VISVESVARAYA TECHNOLOGICAL UNIVERSITY

"JnanaSangama", Belgaum -590014, Karnataka.

LAB REPORT
on

DATA STRUCTURES

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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B. M. S. College of Engineering,

Bull Temple Road, Bangalore 560019

(Affiliated To Visvesvaraya Technological University, Belgaum)

Department of Computer Science and Engineering

CERTIFICATE

This is to certify that the Lab work entitled "**DATA STRUCTURES**" carried out by **PALLE PADMAVATHI(1BM21CS125),** who is bonafide student of **B. M. S. College of Engineering.** It is in partial fulfillment for the award of **Bachelor of Engineering in Computer Science and Engineering** of the Visvesvaraya Technological University, Belgaum during the year 2022-23. The Lab report has been approved as it satisfies the academic requirements in respect of Data structures Lab **- (22CS3PCDST)**work prescribed for the said degree.

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Index Sheet

Course Outcome

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

LAB PROGRAM 1:

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

CODE:

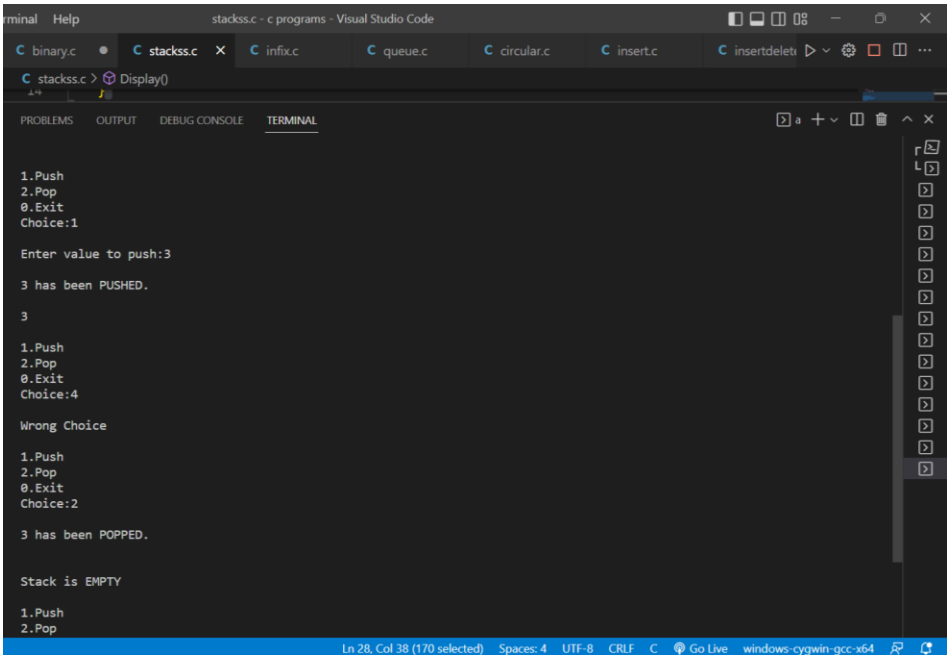
```
#include<stdio.h>
#include<stdlib.h>
#define MAX 5


int top = -1;
int i;
int stk[MAX];


int isEmpty(){
    if(top == -1)
        return 1;
    else
        return 0;
    }



int isFull(){
    if(top == MAX-1)
        return 1;
```

```
    else
        return 0;
    }



void Display(){
    if(isEmpty() == 0){
        for(i=0; i<=top; i++)
                printf("%d ",stk[i]);
        printf("\n");
        }
    else
        printf("\nStack is EMPTY\n");
    }



void Push(){
    int val;
    if(isFull() == 0){
        top++;
        printf("\nEnter value to push:");
        scanf("%d", &val);
        stk[top] = val;
        printf("\n%d has been PUSHED.\n\n", val);
        }
    else
        printf("\nStack is FULL\n");
```

```
    Display();
    }


void Pop(){
    if(isEmpty() == 1)
        printf("\nStack is EMPTY\n");
    else{
        printf("\n%d has been POPPED.\n\n", stk[top]);
        top--;
        }

    Display();
    }


int main(){
    int c=1;
    do{
        printf("\n1.Push \n2.Pop \n0.Exit\nChoice:");
        scanf("%d", &c);
        switch(c){
            case 1:
                Push();
                break;
            case 2:
```

```
                Pop();
                break;
            case 0:
                exit(1);
            default:
                printf("\nWrong Choice\n");
            }
        }while(c != 0);
    return 0;
    }
```

OUTPUT :



LAB PROGRAM2:

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) .

CODE:

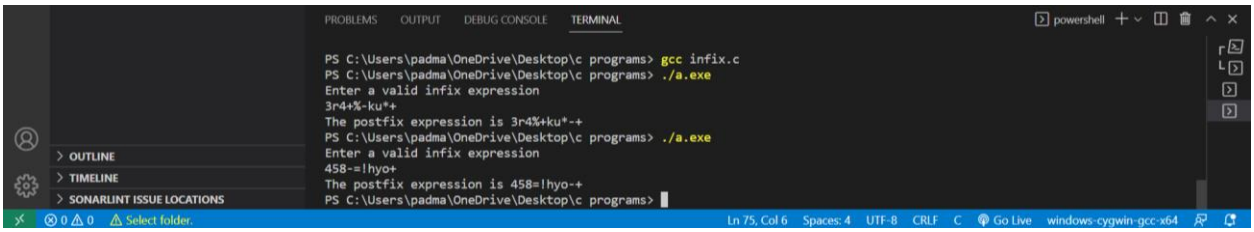
```
#include<stdio.h>
#include<string.h>
int top=-1;
char infix[20],postfix[20],s[20];
void inf_to_post();
int sp(char);
int ip(char);
void push(char);
char pop();
void main()
{
    printf("Enter a valid infix expression\n");
    scanf("%s",infix);
    inf_to_post();
    printf("The postfix expression is %s",postfix);
}
void push(char item)
{
    s[++top]=item;
}
char pop()
```

```
{
    return s[top--];
}
int sp(char item)
{
    switch(item)
    {
        case'+':
        case'-':return 2;
        case'*':
        case'/':return 4;
        case'^':return 5;
        case'(':return 0;
        case'#':return-1;
        default:return 8;
    }
}
int ip(char item)
{
    switch(item)
    {
        case'+':
        case'-':return 1;
        case'*':
        case'/':return 3;
        case'^':return 6;
        case'(':return 9;
```

```
        case')':return 0;
        default:return 7;
    }
}
void inf_to_post()
{
    int i,j=0;
    char symbol;
    push('#');
    for(i=0;i<strlen(infix);i++)
    {
        symbol=infix[i];
        while(sp(s[top])>ip(symbol))
        {
            postfix[j]=pop();
            j++;
        }
        if(sp(s[top])<ip(symbol))
        {
            push(symbol);
        }
        if(sp(s[top])==ip(symbol))
        {
            pop();
        }

    }
```

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


}
```

OUTPUT:



LAB PROGRAM 3:

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

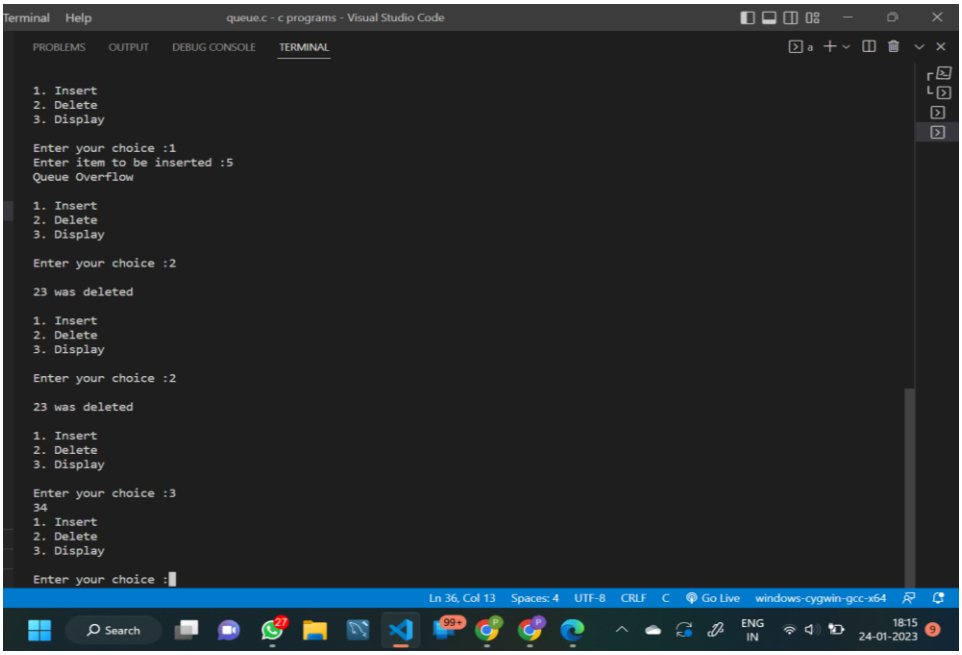
CODE:

```
#include<stdio.h>

#include<stdlib.h>

#define QSIZE 3
```

```c
void insert_rear(int q[],int item, int*r)
{
    if(*r==QSIZE-1)
        printf("Queue Overflow\n");
    else
    {
        (*r)++;
        q[*r]=item;
    }

}
int delete_front(int q[],int *r,int *f)
{
    if(*f>*r)
        printf("Queue underflow\n");
    else
        return q[(*f)++];
}
void display(int q[],int *r,int *f)
{
    int i;
    if(*f>*r)
        printf("Queue is empty\n");
    else
    {
        for(i=*f;i<=*r;i++)
            printf("%d\t",q[i]);
```

