VISVESVARAYATECHNOLOGICALUNIVERSITY

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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 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 **SHRINANDA SHIVPRASAD DINDE (1BM23CS324),** 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/shrinanda27/DSA-C.git

Program 1

Write a program to simulate the working of stack using an array with the following: a) Push b) Pop c) display

→ push, pop and display.

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

#define SIZE 10
int A[SIZE];
int top = -1;

bool isEmpty (){
    return top == -1;
}
void push
bool isFull (){
    return top == SIZE - 1;
}
void push (int x){
    if (isFull()){
        printf (" stack overflow! unable to push %d \n", x);
        return;
    }
    top = top + 1;
    A[top] = x;
    printf (" Pushed %d onto the stack \n", x);
}
int POP(){
    if (isEmpty ()){
        printf (" stack underflow! unable to POP \n");
        return -1;
    }
    return A[top--];
}
```

```
int getTop() {
    if (isEmpty()) {
        Printf ("Stack is empty!")
        return -1;
    }
    return A[top];
}

Void display() {
    if (isEmpty()) {
        Printf ("Stack is empty\n");
        return;
    }
    Printf ("Stack Elements: ");
    for (int i = top; i >= 0; i--) {
        Printf ("%d", A[i]);
    }
    Printf ("\n");
}

int main() {
    int choice, value;
    While (1) {
        Printf ("Stack operations \n");
        Printf ("1. Push \n 2. Pop \n 3. Display \n
                4. get Top Element  5. exit);
        Printf ("Enter your choice: ");
        scanf ("%d", &choice);

Switch (choice) {
    case 1:
        Printf ("Enter value to push: ");
        scanf ("%d", &value);
```

```
            push(value);
            break;
        case 2:
            value = pop();
            if (value != -1){
                printf("Popped %d \n", value);
            }
            break;
        case 3:
            display();
            break;
        case 4:
            value = getTop();
            if (value != -1){
                Printf(" Top element: %d \n", value);
            }
            break;
        case 5:
            Printf(" exiting. \n");
            exit(0);
        default:
            Printf(" Invalid choice");
    }
}
return 0;
}
```

Seen

CODE

```
#include<stdio.h>
#include<stdlib.h>
#include<stdbool.h>
struct stack{
   int size;
   int top;
   int *arr;
};
bool isEmpty(struct stack *ptr){
   return ptr->top==-1;
}
bool isFull(struct stack *ptr){
   return ptr->top==ptr->size-1;
}
void push(int value, struct stack *ptr){
   if (isFull(ptr)){
      printf("Stack OverFlow!! cannot push %d into the stack\n", value);
      return;
   } else {
      ptr->top++;
      ptr->arr[ptr->top]=value;
      printf("%d is pushed into the stack.\n", value);
   }
}
int pop(struct stack *ptr){
   if (isEmpty(ptr)){
      printf("Stack UnderFlow!! cannot pop an element from the stack\n");
      return -1;
   } else {
      int value = ptr->arr[ptr->top];
      ptr->top--;
      printf("%d is popped from the stack.\n", value);
      return value;
   }
}
int peek(struct stack *ptr, int i){
   int arrayIndex = ptr->top-i+1;
```

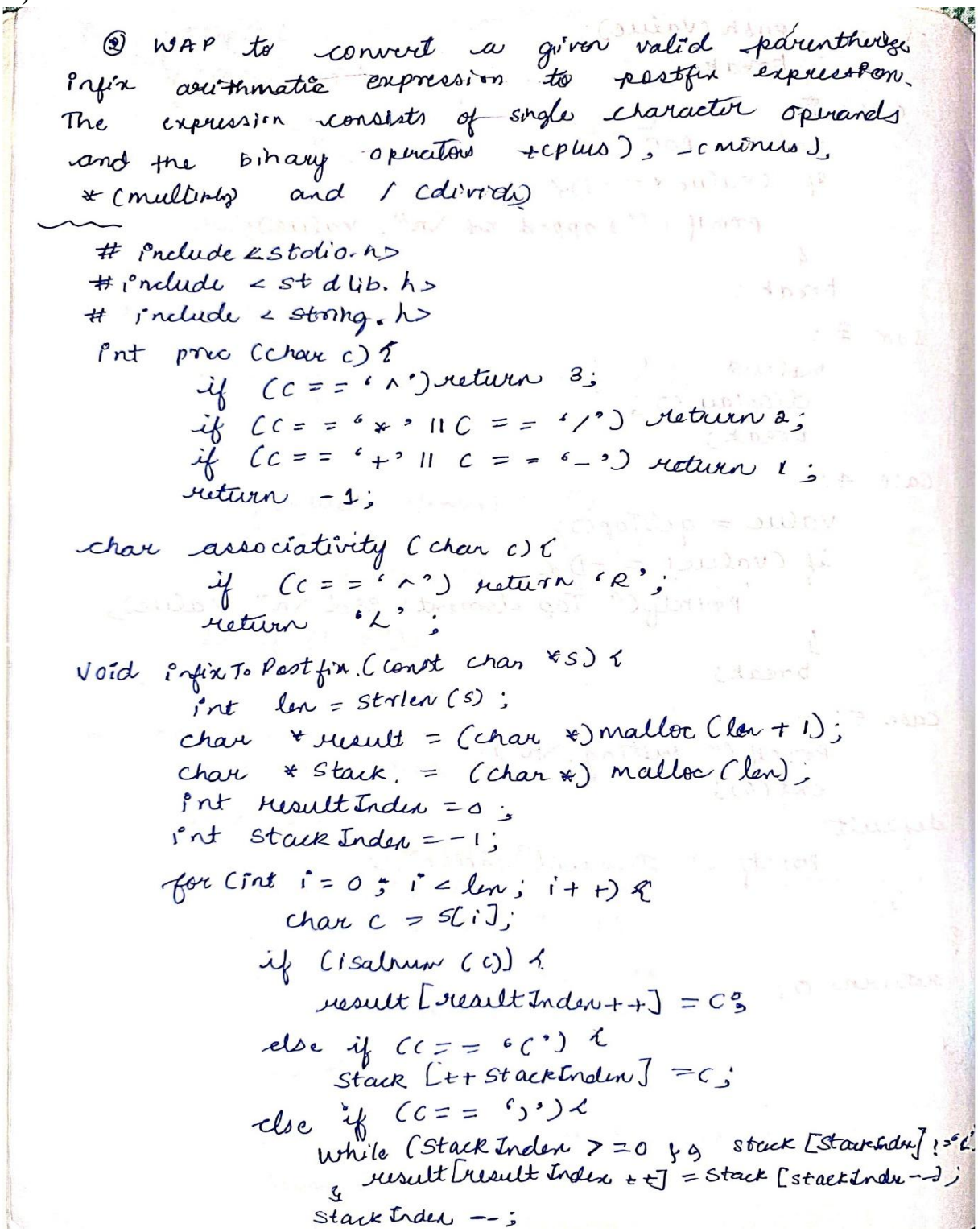
```
    if (arrayIndex<0){
        printf("Invalid Position\n");
        return -1;
    } else {
        return ptr->arr[arrayIndex];
    }
}
void display(struct stack *ptr){
    if (isEmpty(ptr)){
        printf("Stack is empty.\n");
        return;
    }
    printf("Stack elements: ");
    for (int i=0; i<=ptr->top; i++){
        printf("%d ", ptr->arr[i]);
    }
    printf("\n");
}
int stacktop(struct stack *ptr){
    return ptr->arr[ptr->top];
}
int stackbottom(struct stack *ptr){
    return ptr->arr[0];
}
void main(){
    struct stack *s = (struct stack *)malloc(sizeof(struct stack));
    s->size = 80;
    s->top = -1;
    s->arr = (int *)malloc(s->size*sizeof(int));
    printf("Stack has been created successfully!\n");
    int choice, element, i;
    while(1){
        printf("\nOptions: 1. Push  2. Pop  3. Peek  4. Display  5. Exit\n");
        printf("Enter your choice: ");
        scanf("%d", &choice);
        switch(choice){
            case 1:
                printf("Enter the element to push: ");
```

```
            scanf("%d", &element);
            push(element, s);
            break;
        case 2:
            pop(s);
            break;
        case 3:
            printf("Enter the position to peek: ");
            scanf("%d", &i);
            printf("Element at position %d is %d\n", i, peek(s, i));
            break;
        case 4:
            display(s);
            break;
        case 5:
            printf("Exiting...\n");
            exit(0);
        default:
            printf("Invalid choice! Please try again.\n");
    }
  }
}
```

```
Stack has been created successfully!

