ਜਗਤ ਗੁਰੂ ਨਾਨਕ ਦੇਵ
ਪੰਜਾਬ ਸਟੇਟ ਓਪਨ ਯੂਨੀਵਰਸਿਟੀ
ਪਟਿਆਲਾ

JAGAT GURU NANAK DEV
PUNJAB STATE OPEN UNIVERSITY, PATIALA

(Established by Act No. 19 of 2019 of the Legislature of State of Punjab)

The Motto of the University

(SEWA)

SKILL ENHANCEMENT **EMPLOYABILITY** **WISDOM** **ACCESSIBILITY**



Bachelor of Computer Applications (BCA)

Course : Data Structures Lab

Course Code: BCA-3-02 P: Data Structures Lab

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ADDRESS: C/28, THE LOWER MALL, PATIALA-147001
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PROGRAMME COORDINATOR :
Dr. Monika Pathak
Assistant Professor, School of Sciences and Emerging Technologies
Jagat Guru Nanak Dev Punjab State Open University, Patiala

PROGRAMME CO-COORDINATOR :
Dr. Gaurav Dhiman
Assistant Professor, School of Sciences and Emerging Technologies
Jagat Guru Nanak Dev Punjab State Open University, Patiala

COURSE COORDINATOR :
Dr. Baljit Singh Khera (Head)
Professor, School of Sciences and Emerging Technologies
Jagat Guru Nanak Dev Punjab State Open University, Patiala

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PREFACE

Jagat Guru Nanak Dev Punjab State Open University, Patiala was established in Decembas 2019 by Act 19 of the Legislature of State of Punjab. It is the first and only Open Universit of the State, entrusted with the responsibility of making higher education accessible to all especially to those sections of society who do not have the means, time or opportunity to pursue regular education.

In keeping with the nature of an Open University, this University provides a flexible education system to suit every need. The time given to complete a programme is double the duration of a regular mode programme. Well-designed study material has been prepared in consultation with experts in their respective fields.

The University offers programmes which have been designed to provide relevant, skill-based and employability-enhancing education. The study material provided in this booklet is self instructional, with self-assessment exercises, and recommendations for further readings. The syllabus has been divided in sections, and provided as units for simplification.

The Learner Support Centres/Study Centres are located in the Government and Government aided colleges of Punjab, to enable students to make use of reading facilities, and for curriculum-based counselling and practicals. We, at the University, welcome you to be a part of this institution of knowledge.

Prof. G. S. Batra,

Dean Academic Affairs

Bachelor of Computer Applications (BCA)
BCA-3-02P: Data Structures Lab

Total Marks: 50
External Marks: 15
Internal Marks: 35
Credits: 2
Pass Percentage: 40

Course: Data Structures Lab	
Course Code: BCA-3-02P	
Course Outcomes (COs) After the completion of this course, the students will be able to:	
CO1	Implement basic data structures such as arrays and linked list.
CO2	Develop programs to demonstrate fundamental algorithmic problems including Tree Traversals, Graph traversals, and shortest paths.
CO3	Implement various searching and sorting algorithms.
CO4	Develop programs to demonstrate the implementation of various operations on stack
CO5	Develop programs to demonstrate the implementation of various operations on queue

Detailed List of Programs:

Program No.	Name of Program
P1	WAP to demonstrate the concept of one dimensional array finding the sum of array elements.
P2	WAP to insert an element in an array
P3	WAP to delete an element from an array.
P4	WAP to insert an element at the beginning of a linked list
P5	WAP to insert an element at the end of a linked list
P6	WAP to insert an element within the linked list
P7	WAP to demonstrate PUSH and POP operations of stack using array
P8	WAP to demonstrate the implementation of queue using linked list

P9	WAP to search an element from an linear array using linear search.
P10	WAP to Search an element using binary search.
P11	WAP to arrange the list of numbers in ascending order using Bubble Sort.
P12	WAP to arrange the list of numbers in ascending order using Insertion Sort.
P13	WAP to arrange the list of numbers in ascending order using Selection Sort.
P14	WAP to arrange the list of numbers in ascending order using Heap Sort.
P15	WAP to arrange the list of numbers in ascending order using Quicksort Sort.
P16	WAP to arrange the list of numbers in ascending order using Merge sort.
P17	WAP to demonstrate the operation of Pre order Traversing technique of Tree
P18	WAP to demonstrate the operation of Post order Traversing technique of Tree
P19	WAP to implement a simple Depth-First Search (DFS) traversal in Graph .
P20	WAP to implement a simple Breadth-First Search (BFS) traversal in Graph.

