

VISVESVARAYA TECHNOLOGICAL UNIVERSITY

“JnanaSangama”, Belgaum -590014, Karnataka.



DATA STRUCTURE LAB RECORD

Submitted by

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Under the Guidance of

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



B.M.S. COLLEGE OF ENGINEERING
(Autonomous Institution under VTU)
BENGALURU-560019
Sep-2020 to Jan-2021

B. M. S. College of Engineering,
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(Affiliated To Visvesvaraya Technological University, Belgaum)
Department of Computer Science and Engineering



CERTIFICATE

This is to certify that the **LAB RECORD** is carried out by **SAKSHI P KHANDOBA (1BM19CS139)** who is a 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 Visveswaraiiah Technological University, Belgaum during the year 2020-2021. The lab report has been approved as it satisfies the academic requirements in respect of **DATA STRUCTURE LAB RECORD (19CS3PCDST)** work prescribed for the said degree.

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1. _____

2. _____

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 message for stack overflow and stack empty.

```
#include<stdio.h>
#include<process.h>
#include<conio.h>
#define STACK_SIZE 5
int top=-1;
int s[10];
int item;
void push()
{
    if(top == STACK_SIZE - 1)
    {
        printf("Stack Overflow \n");
        return;
    }
    top = top + 1;
    s[top] = item;
}
int pop()
{
    if(top == - 1)
        return - 1;
```

```

        return s[top--];
    }

void display()
{
    int i;
    if(top == - 1)
    {
        printf("Stack is empty \n");
        return;
    }
    printf("Contents of the stack are: \n");
    for(i=top;i>=0;i--)
    {
        printf("%d \n", s[i]);
    }
}

void main()
{
    int item_deleted, choice;
    for(;;)
    {
        printf("\n1:Push \n2:Pop \n3:Display \n4:Exit \n");
        printf("Enter the choice : \n");
        scanf("%d", &choice);
        switch(choice)
        {
            case 1: printf("Enter the item to be inserted \n");
                    scanf("%d", &item);

```

```
        push();
    break;
    case 2: item_deleted = pop() ;
        if(item_deleted == - 1)
            printf("Stack is empty \n");
        else
            printf("Item deleted is %d \n", item_deleted);
        break;
    case 3: display();
        break;
    default:exit(0);
}
}
getch();
}
```

D:\Documents\ds1.exe

```
1:Push
2:Pop
3:Display
4:Exit
Enter the choice :
1
Enter the item to be inserted
200

1:Push
2:Pop
3:Display
4:Exit
Enter the choice :
2
Item deleted is 200

1:Push
2:Pop
3:Display
4:Exit
Enter the choice :
3
Stack is empty

1:Push
2:Pop
3:Display
4:Exit
Enter the choice :
1
Enter the item to be inserted
30

1:Push
2:Pop
3:Display
4:Exit
Enter the choice :
3
Contents of the stack are:
30

1:Push
2:Pop
3:Display
4:Exit
Enter the choice :
```

D:\Documents\ds1.exe

Enter the choice :

3

Contents of the stack are:

30

1:Push

2:Pop

3:Display

4:Exit

Enter the choice :

1

Enter the item to be inserted

20

1:Push

2:Pop

3:Display

4:Exit

Enter the choice :

1

Enter the item to be inserted

30

1:Push

2:Pop

3:Display

4:Exit

Enter the choice :

1

Enter the item to be inserted

40

1:Push

2:Pop

3:Display

4:Exit

Enter the choice :

3

Contents of the stack are:

40

30

20

30

1:Push

2:Pop

3:Display

4:Exit

Enter the choice :

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 + , - , * and /

```
#include<stdio.h>
#include<stdlib.h>
#include<string.h>
int fun1(char symbol)
{
switch(symbol)
{
case '+':
case '-': return 2;
case '*':
case '/': return 4;
case '^':
case '$': return 5;
case '(': return 0;
case '#': return -1;
default : return 8;
}
}
int fun2(char symbol)
{
switch(symbol)
{
case '+':
case '-': return 1;
case '*':
```



```

case '/' : return 3;
case '^' :
case '$' : return 6;
case '(' : return 9;
case ')' : return 0;
default : return 7;
}
}
void infix_postfix(char infix[],char postfix[])
{
int top,j,i;
char s[30];
char symbol;
top=-1;
s[++top]='#';
j=0;
for(i=0;i<strlen(infix);i++)
{
symbol=infix[i];
while(fun1(s[top])>fun2(symbol))
{
postfix[j]=s[top--];
j++;
}
if(fun1(s[top])!=fun2(symbol))
{
s[++top]=symbol;
}
}
}

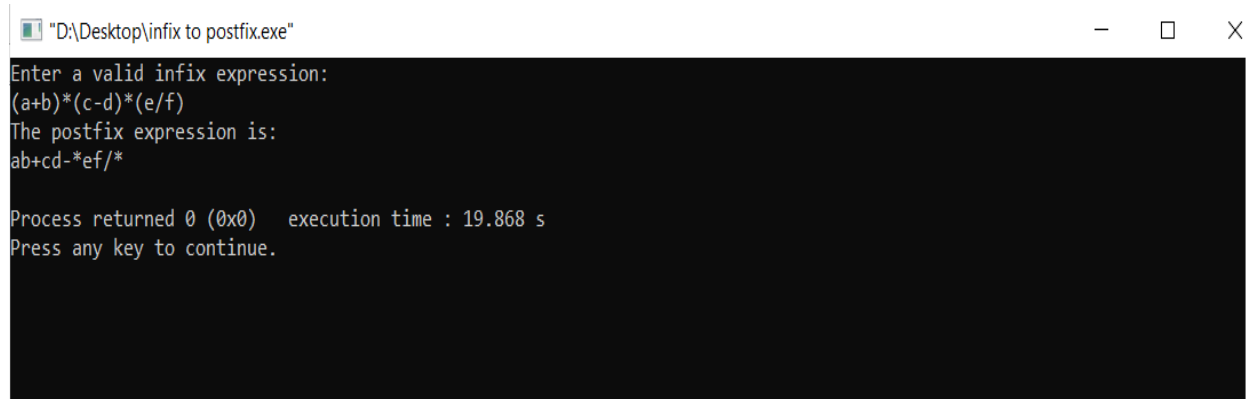
```

```

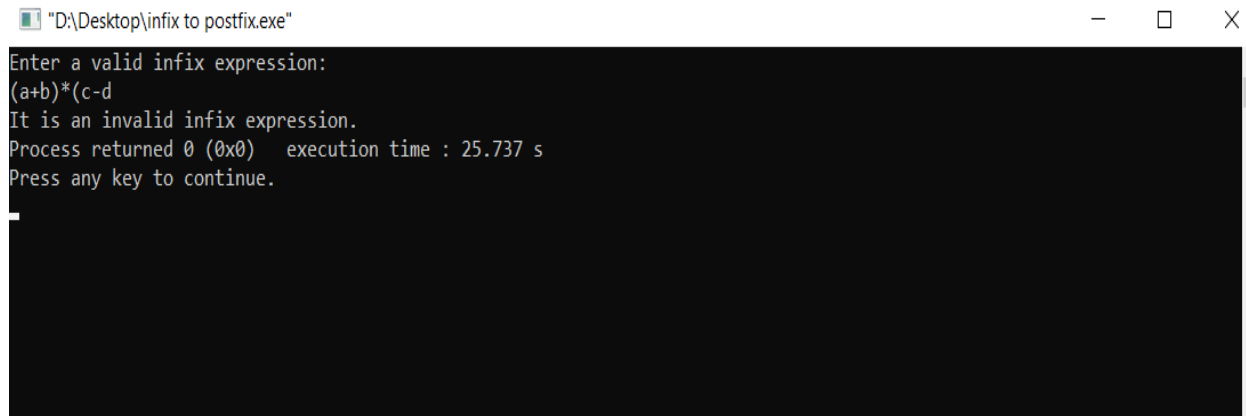
else
top--;
}
while(s[top]!='#')
{
postfix[j++]=s[top--];
}
postfix[j]='\0';
}
void main()
{
char infix[20],postfix[20];
int a=0,b=0,k;
printf("Enter a valid infix expression:\n");
scanf("%s",infix);
for(k=0;k<strlen(infix);k++)
{
if(infix[k]=='(')
a++;
else if(infix[k]==')')
b++;
else
continue;
}
if(a!=b)
{
printf("Invalid infix expression");
exit(0);
}
}