```
    }
}
void main()
{
    int q[QSIZE],r=-1, f=0, c,val_del,item;
    while(1)
    {
        printf("\n1. Insert\n2. Delete\n3. Display\n");
        printf("\nEnter your choice :");
        scanf("%d",&c);
        switch(c)
        {
            case 1: printf("Enter item to be inserted :");
                    scanf("%d",&item);
                    insert_rear(q,item,&r);
                    break;
            case 2: val_del=delete_front(q,&r,&f);
                    printf("\n%d was deleted\n",val_del);
                    break;
            case 3: display(q,&r,&f);
                    break;
            default: printf("\nInvalid choice!!!");
                     exit(0);
                     break;
        }
    }
}
```

OUTPUT:



LAB PROGRAM 4:

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

CODE:

```
#include<stdio.h>

# define MAX 5

int cqueue_arr[MAX];

int front = -1;

int rear = -1;

void insert(int item)

{
```

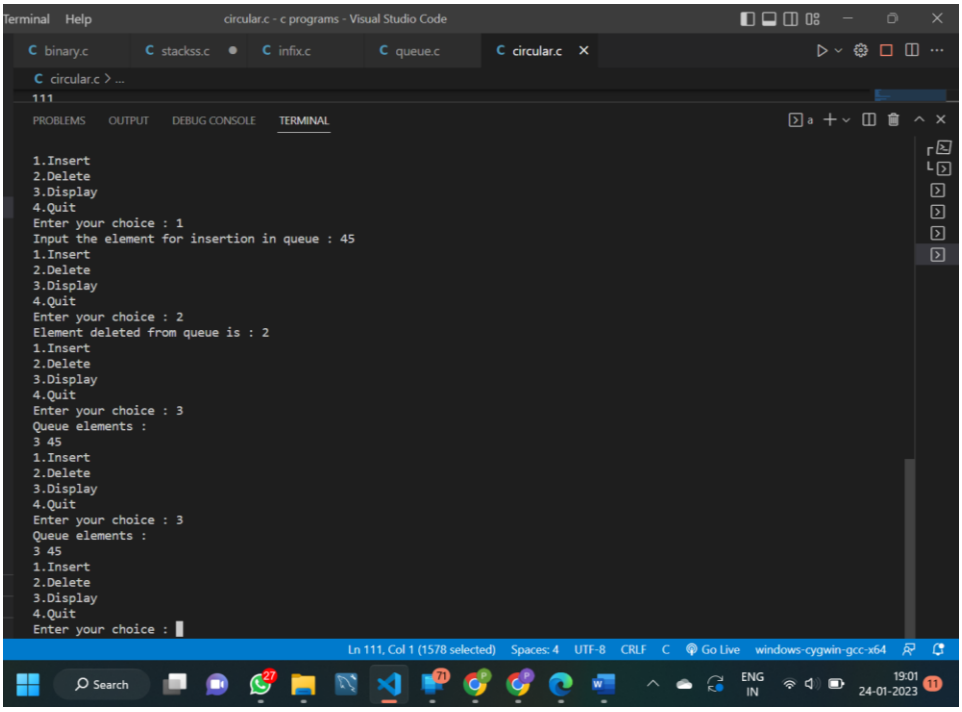
```
if((front == 0 && rear == MAX-1) || (front == rear+1))
{
printf("Queue Overflow \n");
return;
}
if(front == -1)
{
front = 0;
rear = 0;
}
else
{
if(rear == MAX-1)
rear = 0;
else
rear = rear+1;
}
cqueue_arr[rear] = item ;
}
void deletion()
{
if(front == -1)
{
printf("Queue Underflow\n");
return ;
}
printf("Element deleted from queue is : %d\n",cqueue_arr[front]);
```

```
if(front == rear)
{
front = -1;
rear=-1;
}
else
{
if(front == MAX-1)
front = 0;
else
front = front+1;
}
}
void display()
{
int front_pos = front,rear_pos = rear;
if(front == -1)
{
printf("Queue is empty\n");
return;
}
printf("Queue elements :\n");
if( front_pos <= rear_pos )
while(front_pos <= rear_pos)
{
printf("%d ",cqueue_arr[front_pos]);
front_pos++;
```

```
}
else
{
while(front_pos <= MAX-1)
{
printf("%d ",cqueue_arr[front_pos]);
front_pos++;
}
front_pos = 0;
while(front_pos <= rear_pos)
{
printf("%d ",cqueue_arr[front_pos]);
front_pos++;
}
}
printf("\n");
}
int main()
{
int choice,item;
do
{
printf("1.Insert\n");
printf("2.Delete\n");
printf("3.Display\n");
printf("4.Quit\n");
printf("Enter your choice : ");
```

```
scanf("%d",&choice);
switch(choice)
{
case 1 :
printf("Input the element for insertion in queue : ");
scanf("%d", &item);
insert(item);
break;
case 2 :
deletion();
break;
case 3:
display();
break;
case 4:
break;
default:
printf("Wrong choicen");
}
}while(choice!=4);
return 0;
}
```

OUTPUT:



LAB PROGRAM 5:

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

CODE:

```c
#include<stdio.h>

#include<stdlib.h>



typedef struct node{

    int data;

    struct node *next;

}*NODE;
```

```
NODE getnode(){
    NODE p;
    p=(NODE)malloc(sizeof(struct node));
    if(p != NULL)
        return p;
    else{
        printf("No memory allocation.\n");
        exit(0);
    }
}

NODE insertFront(NODE head, int item){
    NODE p;
    p = getnode();
    p->data = item;
    p->next = head;
    head = p;
    return head;
}

NODE insertRear(NODE head, int item){
    NODE p, q;
    q = getnode();
    q->data = item;
    q->next = NULL;

    if(head == NULL)
```

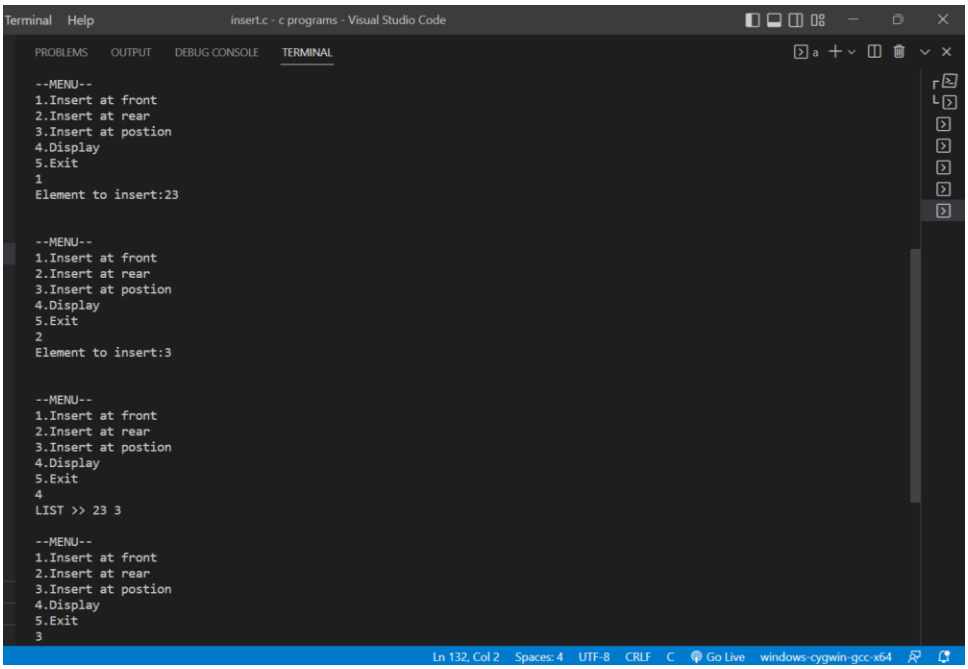
```
        return q;
    p = head;
    while(p->next != NULL)
        p = p->next;
    p->next = q;
    return head;
}

NODE insertPos(NODE head, int item, int pos){
    NODE curr, prev = NULL, newn;
    int count=1;

    newn = getnode();
    newn->data = item;
    newn->next = NULL;

    if(head == NULL){
        if(pos==1)
            return newn;
        else{
            printf("Invalid position\n");
            return 0;
        }
    }

    if(pos == 1){
        newn->next = head;
```

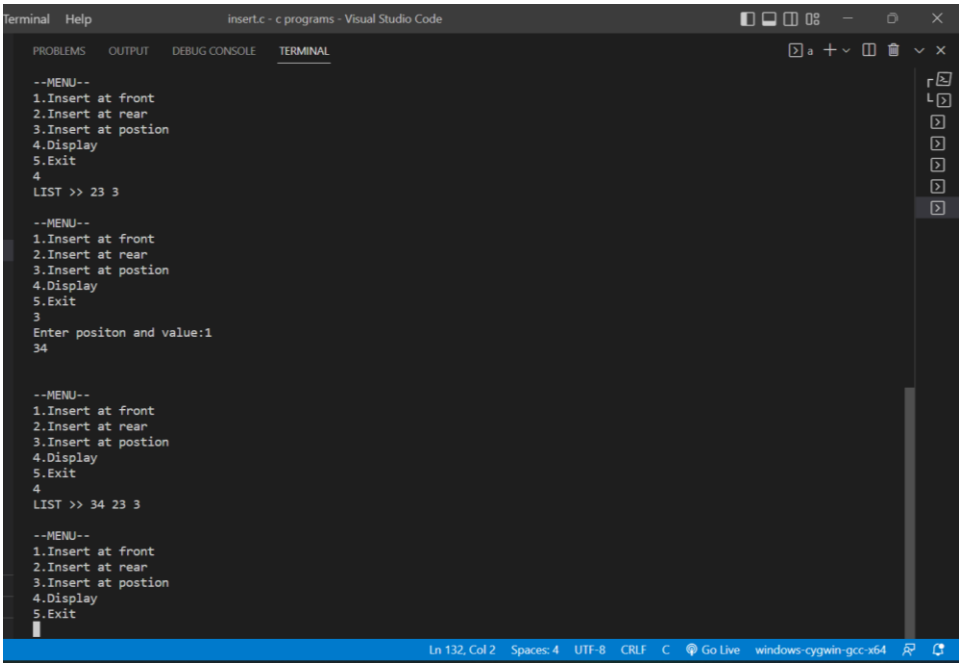
```
        head = newn;
        return head;
    }
    else{
        curr = head;
        while(curr != NULL  &&  count != pos){
            prev = curr;
            curr = curr->next;
            count++;
        }

        if(count == pos){
            prev->next = newn;
            newn->next = curr;
            return head;
        }
        else{
            printf("Invalid position\n");
            return head;
        }
    }
}

void display(NODE head){
    NODE p;
    if(head == NULL){
        printf("List is empty\n");
```