Options: 1. Push  2. Pop  3. Peek  4. Display  5. Exit
Enter your choice: 1
Enter the element to push: 10
10 is pushed into the stack.

Options: 1. Push  2. Pop  3. Peek  4. Display  5. Exit
Enter your choice: 1
Enter the element to push: 20
20 is pushed into the stack.

Options: 1. Push  2. Pop  3. Peek  4. Display  5. Exit
Enter your choice: 1
Enter the element to push: 30
30 is pushed into the stack.

Options: 1. Push  2. Pop  3. Peek  4. Display  5. Exit
Enter your choice: 4
Stack elements: 10 20 30

Options: 1. Push  2. Pop  3. Peek  4. Display  5. Exit
Enter your choice: 3
Enter the position to peek: 2
Element at position 2 is 20

Options: 1. Push  2. Pop  3. Peek  4. Display  5. Exit
Enter your choice: 2
30 is popped from the stack.

Options: 1. Push  2. Pop  3. Peek  4. Display  5. Exit
Enter your choice: 4
Stack elements: 10 20

Options: 1. Push  2. Pop  3. Peek  4. Display  5. Exit
Enter your choice: 5
Exiting...
```

Lab program 2

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



```
② WAP to convert a given valid parenthesized
infix arithmatic 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;
    if(c=='*'||c=='/') return 2;
    if(c=='+'||c=='-') return 1;
    return -1;
}
char associativity(char c){
    if(c=='^') return 'R';
    return 'L';
}
void infixToPostfix(const char *s){
    int len=strlen(s);
    char *result=(char*)malloc(len+1);
    char *stack=(char*)malloc(len);
    int resultIndex=0;
    int stackIndex=-1;
    for(int i=0;i<len;i++){
        char c=s[i];
        if(isalnum(c)){
            result[resultIndex++]=c;
        }
        else if(c=='('){
            stack[++stackIndex]=c;
        }
        else if(c==')'){
            while(stackIndex>=0&&stack[stackIndex]!='('){
                result[resultIndex++]=stack[stackIndex--];
            }
            stackIndex--;
```

```
else {
    while (stackIndex >= 0 && (prec(c) <= prec(
                stack[stackIndex]) &&
        associativity(c) == 'L'))
        result[resultIndex++] = stack[stackIndex--];
    }
    stack[++stackIndex] = c;
  }
}
while (stackIndex >= 0) {
    result[resultIndex++] = stack[stackIndex--];
}
result[resultIndex] = '\0';
printf("%s\n", result);
free(result);
free(stack);
}
int main() {
    char exp[] = "a+b*(c^d-e)^(f+g*h)-i";
    printf("Expression = %s\n", exp);
    infix To Postfix(exp);
    return 0;
}
```

Seer

```
// output
expression = a+b*(c^d-e)^(f+g*h)-i
abcd^e-fgh*+^*+i-
```

CODE

```
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
struct stack{
    int size;
    int top;
    char *arr;
};
int stackTop(struct stack* sp){
    return sp->arr[sp->top];
}
int isEmpty(struct stack *ptr){
    return ptr->top == -1;
}
int isFull(struct stack *ptr){
    return ptr->top == ptr->size - 1;
}
void push(struct stack* ptr, char val){
    if(isFull(ptr)){
        printf("Stack Overflow! Cannot push %c to the stack\n", val);
        return;
    } else {
        ptr->top++;
        ptr->arr[ptr->top] = val;
    }
}
char pop(struct stack* ptr){
    if(isEmpty(ptr)){
        printf("Stack Underflow! Cannot pop from the stack\n");
        return -1;
    } else {
        char val = ptr->arr[ptr->top];
        ptr->top--;
        return val;
    }
}
int precedence(char ch){
```

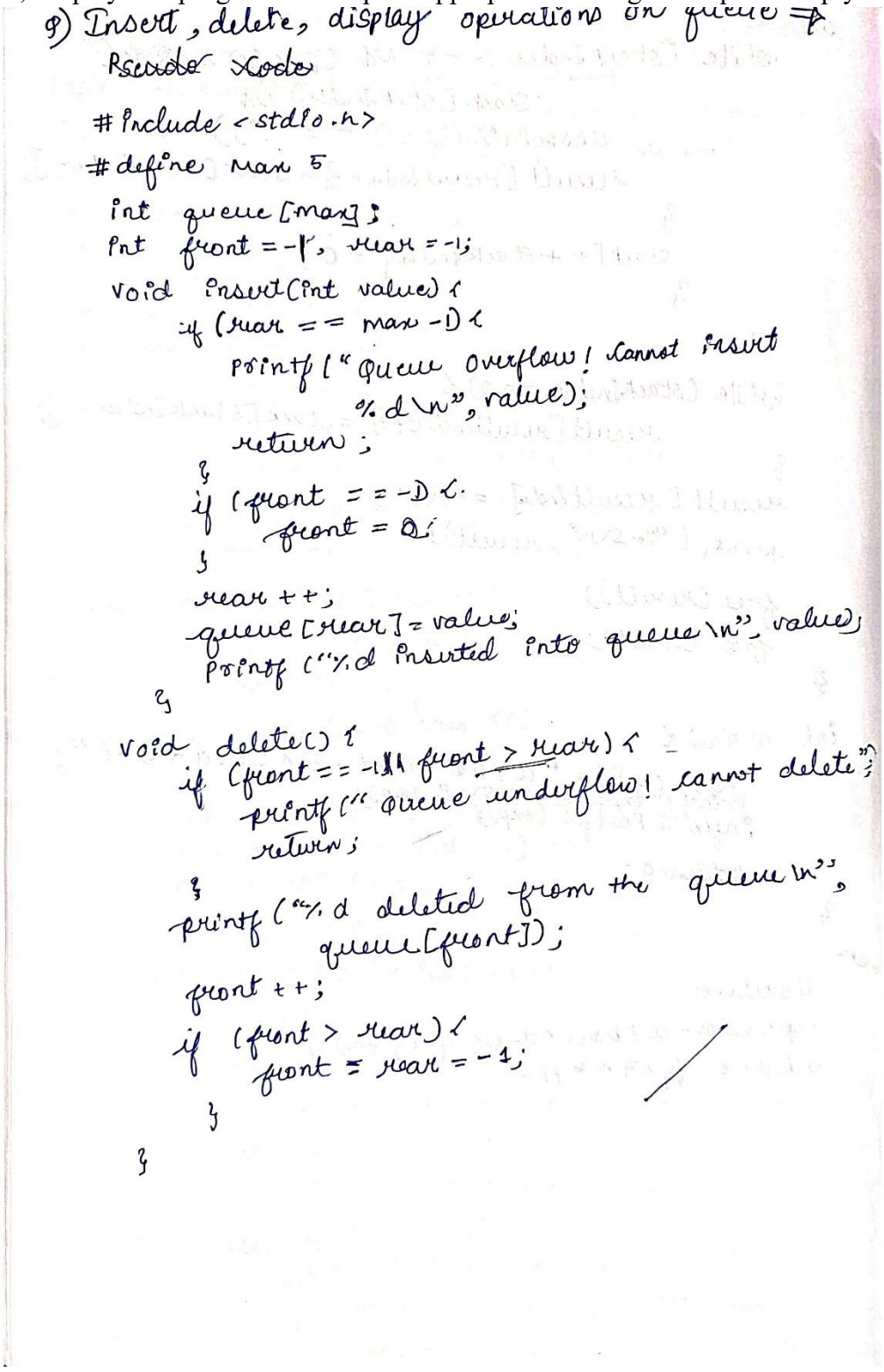
```
    if(ch == '*' || ch == '/')
        return 3;
    else if(ch == '+' || ch == '-')
        return 2;
    else
        return 0;
}
int isOperator(char ch){
    return ch == '+' || ch == '-' || ch == '*' || ch == '/';
}
char* infixToPostfix(char* infix){
    struct stack *sp = (struct stack*) malloc(sizeof(struct stack));
    sp->size = 20;
    sp->top = -1;
    sp->arr = (char *) malloc(sp->size * sizeof(char));
    char *postfix = (char*) malloc((strlen(infix) + 1) * sizeof(char));
    int i = 0;
    int j = 0;
    while(infix[i] != '\0'){
        if((infix[i] >= 'a' && infix[i] <= 'z') || (infix[i] >= 'A' && infix[i] <= 'Z')){
            postfix[j++] = infix[i++];
        }
        else if(infix[i] == '('){
            push(sp, infix[i]);
            i++;
        }
        else if(infix[i] == ')'){
            while(!isEmpty(sp) && stackTop(sp) != '('){
                postfix[j++] = pop(sp);
            }
            pop(sp);
            i++;
        }
        else{
            while(!isEmpty(sp) && precedence(stackTop(sp)) >= precedence(infix[i])){
                postfix[j++] = pop(sp);
            }
            push(sp, infix[i]);
```

