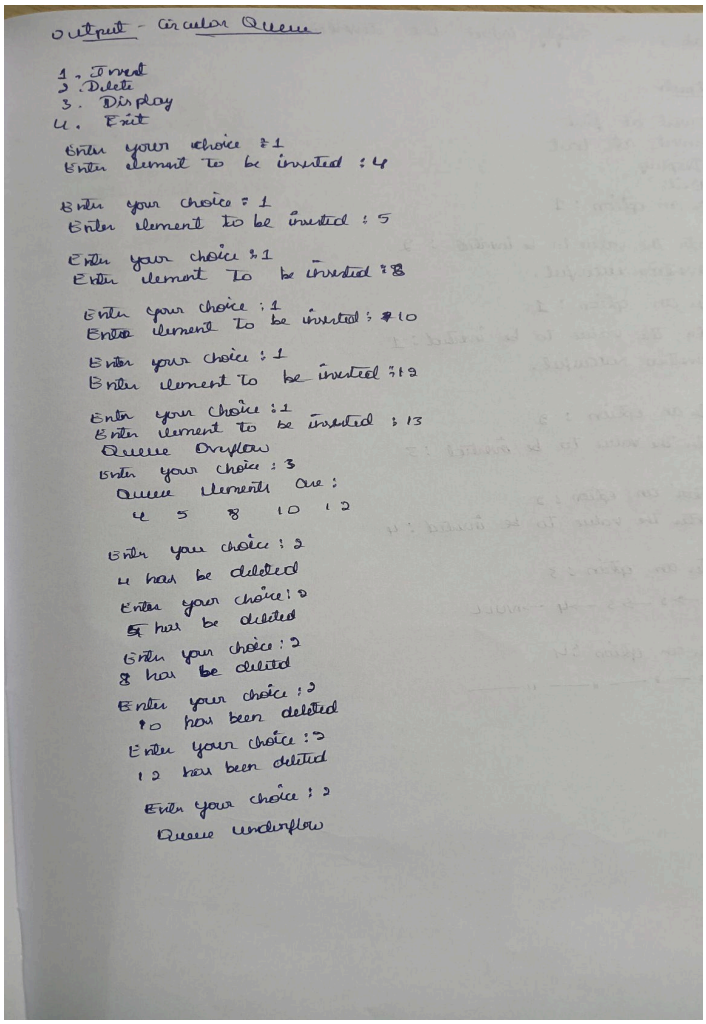
```
empty and queue overflow condition.

#include<stdio.h>
#define size 5
int queue[size], front = -1, rear = -1;
void insert(int de){
    if ((front==0 && rear==size-1) || (rear == (front-1)%(size-1))){
        printf("Queue Overflow");
        return;
    }
    else if (front==-1){
        front = rear=0;
        queue[rear] = de;
    }
    else if (rear==size-1 && front!=0){
        rear = 0;
        queue[rear] = de;
    }
    else{
        rear++;
        queue[rear] = de;
    }
    printf("%d has been inserted\n", de);
}
```



```
void delete ( ){
    if ( front == -1 ){
        printf ("Queue underflow !\n");
        return;
    }
    else
    int temp = queue [front];
    printf ("%d has been deleted \n", 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 \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= 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 Operations :\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;
            case 2 : delete ();
                     break;
            case 3 : display ();
                     break;
            case 4 : return 0;
            default : printf ("Invalid choice. Enter a number from
                               1 to 4\n");
        }
    }
}
```




```c
#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;
    }
```

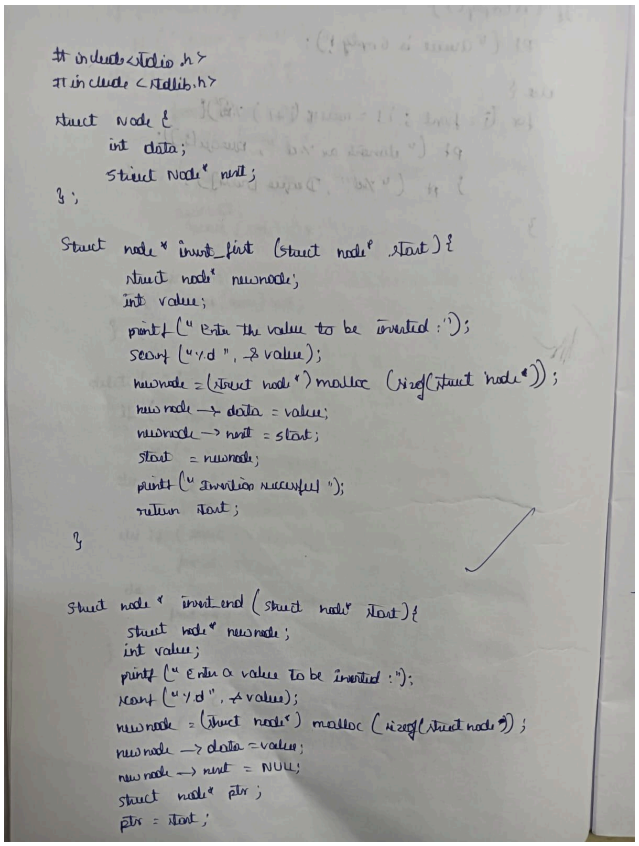
```
    printf("elements of the queue are:");
    if(rear>=front)
    {
        for(int i= front; i<= rear;i++)
        {
            printf("%d ", queue[i]);
        }
    }
    else
    {
        for(int i= front; i< size; i++)
        {
            printf("%d ", queue[i]);
        }
        for(int 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");
        }
    }
}
```

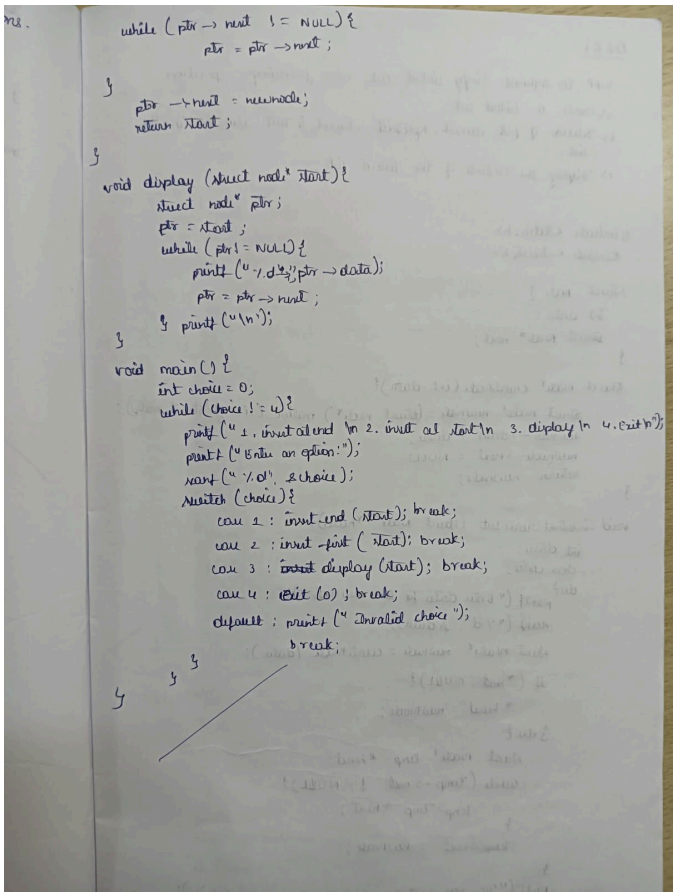
```
 circular queue operators:
1.insert
2.delete
3.display
4.exit
Enter your choice:1
enter element to be inserted 5
 5 has been inserted

 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
```