```

```
}  
infix_postfix(infix,postfix);  
printf("The postfix expression is: \n");  
printf("%s\n",postfix);  
}
```



```
"D:\Desktop\infix to postfix.exe"  
Enter a valid infix expression:  
(a+b)*(c-d)*(e/f)  
The postfix expression is:  
ab+cd-*ef/*  
  
Process returned 0 (0x0) execution time : 19.868 s  
Press any key to continue.
```



```
"D:\Desktop\infix to postfix.exe"  
Enter a valid infix expression:  
(a+b)*(c-d  
It is an invalid infix expression.  
Process returned 0 (0x0) execution time : 25.737 s  
Press any key to continue.
```

LAB PROGRAM 3

Write a program 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.

```
#include<stdio.h>

#include<stdlib.h>

#define queue_size 3

int item,front=0,rear=-1,q[10];

void insertrear()
{
    if(rear==queue_size-1)
    {
        printf("Queue overflow.\n");
        return;
    }
    rear=rear+1;
    q[rear]=item;
}

int delfront()
{
    if(front>rear)
    {
        front=0;
        rear=-1;
        return -1;
    }
}
```

```

    return q[front++];
}

void display()
{
    int i;
    if(front>rear)
    {
        printf("Queue is empty.\n");
        return;
    }
    printf("Contents of queue are : \n");
    for(i=front;i<=rear;i++)
    {
        printf("%d\n",q[i]);
    }
}

int main()
{
    int choice;
    for(;;)
    {
        printf("\n1:Insertrear \n2:Deletefront \n3:Display \n4:Exit\n");
        printf("Enter the choice :");
        scanf("%d",&choice);
        switch(choice)
        {
            case 1:printf("Enter the item to be inserted:\n");
                scanf("%d",&item);

```

```
insertrear();  
break;  
case 2:item=delfront();  
if(item==-1)  
    printf("Queue is empty.\n");  
else  
    printf("Item deleted is %d\n",item);  
break;  
case 3:display();  
break;  
default:exit(0);  
}  
}  
}
```

D:\Documents\queue.exe

```
1:Insertrear
2:Deletefront
3:Display
4:Exit
Enter the choice :1
Enter the item to be inserted:
23

1:Insertrear
2:Deletefront
3:Display
4:Exit
Enter the choice :1
Enter the item to be inserted:
45

1:Insertrear
2:Deletefront
3:Display
4:Exit
Enter the choice :1
Enter the item to be inserted:
67

1:Insertrear
2:Deletefront
3:Display
4:Exit
Enter the choice :1
Enter the item to be inserted:
89
Queue overflow.

1:Insertrear
2:Deletefront
3:Display
4:Exit
Enter the choice :3
Contents of queue are :
23
45
67

1:Insertrear
2:Deletefront
3:Display
4:Exit
Enter the choice :2
Item deleted is 23
```

D:\Documents\queue.exe

Enter the choice :2

Item deleted is 23

1:Insertrear

2:Deletefront

3:Display

4:Exit

Enter the choice :2

Item deleted is 45

1:Insertrear

2:Deletefront

3:Display

4:Exit

Enter the choice :1

Enter the item to be inserted:

49

Queue overflow.

1:Insertrear

2:Deletefront

3:Display

4:Exit

Enter the choice :3

Contents of queue are :

67

1:Insertrear

2:Deletefront

3:Display

4:Exit

Enter the choice :2

Item deleted is 67

1:Insertrear

2:Deletefront

3:Display

4:Exit

Enter the choice :3

Queue is empty.

1:Insertrear

2:Deletefront

3:Display

4:Exit

Enter the choice :4

Process returned 0 (0x0) execution time : 100.968 s

Press any key to continue.

LAB PROGRAM 4

Write a program 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.

```
#include<stdio.h>
#include<stdlib.h>
#include<process.h>
#define queue_size 3
int item, front = 0, rear = -1, q[queue_size], count = 0;
void insertrear ()
{
    if (count == queue_size)
    {
        printf ("Queue overflow.");
        return;
    }
    rear = (rear + 1) % queue_size;
    q[rear] = item;
    count++;
}
int deletefront ()
{
    if (count == 0)
        return -1;
    item = q[front];
    front = (front + 1) % queue_size;
```

```

    count = count - 1;
    return item;
}
void display ()
{
    int i, f;
    if (count == 0)
    {
        printf ("The queue is empty.");
        return;
    }
    f = front;
    printf ("Contents of the queue are : \n");
    for (i = 0; i <= count; i++)
    {
        printf ("%d\n", q[f]);
        f = (f + 1) % queue_size;
    }
}
void main ()
{
    int choice;
    for (;;)
    {
        printf ("\n1.Insert rear \n2.Delete front \n3.Display \n4.Exit \n");
        printf ("Enter the choice : ");
        scanf ("%d", &choice);
        switch (choice)

```

```
{  
case 1:  
    printf ("Enter the item to be inserted :");  
    scanf ("%d", &item);  
    insertrear ();  
    break;  
case 2:  
    item = deletefront ();  
    if (item == -1)  
        printf ("Queue is empty.\n");  
    else  
        printf ("Item deleted is %d.\n", item);  
    break;  
case 3:  
    display ();  
    break;  
default:  
    exit (0);  
}  
}  
}
```

D:\Downloads\circular.exe

```
1.Insert rear
2.Delete front
3.Display
4.Exit
Enter the choice : 1
Enter the item to be inserted :23

1.Insert rear
2.Delete front
3.Display
4.Exit
Enter the choice : 1
Enter the item to be inserted :45

1.Insert rear
2.Delete front
3.Display
4.Exit
Enter the choice : 1
Enter the item to be inserted :67

1.Insert rear
2.Delete front
3.Display
4.Exit
Enter the choice : 1
Enter the item to be inserted :89
Queue overflow.
1.Insert rear
2.Delete front
3.Display
4.Exit
Enter the choice : 3
Contents of the queue are :
23
45
67
23

1.Insert rear
2.Delete front
3.Display
4.Exit
Enter the choice : 2
Item deleted is 23.

1.Insert rear
2.Delete front
3.Display
```

D:\Downloads\circular.exe

3.Display

4.Exit

Enter the choice : 2

Item deleted is 23.