```
            i++;
        }
    }
    while(!isEmpty(sp)){
        postfix[j++] = pop(sp);
    }
    postfix[j] = '\0';
    return postfix;
}
int main(){
    char *infix = "(x-y/z)*(k+d)";
    printf("Postfix expression: %s\n", infixToPostfix(infix));
    return 0;
}
```

```
Postfix expression: xyz/-kd+*
```

Lab programme 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 condition



9) Insert, delete, display operations on queue =>

Source Code

```
#include <stdio.h>
#define max 5
int queue[max];
int front = -1, rear = -1;
void insert(int value) {
    if (rear == max - 1) {
        printf("Queue Overflow! Cannot insert
                %d\n", value);
        return;
    }
    if (front == -1)
        front = 0;
    rear++;
    queue[rear] = value;
    printf("%d inserted into queue\n", value);
}
void delete() {
    if (front == -1 || front > rear) {
        printf("Queue underflow! cannot delete");
        return;
    }
    printf("%d deleted from the queue\n",
            queue[front]);
    front++;
    if (front > rear) {
        front = rear = -1;
    }
}
```

```
void display() {
    if (front == -1) {
        printf ("Queue is empty \n");
        return;
    }
    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 Queue Operations: \n");
        printf ("1. Insert \n");
        printf ("2. Delete \n");
        printf ("3 Display \n");
        printf ("4 Exit \n");
        printf ("Enter your choice: "
                "%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: printf ("exiting... \n");
                return 0;
```

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

//output

queue operations
1. Insert
2. delete
3. display
4. exit
enter your choice: 2
queue underflow ! cannot delete
queue operations
1. Insert
2. delete
3. display
4 exit
enter your choice: 1
value to insert: 1
.
.
.
.
.

enter your choice: 1
queue overflow can not insert!
que operations
1. Insert
2. delete
3. display
4 exit
enter your choi: 5
1 2 3 4 5
.

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

struct queue{
    int size;
    int f;
    int r;
    int *arr;
};
bool isFULL(struct queue *q){
    if(q->r == q->size - 1){
        return true;
    } else {
        return false;
    }
}
bool isEmpty(struct queue *q){
    if(q->r == q->f){
        return true;
    } else {
        return false;
    }
}
void enqueue(struct queue *q, int val){
    if(isFULL(q)){
        printf("Queue Overflow! Cannot enqueue %d into queue\n", val);
    } else {
        q->r = q->r + 1;
        q->arr[q->r] = val;
        printf("%d enqueued into the queue.\n", val);
    }
}
int dequeue(struct queue *q){
    if(isEmpty(q)){
        printf("Queue Underflow!\n");
        return -1;
    } else {
```

```
        q->f++;
        int val = q->arr[q->f];
        return val;
    }
}
void display(struct queue *q){
    if(isEmpty(q)){
        printf("Queue is empty!\n");
    } else {
        printf("Queue elements: ");
        for(int i = q->f + 1; i <= q->r; i++){
            printf("%d ", q->arr[i]);
        }
        printf("\n");
    }
}
int main(){
    struct queue q;
    q.size = 50; q.f = -1;
    q.r = -1;
    q.arr = (int *)malloc(q.size * sizeof(int));
    int choice, val;
    while(1){
        printf("\nOptions: 1. Enqueue  2. Dequeue  3. Display  4. Exit\n");
        printf("Enter your choice: ");
        scanf("%d", &choice);
        switch(choice){
            case 1:
                printf("Enter the element to enqueue: ");
                scanf("%d", &val);
                enqueue(&q, val);
                break;
            case 2:
                val = dequeue(&q);
                if(val != -1){
                    printf("Dequeued element: %d\n", val);
                }
                break;
```

```
            case 3:
                display(&q);
                break;
            case 4:
                printf("Exiting...\n");
                exit(0);
            default:
                printf("Invalid choice! Please try again.\n");
        }
    }
    return 0;
}
```

```
Options: 1. Enqueue  2. Dequeue  3. Display  4. Exit
Enter your choice: 1
Enter the element to enqueue: 10
10 enqueued into the queue.

Options: 1. Enqueue  2. Dequeue  3. Display  4. Exit
Enter your choice: 1
Enter the element to enqueue: 20
20 enqueued into the queue.

Options: 1. Enqueue  2. Dequeue  3. Display  4. Exit
Enter your choice: 1
Enter the element to enqueue: 30
30 enqueued into the queue.

Options: 1. Enqueue  2. Dequeue  3. Display  4. Exit
Enter your choice: 3
Queue elements: 10 20 30

Options: 1. Enqueue  2. Dequeue  3. Display  4. Exit
Enter your choice: 2
Dequeued element: 10

Options: 1. Enqueue  2. Dequeue  3. Display  4. Exit
Enter your choice: 3
Queue elements: 20 30

Options: 1. Enqueue  2. Dequeue  3. Display  4. Exit
Enter your choice: 4
Exiting...
```

LAB PROGRAM 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 messagesfor queue empty and queue overflow conditions

circular queue

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

struct circularqueue {
    int size;
    int f;
    int r;
    int *arr;
};

bool isFull(struct circularqueue *q) {
    if ((q->r+1)% (q->size) == q->f) {
        return true;
    }
    else {
        return false;
    }
}

bool isEmpty(struct circularqueue *q) {
    if (q->r == -1) {
        return true;
    }
    else {
        return false;
    }
}
```

```
void enqueue (struct circularqueue *q, int val)
    if (isFull(q)) {
        printf ("queue overflow \n");
    }
    else {
        if (q->r == -1) {
            q->f = q->r = 0;
        }
        else {
            q->r = (q->r + 1) % q->size;
        }
        q->arr[q->r] = val;
    }
}

int dequeue (struct circularqueue *q) {
    if (isEmpty(q)) {
        printf ("queue is empty! \n");
        return -1;
    }
    else {
        int val = q->arr[q->f];
        if (q->f == q->r) {
            q->f = q->r = -1;
        }
        else {
            q->f = (q->f + 1) % q->size;
        }
        return val;
    }
}
```

```
void display (struct circularqueue *q) {
    if (isEmpty (q)) {
        printf ("queue is empty! \n");
        return;
    }
    else {
        int i = q -> f;
        printf ("Queue elements : ");
        while (i != q -> r) {
            printf ("%d ", q -> arr [i]);
            i = (i+1) % q -> size ;
        }
        Printf ("%d \n", q -> arr [i]);
}

int main () {
    Struct circularqueue q;
    q. size = 5 ;
    q. f = q. r = -1;
    q. arr = (int *) malloc (q. size * sizeof (int));
    enqueue (&q, 10);
    enqueue (&q, 11);
    enqueue (&q, 12);
    enqueue (&q, 13);
    display (&q);
    prentf ("%d \n", dequeue (&q));
    ~~prentf (&q);~~
```

```
enqueue(&q, 14);
display(&q);

enqueue(&q, 14);
display(&q);
printf("%d\n", dqueue(&q));
display(&q);
return 0;
}
```

// Output