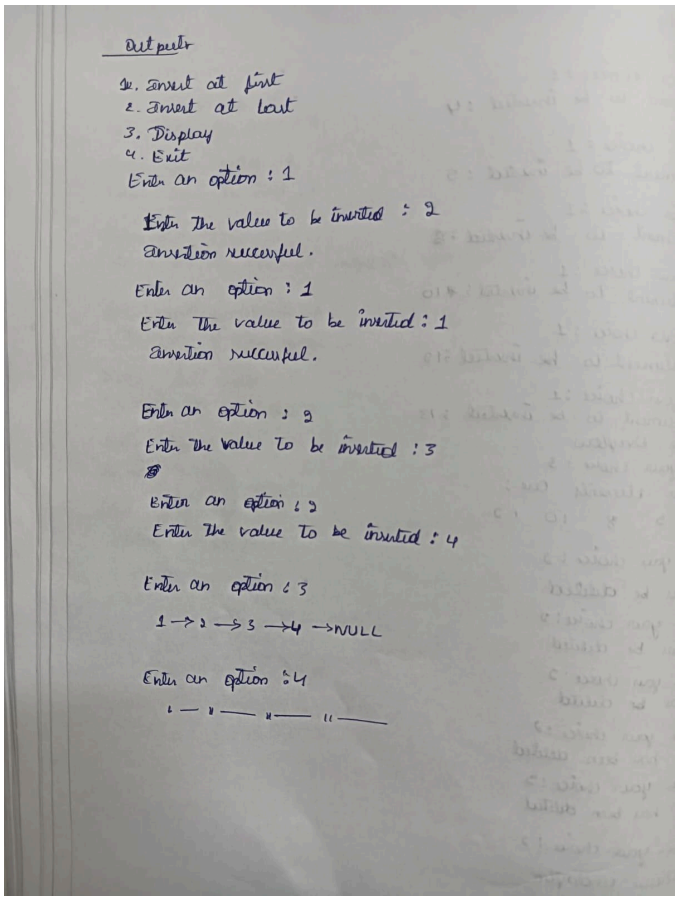
4.WAP to Implement Singly Linked List with following operations
a) Createalinkedlist.
b) Insertion of a node at first position, at any position and at end of list.
Display the contents of the linked list.



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

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

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 (sizeof(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 (sizeof(struct node*));
    newnode -> data = value;
    newnode -> next = NULL;
    struct node* ptr;
    ptr = start;
```



```
while (ptr -> next != NULL) {
        ptr = ptr -> next;
}
    ptr -> next = newnode;
    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");
        printf ("Enter an option:");
        scanf ("%d", &choice);
        switch (choice) {
            case 1 : insert_end (start); break;
            case 2 : insert_first (start); break;
            case 3 : display (start); break;
            case 4 : exit (0); break;
            default : printf ("Invalid choice");
                      break;
        }
    }
```



Output

1. Insert at first
2. Insert at last
3. Display
4. Exit

Enter an option : 1

Enter the value to be inserted : 2

Insertion successful.

Enter an option : 1

Enter the value to be inserted : 1

Insertion successful.

Enter an option : 2

Enter the value to be inserted : 3

Enter an option : 2

Enter the value to be inserted : 4

Enter an option : 3

1 -> 2 -> 3 -> 4 -> NULL

Enter an option : 4

```c
#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;
}
```

```c
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;
}
```

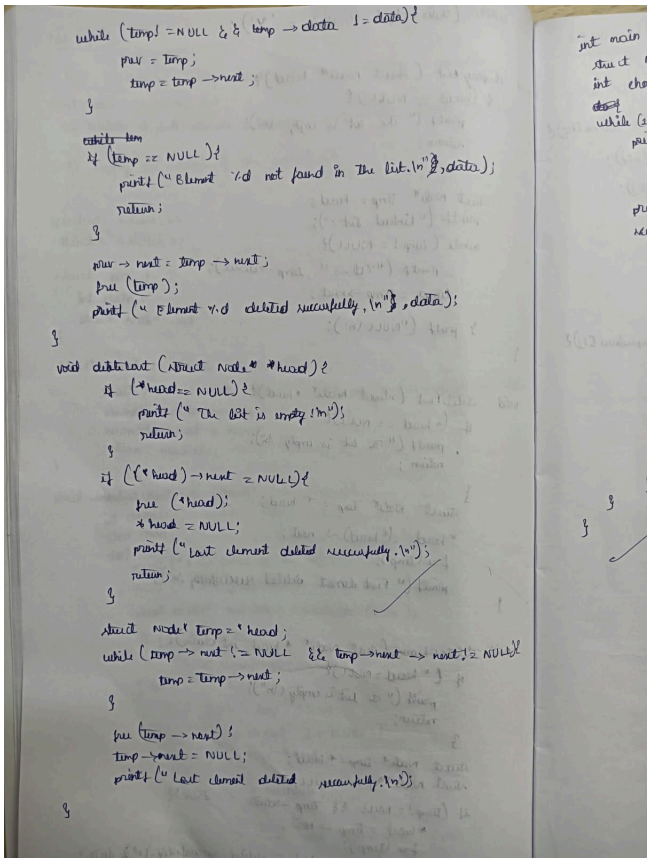
```
enter a value to insert at the start: 6

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.

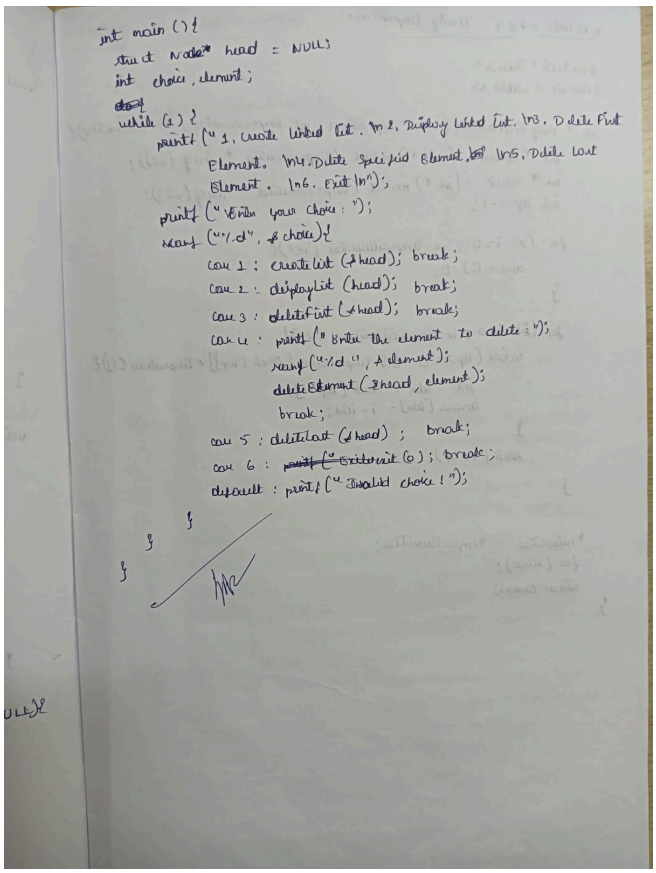
Lab 6 :

Wpp to implement singly linked list with following operation
a> create a linked list.
b> Deletion of first element, specified element & last element in the list.
c> Display the contents of the linked list.