```
        exit(0);
    }
    p = head;
    while(p != NULL){
        printf("%d ", p->data);
        p = p->next;
    }
}


void main()
{
    NODE head = NULL;
    int c, ele, pos, value;


    while(1){
        printf("\n\n--MENU--\n");
        printf("1.Insert at front\n2.Insert at rear\n3.Insert at
postion\n4.Display\n5.Exit\n");
        scanf("%d", &c);
        switch(c){
            case 1:
                printf("Element to insert:");
                scanf("%d", &ele);
                head = insertFront(head, ele);
                break;
            case 2:
                printf("Element to insert:");
```

```
                scanf("%d", &ele);
                head = insertRear(head, ele);
                break;
            case 3:
                printf("Enter positon and value:");
                scanf("%d %d", &pos, &value);
                head = insertPos(head, value, pos);
                break;
            case 4:
                printf("LIST >> ");
                display(head);
                break;
            case 5:
                exit(1);
        }
    }
}
```

OUTPUT:


Terminal Help
insert.c - c programs - Visual Studio Code
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL
--MENU--
1.Insert at front
2.Insert at rear
3.Insert at postion
4.Display
5.Exit
1
Element to insert:23
--MENU--
1.Insert at front
2.Insert at rear
3.Insert at postion
4.Display
5.Exit
2
Element to insert:3
--MENU--
1.Insert at front
2.Insert at rear
3.Insert at postion
4.Display
5.Exit
4
LIST >> 23 3
--MENU--
1.Insert at front
2.Insert at rear
3.Insert at postion
4.Display
5.Exit
3
Ln 132, Col 2 Spaces: 4 UTF-8 CRLF C Go Live windows-cygwin-gcc-x64


Terminal Help
insert.c - c programs - Visual Studio Code
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL
--MENU--
1.Insert at front
2.Insert at rear
3.Insert at postion
4.Display
5.Exit
4
LIST >> 23 3
--MENU--
1.Insert at front
2.Insert at rear
3.Insert at postion
4.Display
5.Exit
3
Enter positon and value:1
34
--MENU--
1.Insert at front
2.Insert at rear
3.Insert at postion
4.Display
5.Exit
4
LIST >> 34 23 3
--MENU--
1.Insert at front
2.Insert at rear
3.Insert at postion
4.Display
5.Exit
Ln 132, Col 2 Spaces: 4 UTF-8 CRLF C Go Live windows-cygwin-gcc-x64

LAB PROGRAM6:

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.

CODE:

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

typedef struct node{
    int data;
    struct node *next;
}*NODE;

NODE getnode(){
    NODE p;
    p=(NODE)malloc(sizeof(struct node));
    if(p != NULL)
        return p;
    else{
        printf("No memory allocation.\n");
        exit(0);
    }
```

```
}


/*
 *  --- Insert Functions ---
 */


NODE insertFront(NODE head, int item){
    NODE p;
    p = getnode();
    p->data = item;
    p->next = head;
    head = p;
    return head;
}


NODE insertRear(NODE head, int item){
    NODE p, q;
    q = getnode();
    q->data = item;
    q->next = NULL;


    if(head == NULL)
        return q;
    p = head;
    while(p->next != NULL)
        p = p->next;
    p->next = q;
```

```
    return head;
}

NODE insertPos(NODE head, int item, int pos){
    NODE curr, prev = NULL, newn;
    int count=1;

    newn = getnode();
    newn->data = item;
    newn->next = NULL;

    if(head == NULL){
        if(pos == 1)
            return newn;
        else{
            printf("Invalid position\n");
            return 0;
        }
    }

    if(pos == 1){
        newn->next = head;
        head = newn;
        return head;
    }
    else{
        curr = head;
```

```
        while(curr != NULL   &&   count != pos){
            prev = curr;
            curr = curr->next;
            count++;
        }

        if(count == pos){
            prev->next = newn;
            newn->next = curr;
            return head;
        }
        else{
            printf("Invalid position\n");
            return head;
        }
    }
}

/*
 *   --- Delete Functions ---
 */

NODE deleteFront(NODE head){
    NODE p;
    if(head == NULL)
        printf("List is empty");
    else{
```

```
        printf("Deleted %d\n", head->data);
        p = head->next;
        free(head);
        return p;
    }
}

NODE deleteRear(NODE head){
    NODE p,prev;
    p = head;
    if(head == NULL)
        printf("List is empty\n");
    else{
        if(p->next == NULL){
            printf("Deleted %d\n", p->data);
            free(p);
            head = NULL;
        }
        while(p->next != NULL){
            prev = p;
            p = p->next;
        }
        printf("Deleted %d\n", p->data);
        free(p);
        prev->next = NULL;
    }
    return head;
```

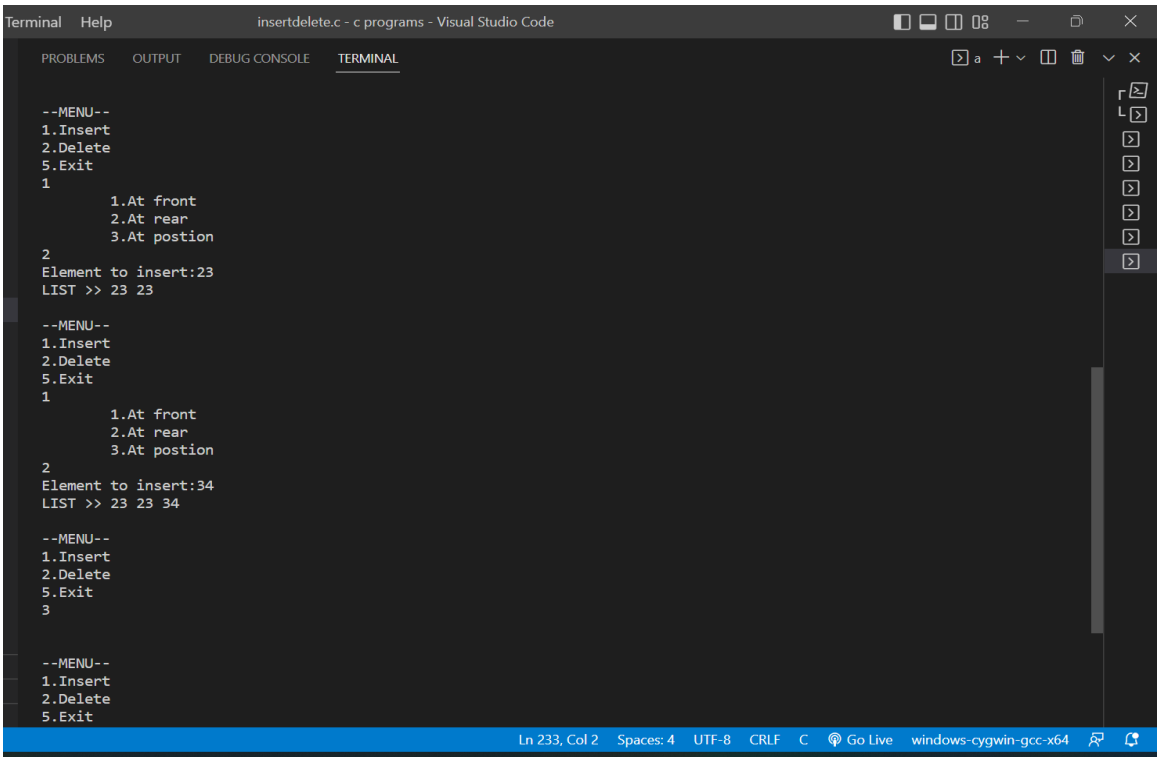
```
}


NODE deletePos(NODE head, int pos){
    NODE p = head;
    if(head == NULL)
        printf("List is empty\n");
    else if(pos == 0){
        printf("Deleted %d\n", head->data);
        NODE temp = head->next;
        free(head);
        head = temp;
    }
    else{
        for(int i=0; i<pos-1; i++){
            p = p->next;
        }
        // now p at element 1 less than given pos
        if(p->next == NULL){
            printf("Invalid Postion\n");
        }
        else{
            NODE temp = p->next;
            printf("Deleted %d\n", temp->data);
            p->next = (p->next)->next;
            free(temp);
        }
    }
```