```
10 11 12 13
10
11 12 13 14
11 12 13 14 15
11
12 13 14 15
```

CODE

```
#include<stdio.h>
#include<stdlib.h>
#include<stdbool.h>
struct circularqueue{
   int size;
   int f;
   int r;
   int *arr;
};
bool isFull(struct circularqueue *q){
   if((q->r + 1) % q->size == q->f){
      return true;
   } else {
      return false;
   }
}
bool isEmpty(struct circularqueue *q){
   if(q->r == -1){
      return true;
   } else {
      return false;
   }
}
void enqueue(struct circularqueue *q, int val){
   if(isFull(q)){
      printf("Queue OverFlow\n");
   } else {
      if(q->r == -1){
         q->f = q->r = 0;
      } else {
         q->r = (q->r + 1) % q->size;
      }
      q->arr[q->r] = val;
      printf("%d enqueued into the queue.\n", val);
   }
}
int dequeue(struct circularqueue *q){
```

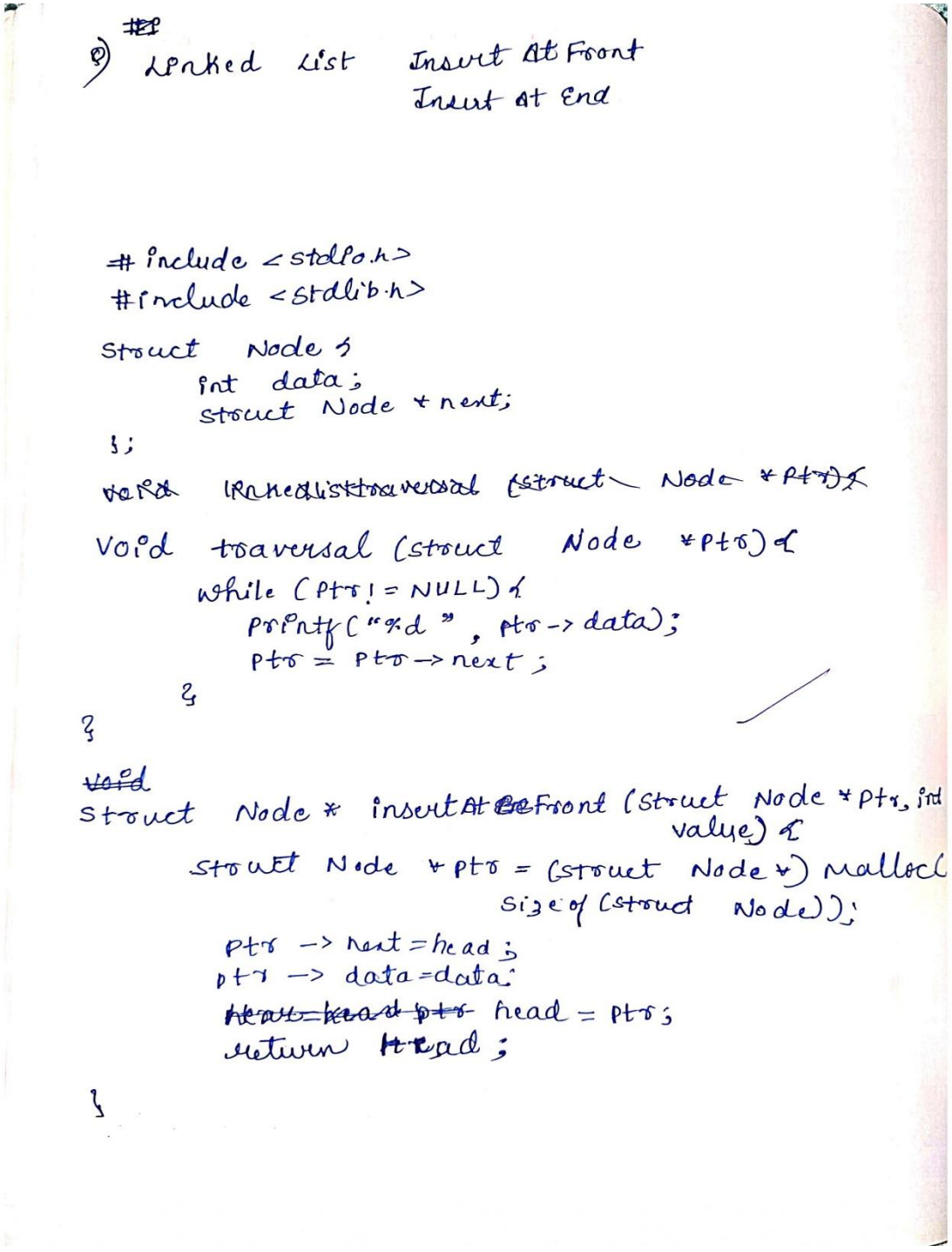
```
    if(isEmpty(q)){
        printf("Queue is empty!\n");
        return -1;
    } else {
        int val = q->arr[q->f];
        if(q->f == q->r){
            q->f = q->r = -1;
        } else {
            q->f = (q->f + 1) % q->size;
        }
        return val;
    }
}
void display(struct circularqueue *q){
    if(isEmpty(q)){
        printf("Queue is empty!\n");
        return;
    }
    int i = q->f;
    printf("Queue elements: ");
    while(i != q->r){
        printf("%d ", q->arr[i]);
        i = (i + 1) % q->size;
    }
    printf("%d\n", q->arr[i]);
}
int main(){
    struct circularqueue q;
    q.size = 5;
    q.f = q.r = -1;
    q.arr = (int*) malloc(q.size * sizeof(int));
    int choice, val;
    while(1){
        printf("\nOptions: 1. Enqueue  2. Dequeue  3. Display  4. Exit\n");
        printf("Enter your choice: ");
        scanf("%d", &choice);
        switch(choice){
            case 1:
```

```
            printf("Enter the element to insert: ");
            scanf("%d", &val);
            enqueue(&q, val);
            break;
        case 2:
            val = dequeue(&q);
            if(val != -1){
                printf("Deleted element: %d\n", val);
            }
            break;
        case 3:
            display(&q);
            break;
        case 4:
            printf("Exiting\n");
            exit(0);
        default:
            printf("Invalid choice!\n");
      }
   }
   return 0;
}
```

```
Options: 1. Enqueue  2. Dequeue  3. Display  4. Exit
Enter your choice: 1
Enter the element to insert: 10
10 enqueued into the queue.

Options: 1. Enqueue  2. Dequeue  3. Display  4. Exit
Enter your choice: 1
Enter the element to insert: 20
20 enqueued into the queue.

Options: 1. Enqueue  2. Dequeue  3. Display  4. Exit
Enter your choice: 3
Queue elements: 10 20

Options: 1. Enqueue  2. Dequeue  3. Display  4. Exit
Enter your choice: 2
Deleted element: 10

Options: 1. Enqueue  2. Dequeue  3. Display  4. Exit
Enter your choice: 4
Exiting
```

LAB PROGRAM 4

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



9) Linked List Insert At Front
Insert At End

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

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

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

struct Node * insertAtFront (struct Node *ptr, int value) {
    struct Node *ptr = (struct Node *) malloc(sizeof(struct Node));
    ptr->next = head;
    ptr->data = data;
    head = ptr;
    return head;
}
```

```
struct Node * InsertAtEnd(struct Node * head,
                          int data) {
    struct Node * ptr = (struct Node *) malloc(
                        sizeof(struct Node));
    ptr -> data = data;
    struct Node * p = head;
    while (p -> next != NULL) {
        p = p -> next;
    }
    p -> next = ptr;
    ptr -> next = NULL;
    return head;
}
void main() {
    struct Node * head = NULL;
    int choice, data;
    while (1) {
        printf("\noperations\n");
        printf("1. Insert At beginning \n");
        printf("2. Insert At end \n");
        printf("3. Traversal \n");
        printf("4. Exit \n");
        printf("Enter your choice:");
        scanf("%d", &choice);
        switch(choice) {
            case 1:
                printf("enter data");
                scanf("%d", &data);
                head = insertAtFirst(head, data);
                break;
```

```
        case 2:
            printf("enter data to insert at the end:");
            scanf("%d", &data);
            head = insertAtend(head, data);
            break;
        case 3:
            printf("Linked List: ");
            traversal(head);
            printf("\n");
            break;
        case 4:
            exit(0);
        default:
            printf("Invalid choice!");
    }
}
```

~~return~~

```
// output
```

Operations
1. Insert at the beginning
2. Insert at the end
3. Traversal
4. exit

enter your choice: 1
enter data to insert at the beginning = 45

operations:
1. Insert at the beginning
2. Insert at the end
3. Traversal
4. ext

Enter your choice: 2
enter data to insert at end =4

operations:
1. Insert at the beginning.
2. Insert at the end.
3. Traversal
4. Exit.
enter your choice: 3
Linked list: 45 4

operations:
1. Insert at the beginning
2. Insert at the end
3. Traversal
4. Exit
Enter your choice: 4

