DATA STRUCTURE LAB FILE

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DATA STRUCTURE LAB (G3)

SUBMITTED TO :

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DEPARTMENT OF COMPUTER SCIENCE &ENGINEERING

VISION

Department of Computer Science & Engineering to be a leading world class technology department playing its role as a key node in national and global knowledge network, thus empowering the computer science industry with the wings of knowledge and power of innovation.

MISSION

The Mission of the department is as follows:

1. To nurture talent of students for research, innovation and excellence in the field of computer engineering starting from Under graduate level.

2. To develop highly analytical and qualified computer engineers by imparting training on cutting edge technology.

3. To produce socially sensitive computer engineers with professional ethics.

4. To focus on R&D environment in close partnership with industry and foreign universities.

5. To produce well-rounded, up to date, scientifically tempered, design oriented engineer and scientists capable of lifelong learning

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EXPERIMENT – 1

Objectives :- Merge Sort Recursive Version.

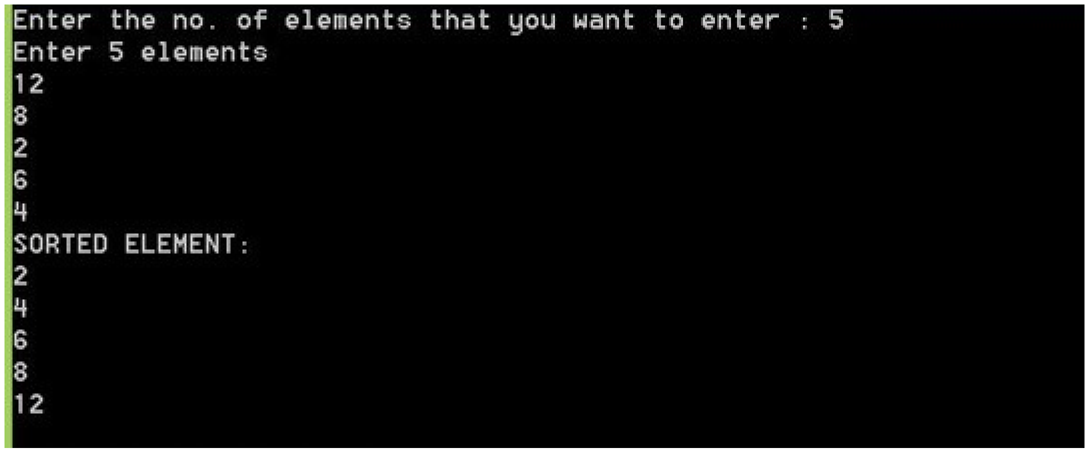
Code: -

```
#include <iostream>
#include <stdlib.h>
using namespace std;

void Merge(int arr[], int l, int m, int r)
{
    int i, j, k, n1=m-l+1, n2=r - m, L[n1], R[n2];
    for (i = 0; i < n1; i++)
        L[i] = arr[l + i];
    for (j = 0; j < n2; j++)
        R[j] = arr[m + 1 + j];

    i=0,j=0,k=l;
    while(i<n1 and j<n2){
        if(L[i]<=R[j]){
            arr[k] = L[i];
            i++;
        }
        else{
            arr[k]=R[j];
            j++;
        }
        k++;
    }
    while(i<n1){
        arr[k] = L[i];
        i++;
        k++;
    }
    while(j<n2) {
        arr[k] = R[j];
        j++;
        k++;
    }
}
void MergeSort(int arr[], int l, int r)
{
    if (l < r){
        int m=l+(r-l)/2;
        MergeSort(arr, l, m);
        MergeSort(arr, m+1, r);
        Merge(arr, l, m, r);
    }
```

```
}
void Array(int A[], int size)
{
   int i;
   for (i = 0; i<size; i++)
      cout<<A[i]<<" ";
      cout<<endl;
}

int main()
{
   int n;
   cin>>n;
   int arr[n];
   for(int i=0;i<n;i++){
      cin>>arr[i];
   }
   int arr_size = sizeof(arr) / sizeof(arr[0]);

   cout<<"Given array: ";
   Array(arr, arr_size);

   MergeSort(arr, 0, arr_size - 1);
```

```
    cout<<"Sorted array: ";
    Array(arr, arr_size);
    return 0;
}
```

OUTPUT



```
Enter the no. of elements that you want to enter : 5
Enter 5 elements
12
8
2
6
4
SORTED ELEMENT:
2
4
6
8
12
```

EXPERIMENT – 2

Objectives :- Merge Sort Iterative Version

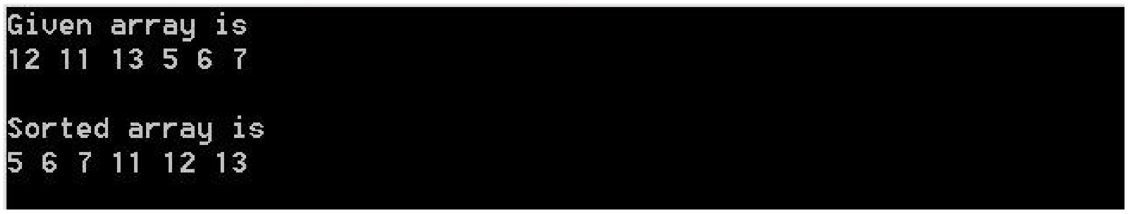
CODE: -

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

void merge(int arr[], int l, int m, int r);
int min(int x, int y) { return (x<y)? x :y; }
void mergeSort(int arr[], int n)
{
int curr_size;
int left_start;
for (curr_size=1; curr_size<=n-1; curr_size = 2*curr_size)
{
   for (left_start=0; left_start<n-1; left_start += 2*curr_size)
   {
      int mid = min(left_start + curr_size - 1, n-1);

      int right_end = min(left_start + 2*curr_size - 1, n-1);

      merge(arr, left_start, mid, right_end);
```

```
    }
}
}

void merge(int arr[], int l, int m, int r)
{
    int i, j, k;
    int n1 = m - l + 1;
    int n2 = r - m;
    int L[n1], R[n2];
    for (i = 0; i < n1; i++)
        L[i] = arr[l + i];
    for (j = 0; j < n2; j++)
        R[j] = arr[m + 1+ j];

    i = 0;
    j = 0;
    k = l;
    while (i < n1 && j < n2)
    {
        if (L[i] <= R[j])
        {
```

```
        arr[k] = L[i];
        i++;
    }
    else
    {
        arr[k] = R[j];
        j++;
    }
    k++;
}

while (i < n1)
{
    arr[k] = L[i];
    i++;
    k++;
}
while (j < n2)
{
    arr[k] = R[j];
    j++;
    k++;
    }
}

void printArray(int A[], int size)
{
    int i;
    for (i=0; i < size; i++)
        printf("%d ", A[i]);
    printf("\n");
}

int main()
{
    int arr[] = {12, 11, 13, 5, 6, 7};
    int n = sizeof(arr)/sizeof(arr[0]);
    printf("Given array is \n");
    printArray(arr, n);
    mergeSort(arr, n);
    printf("\nSorted array is \n");
    printArray(arr, n);
    return 0;
}
```

OUTPUT: -



```
Given array is
12 11 13 5 6 7

Sorted array is
5 6 7 11 12 13
```

EXPERIMENT – 3

Objectives :- Managing Unsorted List- Menu Driven Program To Perform Insert, Delete And Search Operations.

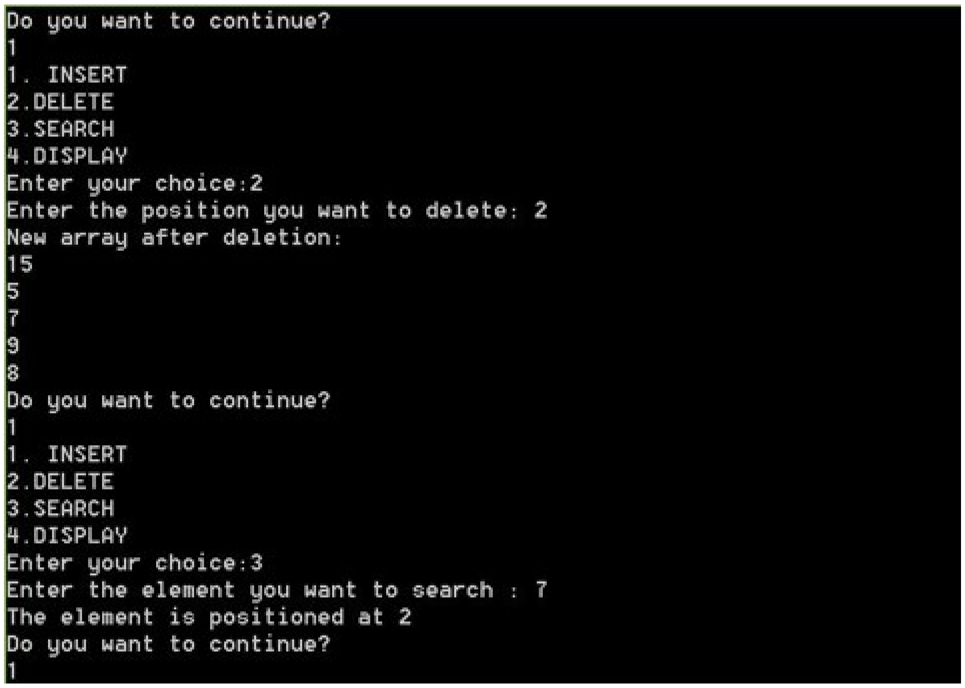
CODE: -

```
#include <iostream>
using namespace std;
int main()
{
    int n;
    cin>>n;
    int arr[100]={0};
    for(int i=0;i<n;i++)
    {
        cin>>arr[i];   //unsorted
    }
    for(int i=0;i<n;i++)
    {
        cout<<arr[i]<<" ";
    }cout<<endl;
    cout<<"1.Insert 2.Delete 3.Find Minimum Element 4.Find
Maximum Element 5.Display List 6.Exit"<<endl;
    char ch='y';
```

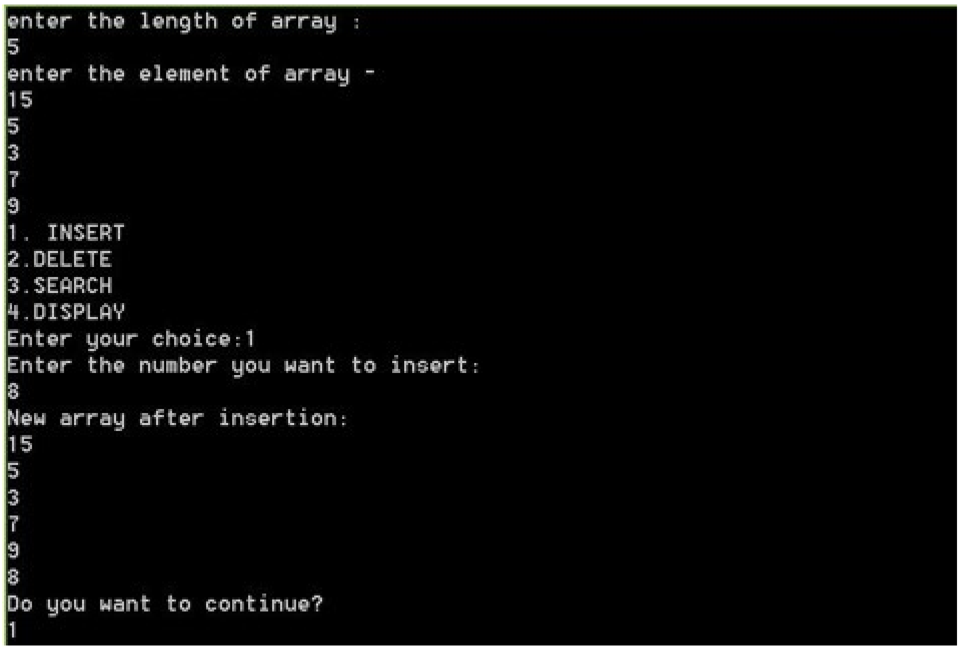
```
while(ch=='y')
{
cout<<"Enter your choice:";
int key;
cin>>key;
if(key==1){
    cout<<"Enter the no. you want to insert :";
    int num1;
    cin>>num1;
    arr[n]=num1;
    n++;
    ch ='y';cout<<endl;
}
else if(key==2){
    cout<<"Enter the index at which u want to delete the
element :";
    int idx;
    cin>>idx;
    for(int j=idx;j<n;j++)
    {
        arr[j]=arr[j+1];
    }n--;ch ='y';cout<<endl;
```

```
}
else if(key==3){
    int min=arr[0];
    for(int i=0;i<n;i++)
    {
        if(arr[i]<min){
            min=arr[i];
        }
    }cout<<"Minimum element is "<<min;
    ch ='y';cout<<endl;
}
else if(key==4){
    int max=arr[0];
    for(int i=0;i<n;i++)
    {
        if(arr[i]>max){
            max=arr[i];
        }

    }cout<<"Maximum element is "<<max;
    ch ='y';cout<<endl;
    }
    else if(key==5){
        cout<<"Currently the list is:"<<endl;
        for(int i=0;i<n;i++)
        {
            cout<<arr[i]<<" ";
        }ch ='y';cout<<endl;
    }
    else if(key==6){
        cout<<"Exit"<<endl;break;
    }
    else{
        cout<<"Invalid";ch ='y';cout<<endl;
    }
    }
    return 0;
}
```

OUTPUT: -