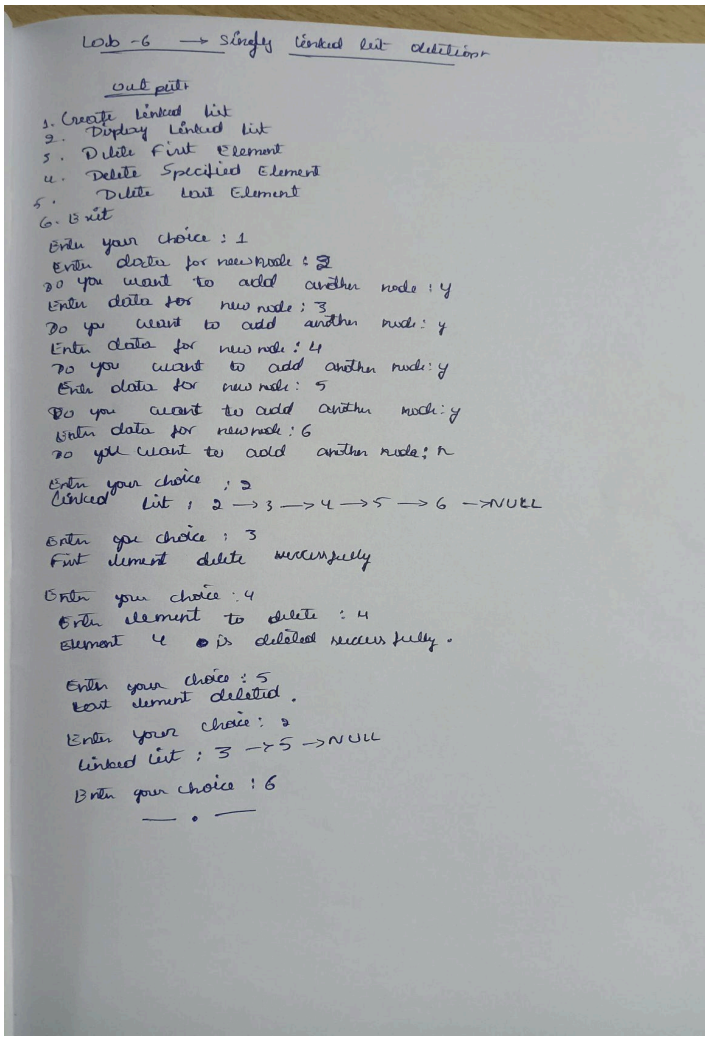
```
#include <stdio.h>
#include <stdlib.h>

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

struct node* createNode(int data){
    struct node* newNode = (struct node*) malloc(sizeof(struct node));
    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.\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.\n");
        return;
    }
    struct Node* temp = *head;
    struct Node** prev = NULL;
    if (temp != NULL && temp->data == data){
        *head = temp -> next;
        free(temp);
        printf("Element %d is deleted successfully.\n", data);
```



```
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!\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;
    while (1){
        printf("1. Create Linked List. \n2. Display Linked List. \n3. Delete First
        Element. \n4. Delete Specified Element. \n5. Delete Last
        Element. \n6. Exit\n");
        printf("Enter your choice: ");
        scanf("%d", &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: exit(0); break;
        default: printf("Invalid choice!");
    }
}
```



Lab - 6 → Singly linked list deletion

output

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 new node : 2
Do you want to add another node : y
Enter data for new node : 3
Do you want to add another node : y
Enter data for new node : 4
Do you want to add another node : y
Enter data for new node : 5
Do you want to add another node : y
Enter data for new node : 6
Do you want to add another node : n

Enter your choice : 2
Linked list : 2 → 3 → 4 → 5 → 6 → NULL

Enter your choice : 3
First element delete successfully

Enter your choice : 4
Enter element to delete : 4
Element 4 is deleted successfully.

Enter your choice : 5
Last element deleted.

Enter your choice : 2
Linked list : 3 → 5 → NULL

Enter your choice : 6

```c
#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;
```

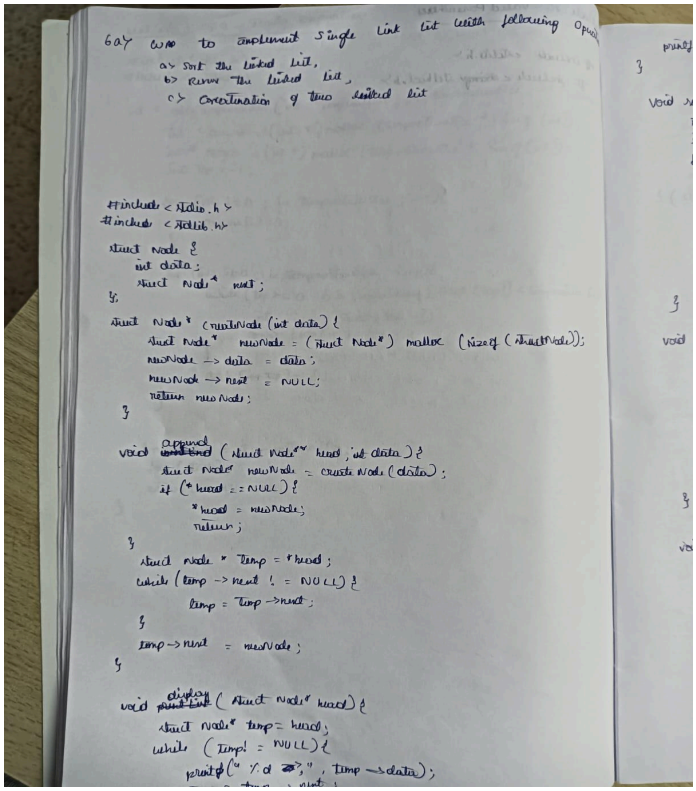
```
    }


    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;
            default:
                printf("Invalid choice. Please try again.\n");
        }
    } while (choice != 6);

    return 0;
}
```