1.Insert rear

2.Delete front

3.Display

4.Exit

Enter the choice : 3

Contents of the queue are :

45

67

23

1.Insert rear

2.Delete front

3.Display

4.Exit

Enter the choice : 2

Item deleted is 45.

1.Insert rear

2.Delete front

3.Display

4.Exit

Enter the choice : 1

Enter the item to be inserted :74

1.Insert rear

2.Delete front

3.Display

4.Exit

Enter the choice : 3

Contents of the queue are :

67

74

45

1.Insert rear

2.Delete front

3.Display

4.Exit

Enter the choice : 4

Process returned 0 (0x0) execution time : 65.470 s

Press any key to continue.

LAB PROGRAMS 5 & 6

Write a program to implement a 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 the list**
- c) Deletion of first element, specified element and last element in the list**
- d) Display the contents of the linked list**

```
#include<stdio.h>

#include<process.h>

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

struct node *head;

void beg_insert ()
{
    struct node *ptr;
    int item;

    ptr = (struct node *) malloc (sizeof (struct node));
    if (ptr == NULL)
    {
        printf ("\nList overflow");
    }
    else
    {
        printf ("\nEnter the value : ");
        scanf ("%d", &item);
        ptr->data = item;
```

```

    ptr->next = head;
    head = ptr;
    printf ("\nNode is inserted at the front.");
}
}
void end_insert ()
{
    struct node *ptr, *temp;
    int item;
    ptr = (struct node *) malloc (sizeof (struct node));
    if (ptr == NULL)
    {
        printf ("\nList overflow");
    }
    else
    {
        printf ("\nEnter the value : ");
        scanf ("%d", &item);
        ptr->data = item;
        if (head == NULL)
        {
            ptr->next = NULL;
            head = ptr;
            printf ("\nNode is inserted.");
        }
        else
        {
            temp = head;

```

```

        while (temp->next != NULL)
        {
            temp = temp->next;
        }
        temp->next = ptr;
        ptr->next = NULL;
        printf ("\nNode is inserted at the end.");
    }
}

void random_insert ()
{
    int i, loc, item;
    struct node *ptr, *temp;
    ptr = (struct node *) malloc (sizeof (struct node));
    if (ptr == NULL)
    {
        printf ("\nList overflow");
    }
    else
    {
        printf ("\nEnter the value : ");
        scanf ("%d", &item);
        ptr->data = item;
        printf ("\nEnter the location of the node after which you want to insert : ");
        scanf ("%d", &loc);
        temp = head;
        for (i = 0; i < loc; i++)

```



```

        {
            temp = temp->next;
            if (temp == NULL)
            {
                printf ("\nCant insert node.");
                return;
            }
        }

        ptr->next = temp->next;
        temp->next = ptr;
        printf ("\nNode is inserted at the specified position.");
    }
}

void beg_delete ()
{
    struct node *ptr;
    if (head == NULL)
    {
        printf ("\nList is empty");
    }
    else
    {
        ptr = head;
        head = ptr->next;
        free (ptr);
        printf ("\nNode is deleted from the front.");
    }
}

```

```

void end_delete ()
{
    struct node *ptr, *ptr1;
    if (head == NULL)
    {
        printf ("\nList is empty");
    }
    else if (head->next == NULL)
    {
        head = NULL;
        free (head);
        printf ("\nThe only node of the list is deleted.");
    }
    else
    {
        ptr = head;
        while (ptr->next != NULL)
        {
            ptr1 = ptr;
            ptr = ptr->next;
        }
        ptr1->next = NULL;
        free (ptr);
        printf ("\nNode is deleted from the end.");
    }
}

void random_delete ()
{

```

```

struct node *ptr, *ptr1;
int loc, i;
printf("\nEnter the location of the node after which you want to perform deletion : ");
scanf ("%d", &loc);
ptr = head;
for (i = 0; i < loc; i++)
{
    ptr1 = ptr;
    ptr = ptr->next;
    if (ptr == NULL)
    {
        printf ("\nCant delete");
        return;
    }
}
ptr1->next = ptr->next;
free (ptr);
printf ("\nNode is deleted from the specified position %d", loc + 1);
}

void display ()
{
    struct node *ptr;
    ptr = head;
    if (ptr == NULL)
    {
        printf ("\nNothing to print. List is empty.");
    }
    else

```

```

{
    printf ("\nList values are : ");
    while (ptr != NULL)
    {
        printf ("\n%d", ptr->data);
        ptr = ptr->next;
    }
}

void main ()
{
    int choice = 0;
    while (choice != 8)
    {
        printf ("\nChoose an option");
        printf("\n1.Insert at front \n2.Insert at end \n3.Insert at specified position \n4.Delete from
front \n5.Delete from end \n6.Delete from specified position \n7.Display list contents
\n8.Exit");
        printf ("\nEnter your choice : ");
        scanf ("%d", &choice);
        switch (choice)
        {
            case 1: beg_insert ();
                break;
            case 2: end_insert ();
                break;
            case 3: random_insert ();
                break;

```

```
    case 4: beg_delete ();  
        break;  
    case 5: end_delete ();  
        break;  
    case 6: random_delete ();  
        break;  
    case 7: display ();  
        break;  
    case 8: exit (0);  
    default: exit (0);  
    }  
}  
}
```

"C:\Users\SAKSHI\Linked List.exe"

```
Choose an option
1.Insert at front
2.Insert at end
3.Insert at specified position
4.Delete from front
5.Delete from end
6.Delete from specified position
7.Display list contents
8.Exit
Enter your choice : 1

Enter the value : 10

Node is inserted at the front.
Choose an option
1.Insert at front
2.Insert at end
3.Insert at specified position
4.Delete from front
5.Delete from end
6.Delete from specified position
7.Display list contents
8.Exit
Enter your choice : 1

Enter the value : 20

Node is inserted at the front.
Choose an option
1.Insert at front
2.Insert at end
3.Insert at specified position
4.Delete from front
5.Delete from end
6.Delete from specified position
7.Display list contents
8.Exit
Enter your choice : 2

Enter the value : 30

Node is inserted at the end.
Choose an option
1.Insert at front
2.Insert at end
3.Insert at specified position
4.Delete from front
5.Delete from end
6.Delete from specified position
```

"C:\Users\SAKSHI\Linked List.exe"

Node is inserted at the end.

Choose an option

1.Insert at front

2.Insert at end

3.Insert at specified position

4.Delete from front

5.Delete from end

6.Delete from specified position

7.Display list contents

8.Exit

Enter your choice : 3

Enter the value : 40

Enter the location of the node after which you want to insert : 1

Node is inserted at the specified position.

Choose an option

1.Insert at front

2.Insert at end

3.Insert at specified position

4.Delete from front

5.Delete from end

6.Delete from specified position

7.Display list contents

8.Exit

Enter your choice : 7

List values are :

20

10

40

30

Choose an option

1.Insert at front

2.Insert at end

3.Insert at specified position

4.Delete from front

5.Delete from end

6.Delete from specified position

7.Display list contents

8.Exit

Enter your choice : 2


Enter the value : 50

Node is inserted at the end.

Choose an option

1.Insert at front

2.Insert at end

 "C:\Users\SAKSHI\Linked List.exe"

Enter your choice : 2

Enter the value : 50

Node is inserted at the end.