```
Do you want to continue?
1
1. INSERT
2.DELETE
3.SEARCH
4.DISPLAY
Enter your choice:2
Enter the position you want to delete: 2
New array after deletion:
15
5
7
9
8
Do you want to continue?
1
1. INSERT
2.DELETE
3.SEARCH
4.DISPLAY
Enter your choice:3
Enter the element you want to search : 7
The element is positioned at 2
Do you want to continue?
1
```



```
enter the length of array :
5
enter the element of array -
15
5
3
7
9
1. INSERT
2.DELETE
3.SEARCH
4.DISPLAY
Enter your choice:1
Enter the number you want to insert:
8
New array after insertion:
15
5
3
7
9
8
Do you want to continue?
1
```

EXPERIMENT – 4

Objectives :- Managing Sorted List - Menu Driven Program To Perform Insert, Delete and Search Operations.

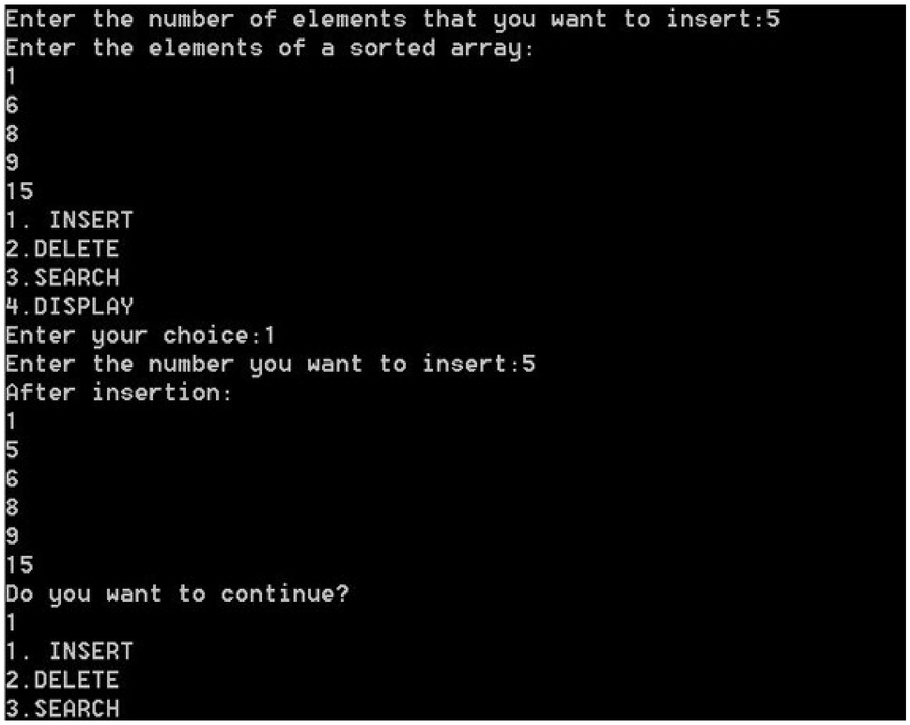
Code:-

```
#include <iostream>
using namespace std;
int main()
{
    int n;
    cin>>n;
    int arr[100]={0};
    for(int i=0;i<n;i++)
    {
        cin>>arr[i];   //sorted
    }
    for(int i=0;i<n;i++)
    {
        cout<<arr[i]<<" ";
    }cout<<endl;
    cout<<"1.Insert 2.Delete 3.Find Minimum Element 4.Find Maximum
Element 5.Display List 6.Exit"<<endl;
    char ch='y';
```

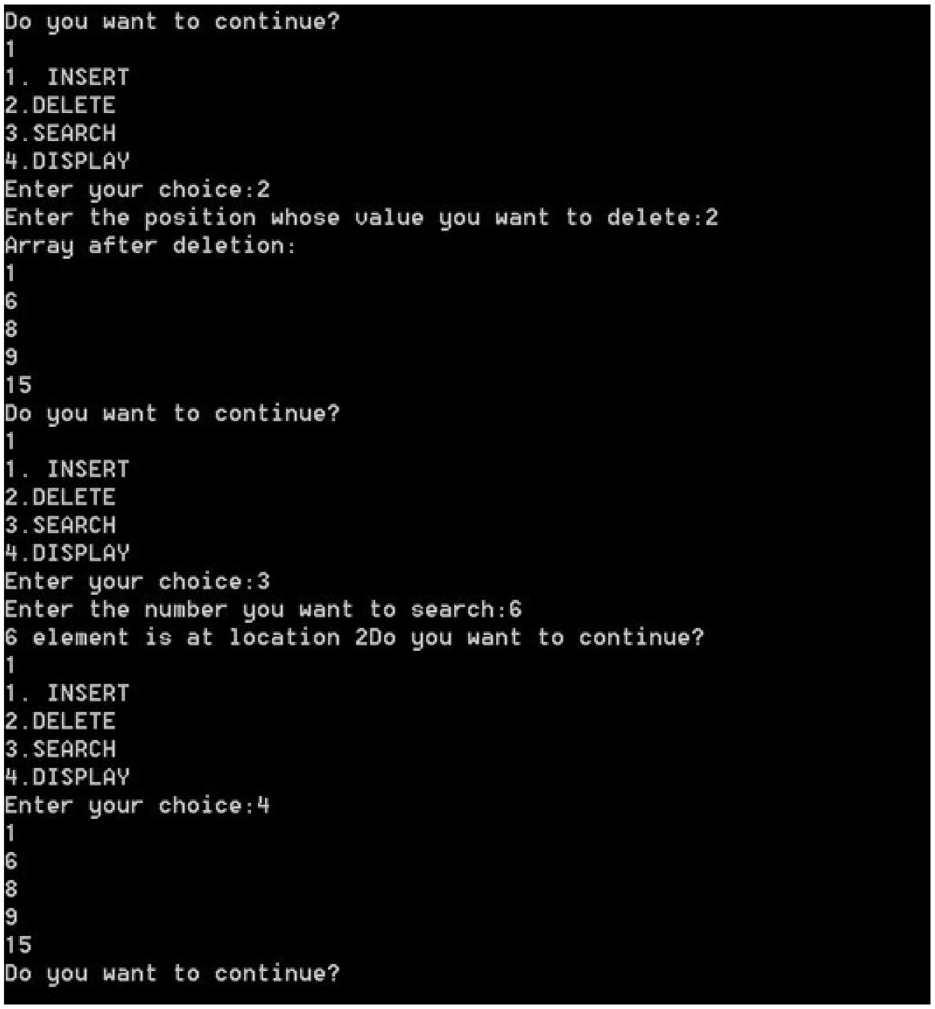
```
while(ch=='y')
{
cout<<"Enter your choice:";
int key;
cin>>key;
if(key==1){
    cout<<"Enter the no. you want to insert :";
    int num1;
    cin>>num1;int t=0;
    for(int i=0;i<n;i++)
    {
        if(num1>arr[i]){
            t++;
        }
        else break;
    }
    for(int j=n-1;j>=t;j--)
    {
        arr[j+1]=arr[j];
    }
    arr[t]=num1;n++;
    ch=='y';cout<<endl;
}
```

```
else if(key==2){
    cout<<"Enter the index at which u want to delete the element :";
    int idx;
    cin>>idx;

    for(int j=idx;j<n;j++)
    {
        arr[j]=arr[j+1];
    }n--;ch=='y';cout<<endl;
}
else if(key==3){
    cout<<"Minimum element is "<<arr[0];
    ch=='y';cout<<endl;
}
else if(key==4){
    cout<<"Maximum element is "<<arr[n-1];
    ch=='y';cout<<endl;
}
else if(key==5){
    cout<<"Currently the list is:"<<endl;
    for(int i=0;i<n;i++)
    {
        cout<<arr[i]<<" ";
        }ch=='y';cout<<endl;
    }
    else if(key==6){
        cout<<"Exit"<<endl;break;
    }
    else{
        cout<<"Invalid";ch=='y';cout<<endl;
    }
    }
    return 0;
}
```

OUTPUT: -



```
Enter the number of elements that you want to insert:5
Enter the elements of a sorted array:
1
6
8
9
15
1. INSERT
2.DELETE
3.SEARCH
4.DISPLAY
Enter your choice:1
Enter the number you want to insert:5
After insertion:
1
5
6
8
9
15
Do you want to continue?
1
1. INSERT
2.DELETE
3.SEARCH
```



```
Do you want to continue?
1
1. INSERT
2.DELETE
3.SEARCH
4.DISPLAY
Enter your choice:2
Enter the position whose value you want to delete:2
Array after deletion:
1
6
8
9
15
Do you want to continue?
1
1. INSERT
2.DELETE
3.SEARCH
4.DISPLAY
Enter your choice:3
Enter the number you want to search:6
6 element is at location 2Do you want to continue?
1
1. INSERT
2.DELETE
3.SEARCH
4.DISPLAY
Enter your choice:4
1
6
8
9
15
Do you want to continue?
```

EXPERIMENT – 5

Objectives :- Stack implementation Using Arrays , Menu Driven Program.

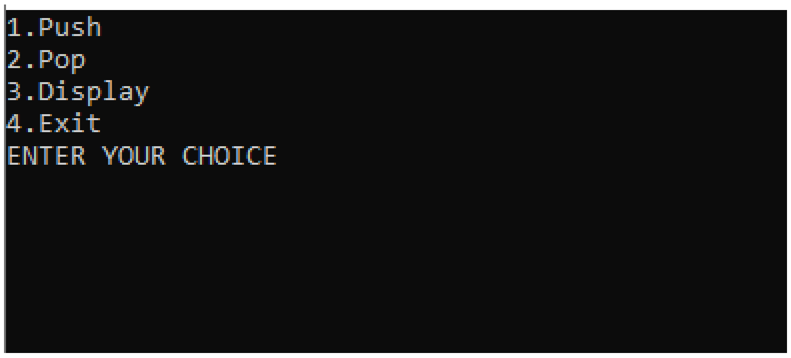
CODE : -

```
#include<stdio.h>
#define MAXSIZE 5
struct stack
{
   int a[MAXSIZE];
   int top;
};
void push(struct stack*s,int x)
{
   if(s->top==MAXSIZE-1)
   {
      printf("STACK IS FULL.\n");
      return;
   }
   s->top=s->top+1;
   s->a[s->top]=x;
}
```

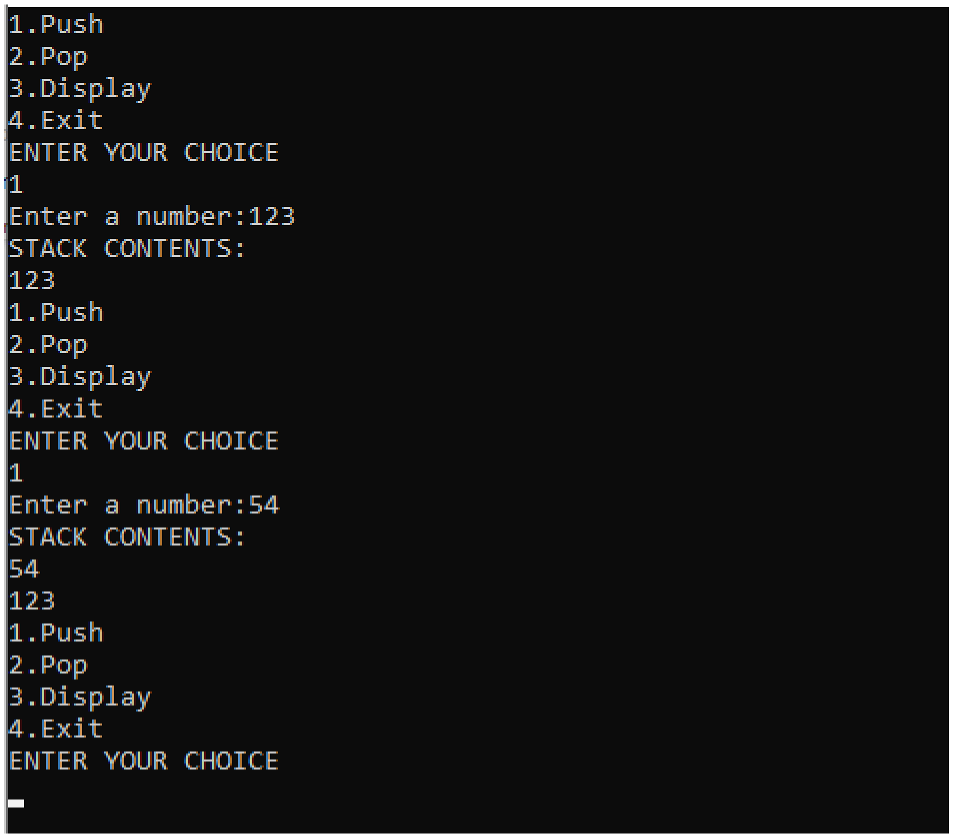
```
int pop(struct stack*s)
{
    int y;
    if(s->top==-1)
    {
        printf("STACK IS EMPTY\n");
        return -1;
    }
    y=s->a[s->top];
    s->top=s->top-1;
    return y;
}
void display(struct stack s)
{
    printf("STACK CONTENTS:\n");
    int i;
    for(i=s.top;i>=0;i--)
    {
        printf("%d\n",s.a[i]);
    }
}
```