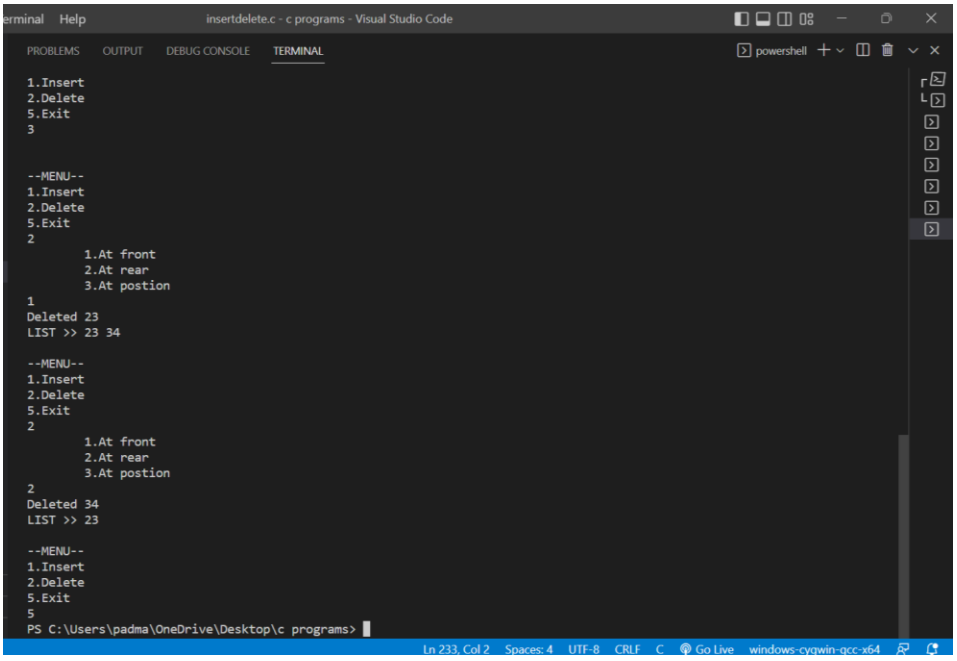
```
    return head;
}

void display(NODE head){
    NODE p;
    if(head == NULL){
        printf("List is empty\n");
        exit(0);
    }
    p = head;
    printf("LIST >> ");
    while(p != NULL){
        printf("%d ", p->data);
        p = p->next;
    }
}

void main()
{
    NODE head = NULL;
    int c, c1, ele, pos, value;
    while(1){
        printf("\n\n--MENU--\n");
        printf("1.Insert\n2.Delete\n5.Exit\n");
        scanf("%d", &c);
        switch(c){
            case 1:
```

```
            printf("\t1.At front\n\t2.At rear\n\t3.At postion\n");
            scanf("%d", &c1);
            switch(c1){
                case 1:
                    printf("Element to insert:");
                    scanf("%d", &ele);
                    head = insertFront(head, ele);
                    display(head);
                    break;
                case 2:
                    printf("Element to insert:");
                    scanf("%d", &ele);
                    head = insertRear(head, ele);
                    display(head);
                    break;
                case 3:
                    printf("Enter positon and value:");
                    scanf("%d %d", &pos, &value);
                    head = insertPos(head, value, pos);
                    display(head);
                    break;
                default:
                    printf("Wrong choice!");
            }
            break;

        case 2:
```

```
                printf("\t1.At front\n\t2.At rear\n\t3.At postion\n");
                scanf("%d", &c1);
                switch(c1){
                    case 1:
                        head = deleteFront(head);
                        display(head);
                        break;
                    case 2:
                        head = deleteRear(head);
                        display(head);
                        break;
                    case 3:
                        printf("Enter positon:");
                        scanf("%d", &pos);
                        head = deletePos(head, pos-1);
                        display(head);
                        break;
                    default:
                        printf("Wrong choice!");
                }
                break;

            case 5:
                exit(1);
        }
    }
}
```

OUTPUT:


Terminal Help
insertdelete.c - c programs - Visual Studio Code
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL
--MENU--
1.Insert
2.Delete
5.Exit
1
1.At front
2.At rear
3.At postion
2
Element to insert:23
LIST >> 23 23
--MENU--
1.Insert
2.Delete
5.Exit
1
1.At front
2.At rear
3.At postion
2
Element to insert:34
LIST >> 23 23 34
--MENU--
1.Insert
2.Delete
5.Exit
3
--MENU--
1.Insert
2.Delete
5.Exit
Ln 233, Col 2 Spaces: 4 UTF-8 CRLF C Go Live windows-cygwin-gcc-x64


Help
insertdelete.c - c programs - Visual Studio Code
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL
powershell
1.Insert
2.Delete
5.Exit
3
--MENU--
1.Insert
2.Delete
5.Exit
2
1.At front
2.At rear
3.At postion
1
Deleted 23
LIST >> 23 34
--MENU--
1.Insert
2.Delete
5.Exit
2
1.At front
2.At rear
3.At postion
2
Deleted 34
LIST >> 23
--MENU--
1.Insert
2.Delete
5.Exit
5
PS C:\Users\padma\OneDrive\Desktop\c programs>
Ln 233, Col 2 Spaces: 4 UTF-8 CRLF C Go Live windows-cygwin-gcc-x64

LAB PROGRAM 7:

WAP to Implement Single Link List with following operations a) Sort the linked list. b) Reverse the linked list. c) Concatenation of two linked lists .

CODE:

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


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


Node getnode(){
  Node x;
  x=(Node) malloc (sizeof(Node));
  if(x!=NULL)
    return x;
  else{
      printf("Memory is not allocated");
      exit(0);
    }
}


Node insert_end(Node first,int item)
```

```
{
  Node temp,x;
  x=getnode();
  x->data=item;
  x->next=NULL;
  if(first==NULL)
     return x;
  temp=first;
  while(temp->next!=NULL)
     temp=temp->next;
  temp->next=x;
  return first;
}


Node sort(Node first){
    Node temp1,temp2,head;
    head=first;
    int swap;
    //second=first->next;
    if(first==NULL)
    printf("EMPTY\n");
    else{
        for(temp1=first;temp1->next!=NULL;temp1=temp1->next){
            for(temp2=temp1->next;temp2!=NULL;temp2=temp2->next){
                if(temp1->data>temp2->data){
                swap=temp1->data;
                temp1->data=temp2->data;
```

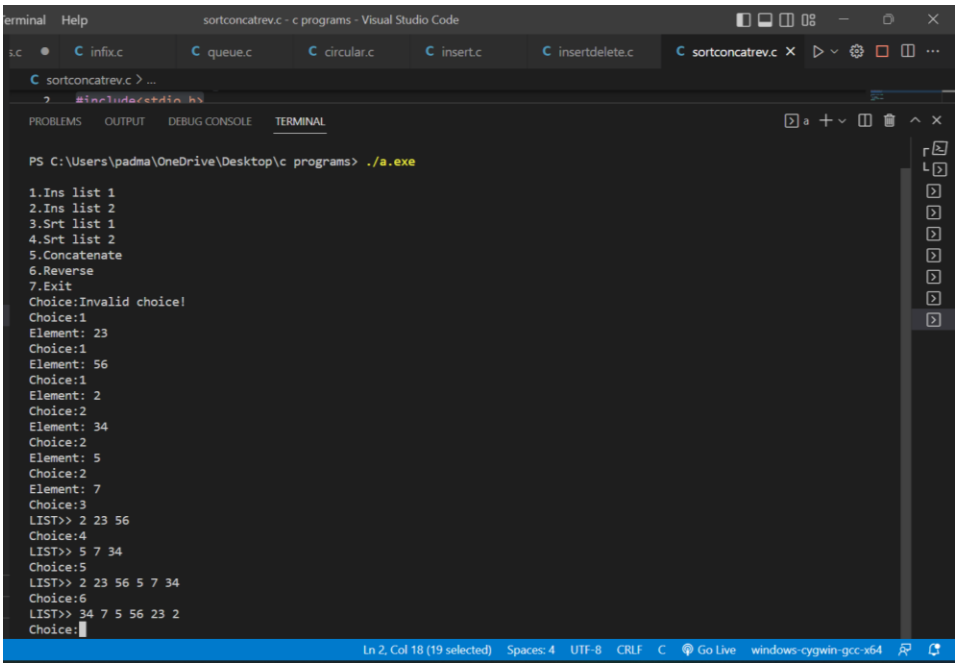
```
                temp2->data=swap;
                }
            }
        }
    }
    return head;
}

Node merging(Node first1, Node first2){
    Node temp=first1;
    while(first1->next!=NULL){
        first1=first1->next;
    }
    first1->next=first2;
    return temp;
}

Node reverse(Node first){
    Node curr,prev,temp;
    prev=NULL;
    curr=first;

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

```
    }
    first=prev;
    return  first;
}

void display(Node first){
    Node temp;
    if(first==NULL)
      printf("List is empty\n");
    else{
        temp=first;
        printf("LIST>> ");
        while(temp!=NULL){
            printf("%d ",temp->data);
            temp=temp->next;
        }
        printf("\n");
    }
}

int main(){
    Node first1=NULL;
    Node first2=NULL;
    int a,value,pos;

        printf("\n1.Ins list 1\n");
        printf("2.Ins list 2\n");
```

```
        printf("3.Srt list 1\n");
        printf("4.Srt list 2\n");
        printf("5.Concatenate\n");
        printf("6.Reverse\n");
        printf("7.Exit\n");
    while(1){
      printf("Choice:");
        scanf("%d",&a);
        switch(a){
            case 1:
                printf("Element: ");
                scanf("%d",&value);
                first1=insert_end(first1,value);
                break;

            case 2:
                printf("Element: ");
                scanf("%d",&value);
                first2=insert_end(first2,value);
                break;

            case 3:
                first1=sort(first1);
                display(first1);
                break;

            case 5:
```

```
                first1=merging(first1,first2);
                display(first1);
                break;

            case 4:
                first2=sort(first2);
                display(first2);
                break;

            case 6:
                first1=reverse(first1);
                display(first1);
                break;

            case 7:
                exit(0);
            default:
                printf("Invalid choice!\n");
        }
    }
  return 0;
}
```

OUTPUT:



LAB PROGRAM 8:

WAP to implement Stack & Queues using Linked Representation.