Code

```
#include <stdio.h>
#include <stdlib.h>
struct Node{
    int data;
    struct Node *next;
};
void linkedlisttraversal(struct Node *ptr){
    while(ptr != NULL){
        printf("%d ", ptr->data);
        ptr = ptr->next;
    }
}
struct Node *insertAtFirst(struct Node *head, int data){
    struct Node *ptr = (struct Node *)malloc(sizeof(struct Node));
    ptr->next = head;
    ptr->data = data;
    head = ptr;
    return head;
}
struct Node *insertAtEnd(struct Node *head, int data){
    struct Node *ptr = (struct Node *)malloc(sizeof(struct Node));
    ptr->data = data;
    ptr->next = NULL;
    if(head == NULL){
        return ptr;
    }
    struct Node *p = head;
    while(p->next != NULL){
        p = p->next;
    }
    p->next = ptr;
    return head;
}
int main(){
    struct Node *head = NULL;
    int choice, data;
    while(1){
        printf("\nMenu:\n");
```

```
        printf("1. Insert at the beginning\n");
        printf("2. Insert at the end\n");
        printf("3. Traverse the list\n");
        printf("4. Exit\n");
        printf("Enter your choice: ");
        scanf("%d", &choice);
        switch(choice){
            case 1:
                printf("Enter data to insert at the beginning: ");
                scanf("%d", &data);
                head = insertAtFirst(head, data);
                break;
            case 2:
                printf("Enter data to insert at the end: ");
                scanf("%d", &data);
                head = insertAtEnd(head, data);
                break;
            case 3:
                printf("Linked List: ");
                linkedlisttraversal(head);
                printf("\n");
                break;
            case 4:
                exit(0);
            default:
                printf("Invalid choice! Please try again.\n");
        }
    }
    return 0;
}
```

```
Menu:
1. Insert at the beginning
2. Insert at the end
3. Traverse the list
4. Exit
Enter your choice: 1
Enter data to insert at the beginning: 10

Menu:
1. Insert at the beginning
2. Insert at the end
3. Traverse the list
4. Exit
Enter your choice: 2
Enter data to insert at the end: 20

Menu:
1. Insert at the beginning
2. Insert at the end
3. Traverse the list
4. Exit
Enter your choice: 3
Linked List: 10 20

Menu:
1. Insert at the beginning
2. Insert at the end
3. Traverse the list
4. Exit
Enter your choice: 4
```

LAB PROGRAM 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

```
Q) a) Create a linked list
   b) Deletion of first element, specified
      and last element
   c) Display.

#include<stdio.h>

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

struct Node* head = NULL;
struct Node *
void create (int data, struct Node *hea d){
    struct Node* newNode = (struct Node *) malloc
                (sizeof (struct Node));
    new Node ->data = data;
    newNode -> next = NULL;
    if (head == NULL) {
          head = newNode;
    } else {
          Struct Node * temp = head;
          while (temp -> next -> next != NULL) {
                temp = temp -> next;
          }
          temp ->next = newNode;
    }
    return head;
}
```

```
Struct Node * deleteFirst( struct Node * head);
    if (head == NULL) return NULL;
    struct Node * ptr = head;
    head = head -> next;
    free (Ptr);
    return head;
}

Struct Node * deleteAtIndex(Struct Node *
                    head, int index) {
    if (head == NULL || index < 0) {
        return head;
    }
    Struct Node *p = head;
    struct Node *q = head -> next;
    if (index == 0) return deleteFirst (head);
    for (int i=0; i < index -1; i++) {
        if (q == NULL) return head;
        p = p -> next;
        q = q -> next;
    }
    p->next = q -> next
    return head;
}
```

```
struct Node* deleteAtLast ( struct Node *head){
  if (head == NULL) return NULL;
  if (head -> next == NULL) {
      free (head);
      return NULL;
  }
  else {
  Struct Node * temp = head;
  struct Node * q = head -> next;

  while (q -> next != NULL){
      P = P-> next;
      q = q -> next;
   }
   p -> next = NULL;
    free (q);
   return head;
}
void display (struct Node * head) {
   struct node * temp = head;
   While (temp != NULL) {
     printf ("%d", temp -> data);
      temp = temp -> next;
   }
   Printf ("\n");
}
```

CODE

```
#include <stdio.h>
#include <stdlib.h>
struct Node {int data; struct Node *next;};
struct Node* head = NULL;
struct Node* create(int data, struct Node *head) {
   struct Node *newnode = (struct Node*)malloc(sizeof(struct Node));
   newnode->data = data; newnode->next = NULL;
   if (head == NULL) head = newnode;
   else {
      struct Node *temp = head;
      while (temp->next != NULL) temp = temp->next;
      temp->next = newnode;
   }
   return head;
}
struct Node* deletefirst(struct Node *head) {
   if (head == NULL) {printf("LINKED LIST is empty"); return NULL;}
   struct Node *ptr = head; head = head->next; free(ptr); return head;
}
struct Node* deleteatindex(struct Node *head, int index) {
   if (head == NULL || index < 0) {printf("LINKED LIST is empty"); return head;}
   if (index == 0) return deletefirst(head);
   struct Node *p = head, *q = head->next;
   for (int i = 0; i < index - 1; i++) {
      if (q == NULL) {printf("index out of range\n"); return head;}
      p = p->next; q = q->next;
   }
   p->next = q->next; free(q); return head;
}
struct Node* deleteatlast(struct Node *head) {
   if (head == NULL) {printf("LINKED LIST is empty"); return NULL;}
   else if (head->next == NULL) {free(head); return NULL;}
   else {
      struct Node *p = head, *q = head->next;
      while (q->next != NULL) {p = p->next; q = q->next;}
      p->next = NULL; free(q);
   }
   return head;
```

```
}
void display(struct Node *head) {
   struct Node *temp = head;
   while (temp != NULL) {printf("%d ", temp->data); temp = temp->next;}
   printf("NULL\n");
}
int main() {
   int choice, data, idx;
   while (1) {
      printf("SELECT:\n1. CREATE\n2. DELETE AT FIRST\n3. DELETE AT INDEX\n4. DELETE AT
LAST\n5. DISPLAY\n6. EXIT\n");
      scanf("%d", &choice);
      switch (choice) {
         case 1: printf("Enter data to create a new node: "); scanf("%d", &data); head = create(data, head); break;
         case 2: head = deletefirst(head); break;
         case 3: printf("Enter the index to delete: "); scanf("%d", &idx); head = deleteatindex(head, idx); break;
         case 4: head = deleteatlast(head); break;
         case 5: printf("Linked List: "); display(head); break;
         case 6: printf("Exiting.....\n"); exit(0);
         default: printf("Invalid choice!!!!!\n");
      }
   }
   return 0;
}
```

```
SELECT:
1. CREATE
2. DELETE AT FIRST
3. DELETE AT INDEX
4. DELETE AT LAST
5. DISPLAY
6. EXIT
1
Enter data to create a new node: 10

SELECT:
1. CREATE
2. DELETE AT FIRST
3. DELETE AT INDEX
4. DELETE AT LAST
5. DISPLAY
6. EXIT
1
Enter data to create a new node: 20

SELECT:
1. CREATE
2. DELETE AT FIRST
3. DELETE AT INDEX
4. DELETE AT LAST
5. DISPLAY
6. EXIT
5
Linked List: 10 20 NULL

SELECT:
1. CREATE
2. DELETE AT FIRST
3. DELETE AT INDEX
4. DELETE AT LAST
5. DISPLAY
6. EXIT
4

SELECT:
1. CREATE
2. DELETE AT FIRST
3. DELETE AT INDEX
4. DELETE AT LAST
5. DISPLAY
6. EXIT
5
Linked List: 10 NULL

SELECT:
1. CREATE
2. DELETE AT FIRST
3. DELETE AT INDEX
4. DELETE AT LAST
5. DISPLAY
6. EXIT
6
Exiting.......
```

LAB PROGRAM 6a

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

6 a) WAP to implement Single Link list of following operations:
Sort the linked list
Reverse the linked list
Concatenation of two linked list.

6 b) WAP to implement Single Link list to stimulate stack & queue operations.