```
int main()
{
    struct stack s;
    int choice,x;
    s.top=-1;
    while(1)
    {
        printf("1.Push\n");
        printf("2.Pop\n");
        printf("3.Display\n");
        printf("4.Exit\n");
        printf("ENTER YOUR CHOICE\n");
        scanf("%d",&choice);
        switch(choice)
        {
            case 1:
                printf("Enter a number:");
                scanf("%d",&x);
                push(&s,x);
                display(s);
                break;
            case 2:
                x=pop(&s);
                if(x!=-1)
                {
                    printf("Popped data is =%d\n",x);
                    display(s);
                }
                break;
            case 3:
                display(s);
                break;
        }
        if(choice==4)
        {
            return 0;
        }
    }
}
```

OUTPUT : -



```
1.Push
2.Pop
3.Display
4.Exit
ENTER YOUR CHOICE
```



```
1.Push
2.Pop
3.Display
4.Exit
ENTER YOUR CHOICE
1
Enter a number:123
STACK CONTENTS:
123
1.Push
2.Pop
3.Display
4.Exit
ENTER YOUR CHOICE
1
Enter a number:54
STACK CONTENTS:
54
123
1.Push
2.Pop
3.Display
4.Exit
ENTER YOUR CHOICE
```

EXPERIMENT – 6

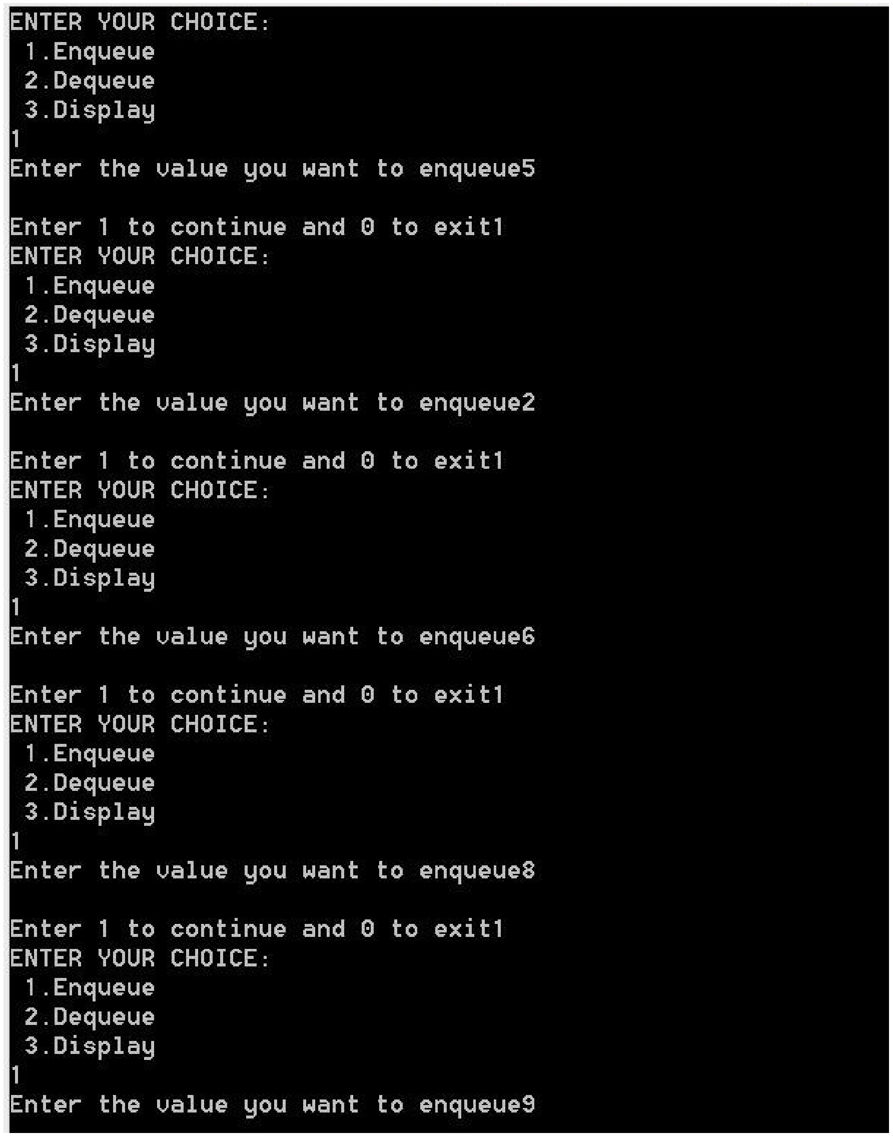
Objectives :- Menu Driven Program For Queue Simulation Using Array .

CODE : -

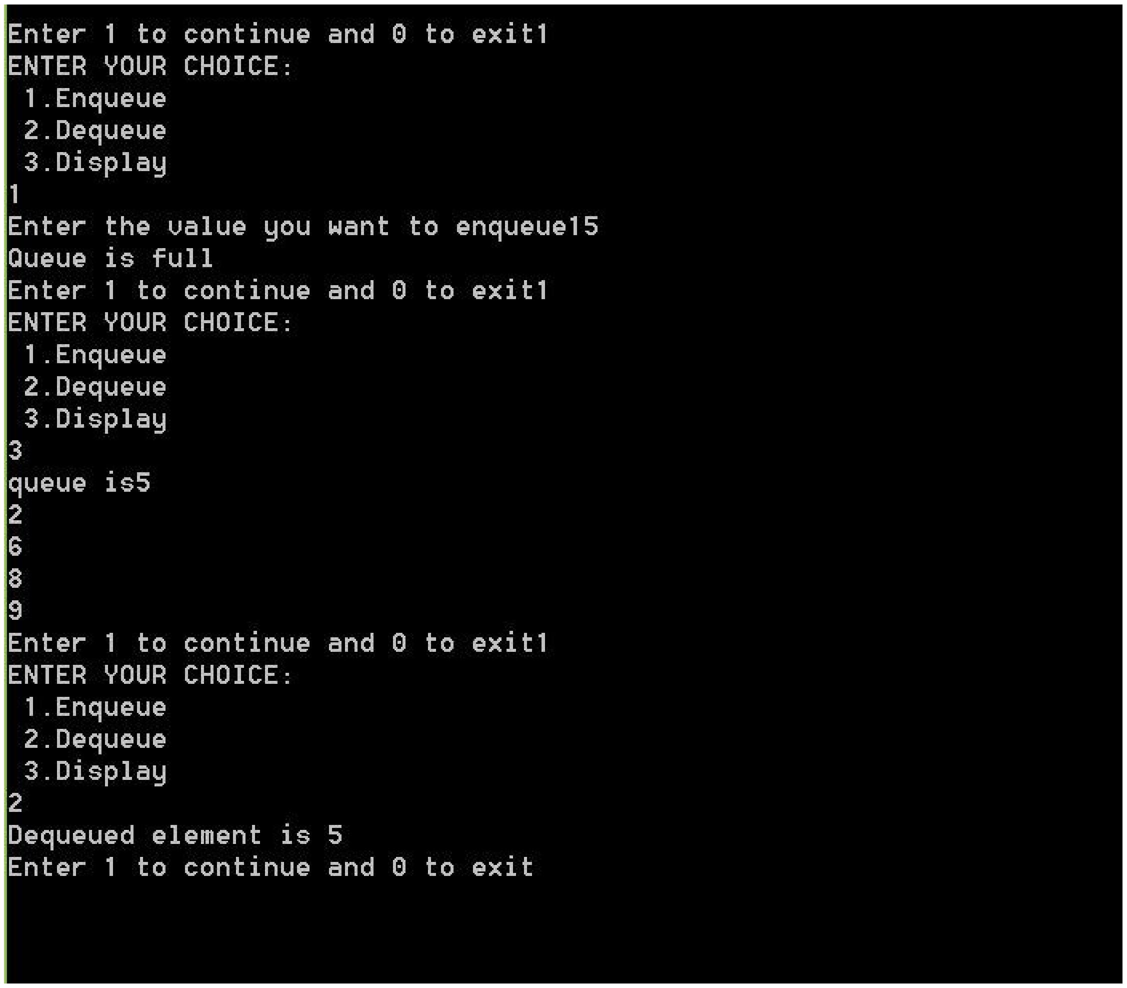
```
#include<stdio.h>
#define N 5
int queue[N];
int front=-1,rear=-1;
void enqueue(int x)
{
        if((rear+1)%N==front)
        {
                printf("Queue is full");
        }
        else if(front==-1 && rear==-1)
        {
                front=rear=0;
                queue[rear]=x;
        }
        else
        {
                rear=(rear+1)%N;
                queue[rear]=x;
    }
}
void dequeue()
{
        if(front==-1&&rear==-1)
        {
                printf("Queue is empty");
        }
```

```
	else if(front==rear)
	{
		printf("dequeued element is %d",queue[front]);
		front=rear=-1;
	}
	else
	{
		printf("Dequeued element is %d", queue[front]);
		front=(front+1)%N;
	}
}
void display()
{
	int i=front;
	if(front==-1 && rear==-1)
	{
		printf("Queue is empty");
	}
	else
	{
		printf("queue is");
		while(i!=rear)
		{
			printf("%d\n",queue[i]);
			i=(i+1)%N;
		}
		printf("%d",queue[rear]);
	}
}
int main()
{
	int ch,a,x;
	do
```

```
        {
                printf("ENTER YOUR CHOICE:\n 1.Enqueue \n
2.Dequeue \n 3.Display \n");
            scanf("%d", &ch);
            switch(ch)
            {
                    case 1:
                        printf("Enter the value you want to enqueue");
                        scanf("%d", &x);
                            enqueue(x);
                            break;
                    case 2:
                            dequeue();
                            break;
                    case 3:
                            display();
                            break;
                default:
                        printf("Invalid Choice");
        }
        printf("\nEnter 1 to continue and 0 to exit");
        scanf("%d", &a);
        }while(a==1);
        return 0;
}
```



```
ENTER YOUR CHOICE:
 1.Enqueue
 2.Dequeue
 3.Display
1
Enter the value you want to enqueue5

Enter 1 to continue and 0 to exit1
ENTER YOUR CHOICE:
 1.Enqueue
 2.Dequeue
 3.Display
1
Enter the value you want to enqueue2

Enter 1 to continue and 0 to exit1
ENTER YOUR CHOICE:
 1.Enqueue
 2.Dequeue
 3.Display
1
Enter the value you want to enqueue6

Enter 1 to continue and 0 to exit1
ENTER YOUR CHOICE:
 1.Enqueue
 2.Dequeue
 3.Display
1
Enter the value you want to enqueue8

Enter 1 to continue and 0 to exit1
ENTER YOUR CHOICE:
 1.Enqueue
 2.Dequeue
 3.Display
1
Enter the value you want to enqueue9
```



```
Enter 1 to continue and 0 to exit1
ENTER YOUR CHOICE:
 1.Enqueue
 2.Dequeue
 3.Display
1
Enter the value you want to enqueue15
Queue is full
Enter 1 to continue and 0 to exit1
ENTER YOUR CHOICE:
 1.Enqueue
 2.Dequeue
 3.Display
3
queue is5
2
6
8
9
Enter 1 to continue and 0 to exit1
ENTER YOUR CHOICE:
 1.Enqueue
 2.Dequeue
 3.Display
2
Dequeued element is 5
Enter 1 to continue and 0 to exit
```

<u>EXPERIMENT – 7</u>

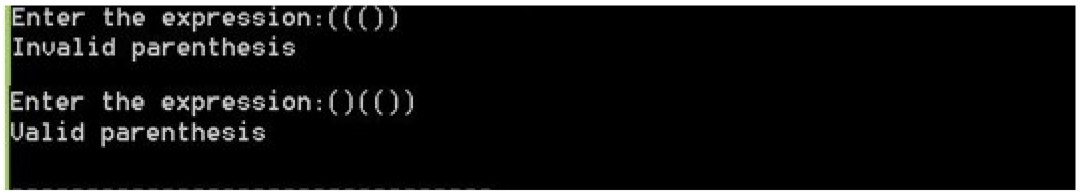
Objectives :- To check if given string contains balanced parenthesis e.g. (()()) is balanced.

CODE : -

```
#include <stdio.h>
#include <string.h>
int top;
void check(char str[], int n, char stack[])
{
    for (int i = 0; i < n; i++)
    {
        if (str[i] == '(') // push
        {
            top = top + 1;
            stack[top] = '(';
        }
        if (str[i] == ')' && stack[top] == '(') //pop
        {
            top = top - 1;
        }
    }
    if (top == -1) // stack is empty
    {
        printf("string is balances\n");
    }
    else
    {
        printf("string is unbalanced:\n");
    }
}
int main()
{
    // balanced parenthesis string
    char str[] = "(a+(b-c))";
    //unbalanced parenthesis string
    char str1[] = "((a+b)";
    char stack[15];
    top = -1;
    check(str, 9, stack); //passing balance to string
    top = -1;
    check(str1, 6, stack); // passing unbalanced to string
    return 0;
```

}

OUTPUT : -