Choose an option

1.Insert at front

2.Insert at end

3.Insert at specified position

4.Delete from front

5.Delete from end

6.Delete from specified position

7.Display list contents

8.Exit

Enter your choice : 4

Node is deleted from the front.

Choose an option

1.Insert at front

2.Insert at end

3.Insert at specified position

4.Delete from front

5.Delete from end

6.Delete from specified position

7.Display list contents

8.Exit

Enter your choice : 5

Node is deleted from the end.

Choose an option

1.Insert at front

2.Insert at end

3.Insert at specified position

4.Delete from front

5.Delete from end

6.Delete from specified position

7.Display list contents

8.Exit

Enter your choice : 6

Enter the location of the node after which you want to perform deletion : 1

Node is deleted from the specified position 2

Choose an option

1.Insert at front


2.Insert at end

3.Insert at specified position

4.Delete from front

5.Delete from end

6.Delete from specified position

 "C:\Users\SAKSHI\Linked List.exe"

Node is deleted from the end.

Choose an option

1.Insert at front

2.Insert at end

3.Insert at specified position

4.Delete from front

5.Delete from end

6.Delete from specified position

7.Display list contents

8.Exit

Enter your choice : 6

Enter the location of the node after which you want to perform deletion : 1

Node is deleted from the specified position 2

Choose an option

1.Insert at front

2.Insert at end

3.Insert at specified position

4.Delete from front

5.Delete from end

6.Delete from specified position

7.Display list contents

8.Exit

Enter your choice : 7

List values are :

10

30

Choose an option

1.Insert at front

2.Insert at end

3.Insert at specified position

4.Delete from front

5.Delete from end

6.Delete from specified position

7.Display list contents

8.Exit

Enter your choice : 8

Process returned 0 (0x0) execution time : 42.754 s

Press any key to continue.

LAB PROGRAM 7

Write a program to implement Single Linked List with following operations

a) Sort the linked list

b) Reverse the linked list

c) Concatenation of two linked lists

```
#include<stdio.h>

#include<conio.h>

#include<process.h>

struct node

{

    int info;

    struct node *link;

};

typedef struct node *NODE;

NODE getnode()

{

    NODE x;

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

    if(x==NULL)

    {

        printf("\nMemory is full\n");

        exit(0);

    }

    return x;

}

NODE insert_front(NODE first,int item)

{

    NODE temp;

    temp=getnode();
```

```

temp->info=item;
temp->link=NULL;
if(first==NULL)
{
    return temp;
}
temp->link=first;
first=temp;
return first;
}
NODE delete_front(NODE first)
{
    NODE temp;
    if(first==NULL)
    {
        printf("List is empty. Cannot delete\n");
        return first;
    }
    temp=first;
    temp = temp->link;
    printf("Item deleted at front end is %d\n",first->info);
    free(first);
    return temp;
}
NODE IF(NODE second,int item)
{
    NODE temp;
    temp=getnode();

```

```

temp->info=item;
temp->link=NULL;
if(second==NULL)
    return temp;
temp->link=second;
second=temp;
return second;
}
NODE IR(NODE second,int item)
{
    NODE temp,cur;
    temp=getnode();
    temp->info=item;
    temp->link=NULL;
    if(second==NULL)
        return temp;
    cur=second;
    while(cur->link!=NULL)
        cur=cur->link;
    cur->link=temp;
    return second;
}
NODE reverse(NODE first)
{
    NODE cur,temp;
    cur=NULL;
    while(first!=NULL)
    {

```

```

    temp=first;
    first=first->link;
    temp->link=cur;
    cur=temp;
}
return cur;
}
NODE ascending(NODE first)
{
    NODE prev=first;
    NODE cur=NULL;
    int temp;
    if(first== NULL)
    {
        return 0;
    }
    else
    {
        while(prev!= NULL)
        {
            cur = prev->link;
            while(cur!= NULL)
            {
                if(prev->info > cur->info)
                {
                    temp = prev->info;
                    prev->info = cur->info;
                    cur->info = temp;

```

```

        }
        cur = cur->link;
    }
    prev= prev->link;
}
}
return first;
}
NODE descending(NODE first)
{
    NODE prev=first;
    NODE cur=NULL;
    int temp;
    if(first==NULL)
    {
        return 0;
    }
    else
    {
        while(prev!= NULL)
        {
            cur = prev->link;
            while(cur!= NULL)
            {
                if(prev->info < cur->info)
                {
                    temp = prev->info;
                    prev->info = cur->info;

```

```

        cur->info = temp;
    }
    cur = cur->link;
}
prev= prev->link;
}
}
return first;
}
NODE concatenate(NODE first,NODE second)
{
    NODE cur;
    if(first==NULL)
        return second;
    if(second==NULL)
        return first;
    cur=first;
    while(cur->link!=NULL)
    {
        cur=cur->link;
    }
    cur->link=second;
    return first;
}
void display(NODE first)
{
    NODE temp;
    if(first==NULL)

```

```

    printf("List is empty. Cannot display items.\n");
    printf("List contents are : ");
    for(temp=first;temp!=NULL;temp=temp->link)
    {
        printf("\n%d",temp->info);
    }
}

void main()
{
    int item,choice,pos,element,option,choice2,item1,num;
    NODE first=NULL;
    NODE second=NULL;
    for(;;)
    {
        printf("\n\nChoose an option");
        printf("\n1:Insert_front \n2:Delete_front \n3:Reverse \n4:Sort \n5.Concatenate \n6:Display
\n7:Exit\n");

        printf("Enter the choice : ");
        scanf("%d",&choice);
        switch(choice)
        {
            case 1: printf("Enter the item at front-end : ");
                    scanf("%d",&item);
                    first=insert_front(first,item);
                    printf("%d inserted at front-end.",first->info);
                    break;
            case 2: first=delete_front(first);
                    break;
            case 3: first=reverse(first);

```




```

    printf("List is reversed.");
    break;
case 4: printf("Press 1 for Ascending-sort and 2 for Descending-sort : ");
    scanf("%d",&option);
    if(option==1)
    {
        first=ascending(first);
        printf("List is sorted in ascending order.");
    }
    if(option==2)
    {
        first=descending(first);
        printf("List is sorted in descending order.");
    }
    break;
case 5: printf("Create a second list\n");
    printf("Enter the number of elements in the second list : ");
    scanf("%d",&num);
    for(int i=1;i<=num;i++)
    {
        printf("\nPress 1 to Insert-front and 2 to Insert-rear : ");
        scanf("%d",&choice2);
        if(choice2==1)
        {
            printf("Enter the item at front-end : ");
            scanf("%d",&item1);
            second=IF(second,item1);
        }
    }

```

```
        if(choice2==2)
        {
            printf("Enter the item at rear-end : ");
            scanf("%d",&item1);
            second=IR(second,item1);
        }
    }
    first=concatenate(first,second);
    printf("\nThe two lists are concatenated.");
    break;
case 6: display(first);
    break;
default: exit(0);
    break;
}
}
}
```