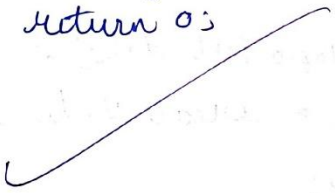
6a

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

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

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

void sortList (Node** head) {
    if (*head == NULL || (*head) -> next == NULL){
        return ;
    }
    Node * i = * head;
    while (i != NULL){
        Node * j = i -> next;
        while (j != NULL) {
            if (i -> data > j -> data) {
                int temp = i -> data;
                i -> data = j -> data;
                j -> data = temp;
            }
            j = j -> next;
        }
        i = i -> next;
    }
}
```

```
void reverseList(Node** head) {
    Node *prev = NULL, *current = *head;
    Node *Next = NULL;
    While (current != NULL) {
        next = current -> next;
        current -> next = prev;
        prev = current;
        current = Next;
    }
    *head = prev;
}

Node * concatenateLists (Node * head1, Node*hea
    if (head1 == NULL) return head2;
    if (head2 == NULL) return head1;
    Node * temp = head1;
    While (temp -> next != NULL) {
        temp = temp -> next;
    }
    temp -> next = head2;
    return head1;
}

int main () {
    Node *list1 = NULL, * list2 = NULL;
    insertEnd (& list1, 3);
    insertEnd (&list1, 1);
    insertEnd (& list1, 5);
    Printf ("original List 1: ");
    displayList (list1);
    SortList (& list1);
    printf ("Sorted List 1: ");
    displayList (list1);
```

```
// Reverse
reverseList(&list1);
printf("Reversed List 1: ");
displayList(list1);

// Insert
insertEnd(&list2, 10);
insertEnd(&list2, 20);
printf("List 2: ");
displayList(list2);

// Concat

Con
Node* concatenated = concatenateLists(list1, list2);
printf("Concatenated List: ");
displayList(concatenated);
return 0;
}
```



Code

```
#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 insertEnd(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 printList(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 = head; struct Node* j; int temp;
   while (i != NULL) {
      j = i->next;
      while (j != NULL) {
         if (i->data > j->data) {temp = i->data; i->data = j->data; j->data = temp;}
         j = j->next;
      }
      i = i->next;
   }
}
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* list1 = NULL; struct Node* list2 = NULL;
    int choice, data;
    do {
        printf("\nMenu:\n1. Insert element into List 1\n2. Insert element into List 2\n3. Sort List 1\n4. Reverse List 1\n5. Concatenate List 1 and List 2\n6. Print List 1\n7. Print List 2\n8. Exit\nEnter your choice: ");
        scanf("%d", &choice);
        switch (choice) {
            case 1: printf("Enter data to insert into List 1: "); scanf("%d", &data); insertEnd(&list1, data); break;
            case 2: printf("Enter data to insert into List 2: "); scanf("%d", &data); insertEnd(&list2, data); break;
            case 3: sortList(list1); printf("List 1 sorted.\n"); break;
            case 4: reverseList(&list1); printf("List 1 reversed.\n"); break;
            case 5: concatenateLists(&list1, list2); printf("List 2 concatenated to List 1.\n"); break;
            case 6: printf("List 1: "); printList(list1); break;
            case 7: printf("List 2: "); printList(list2); break;
            case 8: printf("Exiting...\n"); break;
            default: printf("Invalid choice. Please try again.\n");
        }
    } while (choice != 8);
    return 0;
}
```

```
Menu:
1. Insert element into List 1
2. Insert element into List 2
3. Sort List 1
4. Reverse List 1
5. Concatenate List 1 and List 2
6. Print List 1
7. Print List 2
8. Exit
Enter your choice: 1
Enter data to insert into List 1: 5

Menu:
1. Insert element into List 1
2. Insert element into List 2
3. Sort List 1
4. Reverse List 1
5. Concatenate List 1 and List 2
6. Print List 1
7. Print List 2
8. Exit
Enter your choice: 1
Enter data to insert into List 1: 3

Menu:
1. Insert element into List 1
2. Insert element into List 2
3. Sort List 1
4. Reverse List 1
5. Concatenate List 1 and List 2
6. Print List 1
7. Print List 2
8. Exit
Enter your choice: 3
List 1 sorted.

Menu:
1. Insert element into List 1
2. Insert element into List 2
3. Sort List 1
4. Reverse List 1
5. Concatenate List 1 and List 2
6. Print List 1
7. Print List 2
8. Exit
Enter your choice: 6
List 1: 3 -> 5 -> NULL

Menu:
1. Insert element into List 1
2. Insert element into List 2
3. Sort List 1
4. Reverse List 1
5. Concatenate List 1 and List 2
6. Print List 1
7. Print List 2
8. Exit
Enter your choice: 8
Exiting...
```

LAB PROGRAM 6b

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

```
6b)
#include <stdio.h>
#include <stdlib.h>

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

Struct Node* create Node (int data) {
    Struct Node*new Node = (Struct Node *)
                malloc (size of (struct Node));
    new Node -> data = data;
    new Node -> next = NULL;
    return new Node;
}

Void push (strud Node **top, int data) {
    struct Node* new Node = create Node (data);
    new Node ->next = * top;
    *top = new Node;
    printf ("pushed %d in stack \n", data);
}

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

```
void enqueue(struct Node **rear, struct Node
                **front, int data){
    struct Node* newNode = createNode(data);
    if (*rear == NULL){
        *rear = *front = newNode;
    }
    else {
        (*rear)->next = newNode;
        *rear = newNode;
    }
    printf("Enqueued %d\n", data);
}
int dequeue(struct Node **front, struct Node **rear){
    if (*front == NULL){
        printf("Queue is empty\n");
        return -1;
    }
    int data = (*front)->data;
    struct Node *temp = *front;
    *front = (*front)->next;
    if (*front == NULL){
        *rear = NULL; }
    free(temp);
    printf("Dequeued %d from queue\n", data);
    return data;
}
```

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

CODE

```
#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; printf("Pushed %d onto stack\n", data);
}
int pop(struct Node** top) {
   if (*top == NULL) {printf("Stack is empty\n"); return -1;}
   int data = (*top)->data; struct Node* temp = *top; *top = (*top)->next; free(temp);
   printf("Popped %d from stack\n", data); return data;
}
void enqueue(struct Node** rear, struct Node** front, int data) {
   struct Node* newNode = createNode(data);
   if (*rear == NULL) {*rear = *front = newNode;} else {(*rear)->next = newNode; *rear = newNode;}
   printf("Enqueued %d into queue\n", data);
}
int dequeue(struct Node** front, struct Node** rear) {
   if (*front == NULL) {printf("Queue is empty\n"); return -1;}
   int data = (*front)->data; struct Node* temp = *front; *front = (*front)->next;
   if (*front == NULL) {*rear = NULL;} free(temp); printf("Dequeued %d from queue\n", data); return data;
}
void display(struct Node* head) {
   if (head == NULL) {printf("List is empty\n"); return;}
   struct Node* temp = head; while (temp != NULL) {printf("%d -> ", temp->data); temp = temp->next;}
printf("NULL\n");
}
int main() {
   struct Node* stack = NULL; struct Node* front = NULL; struct Node* rear = NULL;
   int choice, data; while (1) {
      printf("\nMenu:\n1. Push to Stack\n2. Pop from Stack\n3. Display Stack\n4. Enqueue to Queue\n5.
Dequeue from Queue\n6. Display Queue\n7. Exit\nEnter your choice: ");
      scanf("%d", &choice);
      switch (choice) {
```

```
            case 1: printf("Enter data to push onto stack: "); scanf("%d", &data); push(&stack, data); break;
            case 2: pop(&stack); break;
            case 3: printf("Stack: "); display(stack); break;
            case 4: printf("Enter data to enqueue into queue: "); scanf("%d", &data); enqueue(&rear, &front, data);
break;
            case 5: dequeue(&front, &rear); break;
            case 6: printf("Queue: "); display(front); break;
            case 7: exit(0);
            default: printf("Invalid choice. Please try again.\n");
        }
    }
    return 0;
}
```

```
Menu:
1. Push to Stack
2. Pop from Stack
3. Display Stack
4. Enqueue to Queue
5. Dequeue from Queue
6. Display Queue
7. Exit
Enter your choice: 1
Enter data to push onto stack: 10
Pushed 10 onto stack

Enter your choice: 4
Enter data to enqueue into queue: 20
Enqueued 20 into queue

Enter your choice: 3
Stack: 10 -> NULL

Enter your choice: 6
Queue: 20 -> NULL

Enter your choice: 2
Popped 10 from stack

Enter your choice: 5
Dequeued 20 from queue

Enter your choice: 7
```

PROGRAM 7

7. WAP to Implement doubly link list with primitive operations

a) Create a doubly linked list.