CODE:

STACKS USING LINKEDLIST:

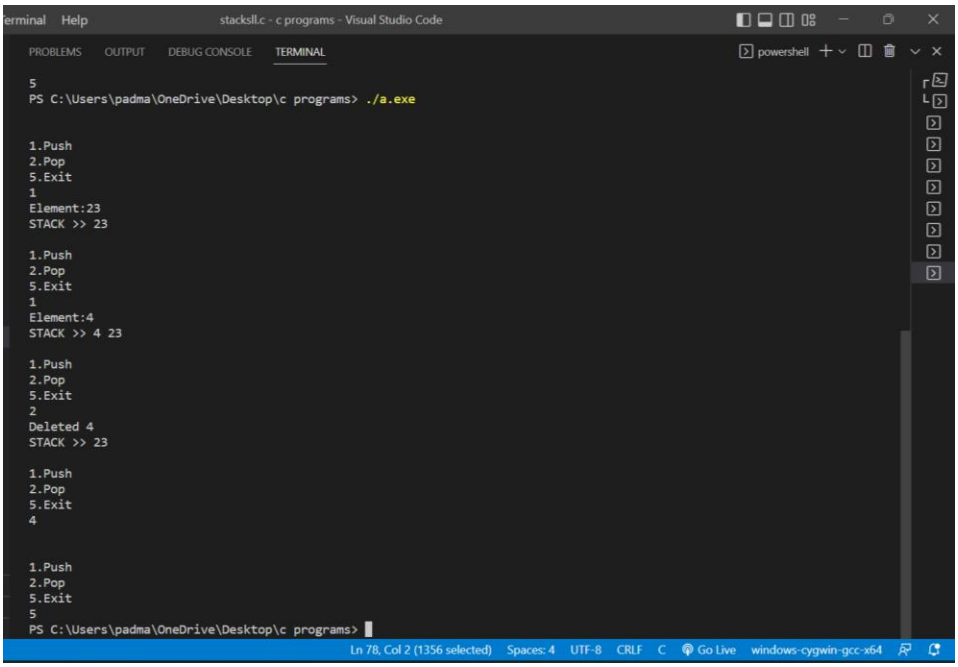
```c
#include<stdio.h>
#include<stdlib.h>


typedef struct node{
    int data;
    struct node *next;
}*NODE;



NODE getnode(){
```

```
    return (NODE)malloc(sizeof(struct node));
}



NODE insertFront(NODE head, int item){
    NODE p;
    p = getnode();
    p->data = item;
    p->next = head;
    head = p;
    return head;
}



NODE deleteFront(NODE head){
    NODE p;
    if(head == NULL)
        printf("Stack is empty");
    else{
        printf("Deleted %d\n", head->data);
        p = head->next;
        free(head);
        return p;
    }
}
```

```c
void display(NODE head){
    NODE p;
    if(head == NULL){
        printf("Stack is empty\n");
        return;
    }
    p = head;
    printf("STACK >> ");
    while(p != NULL){
        printf("%d ", p->data);
        p = p->next;
    }
}



void main()
{
    NODE head = NULL;
    int c, ele;


    while(1){
        printf("\n\n1.Push\n2.Pop\n5.Exit\n");
        scanf("%d", &c);
        switch(c){
            case 1:
                printf("Element:");
                scanf("%d", &ele);
```

```
                head = insertFront(head, ele);
                display(head);
                break;

            case 2:
                head = deleteFront(head);
                display(head);
                break;

            case 5:
                exit(1);
        }
    }
}
```

OUTPUT:



QUEUES USING LINKEDLIST:

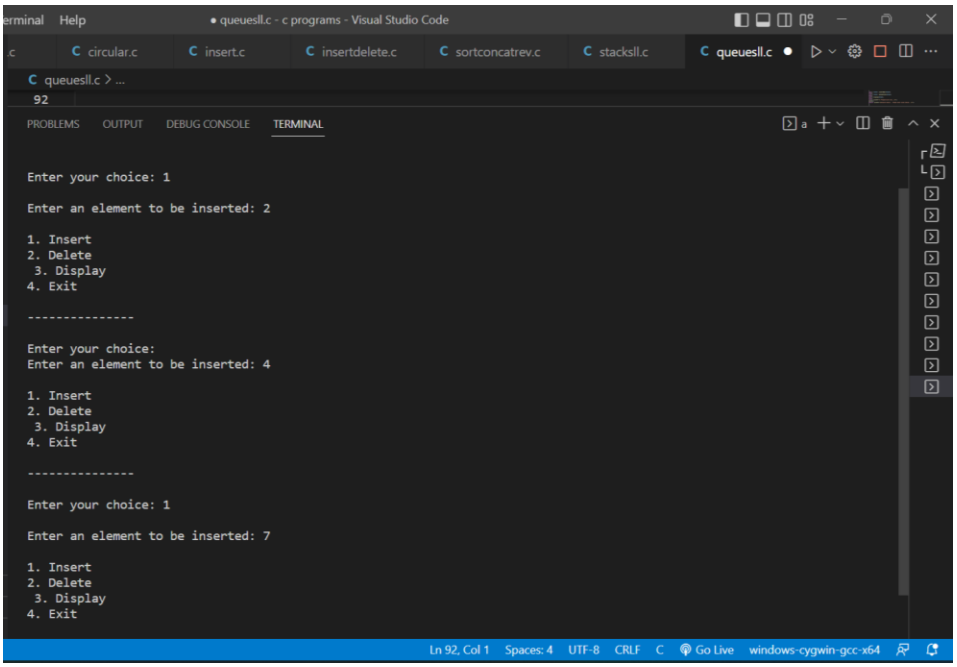
```c
#include<stdlib.h>

// Node creation

struct node

{

in}t info;

struct node *link;

};

typedef struct node *NODE;

// Insert node at the rear end

NODE insertRear(NODE first)

{

NODE temp,cur;

int item;

temp = (NODE)malloc(sizeof(struct node));

if(temp==NULL)
```

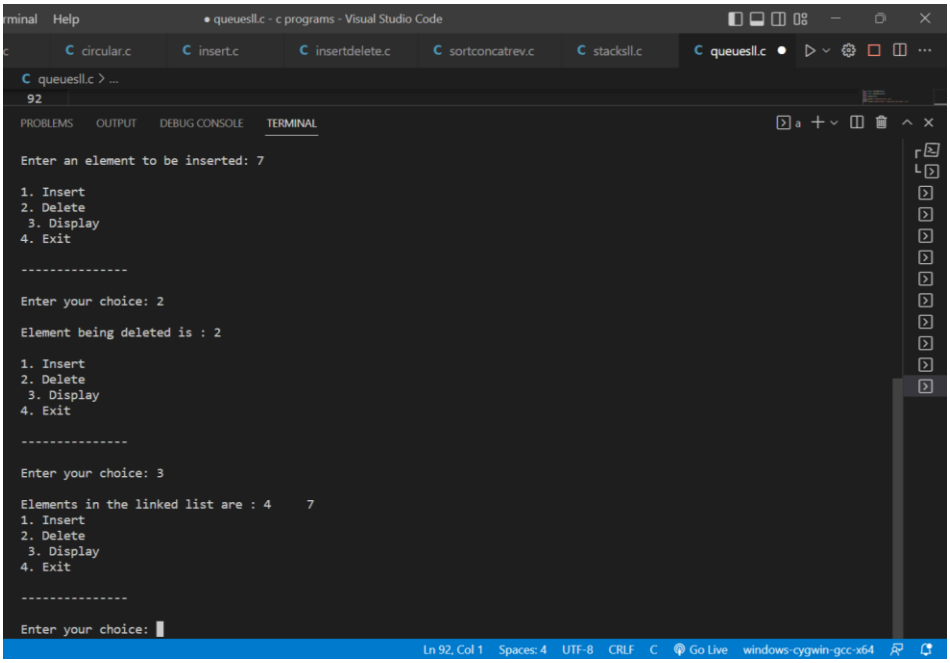
```
{
printf("\n Unable to allocate memory...\n");
return first;
}
printf("\nEnter an element to be inserted: ");
scanf("%d", &item);
temp->info = item;
temp->link = NULL;
if(first == NULL)
first=temp;
else
{
cur=first;
while(cur->link!=NULL)
cur=cur->link;
cur->link=temp;
}
return first;
}
// Delete node from the front end
NODE deleteFront(NODE first)
{
NODE temp;
if(first==NULL)
{
printf("\nThe list is empty.. no elements to delete...\n");
return first;
```

```
}
temp=first;
first = first->link;
printf("\nElement being deleted is : %d\n", temp->info);
free(temp);
return first;
}
// Display the contents of the linked list
void display(NODE first)
{
NODE cur;
if(first == NULL)
printf("\nList is empty, no elements to display\n");
else
{
cur=first;
printf("\nElements in the linked list are : ");
while(cur!=NULL)
{
printf("%d\t",cur->info);
cur=cur->link;
}
}
}
void main()
{
NODE first = NULL;
```

```
int choice;
printf("\n********* Queue implementation using SLL *********\n");
while(1)
{
printf("\n1. Insert\n2. Delete\n 3. Display\n4. Exit\n");
printf("\n---------------\n");
printf("\nEnter your choice: ");
scanf("%d",&choice);
switch(choice)
{
case 1: first = insertRear(first);
break;
case 2: first = deleteFront(first);
break;
case 3: display(first);
break;
case 4: printf("\n Program exits now...\n");
exit(0);
default: printf("\nInvalid choice... Please enter valid choice...\n");
}
}
```

OUTPUT:





LAB PROGRAM9:

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.