 "C:\Users\SAKSHI\Operations on Linked list.exe"

```
Choose an option
1:Insert_front
2:Delete_front
3:Reverse
4:Sort
5.Concatenate
6:Display
7:Exit
Enter the choice : 1
Enter the item at front-end : 10
10 inserted at front-end.
```

```
Choose an option
1:Insert_front
2:Delete_front
3:Reverse
4:Sort
5.Concatenate
6:Display
7:Exit
Enter the choice : 1
Enter the item at front-end : 20
20 inserted at front-end.
```

```
Choose an option
1:Insert_front
2:Delete_front
3:Reverse
4:Sort
5.Concatenate
6:Display
7:Exit
Enter the choice : 1
Enter the item at front-end : 30
30 inserted at front-end.
```

```
Choose an option
1:Insert_front
2:Delete_front
3:Reverse
4:Sort
5.Concatenate
6:Display
7:Exit
Enter the choice : 1
Enter the item at front-end : 40
40 inserted at front-end.
```

 "C:\Users\SAKSHI\Operations on Linked list.exe"


```
7:Exit
Enter the choice : 1
Enter the item at front-end : 40
40 inserted at front-end.
```

```
Choose an option
1:Insert_front
2:Delete_front
3:Reverse
4:Sort
5.Concatenate
6:Display
7:Exit
Enter the choice : 1
Enter the item at front-end : 50
50 inserted at front-end.
```

```
Choose an option
1:Insert_front
2:Delete_front
3:Reverse
4:Sort
5.Concatenate
6:Display
7:Exit
Enter the choice : 1
Enter the item at front-end : 60
60 inserted at front-end.
```

```
Choose an option
1:Insert_front
2:Delete_front
3:Reverse
4:Sort
5.Concatenate
6:Display
7:Exit
Enter the choice : 2
Item deleted at front end is 60
```

```
Choose an option
1:Insert_front
2:Delete_front
3:Reverse
4:Sort
5.Concatenate
6:Display
7:Exit
Enter the choice : 6
```


 "C:\Users\SAKSHI\Operations on Linked list.exe"

```
4:Sort
5.Concatenate
6:Display
7:Exit
Enter the choice : 6
List contents are :
50
40
30
20
10

Choose an option
1:Insert_front
2>Delete_front
3:Reverse
4:Sort
5.Concatenate
6:Display
7:Exit
Enter the choice : 3
List is reversed.

Choose an option
1:Insert_front
2>Delete_front
3:Reverse
4:Sort
5.Concatenate
6:Display
7:Exit
Enter the choice : 6
List contents are :
10
20
30
40
50

Choose an option
1:Insert_front
2>Delete_front
3:Reverse
4:Sort
5.Concatenate
6:Display
7:Exit
Enter the choice : 1
Enter the item at front-end : 15
15 inserted at front-end.
```

 "C:\Users\SAKSHI\Operations on Linked list.exe"

Enter the item at front-end : 15

15 inserted at front-end.

Choose an option

1:Insert_front

2>Delete_front

3:Reverse

4:Sort

5.Concatenate

6:Display

7:Exit

Enter the choice : 1

Enter the item at front-end : 37

37 inserted at front-end.

Choose an option

1:Insert_front

2>Delete_front

3:Reverse

4:Sort

5.Concatenate

6:Display

7:Exit

Enter the choice : 4

Press 1 for Ascending-sort and 2 for Descending-sort : 1

List is sorted in ascending order.

Choose an option

1:Insert_front

2>Delete_front

3:Reverse

4:Sort

5.Concatenate

6:Display

7:Exit

Enter the choice : 6

List contents are :

10

15

20

30

37

40

50

Choose an option

1:Insert_front

2>Delete_front

3:Reverse

4:Sort

"C:\Users\SAKSHI\Operations on Linked list.exe"

```
Choose an option
1:Insert_front
2:Delete_front
3:Reverse
4:Sort
5.Concatenate
6:Display
7:Exit
Enter the choice : 4
Press 1 for Ascending-sort and 2 for Descending-sort : 2
List is sorted in descending order.
```

```
Choose an option
1:Insert_front
2:Delete_front
3:Reverse
4:Sort
5.Concatenate
6:Display
7:Exit
Enter the choice : 6
List contents are :
50
40
37
30
20
15
10
```

```
Choose an option
1:Insert_front
2:Delete_front
3:Reverse
4:Sort
5.Concatenate
6:Display
7:Exit
Enter the choice : 5
Create a second list
Enter the number of elements in the second list : 4

Press 1 to Insert-front and 2 to Insert-rear : 1
Enter the item at front-end : 60

Press 1 to Insert-front and 2 to Insert-rear : 1
Enter the item at front-end : 70

Press 1 to Insert-front and 2 to Insert-rear : 2
Enter the item at rear-end : 80
```

"C:\Users\SAKSHI\Operations on Linked list.exe"

Press 1 to Insert-front and 2 to Insert-rear : 1
Enter the item at front-end : 60

Press 1 to Insert-front and 2 to Insert-rear : 1
Enter the item at front-end : 70

Press 1 to Insert-front and 2 to Insert-rear : 2
Enter the item at rear-end : 80

Press 1 to Insert-front and 2 to Insert-rear : 1
Enter the item at front-end : 90

The two lists are concatenated.

Choose an option

1:Insert_front

2>Delete_front

3:Reverse

4:Sort

5.Concatenate

6:Display

7:Exit

Enter the choice : 6

List contents are :

50

40

37

30

20

15

10

90

70

60

80

Choose an option

1:Insert_front

2>Delete_front

3:Reverse

4:Sort

5.Concatenate

6:Display

7:Exit

Enter the choice : 7

Process returned 0 (0x0) execution time : 170.987 s

Press any key to continue.

LAB PROGRAM 8

Write a program to implement Stacks using Linked List representation

```
#include <stdio.h>
#include <stdlib.h>
void push();
void pop();
void display();
struct node
{
    int val;
    struct node *next;
};
struct node *head;
void main ()
{
    int choice=0;
    while(choice != 4)
    {
        printf("\n1.Push\n2.Pop\n3.Display\n4.Exit");
        printf("\nEnter your choice: ");
        scanf("%d",&choice);
        switch(choice)
        {
            case 1:
            {
                push();
                break;
            }
        }
```

```

        case 2:
        {
            pop();
            break;
        }
        case 3:
        {
            display();
            break;
        }
        case 4:
        {
            printf("Exit");
            break;
        }
        default:
        {
            printf("Please Enter valid choice.\n");
        }
    }
}

void push ()
{
    int val;
    struct node *ptr = (struct node *)malloc(sizeof(struct node));
    if(ptr == NULL)
    {

```

```

        printf("Memory is full.");
    }
    else
    {
        printf("Enter the value: ");
        scanf("%d",&val);
        if(head==NULL)
        {
            ptr->val = val;
            ptr -> next = NULL;
            head=ptr;
        }
        else
        {
            ptr->val = val;
            ptr->next = head;
            head=ptr;
        }
        printf("Value is pushed into the stack.\n");
    }
}

void pop()
{
    int item;
    struct node *ptr;
    if (head == NULL)
    {
        printf("Stack Underflow\n");
    }
}

```


```

    }
else
{
    item = head->val;
    ptr = head;
    head = head->next;
    printf("%d is popped from the stack.\n",item);
    free(ptr);
}
}

void display()
{
    int i;
    struct node *ptr;
    ptr=head;
    if(ptr == NULL)
    {
        printf("Stack is empty.\n");
    }
    else
    {
        printf("Contents of the stack: \n");
        while(ptr!=NULL)
        {
            printf("%d\n",ptr->val);
            ptr = ptr->next;
        }
    }
}