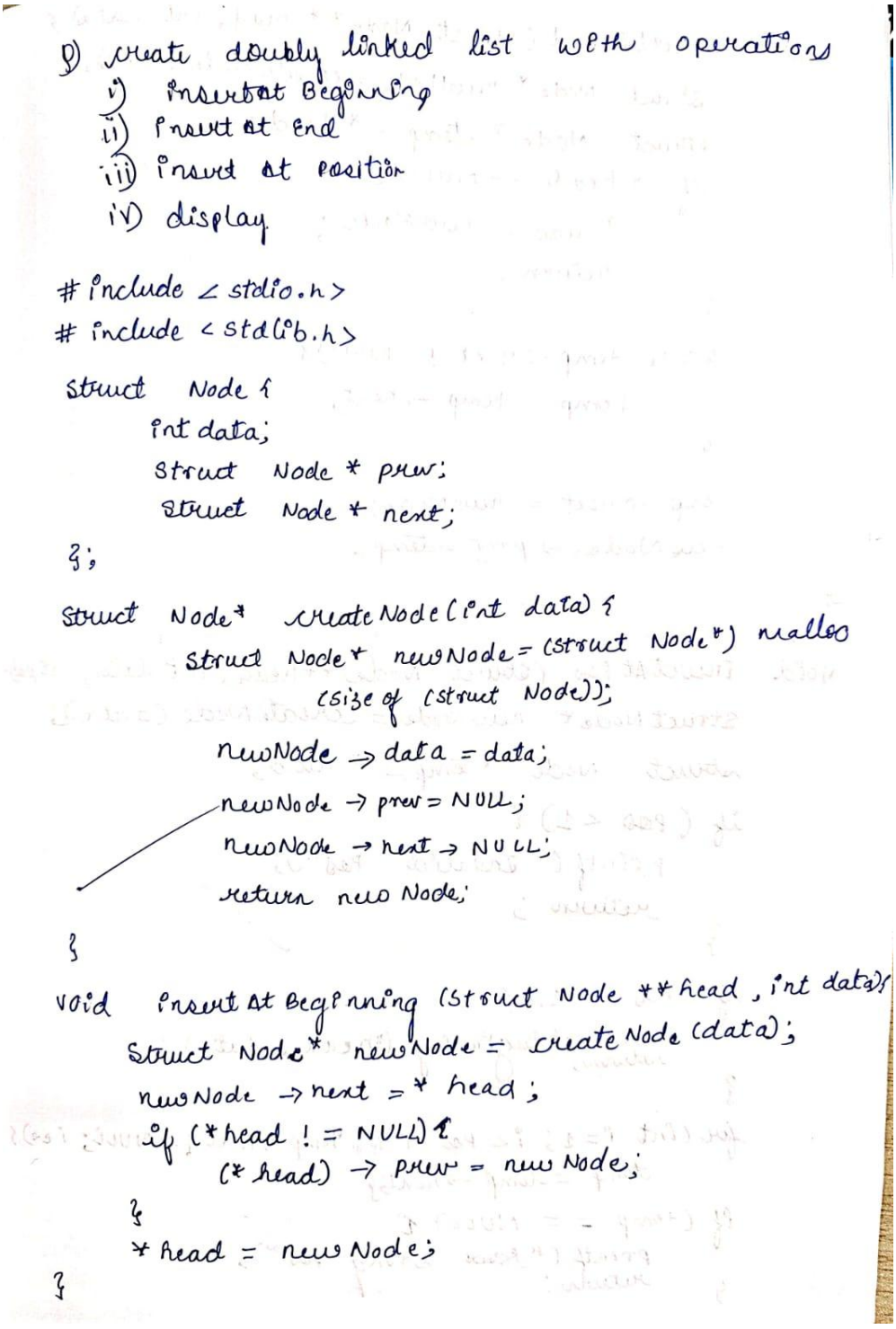
b) Insert a new node at the beginning.

c) Insert the node based on a specific location

d)

Insert a new node at the end.

e) Display the contents of the list



```
7) create doubly linked list with operations
   i) insert at Beginning
   ii) insert at end
   iii) insert at position
   iv) display

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

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

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

void insertAtBeginning (struct Node **head, int data)
    struct Node* newNode = createNode(data);
    newNode -> next = *head;
    if (*head != NULL) {
        (*head) -> prev = newNode;
    }
    *head = newNode;
}
```

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

void insertAtPos (struct Node **head, int data, int
    Struct Node * newNode = createNode (data);
    struct Node * temp = * head;
    if ( pos < 1) {
        printf (" Invalid Pos ");
        return ;
    }
    if (pos == 1) {
        Insert at beginning (*head, data);
        return;
    }
    for (int i = 1; i < pos - 1 && temp -> next != NULL; i++)
        temp = temp -> next;}
    If (temp == NULL) {
        printf (" Wrong pos ");
    }  return;
```

```
    newNode -> next = temp -> next;
    newNode -> prev = temp;
    temp
    newNode -> next -> prev = temp, newNode;
    newtemp -> next = newNode;
}

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

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

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

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

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

void insertAtLocation(struct Node** head, int data, int location) {
    struct Node* newNode = createNode(data);
    if (location == 1) {
        insertAtBeginning(head, data);
        return;
    }
    struct Node* temp = *head;
    for (int i = 1; i < location - 1 && temp != NULL; i++) {
        temp = temp->next;
    }
    if (temp == NULL) {
```

```
        printf("Location out of range.\n");
        return;
    }
    newNode->next = temp->next;
    if (temp->next != NULL) {
        temp->next->prev = newNode;
    }
    temp->next = newNode;
    newNode->prev = temp;
    printf("Inserted %d at location %d.\n", data, location);
}

void insertAtEnd(struct Node** head, int data) {
    struct Node* newNode = createNode(data);
    if (*head == NULL) {
        *head = newNode;
        printf("Inserted %d at the end.\n", data);
        return;
    }
    struct Node* temp = *head;
    while (temp->next != NULL) {
        temp = temp->next;
    }
    temp->next = newNode;
    newNode->prev = temp;
    printf("Inserted %d at the end.\n", data);
}

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

int main() {
```

```
    struct Node* head = NULL;
    int choice, data, location;
    while (1) {
        printf("\n1. Create a doubly linked list\n2. Insert at beginning\n3. Insert at location\n4. Insert at end\n5. Display\n6. Exit\n");
        scanf("%d", &choice);
        switch (choice) {
            case 1:
                printf("Enter data to insert at beginning: ");
                scanf("%d", &data);
                insertAtBeginning(&head, data);
                break;
            case 2:
                printf("Enter data to insert at beginning: ");
                scanf("%d", &data);
                insertAtBeginning(&head, data);
                break;
            case 3:
                printf("Enter data to insert: ");
                scanf("%d", &data);
                printf("Enter location to insert at: ");
                scanf("%d", &location);
                insertAtLocation(&head, data, location);
                break;
            case 4:
                printf("Enter data to insert at end: ");
                scanf("%d", &data);
                insertAtEnd(&head, data);
                break;
            case 5:
                display(head);
                break;
            case 6:
                exit(0);
            default:
                printf("Invalid choice!\n");
        }
    }
    return 0;
```

}

```
1. Create a doubly linked list
2. Insert at beginning
3. Insert at location
4. Insert at end
5. Display
6. Exit
Enter your choice: 1
Enter data to insert at beginning: 10
Inserted 10 at the beginning.

1. Create a doubly linked list
2. Insert at beginning
3. Insert at location
4. Insert at end
5. Display
6. Exit
Enter your choice: 4
Enter data to insert at end: 20
Inserted 20 at the end.

1. Create a doubly linked list
2. Insert at beginning
3. Insert at location
4. Insert at end
5. Display
6. Exit
Enter your choice: 3
Enter data to insert: 15
Enter location to insert at: 2
Inserted 15 at location 2.