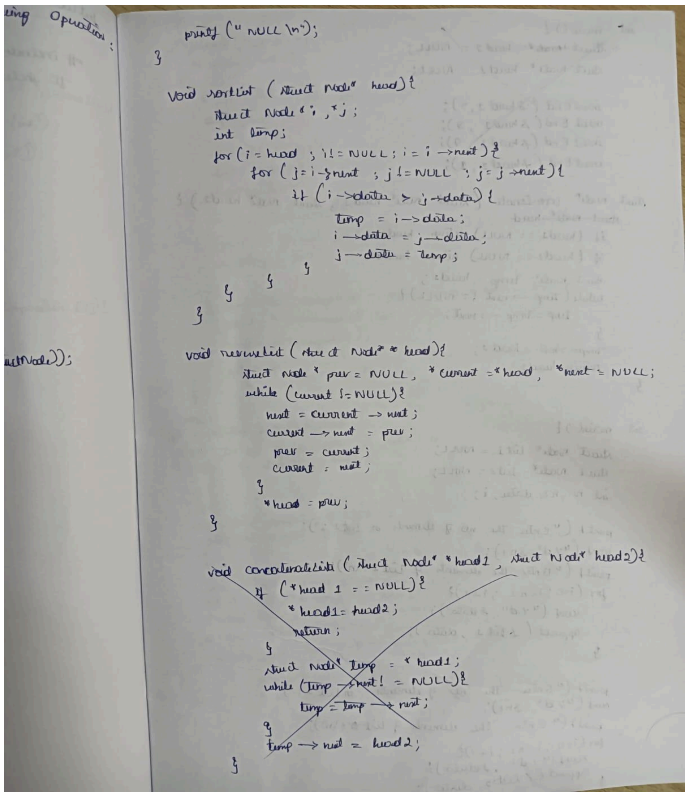
```
Menu:
1. Create Linked List
2. Display Linked List
3. Delete First Element
4. Delete Specified Element
5. Delete Last Element
6. Exit
Enter your choice: 1
Enter data for the new node: 1
Do you want to add another node? (y/n): y
Enter data for the new node: 2
Do you want to add another node? (y/n):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

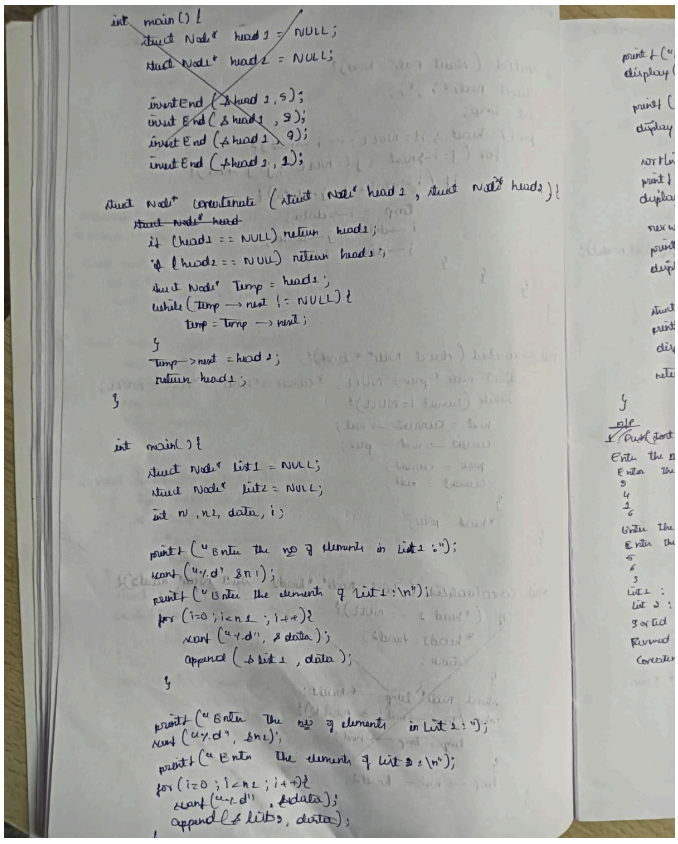
6.6a) WAP to Implement Single Link List with following operations: Sortthelinkedlist, Reversethelinkedlist,Concatenation of two linked lists.



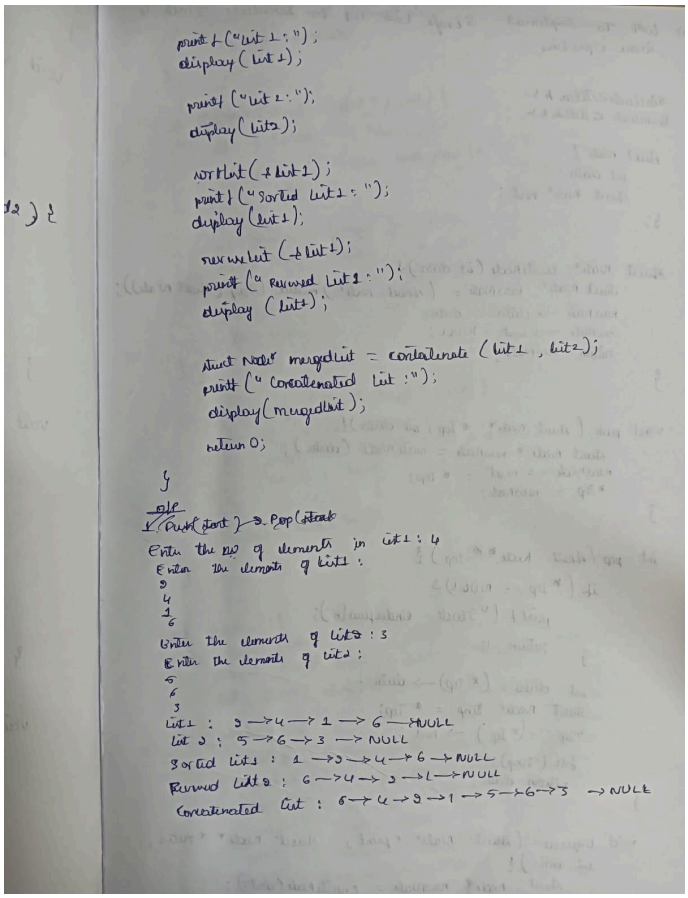
```
6a) WAP to implement single link list with following operations
    a) sort the linked list,
    b) reverse the linked list,
    c) Concatenation of two linked list

#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 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);
```



```
    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;
}
void concatenateLists(struct Node** head1, struct Node* head2) {
    if (*head1 == NULL) {
        *head1 = head2;
        return;
    }
    struct Node* temp = *head1;
    while (temp -> next != NULL) {
        temp = temp -> next;
    }
    temp -> next = head2;
}
```



```
int main() {
    struct Node* head1 = NULL;
    struct Node* head2 = NULL;

    insertEnd(&head1, 9);
    insertEnd(&head1, 9);
    insertEnd(&head1, 9);
    insertEnd(&head1, 1);

struct Node* concatenate(struct Node* head1, struct Node* head2) {
    struct Node* head
    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("\n Enter the no of elements in list1 :");
    scanf("%d", &n1);
    printf("\n Enter the elements of list1 :\n");
    for (i=0; i<n1; i++) {
        scanf("%d", &data);
        append(&list1, data);
    }

    printf("\n Enter the no of elements in list2 :");
    scanf("%d", &n2);
    printf("\n Enter the elements of list2 :\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("\n Sorted List1 :");
    display(list1);

    reverseList(&list1);
    printf("\n Reversed List1 :");
    display(list1);

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

    return 0;
}
```

```
Enter the no of elements in list1 : 4
Enter the elements of list1 :
9
4
1
6
Enter the elements of list2 : 3
Enter the elements of list2 :
5
6
3
List 1 : 9 -> 4 -> 1 -> 6 -> NULL
List 2 : 5 -> 6 -> 3 -> NULL
Sorted Lists : 1 -> 4 -> 6 -> 9 -> NULL
Reversed List 1 : 6 -> 4 -> 9 -> 1 -> NULL
Concatenated List : 6 -> 4 -> 9 -> 1 -> 5 -> 6 -> 3 -> NULL
```