```

```
}
```

 "C:\Users\SAKSHI\Stack Implementation.exe"

```
1.Push
2.Pop
3.Display
4.Exit
Enter your choice: 1
Enter the value: 10
Value is pushed into the stack.
```

```
1.Push
2.Pop
3.Display
4.Exit
Enter your choice: 2
10 is popped from the stack.
```

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

```
1.Push
2.Pop
3.Display
4.Exit
Enter your choice: 1
Enter the value: 20
Value is pushed into the stack.
```

```
1.Push
2.Pop
3.Display
4.Exit
Enter your choice: 1
Enter the value: 30
Value is pushed into the stack.
```

```
1.Push
2.Pop
3.Display
4.Exit
Enter your choice: 1
Enter the value: 40
Value is pushed into the stack.
```

```
1.Push
2.Pop
3.Display
```

"C:\Users\SAKSHI\Stack Implementation.exe"

```
3.Display
4.Exit
Enter your choice: 1
Enter the value: 30
Value is pushed into the stack.

1.Push
2.Pop
3.Display
4.Exit
Enter your choice: 1
Enter the value: 40
Value is pushed into the stack.

1.Push
2.Pop
3.Display
4.Exit
Enter your choice: 1
Enter the value: 50
Value is pushed into the stack.

1.Push
2.Pop
3.Display
4.Exit
Enter your choice: 2
50 is popped from the stack.

1.Push
2.Pop
3.Display
4.Exit
Enter your choice: 3
Contents of the stack:
40
30
20

1.Push
2.Pop
3.Display
4.Exit
Enter your choice: 4
Exit
Process returned 4 (0x4)   execution time : 61.206 s
Press any key to continue.
```

Write a program to implement Queues using Linked List representation

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

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

struct node *front;
struct node *rear;

void insert();
void deleteq();
void display();

int main ()
{
    int choice;
    while(choice != 4)
    {
        printf("\n1.Insert rear\n2.Delete front\n3.Display\n4.Exit\n");
        printf("Enter your choice: ");
        scanf("%d",&choice);
        switch(choice)
        {
            case 1:
                insertq();
                break;
            case 2:
                deleteq();
```

```

        break;
    case 3:
        display();
        break;
    case 4:
        exit(0);
        break;
    default:
        printf("Enter valid choice.\n");
    }
}
}
void insertq()
{
    struct node *ptr;
    int item;
    ptr = (struct node *) malloc (sizeof(struct node));
    if(ptr == NULL)
    {
        printf("Queue Overflow\n");
        return;
    }
    else
    {
        printf("Enter the value: ");
        scanf("%d",&item);
        ptr -> data = item;
        if(front == NULL)

```



```

    {
        front = ptr;
        rear = ptr;
        front -> next = NULL;
        rear -> next = NULL;
    }
    else
    {
        rear -> next = ptr;
        rear = ptr;
        rear->next = NULL;
    }
}


void deleteq()
{
    struct node *ptr;
    if(front == NULL)
    {
        printf("Queue Underflow.\n");
        return;
    }
    else
    {
        ptr = front;
        front = front -> next;
        printf("%d is deleted from the queue.\n",ptr->data);
        free(ptr);
    }
}

```

```

    }
}
void display()
{
    struct node *ptr;
    ptr = front;
    if(front == NULL)
    {
        printf("Queue is empty.\n");
    }
    else
    {
        printf("Contents of the queue are:\n");
        while(ptr != NULL)
        {
            printf("%d\n",ptr -> data);
            ptr = ptr -> next;
        }
    }
}

```

 "C:\Users\SAKSHI\Queue Implementation.exe"

```
1.Insert rear
2.Delete front
3.Display
4.Exit
Enter your choice: 1
Enter the value: 40

1.Insert rear
2.Delete front
3.Display
4.Exit
Enter your choice: 2
40 is deleted from the queue.


1.Insert rear
2.Delete front
3.Display
4.Exit
Enter your choice: 2
Queue Underflow.

1.Insert rear
2.Delete front
3.Display
4.Exit
Enter your choice: 1
Enter the value: 10

1.Insert rear
2.Delete front
3.Display
4.Exit
Enter your choice: 1
Enter the value: 20

1.Insert rear
2.Delete front
3.Display
4.Exit
Enter your choice: 1
Enter the value: 30

1.Insert rear
2.Delete front
3.Display
4.Exit
Enter your choice: 1
Enter the value: 40
```

 "C:\Users\SAKSHI\Queue Implementation.exe"

```
3.Display
4.Exit
Enter your choice: 1
Enter the value: 40

1.Insert rear
2.Delete front
3.Display
4.Exit
Enter your choice: 1
Enter the value: 50

1.Insert rear
2.Delete front
3.Display
4.Exit
Enter your choice: 3
Contents of the queue are:
10
20
30
40
50

1.Insert rear
2.Delete front
3.Display
4.Exit
Enter your choice: 2
10 is deleted from the queue.

1.Insert rear
2.Delete front
3.Display
4.Exit
Enter your choice: 3
Contents of the queue are:
20
30
40
50

1.Insert rear
2.Delete front
3.Display
4.Exit
Enter your choice: 4

Process returned 0 (0x0)   execution time : 34.058 s
Press any key to continue.
```

LAB PROGRAM 9

Write a program to implement doubly linked list with primitive operations:

- a) Create a doubly linked list**
- b) Insert nodes at both ends**
- c) Delete nodes at both ends**
- d) Insert a new node to the left of the specified node**
- e) Insert a new node to the right of the specified node**
- f) Delete all key elements**
- g) Display the contents of the list**

```
#include<stdio.h>

#include<process.h>

struct node
{
    int info;
    struct node *llink;
    struct node *rlink;
};

typedef struct node *NODE;

NODE getnode()
{
    NODE x;
    x=(NODE)malloc(sizeof(struct node));
    if(x==NULL)
    {
        printf("Memory is full.\n");
        exit(0);
    }
    return x;
}

void freenode(NODE x)
```

```

{
    free(x);
}

NODE dinsert_front(int item,NODE head)
{
    NODE temp,cur;
    temp=getnode();
    temp->info=item;
    cur=head->rlink;
    head->rlink=temp;
    temp->llink=head;
    temp->rlink=cur;
    cur->llink=temp;
    return head;
}

NODE dinsert_rear(int item,NODE head)
{
    NODE temp,cur;
    temp=getnode();
    temp->info=item;
    cur=head->llink;
    head->llink=temp;
    temp->rlink=head;
    temp->llink=cur;
    cur->rlink=temp;
    return head;
}

NODE ddelete_front(NODE head)

```

```

{
    NODE cur,next;
    if(head->rlink==head)
    {
        printf("List is empty.\n");
        return head;
    }
    cur=head->rlink;
    next=cur->rlink;
    head->rlink=next;
    next->llink=head;
    printf("Node deleted is %d",cur->info);
    freenode(cur);
    return head;
}

NODE ddelete_rear(NODE head)
{
    NODE cur,prev;
    if(head->rlink==head)
    {
        printf("List is empty.\n");
        return head;
    }
    cur=head->llink;
    prev=cur->llink;
    head->llink=prev;
    prev->rlink=head;
    printf("Node deleted is %d",cur->info);

```