1. Create a doubly linked list
2. Insert at beginning
3. Insert at location
4. Insert at end
5. Display
6. Exit
Enter your choice: 5
10 <-> 15 <-> 20 <-> NULL
```

PROGRAM 8

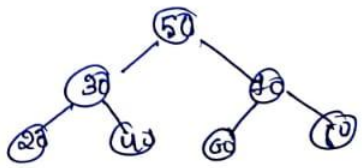
8. Write a program

a) To construct a binary Search tree.

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

```
⑧ Write a programs
a) To construct a binary search tree
b) to traverse the tree using all the methods
   i.e inorder, preorder, post order display all
   traversal order

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

Struct Node {
      int key;
      Struct Node * left;
      struct Node * right;
};

Struct Node* newNode (int key) {
      Struct Node* = (Struct Node* )malloc (sizeof(
                                  struct Node));
      node -> key = key;
      node -> left = node -> right = NULL;
      return node;
}

struct Node* insert (struct Node* node, int key){
      if (node == NULL) return newNode(key);
      if (key < node -> key) {
         node -> left = insert (node -> left, key);
      else if (key > node-> key) {
         node -> right = insert (node->right, key);
      }
      return node;
}
```

```
void inorder(struct node * root) {
    if (root != NULL) {
        inorder(root -> left);
        printf("%d ", root -> key);
        inorder(root -> right);
    }
}

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

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

void main() {
    struct Node * root = NULL;
    root = insert(root, 50);
    root = insert(root, 30);
    root = insert(root, 20);
    root = insert(root, 40);
    root = insert(root, 70);
    root = insert(root, 60);
    root = insert(root, 80);
```



```
printf ("In Orde
inorder (root);
printf ("\n");
printf (" Pre order traversal: ");
preorder (root);
printf ("\n");
printf ("Post order traversal: ");
postorder(root);
printf ("\n");
}
```

In order traversal: 20 30 40 50 60 70 80

Pre order traversal: 50 30 20 40 70 60 80

Post order traversal: 20 40 30 60 80 70 50

Code

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

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

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

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

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

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

void postorderTraversal(Node* root) {
   if (root != NULL) {
```

```
        postorderTraversal(root->left);
        postorderTraversal(root->right);
        printf("%d ", root->data);
    }
}

int main() {
    Node* root = NULL;
    root = insert(root, 50);
    insert(root, 30);
    insert(root, 70);
    insert(root, 20);
    insert(root, 40);
    insert(root, 60);
    insert(root, 80);

    printf("Inorder traversal: ");
    inorderTraversal(root);
    printf("\n");

    printf("Preorder traversal: ");
    preorderTraversal(root);
    printf("\n");

    printf("Postorder traversal: ");
    postorderTraversal(root);
    printf("\n");

    return 0;
}
```

Output

Inorder traversal: 20 30 40 50 60 70 80
Preorder traversal: 50 30 20 40 70 60 80
Postorder traversal: 20 40 30 60 80 70 50

PROGRAM 9

9a Write a programme to traverse a graph by bfs
9b write a programme to traverse a graph by dfs

9a) Write a program to traverse a graph using BFS Method.

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

#define MAX_VERTICES 10

struct queue {
    int items[MAX_VERTICES];
    int front, rear;
};

void initqueue (struct queue* q) {
    q->front = -1;
    q->rear = -1;
}
int isEmpty (struct queue* q) {
    return q->front == -1;
}

void enqueue (struct queue* q, int value) {
    if (q->rear == MAX_VERTICES - 1) {
        printf ("queue is full!\n");
        return;
    }
    if (q->front == -1) {
        q->front = 0;
    }
    q->rear++;
    q->items[q->rear] = value;
}
```

```
void BFS (struct Graph* g, int startVertex) {
    struct Queue q;
    initQueue (&q);
    int visited [MAX_VERTICES] = {0};
    visited [startVertex] = 1;
    enqueue (&q, startVertex);
    printf ("BFS traversal starting from vertex %d
                startVertex);

    While (!isEmpty (&q)) {
        int currentVertex = dequeue (&q);
        printf ("%d ", currentVertex);
        for (int i=0; i < g -> vertices; i++) {
        if (g -> adjMatrix [currentVertex] [i] == 1 &&
                !visited [i]) {
            enqueue (&q, i);
            visited [i] = 1;
        }
    }
    printf ("\n");
}
int main () {
    struct Graph g;
    initGraph (&g, 5);
    addEdge (&g, 0, 1);
    addEdge (&g, 0, 2);
    addEdge (&g, 1, 3);
    addEdge (&g, 1, 4);
    BFS (&g, 0);
    return 0;
}
```

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

```
#include <stdio.h>
#define MAX_VERTICES 100
int graph[MAX_VERTICES][MAX_VERTICES];
int visited[MAX_VERTICES];

void DFS(int vertex, int n) {
    visited[vertex] = 1;
    printf("%d ", vertex);

    for(int i = 0; i < n; i++) {
        if(graph[vertex][i] == 1 && !visited[i]) {
            DFS(i, n);
        }
    }
}

int main() {
    int n, e, x, y;
    printf("Enter the number of vertices: ");
    scanf("%d", &n);
    for(int i=0; i<n; i++) {
        for(int j = 0; j<n; j++) {
            graph[i][j]=0;
        }
        visited[i]=0;
    }
    printf("Enter the number of edges: ");
    scanf("%d", &e);
```

```
for(int i=0 ; i <e; i++){
        printf ("Enter edge (x y): ");
        scanf("%d %d", &x, &y);
        graph[x][y] = 1;
        graph[y][x] = 1;
}
printf("DFS Traversal starting from vertex 0: \n");
DFS (0, N);
return 0;
}
```

Enter the number of vertices: 5
Enter the number of edges: 4
Enter edge (x, y): 0 1
Enter edge (x, y): 0 2
Enter edge (x, y): 1 3
Enter edge (x y): 2 4

DFS Traversal starting from vertex 0: 0 1 3 2 4

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

#define MAX 100

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

void enqueue(int value) {
    if (rear == MAX - 1) {
        return;
    }
    if (front == -1) {
        front = 0;
    }
    queue[++rear] = value;
}

int dequeue() {
    if (front == -1 || front > rear) {
        return -1;
    }
    return queue[front++];
}

int isQueueEmpty() {
    return front == -1 || front > rear;
}

void bfs(int graph[MAX][MAX], int n, int start) {
    for (int i = 0; i < n; i++) {
        visited[i] = 0;
    }
    enqueue(start);
    visited[start] = 1;
    while (!isQueueEmpty()) {
        int current = dequeue();
        printf("%d ", current);
```

```
        for (int i = 0; i < n; i++) {
            if (graph[current][i] == 1 && !visited[i]) {
                enqueue(i);
                visited[i] = 1;
            }
        }
    }
}

int main() {
    int n, start;
    int graph[MAX][MAX];

    printf("Enter the number of vertices: ");
    scanf("%d", &n);

    printf("Enter the adjacency matrix:\n");
    for (int i = 0; i < n; i++) {
        for (int j = 0; j < n; j++) {
            scanf("%d", &graph[i][j]);
        }
    }

    printf("Enter the starting vertex: ");
    scanf("%d", &start);

    printf("BFS Traversal: ");
    bfs(graph, n, start);

    return 0;
}
```

```
Enter the number of vertices: 5
Enter the adjacency matrix:
0 1 1 0 0
1 0 1 1 0
1 1 0 1 1
0 1 1 0 1
0 0 1 1 0
Enter the starting vertex: 0
BFS Traversal: 0 1 2 3 4
```

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

#define MAX 100

int visited[MAX];

void dfs(int graph[MAX][MAX], int n, int vertex) {
    printf("%d ", vertex);
    visited[vertex] = 1;
    for (int i = 0; i < n; i++) {
        if (graph[vertex][i] == 1 && !visited[i]) {
            dfs(graph, n, i);
        }
    }
}

int main() {
    int n, start;
    int graph[MAX][MAX];

    printf("Enter the number of vertices: ");
    scanf("%d", &n);

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

```
    printf("Enter the starting vertex: ");
    scanf("%d", &start);

    for (int i = 0; i < n; i++) {
        visited[i] = 0;
    }

    printf("DFS Traversal: ");
    dfs(graph, n, start);

    return 0;
}
```

```
Enter the number of vertices: 5
Enter the adjacency matrix:
0 1 1 0 0
1 0 1 1 0
1 1 0 1 1
0 1 1 0 1
0 0 1 1 0
Enter the starting vertex: 0
DFS Traversal: 0 1 2 3 4
```