CODE:

```
// C program for the all operations in

// the Doubly Linked List

#include <stdio.h>

#include <stdlib.h>


// Linked List Node

struct node {

    int info;

    struct node *prev, *next;

};

struct node* start = NULL;


// Function to traverse the linked list

void traverse()

{

    // List is empty

    if (start == NULL) {

        printf("\nList is empty\n");

        return;

    }

    // Else print the Data

    struct node* temp;
```

```
    temp = start;
    while (temp != NULL) {
        printf("Data = %d\n", temp->info);
        temp = temp->next;
    }
}

// Function to insert at the front
// of the linked list
void insertAtFront()
{
    int data;
    struct node* temp;
    temp = (struct node*)malloc(sizeof(struct node));
    printf("\nEnter number to be inserted: ");
    scanf("%d", &data);
    temp->info = data;
    temp->prev = NULL;

    // Pointer of temp will be
    // assigned to start
    temp->next = start;
    start = temp;
}

// Function to insert at the end of
// the linked list
```

```c
void insertAtEnd()

{

    int data;

    struct node *temp, *trav;

    temp = (struct node*)malloc(sizeof(struct node));

    temp->prev = NULL;

    temp->next = NULL;

    printf("\nEnter number to be inserted: ");

    scanf("%d", &data);

    temp->info = data;

    temp->next = NULL;

    trav = start;


    // If start is NULL

    if (start == NULL) {


        start = temp;

    }


    // Changes Links

    else {

        while (trav->next != NULL)

            trav = trav->next;

        temp->prev = trav;

        trav->next = temp;

    }

}
```

```
// Function to insert at any specified
// position in the linked list
void insertAtPosition()
{
    int data, pos, i = 1;
    struct node *temp, *newnode;
    newnode = malloc(sizeof(struct node));
    newnode->next = NULL;
    newnode->prev = NULL;

    // Enter the position and data
    printf("\nEnter position : ");
    scanf("%d", &pos);


    // If start==NULL,
    if (start == NULL) {
        start = newnode;
        newnode->prev = NULL;
        newnode->next = NULL;
    }

    // If position==1,
    else if (pos == 1) {
    // this is author method its correct but we can simply call
insertAtfront() function for this special case
```

```
    /* newnode->next = start;
        newnode->next->prev = newnode;
        newnode->prev = NULL;
        start = newnode; */
    // now this is improved by Jay Ghughriwala on geeksforgeeks
    insertAtFront();
    }

    // Change links
    else {
    printf("\nEnter number to be inserted: ");
    scanf("%d", &data);
    newnode->info = data;
    temp = start;
        while (i < pos - 1) {
            temp = temp->next;
            i++;
        }
        newnode->next = temp->next;
        newnode->prev = temp;
        temp->next = newnode;
        temp->next->prev = newnode;
    }
}

// Function to delete from the front
// of the linked list
```

```
void deleteFirst()

{

    struct node* temp;

    if (start == NULL)

        printf("\nList is empty\n");

    else {

        temp = start;

        start = start->next;

        if (start != NULL)

            start->prev = NULL;

        free(temp);

    }

}


// Function to delete from the end

// of the linked list

void deleteEnd()

{

    struct node* temp;

    if (start == NULL)

        printf("\nList is empty\n");

    temp = start;

    while (temp->next != NULL)

        temp = temp->next;

    if (start->next == NULL)

        start = NULL;

    else {
```

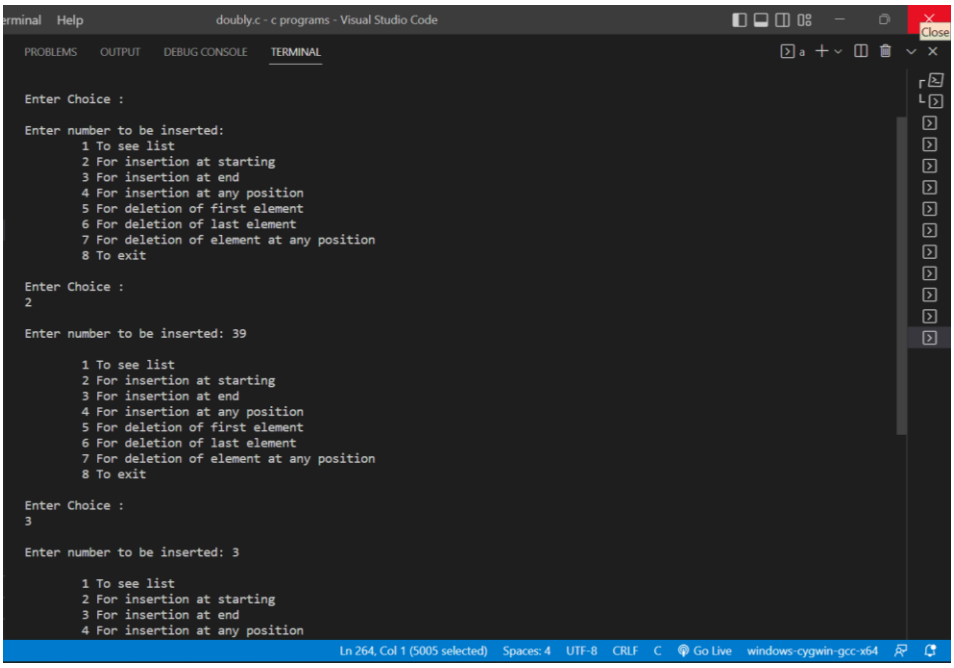
```
        temp->prev->next = NULL;
        free(temp);
    }
}

// Function to delete from any specified
// position from the linked list
void deletePosition()
{
    int pos, i = 1;
    struct node *temp, *position;
    temp = start;

    // If DLL is empty
    if (start == NULL)
        printf("\nList is empty\n");

    // Otherwise
    else {
        // Position to be deleted
        printf("\nEnter position : ");
        scanf("%d", &pos);

        // If the position is the first node
        if (pos == 1) {
            deleteFirst(); // im,proved by Jay Ghughriwala on
GeeksforGeeks
```

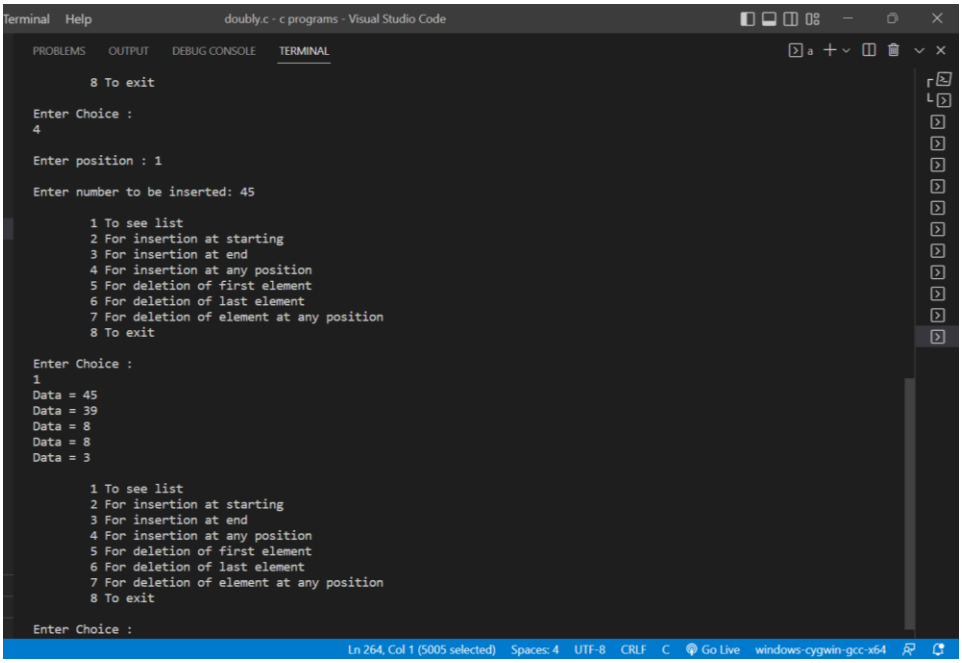
```
            if (start != NULL) {
                start->prev = NULL;
            }
            free(position);
            return;
        }

        // Traverse till position
        while (i < pos - 1) {
            temp = temp->next;
            i++;
        }
        // Change Links
        position = temp->next;
        if (position->next != NULL)
            position->next->prev = temp;
        temp->next = position->next;

        // Free memory
        free(position);
    }
}

// Driver Code
int main()
{
    int choice;
```

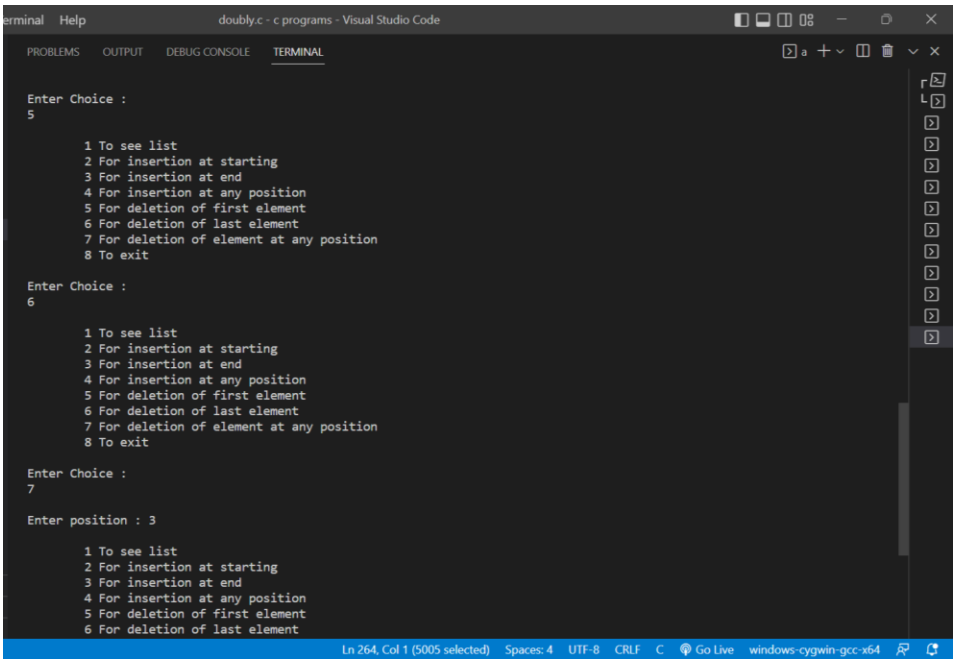
```
    while (1) {


        printf("\n\t1 To see list\n");
        printf("\t2 For insertion at"
            " starting\n");
        printf("\t3 For insertion at"
            " end\n");
        printf("\t4 For insertion at "
            "any position\n");
        printf("\t5 For deletion of "
            "first element\n");
        printf("\t6 For deletion of "
            "last element\n");
        printf("\t7 For deletion of "
            "element at any position\n");
        printf("\t8 To exit\n");
        printf("\nEnter Choice :\n");
        scanf("%d", &choice);


        switch (choice) {
        case 1:
            traverse();
            break;
        case 2:
            insertAtFront();
            break;
        case 3:
```