```c
#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;
}


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

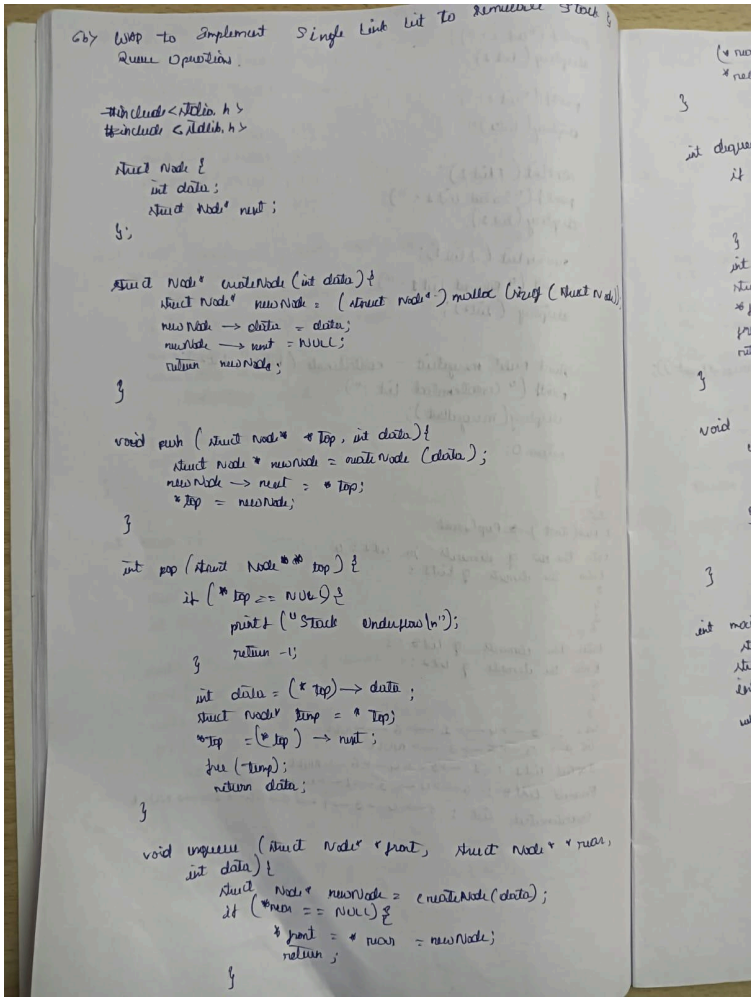
```
void sortList(struct Node** head) {
    struct Node* i, *j;
    int temp;
    for (i = *head; i != NULL; i = i->next) {
        for (j = i->next; j != NULL; j = j->next) {
            if (i->data > j->data) {
                temp = i->data;
                i->data = j->data;
                j->data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

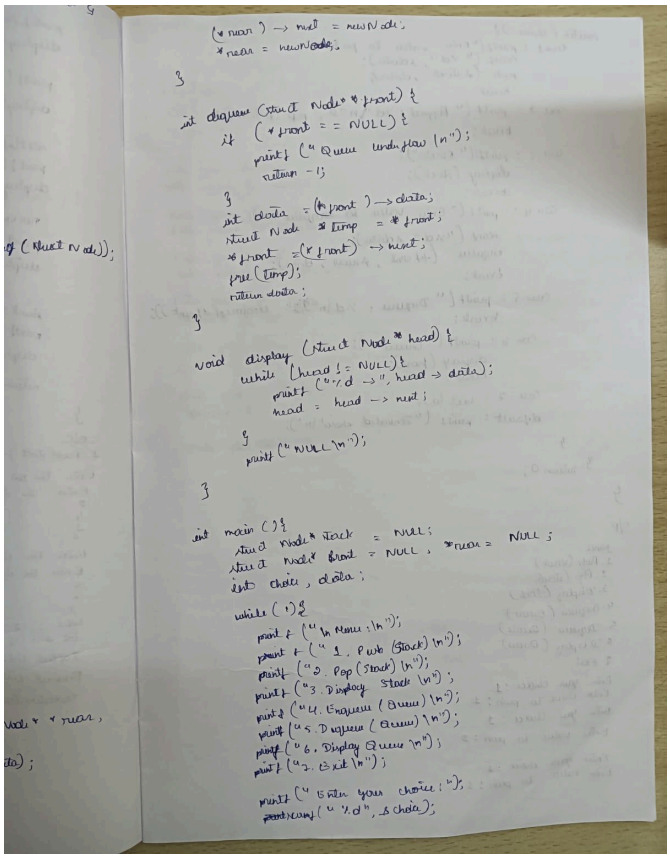
```
    struct Node* list1 = NULL;
    struct Node* list2 = NULL;
    int n1, n2, data, i;


    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;
}
```

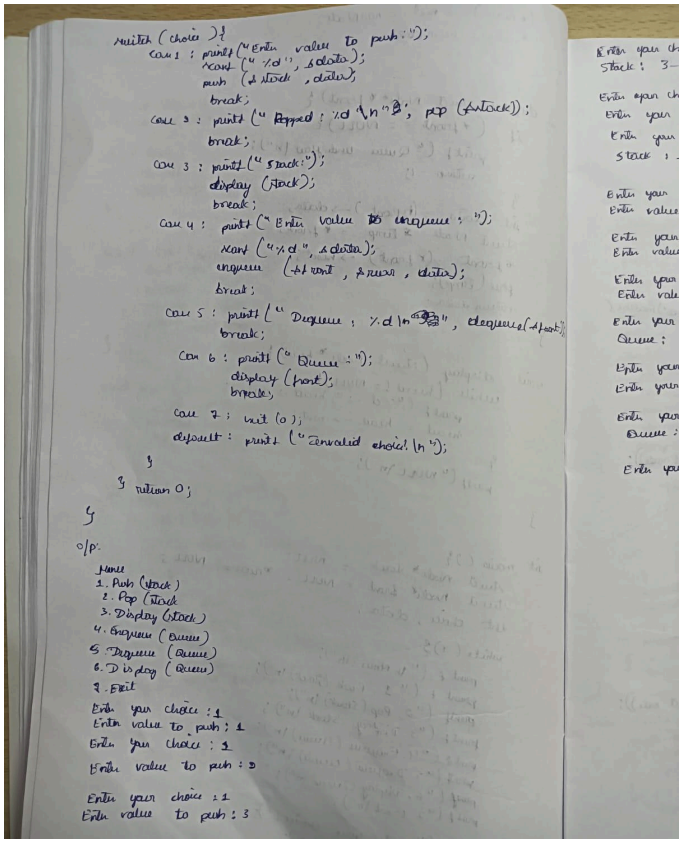
```
Enter the number of elements in List 1: 3
Enter the elements of List 1:
5
4
7
Enter the number of elements in List 2: 3
Enter the elements of List 2:
8
9
10
List 1: 5 -> 4 -> 7 -> NULL
List 2: 8 -> 9 -> 10 -> NULL
Sorted List 1: 4 -> 5 -> 7 -> NULL
Reversed List 1: 7 -> 5 -> 4 -> NULL
Concatenated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

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





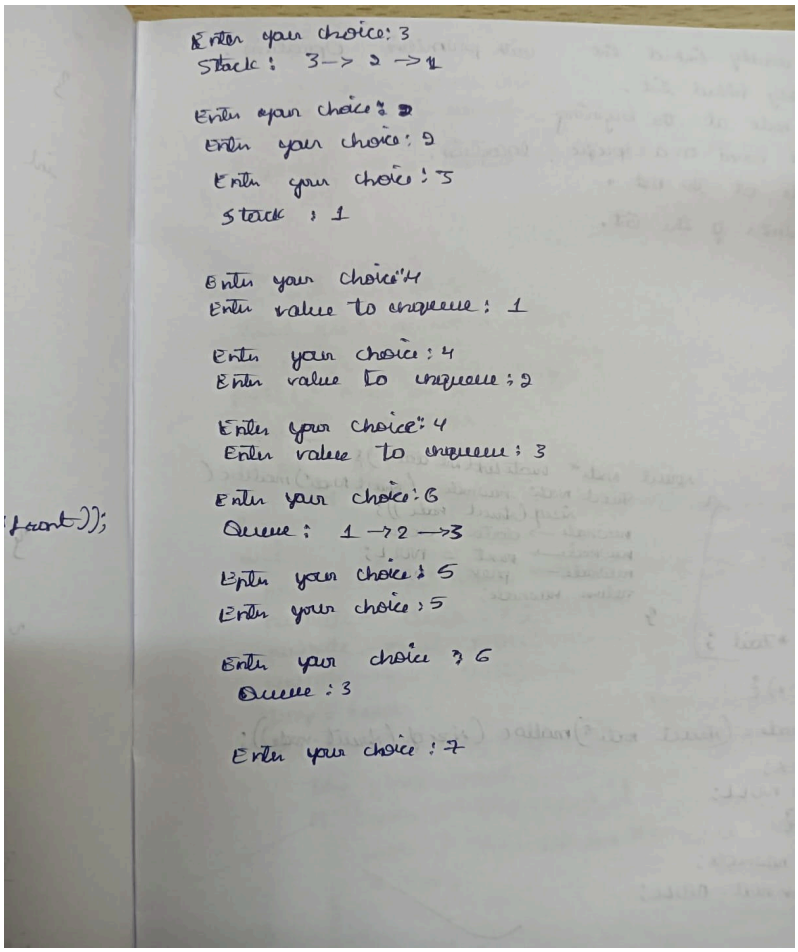
```
    (*rear) -> next = newNode;
    *rear = newNode;
}

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 ("\n Menu :\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 ("Dequeue : %d \n", dequeue(&front));
             break;
    case 6 : printf ("Queue :");
             display (front);
             break;
    case 7 : exit (0);
    default : printf ("Invalid choice! \n");
  }
 return 0;
}
```

o/p:

```
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
Enter your choice : 1
Enter value to push : 2

Enter your choice : 1
Enter value to push : 3
```




```c
#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 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;
}
```

```c
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;
}
```