```

    freenode(cur);
    return head;
}
NODE insert_leftpos(int item,NODE head)
{
    NODE temp,cur,prev;
    if(head->rlink==head)
    {
        printf("List is empty.\n");
        return head;
    }
    cur=head->rlink;
    while(cur!=head)
    {
        if(item==cur->info)
            break;
        cur=cur->rlink;
    }
    if(cur==head)
    {
        printf("Key not found.\n");
        return head;
    }
    prev=cur->llink;
    printf("Enter towards left of %d = ",item);
    temp=getnode();
    scanf("%d",&temp->info);
    prev->rlink=temp;

```



```

temp->llink=prev;
cur->llink=temp;
temp->rlink=cur;
return head;
}
NODE insert_rightpos(int item,NODE head)
{
    NODE temp,cur,prev;
    if(head->rlink==head)
    {
        printf("List is empty.\n");
        return head;
    }
    cur=head->llink;
    while(cur!=head)
    {
        if(item==cur->info)
            break;
        cur=cur->llink;
    }
    if(cur==head)
    {
        printf("Key not found.\n");
        return head;
    }
    prev=cur->rlink;
    printf("Enter towards right of %d = ",item);
    temp=getnode();

```

```

scanf("%d",&temp->info);
prev->llink=temp;
temp->rlink=prev;
cur->rlink=temp;
temp->llink=cur;
return head;
}
NODE delete_all_key(int item,NODE head)
{
    NODE prev,cur,next;
    int count;
    if(head->rlink==head)
    {
        printf("List is empty.");
        return head;
    }
    count=0;
    cur=head->rlink;
    while(cur!=head)
    {
        if(item!=cur->info)
            cur=cur->rlink;
        else
        {
            count++;
            prev=cur->llink;
            next=cur->rlink;
            prev->rlink=next;

```

```

        next->llink=prev;
        freenode(cur);
        cur=next;
    }
}
if(count==0)
    printf("Key not found.");
else
    printf("Key found at %d positions and are deleted.\n", count);
return head;
}
void display(NODE head)
{
    NODE temp;
    if(head->rlink==head)
    {
        printf("List is empty.\n");
        return;
    }
    printf("Contents of the list : \n");
    temp=head->rlink;
    while(temp!=head)
    {
        printf("%d ",temp->info);
        temp=temp->rlink;
    }
    printf("\n");
}


```

```

void main()
{
    NODE head,last;
    int item, choice;
    head=getnode();
    head->rlink=head;
    head->llink=head;
    for(;;)
    {
        printf("\n1:Insert front\n2:Insert rear\n3>Delete front\n4>Delete rear\n5:Insert left
position\n6:Insert right position\n7>Delete all key elements\n8:Display\n9:Exit\n");
        printf("Enter the choice : ");
        scanf("%d",&choice);
        switch(choice)
        {
            case 1: printf("Enter the item to be inserted at front end : ");
                    scanf("%d",&item);
                    last=dinsert_front(item,head);
                    break;
            case 2: printf("Enter the item to be inserted at rear end : ");
                    scanf("%d",&item);
                    last=dinsert_rear(item,head);
                    break;
            case 3: last=ddelete_front(head);
                    break;
            case 4: last=ddelete_rear(head);
                    break;
            case 5: printf("Enter the key item : ");
                    scanf("%d",&item);

```

```
        head=insert_leftpos(item,head);
        break;
case 6: printf("Enter the key item : ");
        scanf("%d",&item);
        head=insert_rightpos(item,head);
        break;
case 7: printf("Enter the key item : ");
        scanf("%d",&item);
        head=delete_all_key(item,head);
        break;
case 8: display(head);
        break;
default: exit(0);
    }
}
}
```

 "C:\Users\SAKSHI\Doubly Linked List.exe"


```
1:Insert front
2:Insert rear
3>Delete front
4>Delete rear
5:Insert left position
6:Insert right position
7>Delete all key elements
8:Display
9:Exit
Enter the choice : 1
Enter the item to be inserted at front end : 12

1:Insert front
2:Insert rear
3>Delete front
4>Delete rear
5:Insert left position
6:Insert right position
7>Delete all key elements
8:Display
9:Exit
Enter the choice : 1
Enter the item to be inserted at front end : 34

1:Insert front
2:Insert rear
3>Delete front
4>Delete rear
5:Insert left position
6:Insert right position
7>Delete all key elements
8:Display
9:Exit
Enter the choice : 2
Enter the item to be inserted at rear end : 56

1:Insert front
2:Insert rear
3>Delete front
4>Delete rear
5:Insert left position
6:Insert right position
7>Delete all key elements
8:Display
9:Exit
Enter the choice : 1
Enter the item to be inserted at front end : 87


1:Insert front
```

 "C:\Users\SAKSHI\Doubly Linked List.exe"

```
1:Insert front
2:Insert rear
3>Delete front
4>Delete rear
5:Insert left position
6:Insert right position
7>Delete all key elements
8:Display
9:Exit
Enter the choice : 2
Enter the item to be inserted at rear end : 93

1:Insert front
2:Insert rear
3>Delete front
4>Delete rear
5:Insert left position
6:Insert right position
7>Delete all key elements
8:Display
9:Exit
Enter the choice : 8
Contents of the list :
87 34 12 56 93

1:Insert front
2:Insert rear
3>Delete front
4>Delete rear
5:Insert left position
6:Insert right position
7>Delete all key elements
8:Display
9:Exit
Enter the choice : 3
Node deleted is 87
1:Insert front
2:Insert rear
3>Delete front
4>Delete rear
5:Insert left position
6:Insert right position
7>Delete all key elements
8:Display
9:Exit
Enter the choice : 4
Node deleted is 93
1:Insert front
2:Insert rear
```

 "C:\Users\SAKSHI\Doubly Linked List.exe"


```
4:Delete rear
5:Insert left position
6:Insert right position
7:Delete all key elements
8:Display
9:Exit
Enter the choice : 8
Contents of the list :
34 12 56

1:Insert front
2:Insert rear
3:Delete front
4:Delete rear
5:Insert left position
6:Insert right position
7:Delete all key elements
8:Display
9:Exit
Enter the choice : 5
Enter the key item : 12
Enter towards left of 12 = 45

1:Insert front
2:Insert rear
3:Delete front
4:Delete rear
5:Insert left position
6:Insert right position
7:Delete all key elements
8:Display
9:Exit
Enter the choice : 8
Contents of the list :
34 45 12 56

1:Insert front
2:Insert rear
3:Delete front
4:Delete rear
5:Insert left position
6:Insert right position
7:Delete all key elements
8:Display
9:Exit
Enter the choice : 6
Enter the key item : 34
Enter towards right of 34 = 12

1:Insert front
```


 "C:\Users\SAKSHI\Doubly Linked List.exe"

```
3:Delete front
4:Delete rear
5:Insert left position
6:Insert right position
7:Delete all key elements
8:Display
9:Exit
Enter the choice : 8
Contents of the list :
34 12 45 12 56

1:Insert front
2:Insert rear
3:Delete front
4:Delete rear
5:Insert left position
6:Insert right position
7:Delete all key elements
8:Display
9:Exit
Enter the choice : 7
Enter the key item : 12
Key found at 2 positions and are deleted.