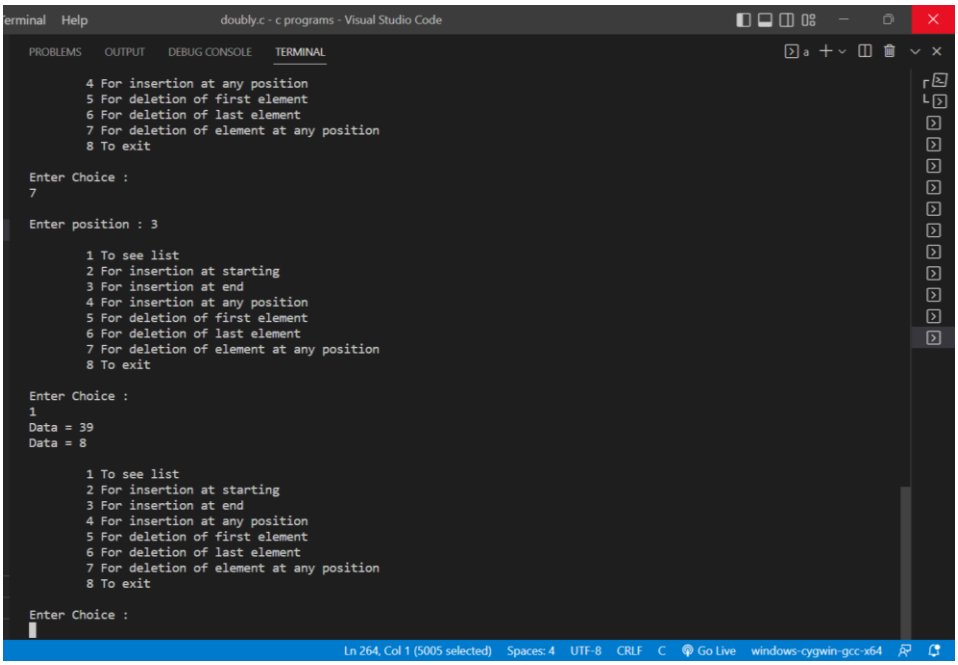
```
            insertAtEnd();
            break;
        case 4:
            insertAtPosition();
            break;
        case 5:
            deleteFirst();
            break;
        case 6:
            deleteEnd();
            break;
        case 7:
            deletePosition();
            break;

        case 8:
            exit(1);
            break;
        default:
            printf("Incorrect Choice. Try Again \n");
            continue;
        }
    }
    return 0;
}
```

OUTPUT:


rminal Help
doubly.c - c programs - Visual Studio Code
PROBLEMS
OUTPUT
DEBUG CONSOLE
TERMINAL
Enter Choice :
Enter number to be inserted:
1 To see list
2 For insertion at starting
3 For insertion at end
4 For insertion at any position
5 For deletion of first element
6 For deletion of last element
7 For deletion of element at any position
8 To exit
Enter Choice :
2
Enter number to be inserted: 39
1 To see list
2 For insertion at starting
3 For insertion at end
4 For insertion at any position
5 For deletion of first element
6 For deletion of last element
7 For deletion of element at any position
8 To exit
Enter Choice :
3
Enter number to be inserted: 3
1 To see list
2 For insertion at starting
3 For insertion at end
4 For insertion at any position
Ln 264, Col 1 (5005 selected)
Spaces: 4
UTF-8
CRLF
C
Go Live
windows-cygwin-gcc-x64


Terminal Help
doubly.c - c programs - Visual Studio Code
PROBLEMS
OUTPUT
DEBUG CONSOLE
TERMINAL
8 To exit
Enter Choice :
4
Enter position : 1
Enter number to be inserted: 45
1 To see list
2 For insertion at starting
3 For insertion at end
4 For insertion at any position
5 For deletion of first element
6 For deletion of last element
7 For deletion of element at any position
8 To exit
Enter Choice :
1
Data = 45
Data = 39
Data = 8
Data = 8
Data = 3
1 To see list
2 For insertion at starting
3 For insertion at end
4 For insertion at any position
5 For deletion of first element
6 For deletion of last element
7 For deletion of element at any position
8 To exit
Enter Choice :
Ln 264, Col 1 (5005 selected)
Spaces: 4
UTF-8
CRLF
C
Go Live
windows-cygwin-gcc-x64


erminal Help
doubly.c - c programs - Visual Studio Code
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL
Enter Choice :
5
1 To see list
2 For insertion at starting
3 For insertion at end
4 For insertion at any position
5 For deletion of first element
6 For deletion of last element
7 For deletion of element at any position
8 To exit
Enter Choice :
6
1 To see list
2 For insertion at starting
3 For insertion at end
4 For insertion at any position
5 For deletion of first element
6 For deletion of last element
7 For deletion of element at any position
8 To exit
Enter Choice :
7
Enter position : 3
1 To see list
2 For insertion at starting
3 For insertion at end
4 For insertion at any position
5 For deletion of first element
6 For deletion of last element
Ln 264, Col 1 (5005 selected) Spaces: 4 UTF-8 CRLF C Go Live windows-cygwin-gcc-x64


erminal Help
doubly.c - c programs - Visual Studio Code
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL
4 For insertion at any position
5 For deletion of first element
6 For deletion of last element
7 For deletion of element at any position
8 To exit
Enter Choice :
7
Enter position : 3
1 To see list
2 For insertion at starting
3 For insertion at end
4 For insertion at any position
5 For deletion of first element
6 For deletion of last element
7 For deletion of element at any position
8 To exit
Enter Choice :
1
Data = 39
Data = 8
1 To see list
2 For insertion at starting
3 For insertion at end
4 For insertion at any position
5 For deletion of first element
6 For deletion of last element
7 For deletion of element at any position
8 To exit
Enter Choice :
Ln 264, Col 1 (5005 selected) Spaces: 4 UTF-8 CRLF C Go Live windows-cygwin-gcc-x64

LAB PROGRAM10:

Write a program a) To construct a binary Search tree. b) To traverse the tree using all the methods i.e., in-order, preorder and post order c) To display the elements in the tree.

CODE:

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


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



node getnode(int item){
    node temp = (node)malloc(sizeof(struct Node));

    temp->left = NULL;
    temp->data = item;
    temp->right = NULL;

    return temp;
}
```

```
node insert(node root, int ele){
    if(root == NULL)
        return getnode(ele);
    else if(ele < root->data)
        root->left = insert(root->left, ele);
    else if(ele > root->data)
        root->right = insert(root->right, ele);

    return root;
}



void inorder(node root){
    if(root == NULL)
        return;

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



void preorder(node root){
    if(root == NULL)
        return;

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

```
    preorder(root->left);
    preorder(root->right);
}



void postorder(node root){
    if(root == NULL)
        return;

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



int search(node root, int ele){
    if(root == NULL)
        return 0;

    node temp = root;
    while(temp != NULL){
        if(ele == temp->data)
            return 1;
        else if(ele < temp->data)
            temp = temp->left;
        else // if ele > temp->data
            temp = temp->right;
```

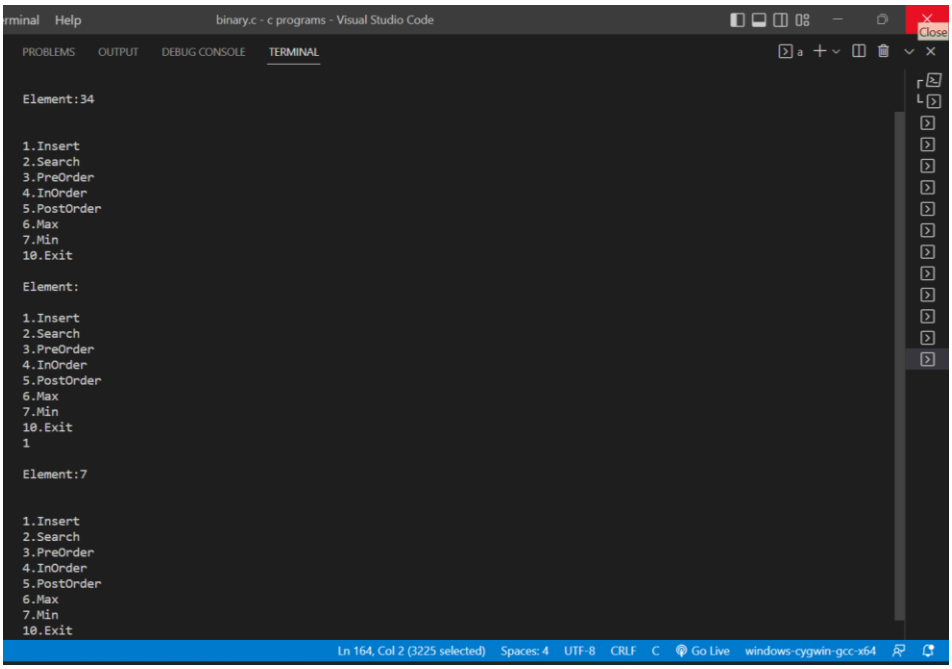
```
    }
    // if not found within while loop, ret 0;
    return 0;
}



int max(node root){
    if(root == NULL)
        return -1;

    int maxval;
    node temp = root;
    while(root != NULL){
        maxval = root->data;
        root = root->right;
    }
    return maxval;
}



int min(node root){
    if(root == NULL)
        return -1;

    int minval;
    node temp = root;
    while(root != NULL){
```