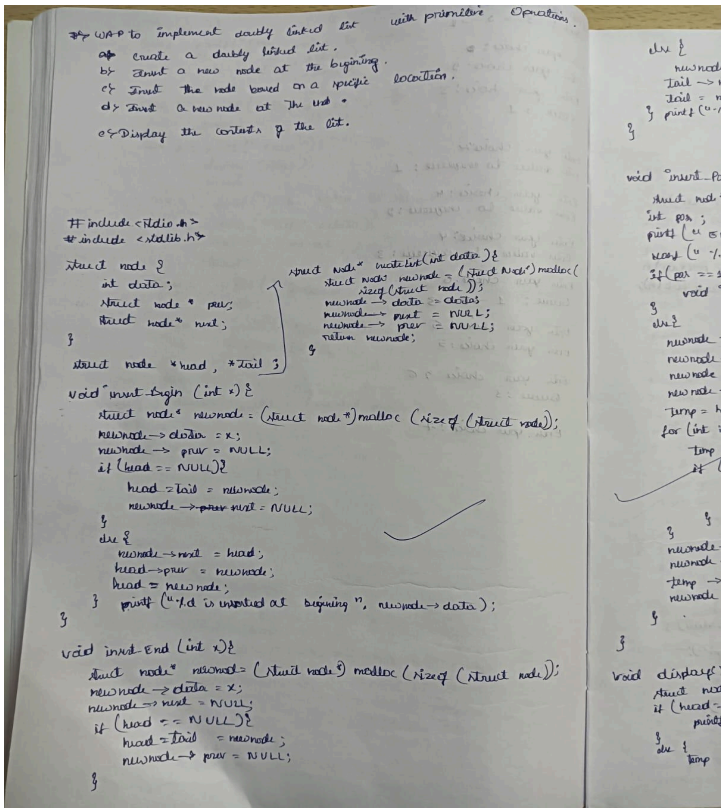
```
Menu:
1. Push (Stack)
2. Pop (Stack)
3. Display Stack
4. Enqueue (Queue)
5. Dequeue (Queue)
6. Display Queue
7. Exit
Enter your choice: 1
Enter value to push: 1

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
```

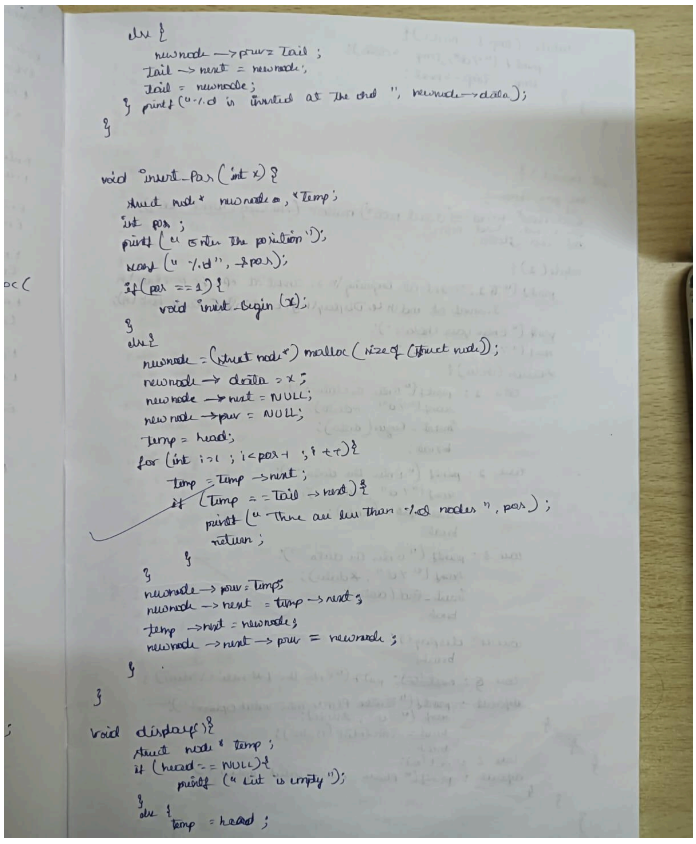
```
Menu:
1. Push (Stack)
2. Pop (Stack)
3. Display Stack
4. Enqueue (Queue)
5. Dequeue (Queue)
6. Display Queue
7. Exit
Enter your choice: 2
Popped: 3

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>
```

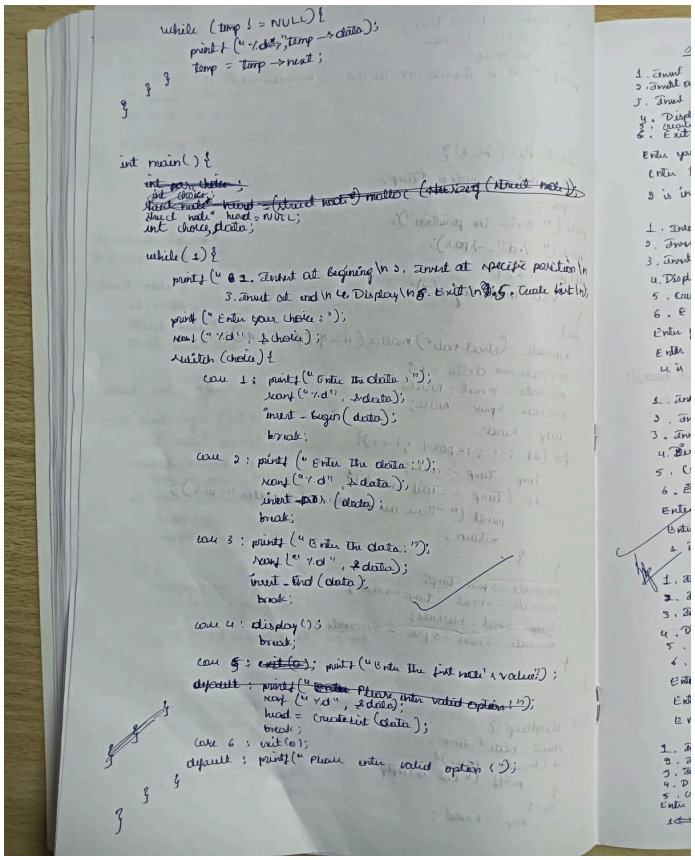
7.WAP to Implement doubly link list with primitive operations