```
Enter the expression:((())
Invalid parenthesis

Enter the expression:()(())
Valid parenthesis
```

EXPERIMENT – 8

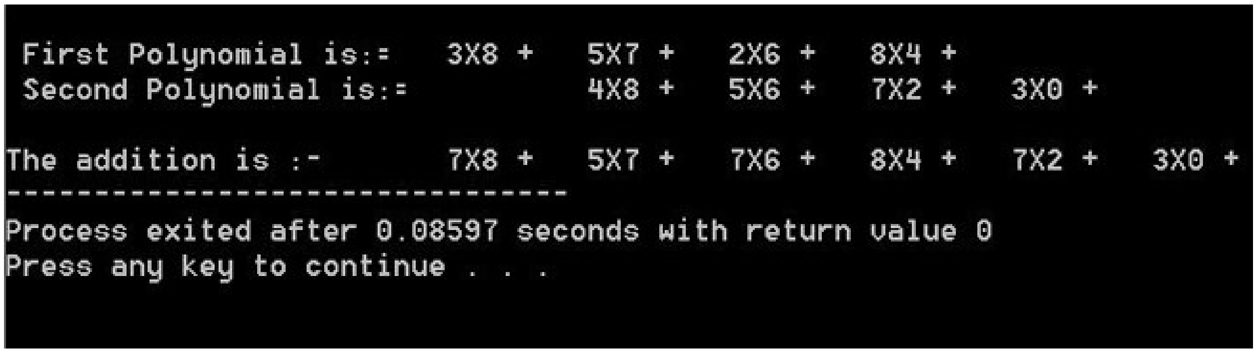
Objectives :- USING ARRAY AND WRITE PROGRAM TO ADD AND MULTIPLY TWO POLYNOMIALS.

CODE: -

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

struct node{
    int coef;
   int expr ;
   struct node*next;
};
struct node*Getnode(){
    struct node *p;
    p=(struct node *)malloc(sizeof(struct node));
    return p;
}

void Insbeg(struct node **list,int c, int e){
    struct node *temp;
    temp=Getnode();
    temp->coef=c;
    temp->expr=e;
    temp->next=*list;
    *list=temp;
}

 void Inend(struct node **list,int c,int e){
   struct node *temp,*p;
   temp= *list;
   if(*list==NULL)
      Insbeg(&(*list),c,e);
    else
    {
        while(temp->next!=NULL)
           temp=temp->next;
        p=Getnode();
        p->coef=c;
        p->expr=e;
        p->next=NULL;
        temp->next=p;
    }

}

 void Traverse(struct node *list)
{
    struct node *t;
    t=list;
    while(t!=NULL){
        printf("\t %dX%d +",t->coef,t->expr);
        t=t->next;
    }
}

struct node * addPolynomial(struct node *poly1,struct node
*poly2){
    struct node *poly3=NULL;
struct node *p,*q;
p=poly1;
q=poly2;

while(p!=NULL && q!=NULL){
    if(p->expr==q->expr){
        Inend(&poly3,p->coef+q->coef,p->expr);
        p=p->next;
        q=q->next;
    }
    else{
        if(p->expr>q->expr)
        {
            Inend(&poly3,p->coef,p->expr);
            p=p->next;
        }
        else
        {
           Inend(&poly3,q->coef,q->expr);
            q=q->next;
        }
    }
}
while(p!=NULL){
     Inend(&poly3,p->coef,p->expr);
            p=p->next;
}

 while(q!=NULL){
     Inend(&poly3,q->coef,q->expr);
```

```
            q=q->next;
    }

    return poly3;
}

int  main() {
    struct node *start1,*start2,*start3;
    start1=NULL;
    start2=NULL;
    start3=NULL;


    int x;

    Inend(&start1,3,8);
    Inend(&start1,5,7);
    Inend(&start1,2,6);
    Inend(&start1,8,4);
    printf("\n First Polynomial is:= ");
    Traverse(start1);

    Inend(&start2,4,8);
    Inend(&start2,5,6);
    Inend(&start2,7,2);
    Inend(&start2,3,0);
    printf("\n Second Polynomial is:= ");
    Traverse(start2);

    start3=addPolynomial(start1,start2);
    printf("\n\n");
    printf("The addition is :- ");
    Traverse(start3);

     return 0;
}
```

OUTPUT: -



```
 First Polynomial is:=   3X8 +   5X7 +   2X6 +   8X4 +
 Second Polynomial is:=          4X8 +   5X6 +   7X2 +   3X0 +

The addition is :-       7X8 +   5X7 +   7X6 +   8X4 +   7X2 +   3X0 +
--------------------------------
Process exited after 0.08597 seconds with return value 0
Press any key to continue . . .
```

EXPERIMENT – 9

Objectives:- Infix To Postfix Conversion Using Stack.

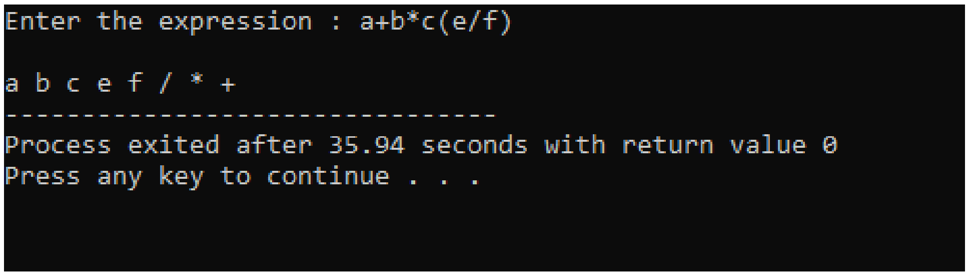
CODE: -

```
#include<stdio.h>
#include<ctype.h>
char stack[100];
int top = -1;

void push(char x)
{
    stack[++top] = x;
}
char pop()
{
    if(top == -1)
        return -1;
    else
        return stack[top--];
}
```

```
int priority(char x)
{
    if(x == '(')
        return 0;
    if(x == '+' || x == '-')
        return 1;
    if(x == '*' || x == '/')
        return 2;
    return 0;
}

int main()
{
    char exp[100];
    char *e, x;
    printf("Enter the expression : ");
    scanf("%s",exp);
    printf("\n");
    e = exp;
    while(*e != '\0')
```

```
{
    if(isalnum(*e))
        printf("%c ",*e);
    else if(*e == '(')
        push(*e);
    else if(*e == ')')
    {
        while((x = pop()) != '(')
            printf("%c ", x);
    }
    else
    {
        while(priority(stack[top]) >= priority(*e))
            printf("%c ",pop());
        push(*e);
    }
    e++;
}
while(top != -1)
{
    printf("%c ",pop());
}return 0;
}
```

OUTPUT: -



```
Enter the expression : a+b*c(e/f)

a b c e f / * +
--------------------------------
Process exited after 35.94 seconds with return value 0
Press any key to continue . . .
```

EXPERIMENT – 10

Objectives :- SPARSE MATRIX ADDITION

CODE : -

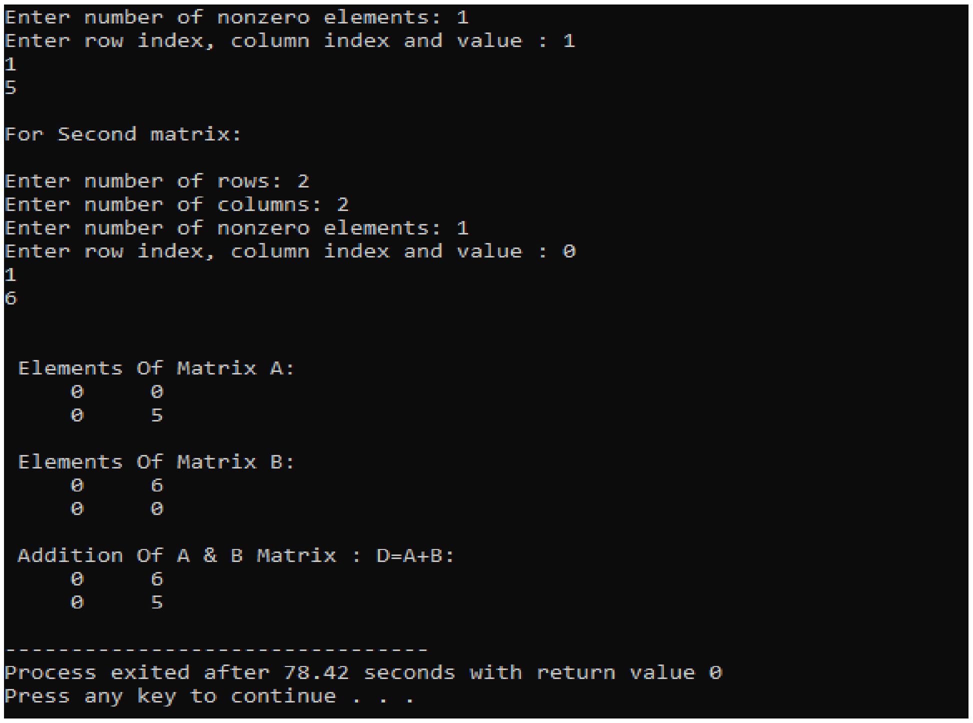
```
#include<stdio.h>
#define size 20

struct sparse
{
   int rows , columns , d ;
   int row[size] , col[size], value[size];
};

void readMatrix(struct sparse *P)
{
   int i,a,b,c;

   printf("Enter number of rows: ");
   scanf("%d",&P->rows);

   printf("Enter number of columns: ");
   scanf("%d",&P->columns);
   printf("Enter number of nonzero elements: ");
```

```
    scanf("%d",&P->d);
    for(i=0;i<P->d;i++)
    {
        printf("Enter row index, column index and value : ");
        scanf("%d%d%d",&a,&b,&c);
        P->row[i]=a;
        P->col[i]=b;
        P->value[i]=c;
    }
}
void printMatrix(struct sparse Q)
{
    int i,j,k=0;

    for(i=0;i<Q.rows;i++)
    {
        for(j=0;j<Q.columns;j++)
        {
            if((i==Q.row[k])&&(j==Q.col[k]))
            {
                printf("%6d",Q.value[k]);
                k++;
            }
            else
                printf("%6d",0);
        }
        printf("\n");
    }
}
struct sparse addMatrix(struct sparse A, struct sparse B)
{
    struct sparse C;
    int i,j,k;
    i=0;
    j=0;
    k=0;
    while(i<A.d && j<B.d)
    {
        if(A.row[i]==B.row[j]&&A.col[i]==B.col[j])
        {
            if(A.value[i]+B.value[j]!=0)
            {
                C.row[k]=A.row[i];
                C.col[k]=A.col[i];
                C.value[k]=A.value[i]+B.value[j];
                k++;
            }
            i++;
            j++;
        }
        if((A.row[i]<B.row[j])||(A.row[i]==B.row[j]&&A.col[i]<B.col[j]))
        {
            C.row[k]=A.row[i];
            C.col[k]=A.col[i];
            C.value[k]=A.value[i];
            i++;
            k++;
        }
        else
        {
            C.row[k]=B.row[j];
            C.col[k]=B.col[j];
            C.value[k]=B.value[j];
            j++;
            k++;
        }
```

```
}

while(i<A.d)
{
   C.row[k]=A.row[i];
   C.col[k]=A.col[i];
   C.value[k]=A.value[i];
   i++;
   k++;
}
while(j<B.d)
{
   C.row[k]=B.row[j];
   C.col[k]=B.col[j];
   C.value[k]=B.value[j];
   j++;
   k++;
}
C.rows=A.rows;
C.columns=A.columns;
C.d=k;
return C;
```

```
}
int main()
{
   struct sparse A,B;
   printf("For First matrix:\n\n");
   readMatrix(&A);
   printf("\n");
   printf("For Second matrix:\n\n");
   readMatrix(&B);
   printf("\n");
   printf("\n Elements Of Matrix A:\n");
   printMatrix(A);
   printf("\n Elements Of Matrix B:\n");
   printMatrix(B);
   printf("\n Addition Of A & B Matrix : D=A+B:\n");
   printMatrix(addMatrix(A,B));
   return 0;
}
```

OUTPUT : -



```
Enter number of nonzero elements: 1
Enter row index, column index and value : 1
1
5

For Second matrix:

Enter number of rows: 2
Enter number of columns: 2
Enter number of nonzero elements: 1
Enter row index, column index and value : 0
1
6


 Elements Of Matrix A:
     0     0
     0     5

 Elements Of Matrix B:
     0     6
     0     0

 Addition Of A & B Matrix : D=A+B:
     0     6
     0     5

--------------------------------
Process exited after 78.42 seconds with return value 0
Press any key to continue . . .
```