1:Insert front
2:Insert rear
3:Delete front
4:Delete rear
5:Insert left position
6:Insert right position
7:Delete all key elements
8:Display
9:Exit
Enter the choice : 8
Contents of the list :
34 45 56

1:Insert front
2:Insert rear
3:Delete front
4:Delete rear
5:Insert left position
6:Insert right position
7:Delete all key elements
8:Display
9:Exit
Enter the choice : 9

Process returned 0 (0x0)   execution time : 172.064 s
Press any key to continue.
```

LAB PROGRAM 10

Write a program

a) To construct a Binary Search Tree

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

c) To display the elements in the tree

```
#include<stdio.h>
#include<process.h>
struct node
{
    int info;
    struct node *rlink;
    struct node *llink;
};
typedef struct node *NODE;
NODE getnode()
{
    NODE x;
    x=(NODE)malloc(sizeof(struct node));
    if(x==NULL)
    {
        printf("Memory is full.\n");
        exit(0);
    }
    return x;
}
void freenode(NODE x)
{
    free(x);
}
```

```

}
NODE insert(NODE root,int item)
{
    NODE temp,cur,prev;
    temp=getnode();
    temp->rlink=NULL;
    temp->llink=NULL;
    temp->info=item;
    if(root==NULL)
        return temp;
    prev=NULL;
    cur=root;
    while(cur!=NULL)
    {
        prev=cur;
        cur=(item<cur->info)?cur->llink:cur->rlink;
    }
    if(item<prev->info)
        prev->llink=temp;
    else
        prev->rlink=temp;
    return root;
}
NODE delete(NODE root,int item)
{
    NODE cur,parent,q,suc;
    if(root==NULL)
    {

```

```

    printf("Empty\n");
    return root;
}
parent=NULL;
cur=root;
while(cur!=NULL&&item!=cur->info)
{
    parent=cur;
    cur=(item<cur->info)?cur->llink:cur->rlink;
}
if(cur==NULL)
{
    printf("Not found.\n");
    return root;
}
if(cur->llink==NULL)
    q=cur->rlink;
else if(cur->rlink==NULL)
    q=cur->llink;
else
{
    suc=cur->rlink;
    while(suc->llink!=NULL)
        suc=suc->llink;
    suc->llink=cur->llink;
    q=cur->rlink;
}
if(parent==NULL)

```

```

        return q;
    if(cur==parent->llink)
        parent->llink=q;
    else
        parent->rlink=q;
    freenode(cur);
    return root;
}

void preorder(NODE root)
{
    if(root!=NULL)
    {
        printf("%d\n",root->info);
        preorder(root->llink);
        preorder(root->rlink);
    }
}

void postorder(NODE root)
{
    if(root!=NULL)
    {
        postorder(root->llink);
        postorder(root->rlink);
        printf("%d\n",root->info);
    }
}

void inorder(NODE root)
{

```

```

    if(root!=NULL)
    {
        inorder(root->llink);
        printf("%d\n",root->info);
        inorder(root->rlink);
    }
}

void display(NODE root,int i)
{
    int j;
    if(root!=NULL)
    {
        display(root->rlink,i+1);
        for(j=0;j<i;j++)
            printf(" ");
        printf("%d\n",root->info);
        display(root->llink,i+1);
    }
}

void main()
{
    int item,choice;
    NODE root=NULL;
    for(;;)
    {
        printf("\n1.Insert\n2.Delete\n3.Preorder\n4.Postorder\n5.Inorder\n6.Display\n7.Exit\n");
        printf("Enter the choice: ");
        scanf("%d",&choice);
    }
}

```

```

switch(choice)
{
    case 1: printf("Enter the item: ");
            scanf("%d",&item);
            root=insert(root,item);
            break;
    case 2: printf("Enter the item: ");
            scanf("%d",&item);
            root=delete(root,item);
            break;
    case 3: printf("Preorder traversal: \n");
            preorder(root);
            break;
    case 4: printf("Postorder traversal: \n");
            postorder(root);
            break;
    case 5: printf("Inorder traversal: \n");
            inorder(root);
            break;
    case 6: printf("Elements in the tree: \n");
            display(root,0);
            break;
    default:exit(0);
            break;
}
}
}

```

 "C:\Users\SAKSHI\Binary Search Tree.exe"

```
1.Insert
2.Delete
3.Preorder
4.Postorder
5.Inorder
6.Display
7.Exit
Enter the choice: 1
Enter the item: 56
```

```
1.Insert
2.Delete
3.Preorder
4.Postorder
5.Inorder
6.Display
7.Exit
Enter the choice: 1
Enter the item: 23
```

```
1.Insert
2.Delete
3.Preorder
4.Postorder
5.Inorder
6.Display
7.Exit
Enter the choice: 1
Enter the item: 12
```

```
1.Insert
2.Delete
3.Preorder
4.Postorder
5.Inorder
6.Display
7.Exit
Enter the choice: 1
Enter the item: 65
```

```
1.Insert
2.Delete
3.Preorder
4.Postorder
5.Inorder
6.Display
7.Exit
Enter the choice: 1
Enter the item: 45
```


 "C:\Users\SAKSHI\Binary Search Tree.exe"

Enter the choice: 1

Enter the item: 45

- 1.Insert
- 2.Delete
- 3.Preorder
- 4.Postorder
- 5.Inorder
- 6.Display
- 7.Exit

Enter the choice: 1

Enter the item: 84

- 1.Insert
- 2.Delete
- 3.Preorder
- 4.Postorder
- 5.Inorder
- 6.Display
- 7.Exit

Enter the choice: 6

Elements in the tree:

```
      84
     65
56
      45
     23
      12
```

- 1.Insert
- 2.Delete
- 3.Preorder
- 4.Postorder
- 5.Inorder
- 6.Display
- 7.Exit

Enter the choice: 2

Enter the item: 12

- 1.Insert
- 2.Delete
- 3.Preorder
- 4.Postorder
- 5.Inorder
- 6.Display
- 7.Exit

Enter the choice: 6

Elements in the tree:

```
      84
     65
```

 "C:\Users\SAKSHI\Binary Search Tree.exe"

```
7.Exit
Enter the choice: 6
Elements in the tree:
    84
  65
56
    45
    23
```

```
1.Insert
2.Delete
3.Preorder
4.Postorder
5.Inorder
6.Display
7.Exit
Enter the choice: 3
Preorder traversal:
56
23
45
65
84
```

```
1.Insert
2.Delete
3.Preorder
4.Postorder
5.Inorder
6.Display
7.Exit
Enter the choice: 4
Postorder traversal:
45
23
84
65
56
```

```
1.Insert
2.Delete
3.Preorder
4.Postorder
5.Inorder
6.Display
7.Exit
Enter the choice: 5
Inorder traversal:
23
45
```

"C:\Users\SAKSHI\Binary Search Tree.exe"

56
23
45
65
84

1.Insert
2.Delete
3.Preorder
4.Postorder
5.Inorder
6.Display
7.Exit

Enter the choice: 4
Postorder traversal:

45
23
84
65
56

1.Insert
2.Delete
3.Preorder
4.Postorder
5.Inorder
6.Display
7.Exit

Enter the choice: 5
Inorder traversal:

23
45
56
65
84

1.Insert
2.Delete
3.Preorder
4.Postorder
5.Inorder
6.Display
7.Exit

Enter the choice: 7

Process returned 0 (0x0) execution time : 189.194 s
Press any key to continue.