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

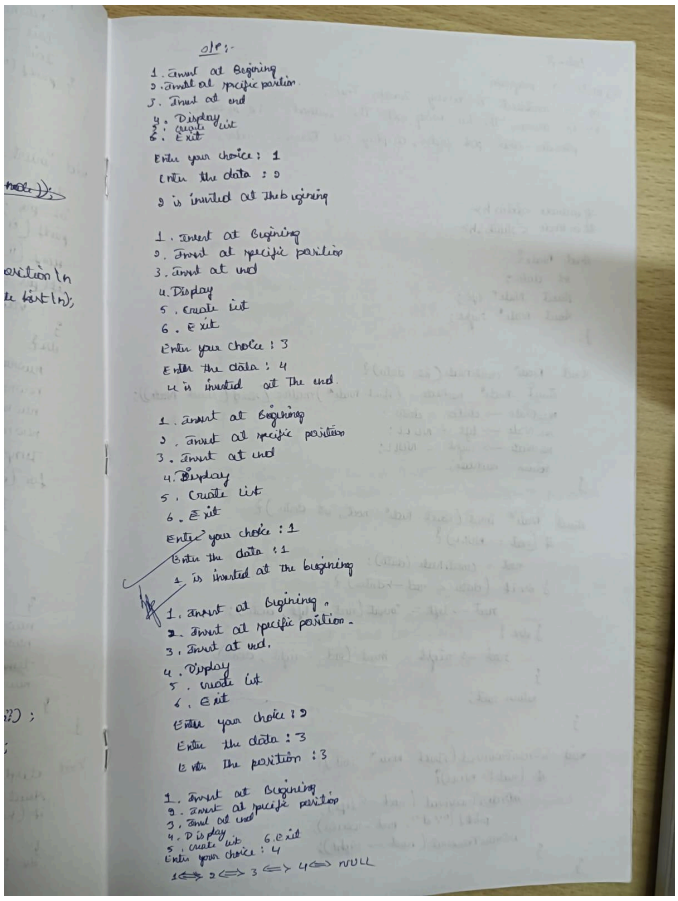




```
    else {
        newnode -> prev = Tail ;
        Tail -> next = newnode;
        Tail = newnode;
    } printf ("%d is inserted at the end ", newnode -> data);
}

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

    while (1) {
        printf ("0 1. Insert at beginning\n 2. Insert at specific position\n
                 3. Insert at end\n 4. Display\n 5. Exit\n 6. Create list\n");
        printf ("Enter your choice : ");
        scanf ("%d", &choice);
        switch (choice) {
            case 1 : printf ("Enter the data :");
                     scanf ("%d", &data);
                     insert_begin (data);
                     break;
            case 2 : printf ("Enter the data :");
                     scanf ("%d", &data);
                     insert_pos (data);
                     break;
            case 3 : printf ("Enter the data :");
                     scanf ("%d", &data);
                     insert_end (data);
                     break;
            case 4 : display();
                     break;
            case 5 : exit(0); printf ("Enter the first node's value");
            default : printf ("Please enter valid option !");
                     scanf ("%d", &data);
                     head = CreateList (data);
                     break;
            case 6 : exit(0);
            default : printf ("Please enter valid option ");
        }
    }
}
```




```c
#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;
}
```

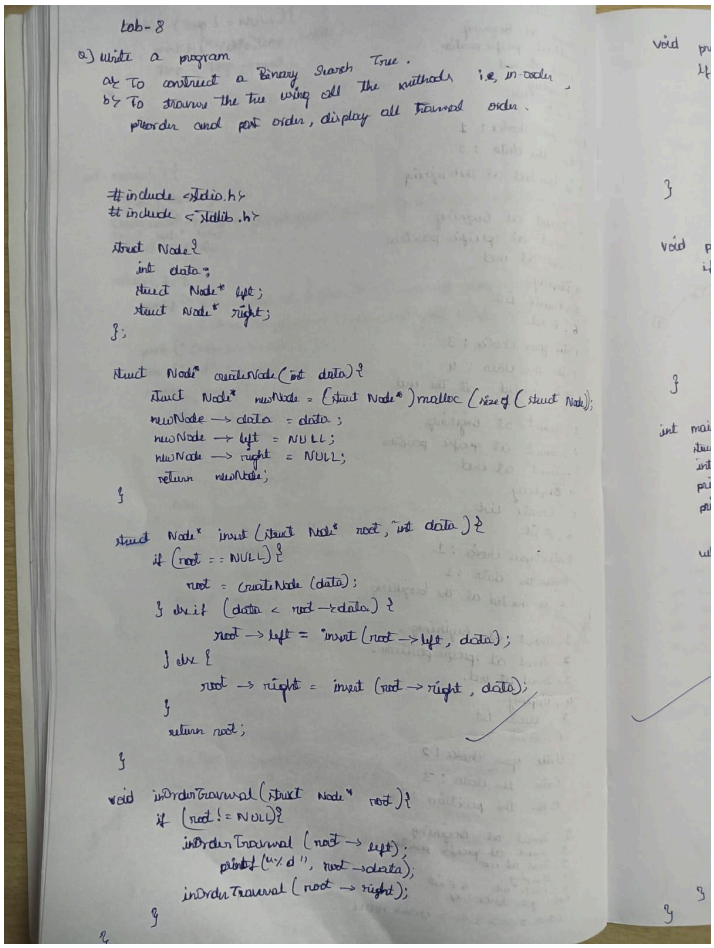
```
Menu:
1. Create the doubly linked list
2. Insert a new node at the beginning
3. Insert a new node at a specific position
4. Insert a new node at the end
5. Display the contents of the list
6. Exit
Enter your choice: 1
Enter the first node's value: 2
List created with first node having value: 2

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
```

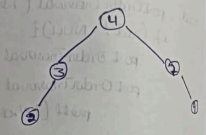
8.Write a program

a) ToconstructabinarySearchtree.
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.



```
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\n2. In-Order Traversal\n3. Pre-order
        Traversal\n4. Post-Order Traversal\n5. 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 !");
        }
    }
    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 : 4

Enter your choice : 1
Enter the value to insert : 7

Enter your choice : 1
Enter the value to insert : 3

Enter your choice : 1
Enter the value to insert : 9

Enter your choice : 1
Enter the value to insert : 2

Enter your choice : 2
In-order Traversal : 2 3 4 7 9

Enter your choice : 3
Pre-Order Traversal : 4 3 2 7 9

Enter your choice : 4
Post-order Traversal : 2 3 9 7 4

Enter your choice : 5
```



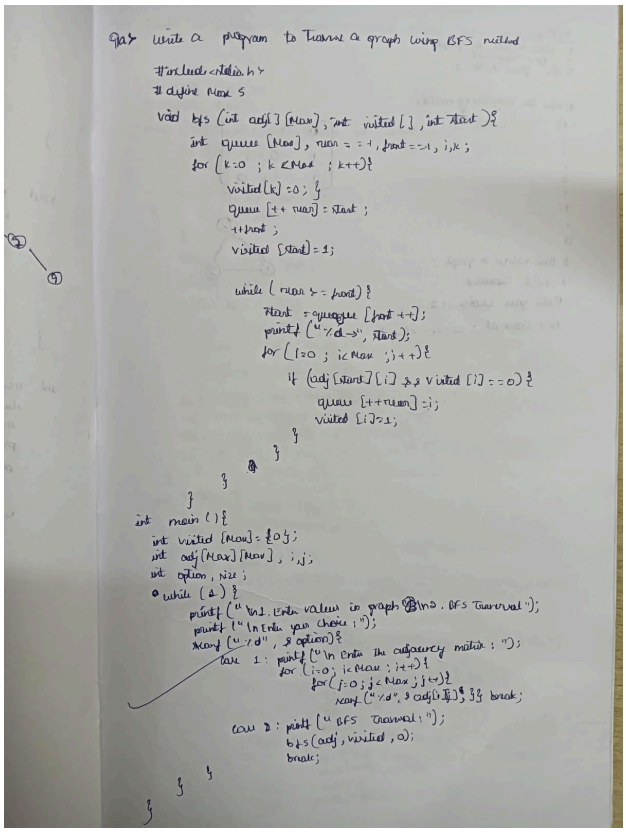
```c
#include <stdio.h>
#include <stdlib.h>


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 {
        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);
    }
}
```

```c
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: ");
```