EXPERIMENT – 11

Objectives :- Sparse Matric Transpose And Multiplication

CODE : -

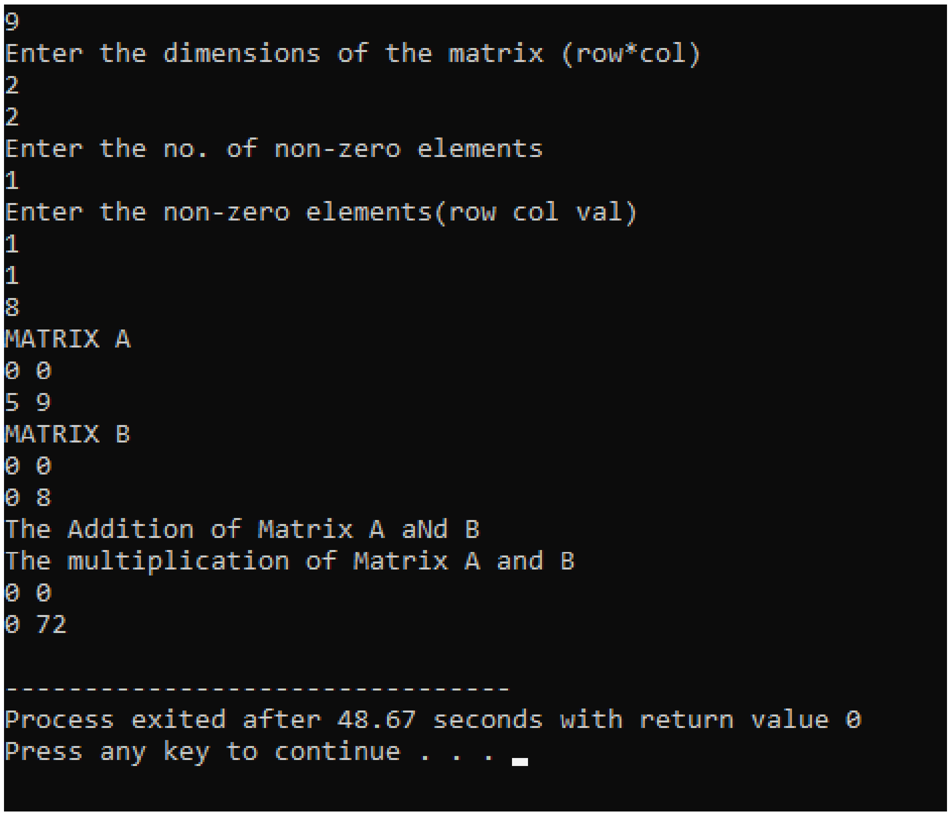
```
#include<stdio.h>
#include<stdlib.h>
#define size 100

struct sparse
{
   int nrows,ncols,nz;
   int row[size],col[size],val[size];
};

void readMatrix(struct sparse *s)
{
   int i;
   printf("Enter the dimensions of the matrix (row*col)\n");
   scanf("%d %d",&s->nrows,&s->ncols);
   printf("Enter the no. of non-zero elements\n");
   scanf("%d",&s->nz);

   printf("Enter the non-zero elements(row col val)\n");
```

```
    for(i=0;i<s->nz;i++)
    {
        scanf("%d %d %d",&s->row[i],&s->col[i],&s->val[i]);
    }
}

void printMatrix(struct sparse s)
{
    int i,j,k=0;
    for(i=0;i<s.nrows;i++)
    {
        for(j=0;j<s.ncols;j++)
        {
            if(k<s.nz && i==s.row[k] && j==s.col[k])
            printf("%d ",s.val[k++]);
            else
            {
                printf("%d ",0);
            }
        }
        printf("\n");
    }
}
```

```
struct sparse Transpose(struct sparse A)
{
   struct sparse B;
   int C[A.ncols],t[A.ncols];
   int i;
   B.nrows=A.ncols;
   B.ncols=A.nrows;
   B.nz=A.nz;
   for(i=0;i<A.ncols;i++)
   {
      C[i]=0;
   }
   for(i=0;i<A.nz;i++)
   {
      C[A.col[i]]++;
   }
   t[0]=0;
   for(i=1;i<A.ncols;i++)
   {
      t[i]=t[i-1]+C[i-1];
   }
   for(i=0;i<A.nz;i++)
   {
        B.row[t[A.col[i]]]=A.col[i];
        B.col[t[A.col[i]]]=A.row[i];
        B.val[t[A.col[i]]]=A.val[i];
        t[A.col[i]]++;
    }
    return B;
}
struct sparse addMatrix(struct sparse A,struct sparse B)
{
    struct sparse C;
    int i,j,k;
    i=j=k=0;
    while(i<A.nz && j<B.nz)
    {
        if(A.row[i]==B.row[j] && A.col[i]==B.col[j])
        {
            if(A.val[i]+B.val[j]!=0)
            {
                C.row[k]=A.row[i];
                C.col[k]=A.col[i];
                C.val[k]=A.val[i]+B.val[j];
                k++;
            }
            i++;
            j++;
        }
        if((A.row[i]<B.row[j])|| (A.row[i]==B.row[j] &&
A.col[i]<B.col[j]))
        {
            C.row[k]=A.row[i];
            C.col[k]=A.col[i];
            C.val[k]=A.val[i];
            i++;
            k++;
        }
        else
        {
            C.row[k]=B.row[j];
            C.col[k]=B.col[j];
            C.val[k]=B.val[j];
            j++;
            k++;
        }
    }
    while(i<A.nz)
    {
        C.row[k]=A.row[i];
        C.col[k]=A.col[i];
        C.val[k]=A.val[i];
        i++;
        k++;
    }
    while(j<B.nz)
    {
        C.row[k]=B.row[j];
        C.col[k]=B.col[j];
        C.val[k]=B.val[j];
        j++;
        k++;
    }
    C.nrows=A.nrows;
    C.ncols=A.ncols;
    C.nz=k;
    return C;
}
void mulMatrix(struct sparse a,struct sparse m)
{
        if(a.ncols!=m.nrows)
    {
        printf("Matrices can't be multiplied");
        return;
    }
    struct sparse b=Transpose(m);
    int res[size][size]={};
    int i=0,j;
    while(i<a.nz)
    {
        j=0;
        while(j<b.nz)
        {
            if(a.col[i]==b.col[j])
                res[a.row[i]][b.row[j]]+=a.val[i]*b.val[j];
            j++;
        }
        i++;
    }
    i=0;
    while(i<a.nrows)
    {
        j=0;
        while(j<b.nrows)
        {
            printf("%d ",res[i][j]);
```

```
            j++;
        }
        printf("\n");
        i++;
    }
}
int main()
{
    struct sparse A,B,C;
    readMatrix(&A);
    readMatrix(&B);
    printf("MATRIX A\n");
    printMatrix(A);
    printf("MATRIX B\n");
    printMatrix(B);
    printf("The Addition of Matrix A aNd B\n");
    addMatrix(A,B);
    printf("The multiplication of Matrix A and B\n");
    mulMatrix(A,B);
}
```

OUTPUT : -



```
9
Enter the dimensions of the matrix (row*col)
2
2
Enter the no. of non-zero elements
1
Enter the non-zero elements(row col val)
1
1
8
MATRIX A
0 0
5 9
MATRIX B
0 0
0 8
The Addition of Matrix A aNd B
The multiplication of Matrix A and B
0 0
0 72

--------------------------------
Process exited after 48.67 seconds with return value 0
Press any key to continue . . .
```

EXPERIMENT – 12

Objectives :- Menu Driven Simple Linked List Without Head Node . Insert (at Start , End , After), Delete , Search , Count Operations.

CODE : -

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

struct node
{
   int info;
   struct node *link;
};

struct node *createlist(struct node *start);
void displaylist(struct node *start);
void countnodes(struct node *start);
void search(struct node *start,int x);
struct node *insertinbeginning(struct node *start,int data);
void insertatend(struct node *start,int data);
void insertafter(struct node *start,int data,int x);
struct node *insertbefore(struct node *start,int data,int x);
struct node *insertatposition(struct node *start,int data,int k);
struct node *deletenode(struct node *start,int data);
struct node *reverselist(struct node *start);

main()
{
    struct node *start=NULL;
    int choice,data,x,k;

    start=createlist(start);

    while(1)
    {
        printf("\n\t\t\t-----------------Menu-----------------\n");
        printf("\t\t\t 1.Display list                        \n");
        printf("\t\t\t 2.Count no of nodes                   \n");
        printf("\t\t\t 3.Search for an element               \n");
        printf("\t\t\t 4.Add to empty list/add at the beginning \n");
        printf("\t\t\t 5.Add a node at the end of the list   \n");
        printf("\t\t\t 6.Add a after a specefied node        \n");
        printf("\t\t\t 7.Add a before a specefied node       \n");
        printf("\t\t\t 8.Add a node at a given position      \n");
        printf("\t\t\t 9.Delete a node                       \n");
        printf("\t\t\t 10.Reverse the list                    \n");
        printf("\t\t\t 11.Quit                                \n");

        printf("ENTER YOUR CHOICE: ");
        scanf("%d",&choice);

        if(choice==11)
           break;

        switch(choice)
        {
           case 1:
              displaylist(start);
              break;
           case 2:
              countnodes(start);
              break;
           case 3:
              printf("Enter element you want to search");
              scanf("%d",&data );
              search(start,data);
              break;
           case 4:
              printf("Enter an element you want to insert: ");
              scanf("%d",&data);
              start=insertinbeginning(start,data);
              break;
           case 5:
              printf("Enter element you want to enter: ");
              scanf("%d",&data);
              insertatend(start,data);
              break;
           case 6:
              printf("Enter element you want to enter: ");
              scanf("%d",&data);
              printf("enter the element after which you want to insert: ");
              scanf("%d",&x);
              insertafter(start,data,x);
              break;
           case 7:
              printf("Enter element you want to enter: ");
              scanf("%d",&data);
              printf("enter the element before which you want to insert: ");
              scanf("%d",&x);
              start=insertbefore(start,data,x);
              break;
```

```
        case 8:
          printf("Enter element you want to enter: ");
          scanf("%d",&data);
          printf("enter the position at which to insert: ");
          scanf("%d",&k);
          start=insertatposition(start,data,k);
          break;
        case 9:
          printf("Enter the element you want to delete: ");
          scanf("%d", &x);
          start=deletenode(start,x);
          break;
        case 10:
          start=reverselist(start);
          break;
        default:
          printf("  INVALID CHOICE ");
      }
    }
}


struct node *createlist(struct node *start)
```

```
{
   int i,n,data;

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

   if(n==0)
      return start;

   printf("\nEnter the first element to be inserted \n");
   scanf("%d",&data);

   start=insertinbeginning(start,data);

   for(i=2; i<=n; i++)
   {
      printf("Enter the next elements to be inserted \n");
      scanf("%d",&data);
      insertatend(start,data);

   }
   return start;
}
```

```
struct node *insertinbeginning(struct node *start,int data)
{
   struct node *temp;
   temp=(struct node*)malloc(sizeof(struct node));
   temp->info=data;

   temp->link=start;
   start=temp;

   return start;
}

void insertatend(struct node *start,int data)
{
   struct node *p,*temp;
   temp=(struct node*)malloc(sizeof(struct node));
   temp->info=data;

   p=start;
   while(p->link!=NULL)
      p=p->link;
```

```
    p->link=temp;
    temp->link=NULL;
}

void displaylist(struct node *start)
{
    struct node *p;

    if(start==NULL)
    {
        printf("\n List is empty \n ");
        return;
    }
    printf("List is: ");
    p=start;
    while(p!=NULL)
    {
        printf(" %d ",p->info);
        p=p->link;

    }
    printf(" \n ");
```

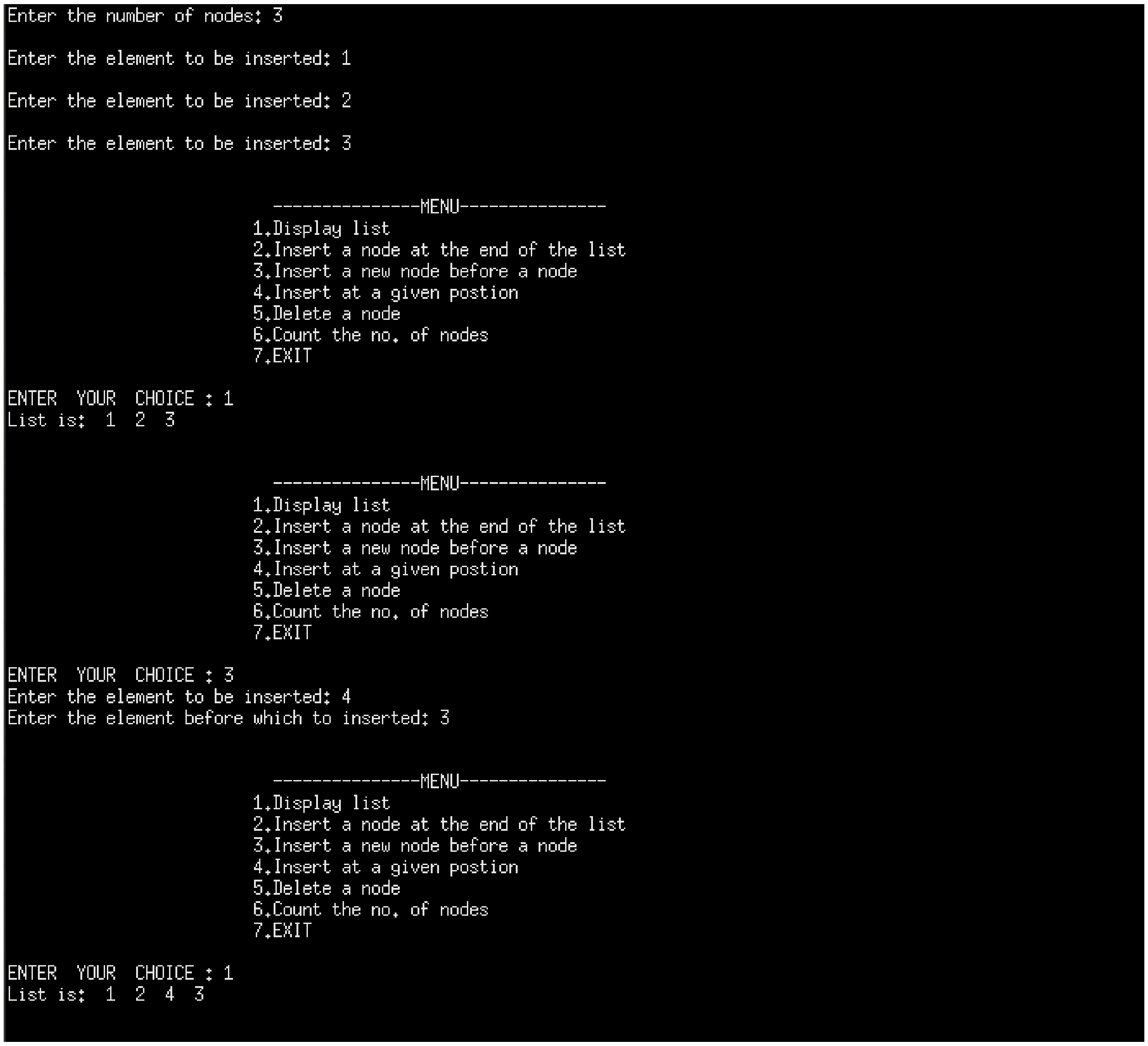
```
}

void countnodes(struct node *start)
{
   int n=0;
   struct node *p;
   p=start;
   while(p!=NULL)
   {
      n++;
      p=p->link;
   }
   printf("No of nodes in the list are: %d \n",n);