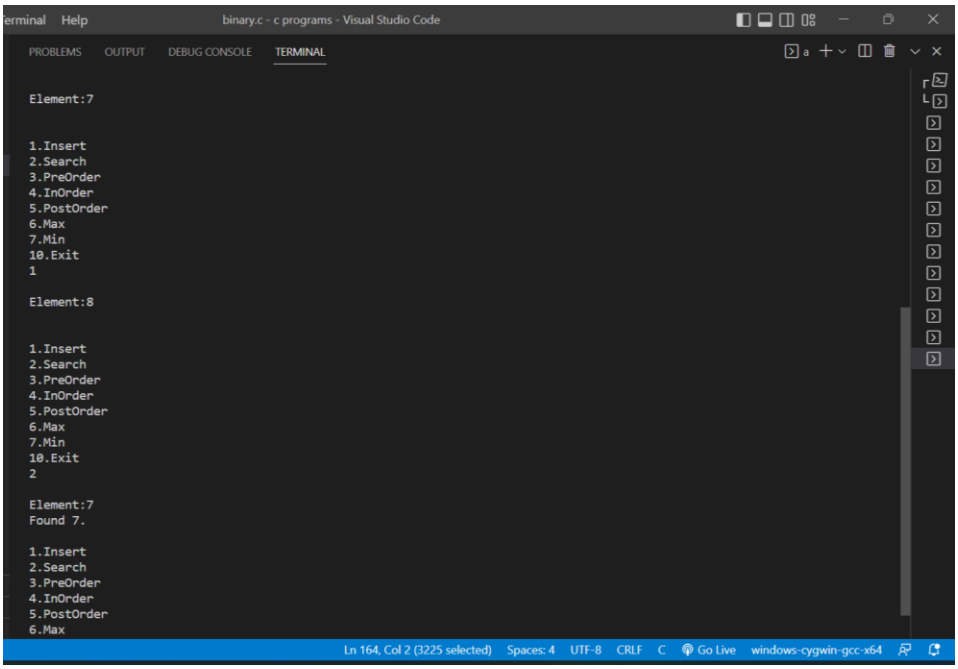
```
        minval = root->data;
        root = root->left;
    }
    return minval;
}



void main(){
    node root = NULL;
    int e, ch = 1;

    while(ch!=10){

printf("\n\n1.Insert\n2.Search\n3.PreOrder\n4.InOrder\n5.PostOrder\n");
        printf("6.Max\n7.Min\n10.Exit\n");
        scanf("%d", &ch);
        printf("\n");

        switch(ch){
            case 1:
                printf("Element:");
                scanf("%d", &e);
                root = insert(root, e);
                break;

            case 2:
                printf("Element:");
```

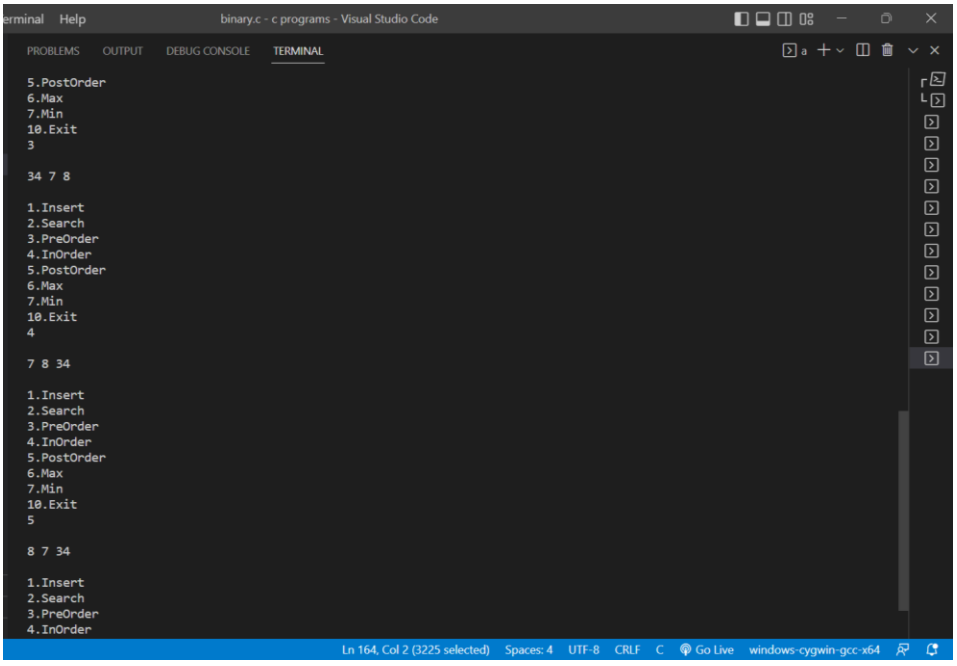
```
            scanf("%d", &e);
            if(search(root, e))
                printf("Found %d.", e);
            else
                printf("Couldn't find %d.", e);
            break;

        case 3:
            preorder(root);
            break;

        case 4:
            inorder(root);
            break;

        case 5:
            postorder(root);
            break;

        case 6:
            printf("Max: %d", max(root));
            break;

        case 7:
            printf("Min: %d", min(root));
            break;
```

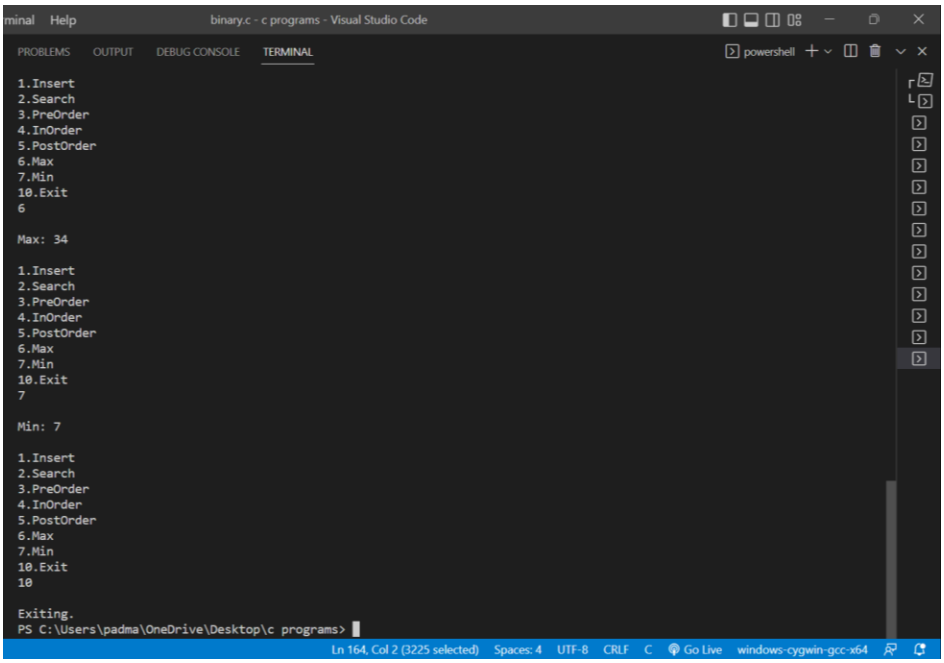
```
            case 10:
                printf("Exiting.");
                exit(1);

            default:
                printf("Wrong input!");
        }
    }
}
```

OUTPUT:




erminal Help
binary.c - c programs - Visual Studio Code
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL
Element:7
1.Insert
2.Search
3.PreOrder
4.InOrder
5.PostOrder
6.Max
7.Min
10.Exit
1
Element:8
1.Insert
2.Search
3.PreOrder
4.InOrder
5.PostOrder
6.Max
7.Min
10.Exit
2
Element:7
Found 7.
1.Insert
2.Search
3.PreOrder
4.InOrder
5.PostOrder
6.Max
Ln 164, Col 2 (3225 selected) Spaces: 4 UTF-8 CRLF C Go Live windows-cygwin-gcc-x64


erminal Help
binary.c - c programs - Visual Studio Code
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL
5.PostOrder
6.Max
7.Min
10.Exit
3
34 7 8
1.Insert
2.Search
3.PreOrder
4.InOrder
5.PostOrder
6.Max
7.Min
10.Exit
4
7 8 34
1.Insert
2.Search
3.PreOrder
4.InOrder
5.PostOrder
6.Max
7.Min
10.Exit
5
8 7 34
1.Insert
2.Search
3.PreOrder
4.InOrder
Ln 164, Col 2 (3225 selected) Spaces: 4 UTF-8 CRLF C Go Live windows-cygwin-gcc-x64


minal Help
binary.c - c programs - Visual Studio Code
PROBLEMS
OUTPUT
DEBUG CONSOLE
TERMINAL
powershell
1.Insert
2.Search
3.PreOrder
4.InOrder
5.PostOrder
6.Max
7.Min
10.Exit
6
Max: 34
1.Insert
2.Search
3.PreOrder
4.InOrder
5.PostOrder
6.Max
7.Min
10.Exit
7
Min: 7
1.Insert
2.Search
3.PreOrder
4.InOrder
5.PostOrder
6.Max
7.Min
10.Exit
10
Exiting.
PS C:\Users\padma\OneDrive\Desktop\c programs>
Ln 164, Col 2 (3225 selected)
Spaces: 4
UTF-8
CRLF
C
Go Live
windows-cygwin-gcc-x64