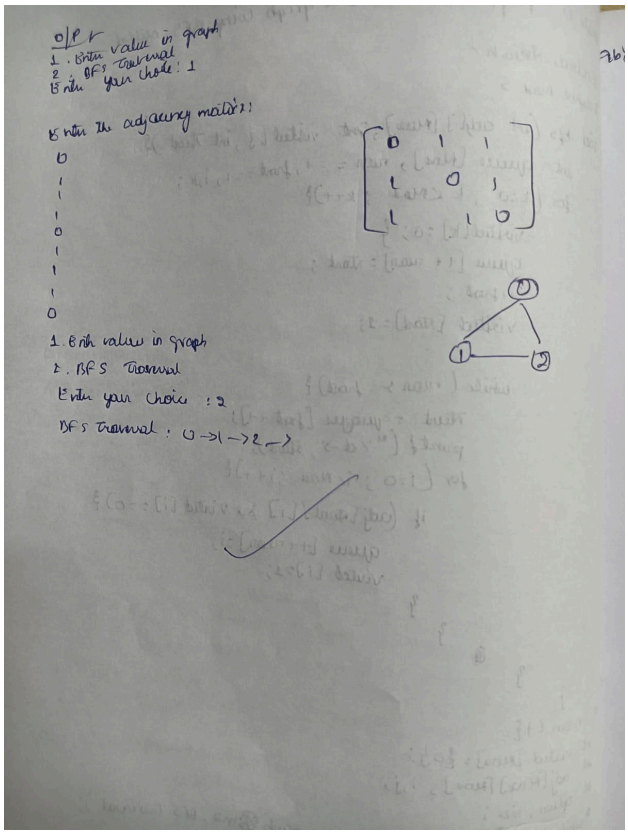
```c
                inOrderTraversal(root);
                printf("\n");
                break;
            case 3:
                printf("Pre-order Traversal: ");
                preOrderTraversal(root);
                printf("\n");
                break;
            case 4:
                printf("Post-order 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.



```
Q9a) Write a program to Traverse a graph using BFS method

#include<stdio.h>
#define Max 5
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;
    while(1){
        printf("\n1. Enter values in graph\n2. BFS Traversal");
        printf("\nEnter your choice:");
        scanf("%d", &option);
        switch(option){
            case 1: printf("\n Enter the adjacency matrix:");
                    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;
        }
    }
}
```



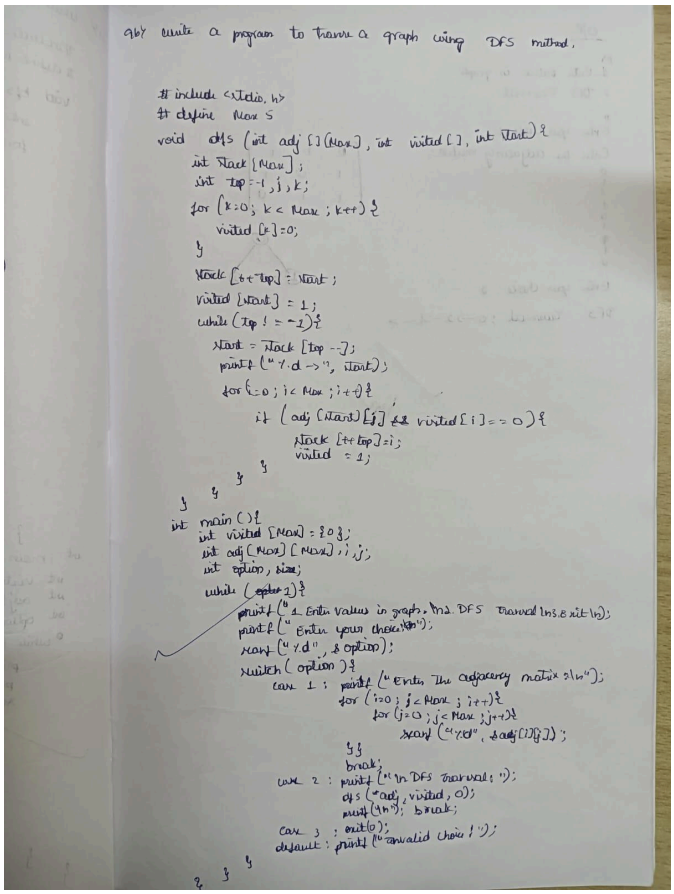
```
O/P:
1. Enter values in graph
2. BFS Traversal
Enter your choice: 1
Enter the adjacency matrix:
0
1
1
1
0
1
1
1
0
1. Enter values in graph
2. BFS Traversal
Enter your choice: 2
BFS Traversal: 0->1->2->
```

```c
#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)
```

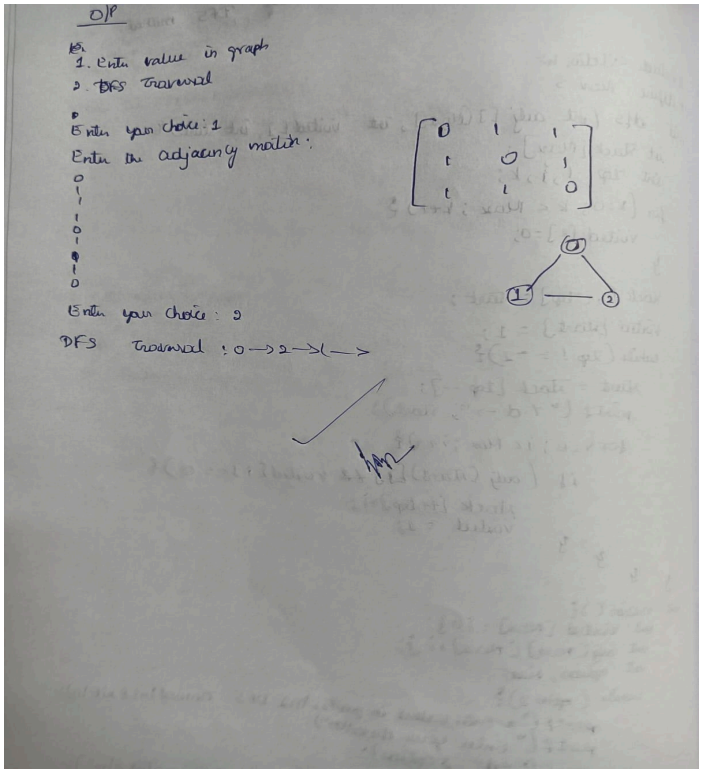
```
        {
            case 1: printf("\n Enter the adjacency matrix:\n");
                    for(i=0;i<MAX;i++){
                        for(j=0;j<MAX;j++){
                            scanf("%d",&adj[i][j]);
                        }
                    }
                    break;

            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
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.



```
9b) Write a program to traverse a graph using DFS method.

#include <stdio.h>
#define Max 5
void dfs (int adj [] [Max], int visited [], int start) {
    int stack [Max];
    int top = -1, j, 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 (j=0 ; j< Max ; j++) {
            if (adj [start] [j] && visited [j] == 0) {
                stack [++top] = j;
                visited = 1;
            }
        }
    }
}
int main () {
    int visited [Max] = {0};
    int adj [Max] [Max], i, j;
    int option, size;
    while (option != 3) {
        printf ("1. Enter values in graph. \n2. DFS traversal \n3. Exit \n");
        printf ("Enter your choice \n");
        scanf ("%d", &option);
        switch (option) {
            case 1 : printf ("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 : exit (0);
            default : printf ("Invalid choice ! ");
        }
    }
}
```



```
O/P

1. Enter value in graph
2. DFS traversal

Enter your choice : 1
Enter the adjacency matrix :
0
1
1
1
0
1
1
1
0

Enter your choice : 2
DFS traversal : 0 --> 2 --> 1 -->
```

```c
#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 \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("\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.
```