}

void insertafter(struct node *start,int data,int x)
{
   struct node *temp,*p;

   p=start;
   while(p!=NULL)
   {
      if(p->info==x)
          break;
      p=p->link;
   }
   if(p==NULL)
      printf("%d not present in the list\n ",x);
   else
   {
   temp=(struct node *)malloc(sizeof(struct node));
   temp->info=data;
   temp->link=p->link;
   p->link=temp;
   }
}

struct node *insertbefore(struct node *start,int data,int x)
{
   struct node *temp,*p;

   if(start==NULL)
   {
      printf("list is empty \n");
      return start;
```

```
}

if(x==start->info)
{
    temp=(struct node *)malloc(sizeof(struct node));
    temp->info=data;
    temp->link=start;
    start=temp;

    return start;
}

p=start;
while(p->link!=NULL)
{
    if(p->link->info==x)
        break;
    p=p->link;
}

if(p->link==NULL)
    printf("%d not found in the list \n",x);
else
```

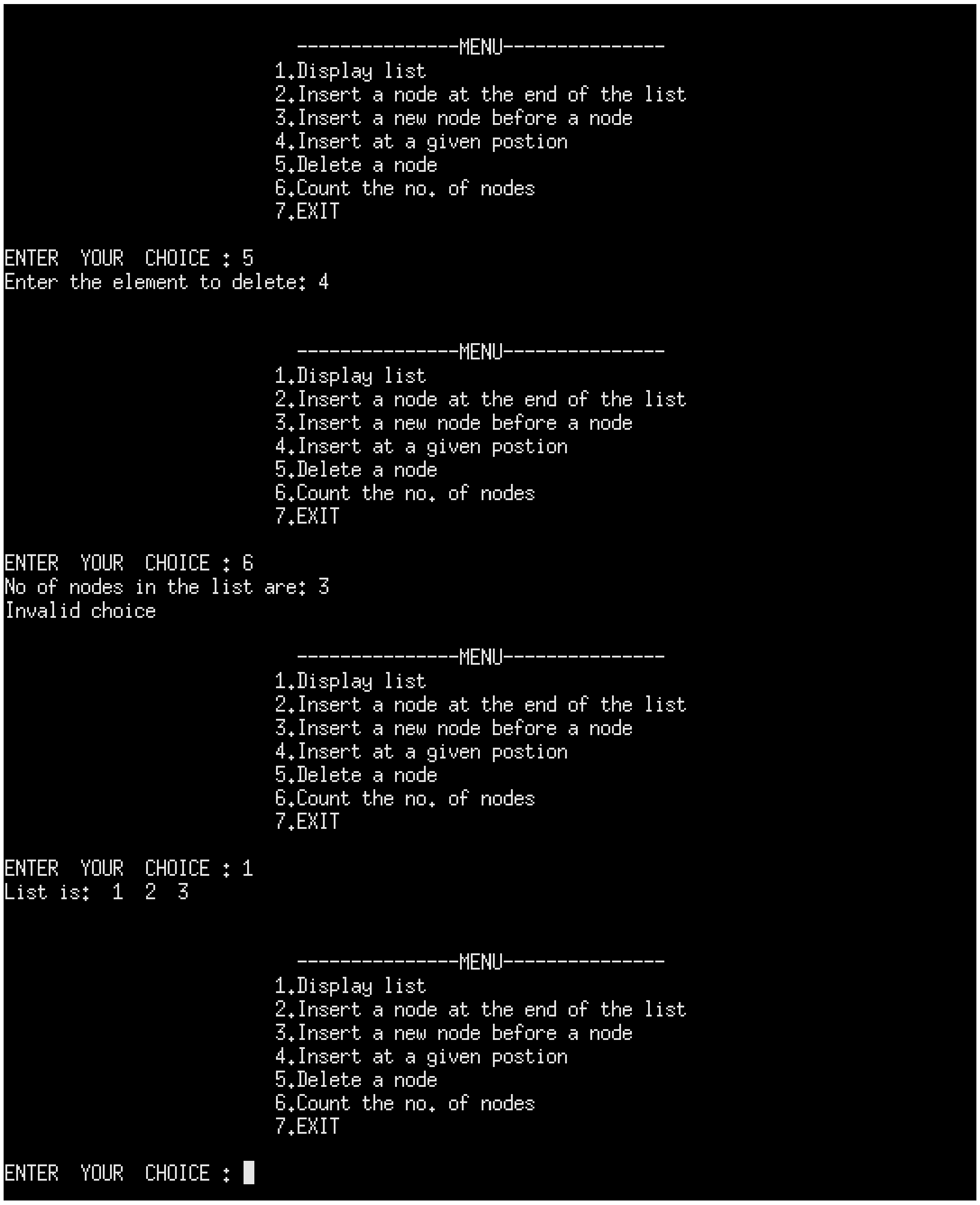
```
    {
        temp=(struct node *)malloc(sizeof(struct node));
        temp->info=data;
        temp->link=p->link;
        p->link=temp;
    }
    return start;
}

struct node *insertatposition(struct node *start,int data,int k)
{
    struct node *temp,*p;
    int i;

    if(k==1)
    {
        temp=(struct node *)malloc(sizeof(struct node));
        temp->info=data;
        temp->link=start;
        start=temp;

        return start;
    }
    p=start;
    for(i=1; i<k-1 && p!=NULL; i++)
        p=p->link;

    if(p==NULL)
        printf("you can insert only upto %dth position \n\n",i);
    else
    {
        temp=(struct node *)malloc(sizeof(struct node));
        temp->info=data;
        temp->link=p->link;
        p->link=temp;

    }

        return start;

}

void search(struct node *start,int x)
{
    struct node *p;
    int position=1;

    p=start;
    while(p!=NULL)
    {
        if(p->info==x)
            break;
        position++;
        p=p->link;

    }
    if(p==NULL)
        printf("%d not foung on the list \n", x);
    else
    printf("%d was found at %d positon: \n",x,position);
}

struct node *deletenode(struct node *start, int x)
{
    struct node *temp,*p;
    if(start==NULL)
    {
        printf("List is empty\n");
        return start;
    }

    if(start->info==x)
    {
        temp=start;
        start=start->link;
        free(temp);
        return start;
    }

    p=start;
    while(p->link!=NULL)
    {
        if(p->link->info==x)
            break;
        p=p->link;
    }

    if(p->link==NULL)
        printf("Element %d is not in list \n\n",x);
    else
    {
        temp=p->link;
        p->link=temp->link;
        free(temp);
    }
    return start;

}

struct node *reverselist(struct node *start)
{
    struct node *prev,*ptr,*next;
    prev=NULL;
    ptr=start;
    while(ptr!=NULL)
    {
        next=ptr->link;
        ptr->link=prev;
        prev=ptr;
        ptr=next;

    }
    start=prev;
    return start;
```

}

OUTPUT : -



```
Enter the number of nodes: 3

Enter the element to be inserted: 1

Enter the element to be inserted: 2

Enter the element to be inserted: 3


                           ---------------MENU---------------
                         1.Display list
                         2.Insert a node at the end of the list
                         3.Insert a new node before a node
                         4.Insert at a given postion
                         5.Delete a node
                         6.Count the no. of nodes
                         7.EXIT

ENTER  YOUR  CHOICE : 1
List is:  1  2  3


                           ---------------MENU---------------
                         1.Display list
                         2.Insert a node at the end of the list
                         3.Insert a new node before a node
                         4.Insert at a given postion
                         5.Delete a node
                         6.Count the no. of nodes
                         7.EXIT

ENTER  YOUR  CHOICE : 3
Enter the element to be inserted: 4
Enter the element before which to inserted: 3


                           ---------------MENU---------------
                         1.Display list
                         2.Insert a node at the end of the list
                         3.Insert a new node before a node
                         4.Insert at a given postion
                         5.Delete a node
                         6.Count the no. of nodes
                         7.EXIT

ENTER  YOUR  CHOICE : 1
List is:  1  2  4  3
```



```
                          ---------------MENU---------------
                        1.Display list
                        2.Insert a node at the end of the list
                        3.Insert a new node before a node
                        4.Insert at a given postion
                        5.Delete a node
                        6.Count the no. of nodes
                        7.EXIT

ENTER  YOUR  CHOICE : 5
Enter the element to delete: 4


                          ---------------MENU---------------
                        1.Display list
                        2.Insert a node at the end of the list
                        3.Insert a new node before a node
                        4.Insert at a given postion
                        5.Delete a node
                        6.Count the no. of nodes
                        7.EXIT

ENTER  YOUR  CHOICE : 6
No of nodes in the list are: 3
Invalid choice

                          ---------------MENU---------------
                        1.Display list
                        2.Insert a node at the end of the list
                        3.Insert a new node before a node
                        4.Insert at a given postion
                        5.Delete a node
                        6.Count the no. of nodes
                        7.EXIT

ENTER  YOUR  CHOICE : 1
List is:  1  2  3


                          ---------------MENU---------------
                        1.Display list
                        2.Insert a node at the end of the list
                        3.Insert a new node before a node
                        4.Insert at a given postion
                        5.Delete a node
                        6.Count the no. of nodes
                        7.EXIT

ENTER  YOUR  CHOICE :
```

EXPERIMENT – 13

Objective :- MENU DRIVEN SIMPLE LINKED LIST WITH HEAD NODE. INSERT(START, END, AFTER), DELETE, SEARCH,COUNT OPERATIONS.

CODE : -

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

struct node
{
   int info;
   struct node *link;
};

void createlist(struct node *head);
void displaylist(struct node *head);
void insertatend(struct node *head,int data);
void insertbefore(struct node *head,int data,int x);
void insertatposition(struct node *head,int data,int k);
void deletenode(struct node *head,int data);
void countnodes(struct node *head);
```

```
main()
{
   int x,choice,k,data;
   struct node *head;

   head=(struct node *)malloc(sizeof(struct node));
   head->info=0;
   head->link=NULL;

   createlist(head);

   while(1)
   {
      printf("\n\n\t\t\t   ---------------MENU---------------     \n ");
      printf("\t\t\t 1.Display list                              \n ");
      printf("\t\t\t 2.Insert a node at the end of the list   \n ");
      printf("\t\t\t 3.Insert a new node before a node         \n ");
      printf("\t\t\t 4.Insert at a given postion                \n ");
      printf("\t\t\t 5.Delete a node                             \n ");
      printf("\t\t\t 6.Count the no. of nodes                   \n ");
      printf("\t\t\t 7.EXIT                                     \n ");
printf("\nENTER  YOUR  CHOICE : ");
scanf("%d",&choice);

if(choice==7)
   break;

switch(choice)
{
   case 1:
      displaylist(head);
      break;
   case 2:
      printf("Enter the element to be inserted: ");
      scanf("%d",&data);
      insertatend(head,data);
      break;
   case 3:
      printf("Enter the element to be inserted: ");
      scanf("%d",&data);
      printf("Enter the element before which to inserted: ");
      scanf("%d",&x);
      insertbefore(head,data,x);
      break;
```

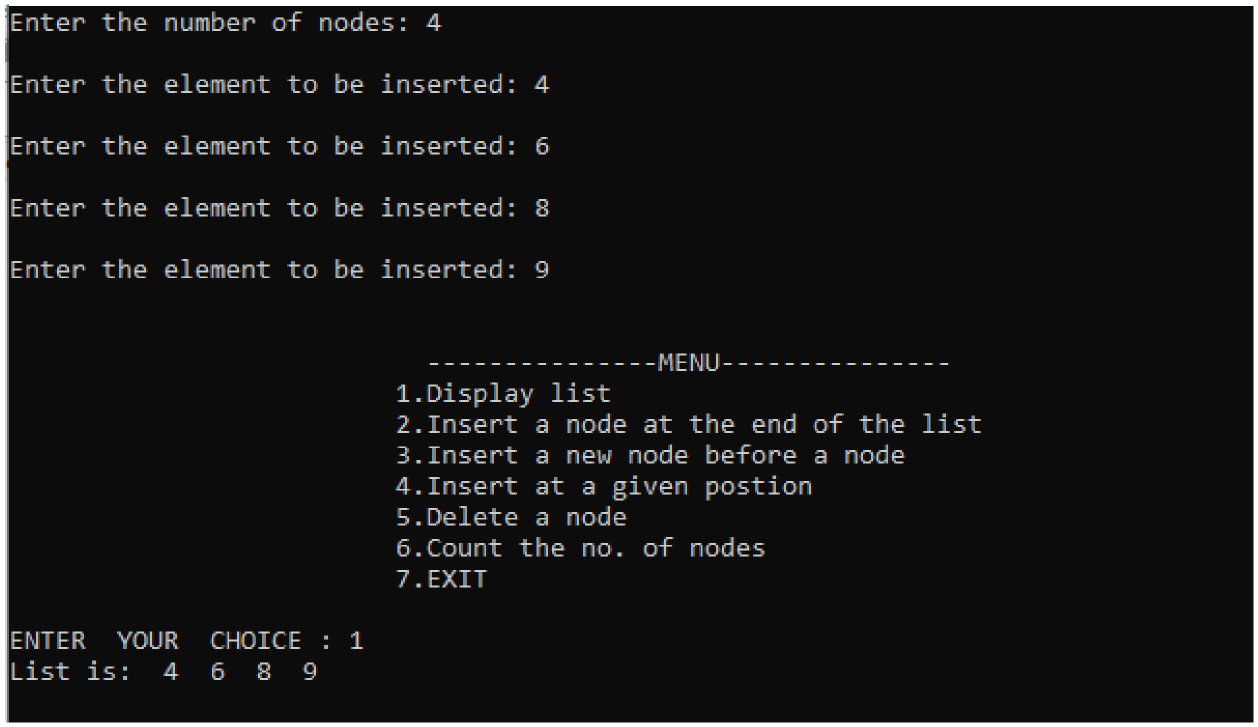
```
            case 4:
                printf("Enter the element to be inserted: ");
                scanf("%d",&data);
                printf("Enter the postion before which to insert: ");
                scanf("%d",&k);
                insertatposition(head,data,k);
                break;
            case 5:
                printf("Enter the element to delete: ");
                scanf("%d",&data);
                deletenode(head,data);
                break;
            case 6:
                countnodes(head);

            default:
                printf("Invalid choice");
        }
    }


}
void insertatend(struct node *head, int data)
```

```
{
   struct node *p,*temp;
   temp=(struct node *)malloc(sizeof(struct node));
   temp->info=data;

   p=head;
   while(p->link!=NULL)
      p=p->link;

   p->link=temp;
   temp->link=NULL;

}

void createlist(struct node *head)
{
   int i,n,data;

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

   for(i=0; i<n; i++)
   {
        printf("\nEnter the element to be inserted: ");
        scanf("%d",&data);
        insertatend(head,data);
    }
}

void insertbefore(struct node *head,int data,int x)
{
    struct node *temp,*p;

    p=head;
    while(p->link!=NULL)
    {
        if(p->link->info==x)
            break;
        p=p->link;
    }
    if(p->link==NULL)
        printf("%d not present in list \n",x);
    else
    {
        temp=(struct node * )malloc(sizeof(struct node));
        temp->info=data;
        temp->link=p->link;
        p->link=temp;

    }
}

void displaylist(struct node *head)
{
    struct node *p;
    if(head->link==NULL)
    {
        printf("List is empty\n");
        return;
    }
    p=head->link;
    printf("List is: ");
    while(p!=NULL)
    {
        printf(" %d ",p->info);
        p=p->link;
    }
    printf("\n");
}
```

```
void insertatposition(struct node *head,int data,int k)
{
    struct node *temp,*p;
    int i;

    p=head;
    for(i=1; i<=k-1 && p!=NULL; i++)
        p=p->link;

    if(p==NULL)
        printf("You can insert only upto %dth position\n\n",i-1);
    else
    {
        temp=(struct node *)malloc(sizeof(struct node));
        temp->info=data;
        temp->link=p->link;
        p->link=temp;
    }

}
```

```
void deletenode(struct node *head, int data)
{
   struct node *temp,*p;

   p=head;
   while(p->link!=NULL)
   {
      if(p->link->info==data)
         break;
      p=p->link;
   }
   if(p->link==NULL)
      printf("Element %d not found \n",data);
   else
   {
      temp=p->link;
      p->link=temp->link;
      free(temp);
   }
}

void countnodes(struct node *head)
{
   int n=0;
   struct node *p;
   p=head;
   while(p!=NULL)
   {
      n++;
      p=p->link;
   }
   printf("No of nodes in the list are: %d \n",n-1);

}
```

OUTPUT:-



```
Enter the number of nodes: 4

Enter the element to be inserted: 4

Enter the element to be inserted: 6

Enter the element to be inserted: 8

Enter the element to be inserted: 9


                           ---------------MENU---------------
                         1.Display list
                         2.Insert a node at the end of the list
                         3.Insert a new node before a node
                         4.Insert at a given postion
                         5.Delete a node
                         6.Count the no. of nodes
                         7.EXIT

ENTER  YOUR  CHOICE : 1
List is:  4  6  8  9
```

EXPERIMENT – 14

Objective :- Maintain A sorted Linked List , Implementation Insert, Delete , Search , Count .

CODE : -

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

struct node
{
   int info;
   struct node *link;
};

struct node *createlist(struct node *start);
void displaylist(struct node *start);
void countnodes(struct node *start);
void search(struct node *start,int x);
struct node *insertinbeginning(struct node *start,int data);
void insertatend(struct node *start,int data);
void insertafter(struct node *start,int data,int x);
struct node *insertbefore(struct node *start,int data,int x);
struct node *insertatposition(struct node *start,int data,int k);
struct node *deletenode(struct node *start,int data);
struct node *reverselist(struct node *start);

main()
{
   struct node *start=NULL;
   int choice,data,x,k;

   start=createlist(start);

   while(1)
   {
       printf("\t\t\t\n-----------------Menu-----------------\n");
       printf("\t\t\t 1.Display list                         \n");
       printf("\t\t\t 2.Count no of nodes                    \n");
       printf("\t\t\t 3.Search for an element                \n");
       printf("\t\t\t 4.Add to empty list/add at the beginning \n");
       printf("\t\t\t 5.Add a node at the end of the list    \n");
       printf("\t\t\t 6.Add a after a specefied node         \n");
       printf("\t\t\t 7.Add a before a specefied node        \n");
       printf("\t\t\t 8.Add a node at a given position       \n");
       printf("\t\t\t 9.Delete a node                        \n");
       printf("\t\t\t 10.Quit                                \n");
printf("ENTER YOUR CHOICE: ");
scanf(" %d ", &choice);

if(choice==10)
   break;

switch(choice)
{
   case 1:
      displaylist(start);
      break;
   case 2:
      countnodes(start);
      break;
   case 3:
      printf("Enter element you want to search");
      scanf(" % d",&data );
      search(start,data);
      break;
   case 4:
      printf("Enter an element you want to insert: ");
      scanf(" %d ",&data);
      start=insertinbeginning(start,data);
```

```
    break;
case 5:
    printf("Enter element you want to enter: ");
    scanf("%d",&data);
    insertatend(start,data);
    break;
case 6:
    printf("Enter element you want to enter: ");
    scanf("%d",data);
    printf("enter the element after which you want to insert: ");
    scanf("%d",&x);
    insertafter(start,data,x);
    break;
case 7:
    printf("Enter element you want to enter: ");
    scanf("%d",data);
    printf("enter the element before which you want to insert: ");
    scanf("%d",&x);
    start=insertbefore(start,data,x);
    break;
case 8:
    printf("Enter element you want to enter: ");
    scanf("%d",data);
```

```
            printf("enter the position at which to insert: ");
            scanf("%d",&k);
            start=insertatposition(start,data,k);
            break;
        case 9:
            printf("Enter the element you want to delete: ");
            scanf("%d", &x);
            start=deletenode(start,x);
            break;
        default:
            printf("  INVALID CHOICE ");
        }
    }
}
struct node *createlist(struct node *start)
{
    int i,n,data;
    printf("Enter the number of nodes : ");
    scanf("%d",&n);
    if(n==0)
        return start;
    printf("\nEnter the first element to be inserted \n");
    scanf("%d",&data);
    start=insertinbeginning(start,data);
    for(i=2; i<=n; i++)
    {
        printf("Enter the next elements to be inserted \n ");
        scanf("%d",&data);
        insertatend(start,data);
    }
    return start;
}
struct node *insertinbeginning(struct node *start,int data)
{
    struct node *temp;
    temp=(struct node*)malloc(sizeof(struct node));
    temp->info=data;
    temp->link=start;
    start=temp;
    return start;
}
void insertatend(struct node *start,int data)
{
    struct node *p,*temp;
    temp=(struct node*)malloc(sizeof(struct node));
    temp->info=data;
    p=start;
    while(p->link!=NULL)
        p=p->link;

    p->link=temp;
    temp->link=NULL;
}
void displaylist(struct node *start)
{
    struct node *p;
    if(start==NULL)
    {
        printf("\n List is empty \n ");
        return;
    }
    printf("List is: ");
    p=start;
    while(p!=NULL)
    {
        printf(" %d ",p->info);
        p=p->link;
    }
    printf(" \n ");
```

```
}
void countnodes(struct node *start)
{
   int n=0;
   struct node *p;
   p=start;
   while(p!=NULL)
   {
      n++;
      p=p->link;
   }
   printf("No of nodes in the list are: %d ",n)
}
void insertafter(struct node *start,int data,int x)
{
   struct node *temp,*p;
   p=start;
   while(p!=NULL)
   {
      if(p->info==x)
         break;
      p=p->link;
   }
```

```
    if(p==NULL)
        printf("%d not present in the list\n ",x);
    else
    {
    temp=(struct node *)malloc(sizeof(struct node));
    temp->info=data;
    temp->link=p->link;
    p->link=temp;
    }
}
struct node *insertbefore(struct node *start,int data,int x)
{
    struct node *temp,*p;

    if(start==NULL)
    {
        printf("list is empty \n");
        return start;
    }
    if(x==start->info)
    {
        temp=(struct node *)malloc(sizeof(struct node));
        temp->info=data;
        temp->link=start;
        start=temp;
        return start;
    }
    p=start;
    while(p->link!=NULL)
    {
        if(p->link->info==x)
            break;
        p=p->link;
    }
    if(p->link==NULL)
        printf("%d not found in the list ",x);
    else
    {
        temp=(struct node *)malloc(sizeof(struct node));
        temp->info=data;
        temp->link=p->link;
        p->link=temp;
    }
    return start;
}
struct node *insertatposition(struct node *start,int data,int k)
```

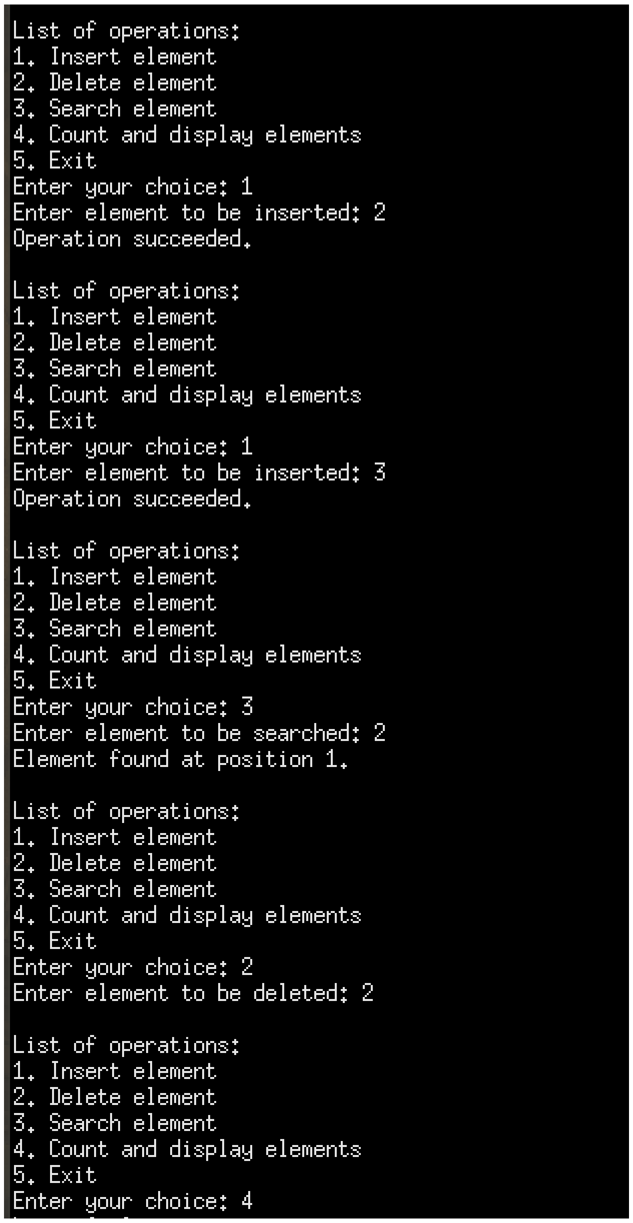
```
{
   struct node *temp,*p;
   int i;
   if(k==1)
   {
      temp=(struct node *)malloc(sizeof(struct node));
      temp->info=data;
      temp->link=start;
      start=temp;
      return start;
   }
   p=start;
   for(i=1; i<k-1 && p!=NULL; i++)
      p=p->link;
   if(p==NULL)
      printf("you can insert only upto %dth position \n\n",i);
   else
   {
      temp=(struct node *)malloc(sizeof(struct node));
      temp->info=data;
      temp->link=p->link;
      p->link=temp;
   }
```

```
        return start;
}
void search(struct node *start,int x)
{
    struct node *p;
    int position=1;
    p=start;
    while(p!=NULL)
    {
        if(p->info==x)
            break;
        position++;
        p=p->link;
    }
    if(p==NULL)
        printf("%d not foung on the list  ", x);
    else
    printf("%d was found at %d positon: ",x,position);
}
struct node *deletenode(struct node *start, int x)
{
    struct node *temp,*p;
    if(start==NULL)
```

```
{
   printf("List is empty\n");
   return start;
}
if(start->info==x)
{
   temp=start;
   start=start->link;
   free(temp);
   return start;
}
p=start;
while(p->link!=NULL)
{
   if(p->link->info==x)
      break;
   p=p->link;
}
if(p->link==NULL)
   printf("Element %d is not in list \n\n",x);
else
{
   temp=p->link;
```

```
        p->link=temp->link;
        free(temp);
    }
    return start;
}
```

Output :-



```
List of operations:
1. Insert element
2. Delete element
3. Search element
4. Count and display elements
5. Exit
Enter your choice: 1
Enter element to be inserted: 2
Operation succeeded.

List of operations:
1. Insert element
2. Delete element
3. Search element
4. Count and display elements
5. Exit
Enter your choice: 1
Enter element to be inserted: 3
Operation succeeded.

List of operations:
1. Insert element
2. Delete element
3. Search element
4. Count and display elements
5. Exit
Enter your choice: 3
Enter element to be searched: 2
Element found at position 1.

List of operations:
1. Insert element
2. Delete element
3. Search element
4. Count and display elements
5. Exit
Enter your choice: 2
Enter element to be deleted: 2

List of operations:
1. Insert element
2. Delete element
3. Search element
4. Count and display elements
5. Exit
Enter your choice: 4
```

EXPERIMENT – 15

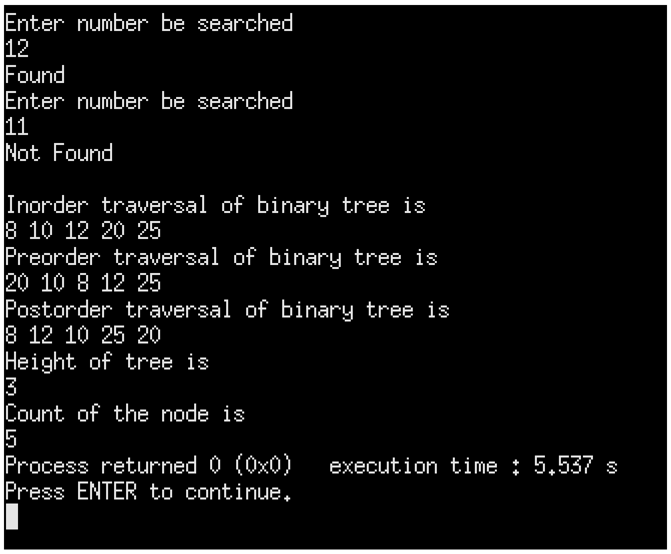
OBJECTIVES :- IMPLEMENTATION OF INSERT, DELETE, SEARCH, INORDER, PREORDER, POSTORDER, HEIGHT,COUNTNODES, FUNCTIONS FOR BINARY SEARCH TREE.

CODE : -

```
#include <iostream>
using namespace std;
struct Node{
    int data;
    Node *left, *right;
};
Node* insert(Node *root, int value){
    if(root == NULL){
        Node *k = new Node;
        k->data = value;
        k->left = NULL;
        k->right = NULL;
    }
    if(value > root->data){
        root->right = insert(root->right, value);
    }
    else{
        root->left = insert(root->left, value);
    }
    return root;
}
Node* minNode(Node *node){
    Node *current = node;
    while(current != NULL && current->left != NULL){
        current = current->left;
    }
    return current;
}
int count(Node *node){
    if(node == NULL)
        return 0;

    return count(node->left) + count(node->right) + 1;
}

bool search(Node *node, int value){
    if(node->data == value || node == NULL){
        return node;
    }
    if(node->data < value){
        return search(node->right, value);
    }
    return search(node->left, value);
}

int height(Node *node){
    if(node == NULL)
        return 0;
    return max(height(node->left), height(node->right)) + 1;
}
void preorder(Node *node){
    if(node == NULL)
        return;
    cout<<node->data<<" ";
    preorder(node->left);
    preorder(node->right);
}
void postorder(Node *node){
    if(node == NULL)
        return;
    postorder(node->left);
    postorder(node->right);
    cout<<node->data<<" ";
```

```
}
void inorder(Node *node){
    if(node == NULL)
        return;
    inorder(node->left);
    cout<<node->data<<" ";
    inorder(node->right);
}
Node* deleteNode(Node *node, int element){
    if(node == NULL){
        return node;
    }
    if(element < node->data){
        node->left = deleteNode(node->left,element);
    }
    else if(element > node->data){
        node->right = deleteNode(node->right,element);
    }
    else{
        if(node->left == NULL){
            Node *t = node->right;
            return t;
        }
        else if(node->right == NULL){
            Node *t = node->left;
            return t;
        }
        Node *temp = minNode(node->right);
        node->data = temp->data;
        node->right = deleteNode(node->right, temp->data);
    }
}

int main(){
    return 0;
}
```

OUTPUT :-



```
Enter number be searched
12
Found
Enter number be searched
11
Not Found

Inorder traversal of binary tree is
8 10 12 20 25
Preorder traversal of binary tree is
20 10 8 12 25
Postorder traversal of binary tree is
8 12 10 25 20
Height of tree is
3
Count of the node is
5
Process returned 0 (0x0)   execution time : 5.537 s
Press ENTER to continue.
```

EXPERIMENT – 16

OBJECTIVES :- IMPLEMENT PRIORITY QUEUE USING MAXHEAP: INSERTQ(), DELETEQ(), DISPLAYHEAP() ARE THE FUNCTIONS TO BE IMPLEMENTED.

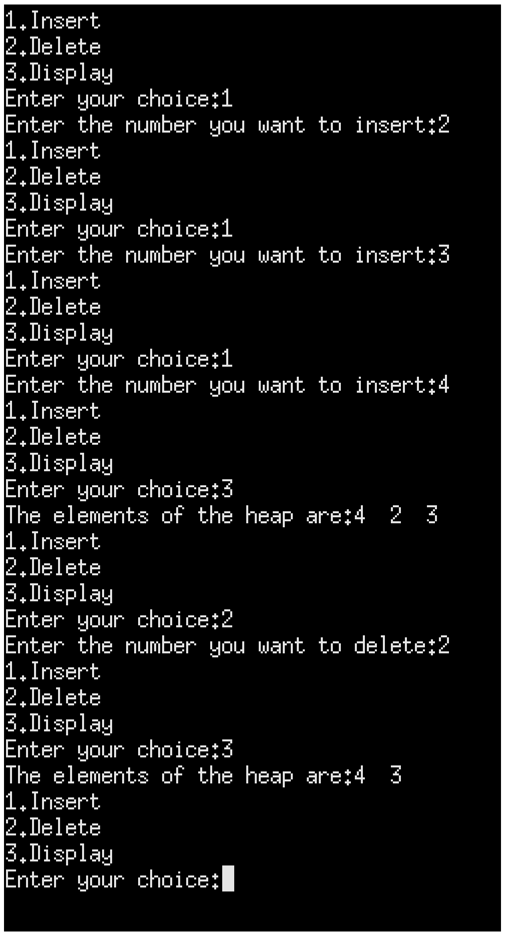
CODE : -

```
#include <stdio.h>
#include <stdlib.h>
int size=0;
void swap(int *x,int *y)
{
   int temp= *y;
   *y = *x;
   *x =temp;
}
//function to create a heap
void heapify(int array[],int size,int i)
{
   if(size==1)
   {
      printf("Only one element in the heap\n");
   }
   else{
   int largest=i;
```

```
    int l= 2*i+1;
    int r=2*i+2;
    if(l<size&&array[l]>array[largest])
        largest=l;
     if(r<size&&array[r]>array[largest])
        largest=r;
    if(largest!=i)
    {
        swap(&array[i],&array[largest]);
    heapify(array,size,largest);
    }
    }
    }
void insert(int array[],int data)
{
    if(size==0)
    {
        array[0]=data;
        size+=1;
    }
    else
    {
        array[size]=data;
        size+=1;
        //to convert array into heap
        for(int i=size/2-1;i>=0;i--)
        {
        heapify(array,size,i);
        }
    }
}
void deletee(int array[],int data)
{
    int i;
    for( i=0;i<size;i++)
    {
        if(data==array[i])
        break;
    }
   swap(&array[i],&array[size-1]);
    size-=1;
for(int i=size/2-1;i>=0;i--){
    heapify(array,size,i);
}
}
void printarray(int array[],int size)
```

```
{
    for(int i=0;i<size;i++)
        printf("%d  ",array[i]);
       printf("\n");

}

int main()
{
    int array[10],num,data;
    int choice;
    while(1)
    {
        printf("1.Insert\n");
        printf("2.Delete\n");
        printf("3.Display\n");
        printf("Enter your choice:");
        scanf("%d",&choice);
        switch(choice)
        {
            case 1:
                {
                printf("Enter the number you want to insert:");
            scanf("%d",&num);
            insert(array,num);
            break;
            }
        case 2:
            {
            printf("Enter the number you want to delete:");
            scanf("%d",&data);
            deletee(array,data);
            break;
            }
        case 3:
            {
            printf("The elements of the heap are:");
            printarray(array,size);
            }
        }
    }
}
```

OUTPUT: -



```
1.Insert
2.Delete
3.Display
Enter your choice:1
Enter the number you want to insert:2
1.Insert
2.Delete
3.Display
Enter your choice:1
Enter the number you want to insert:3
1.Insert
2.Delete
3.Display
Enter your choice:1
Enter the number you want to insert:4
1.Insert
2.Delete
3.Display
Enter your choice:3
The elements of the heap are:4  2  3
1.Insert
2.Delete
3.Display
Enter your choice:2
Enter the number you want to delete:2
1.Insert
2.Delete
3.Display
Enter your choice:3
The elements of the heap are:4  3
1.Insert
2.Delete
3.Display
Enter your choice:
```

EXPERIMENT – 17

Objectives :- Design Heapsort () to sort an array in Ascending Order .

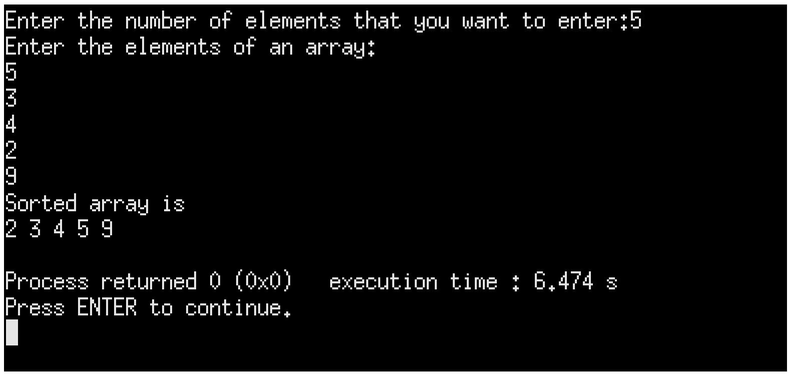
CODE : -

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

 void swap(int *x, int *y)
 {
   int temp = *x;
   *x = *y;
   *y = temp;
 }

 void heapify(int arr[], int n, int i) {
   // Find largest among root, left child and right child
   int largest = i;
   int l = 2 * i + 1;
   int r = 2 * i + 2;

   if (l < n && arr[l] > arr[largest])
     largest = l;
```

```
  if (r < n && arr[r] > arr[largest])
    largest = r;



  if (largest != i) {
    swap(&arr[i], &arr[largest]);
    heapify(arr, n, largest);
  }
}

// Main function to do heap sort
void heapSort(int arr[], int n)
 {
    for (int i = n / 2 - 1; i >= 0; i--)
    heapify(arr, n, i);

  // Heap sort
  for (int i = n - 1; i >= 0; i--) {
    swap(&arr[0], &arr[i]);

    // Heapify root element to get highest element at root again
    heapify(arr, i, 0);
  }
```

```
}

// Print an array
void printArray(int arr[], int n) {
  for (int i = 0; i < n; ++i)
    printf("%d ", arr[i]);
  printf("\n");
}

// Driver code
int main() {
  int array[10],n;
  printf("Enter the number of elements that you want to enter:");
  scanf("%d",&n);
  printf("Enter the elements of an array:\n");
  for(int i=0;i<n;i++)
  {
  scanf("%d",&array[i]);
  }
  heapSort(array, n);
  printf("Sorted array is \n");
  printArray(array, n);
}
```

OUTPUT :-



```
Enter the number of elements that you want to enter:5
Enter the elements of an array:
5
3
4
2
9
Sorted array is
2 3 4 5 9

Process returned 0 (0x0)   execution time : 6.474 s
Press ENTER to continue.
```