1. Aim: To display Fibonacci series up to a range.

```
#include<stdio.h>
#include<conio.h>
void main()
{
int a,b,c,n;
clrscr();
printf("\n Enter range:");
scanf("%d",&n);
a=0,b=1,c=0;
printf("%d \t %d",a,b);
c=a+b;
while(c<=n)
{
printf("\t%d",c);
a=b;
b=c;
c=a+b;
}
getch();
}
```

Output:



2. Aim: To read n numbers and display it.

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

void main()
{
int i,n, a[10];
clrscr();
printf("\nEnter the number of element : \n");
scanf("%d",&n);
printf("Enter element: \n");
for(i=0;i<n;i++)
{
printf("a[%d]=",i);
```

```
scanf("%d",&a[i]);
}
printf("\n Display array element: \n");
for(i=0;i<n;i++)
{
printf("a[%d]=%d\n",i,a[i]);

}
getch();
}
```

Output:



3. Aim: To demonstrate the concept of one dimensional array finding the sum of array elements.

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

void  main()
{
int i,n, a[10],s;
clrscr();
printf("Enter the number of element :\n");
scanf("%d",&n);
s=0;
printf("Enter element:\n");
for(i=0;i<n;i++)
```

```
{
printf(“a[%d]=”,i);
scanf(“%d”,&a[i]);
s=s+a[i];
}
printf(“Sum of array element:%d”,s);
getch();
}
```

Output:

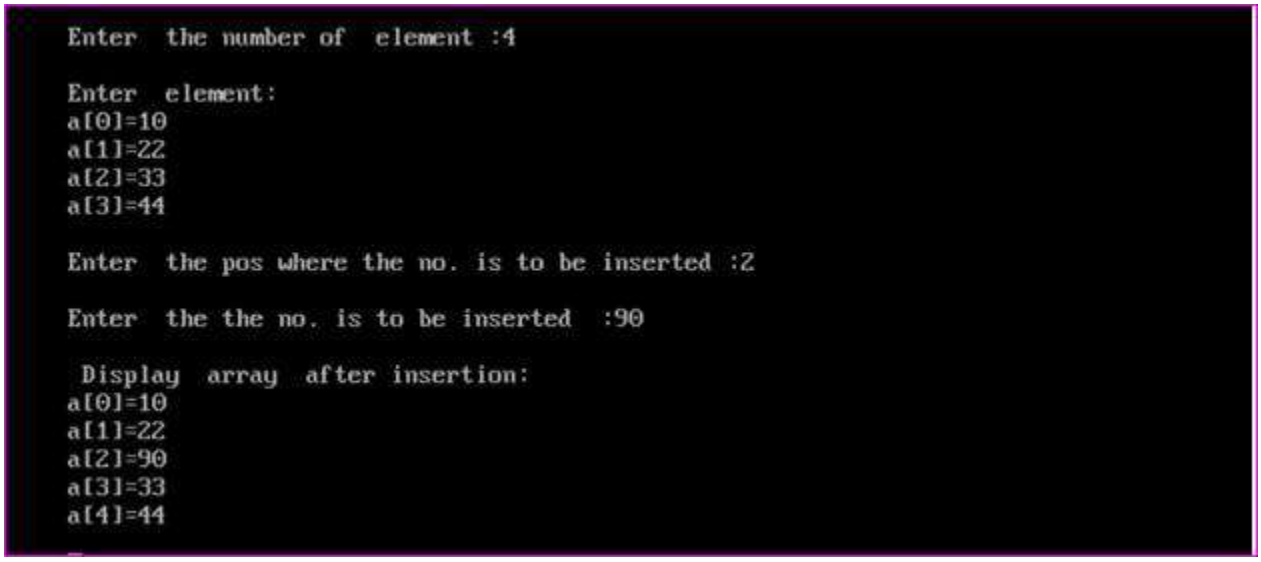


4. Aim: To insert an element in an array.

```
#include<stdio.h>
#include<conio.h>
{
int i,n,pos,num, a[10];
clrscr();
printf(“Enter the number of element :\n”);
scanf(“%d”,&n);
printf(“Enter element:\n”);
for(i=0;i<n;i++)
{
printf(“a[%d]=”,i);
scanf(“%d”,&a[i]);
}
printf(“\nEnter the pos where the no. is to be inserted :”);
scanf(“%d”,&pos);
printf(“\nEnter the the no. is to be inserted :”);
scanf(“%d”,&num);
for(i=n-1;i>=pos;i--)
{
a[i+1]=a[i];
n=n+1;
a[pos]=num;
}
```

```
printf(“\n Display array after insertion:\n”);
for(i=0;i<n;i++)
{
printf(“a[%d]=%d\n”,i,a[i]);
}
getch();
}
```

Output:

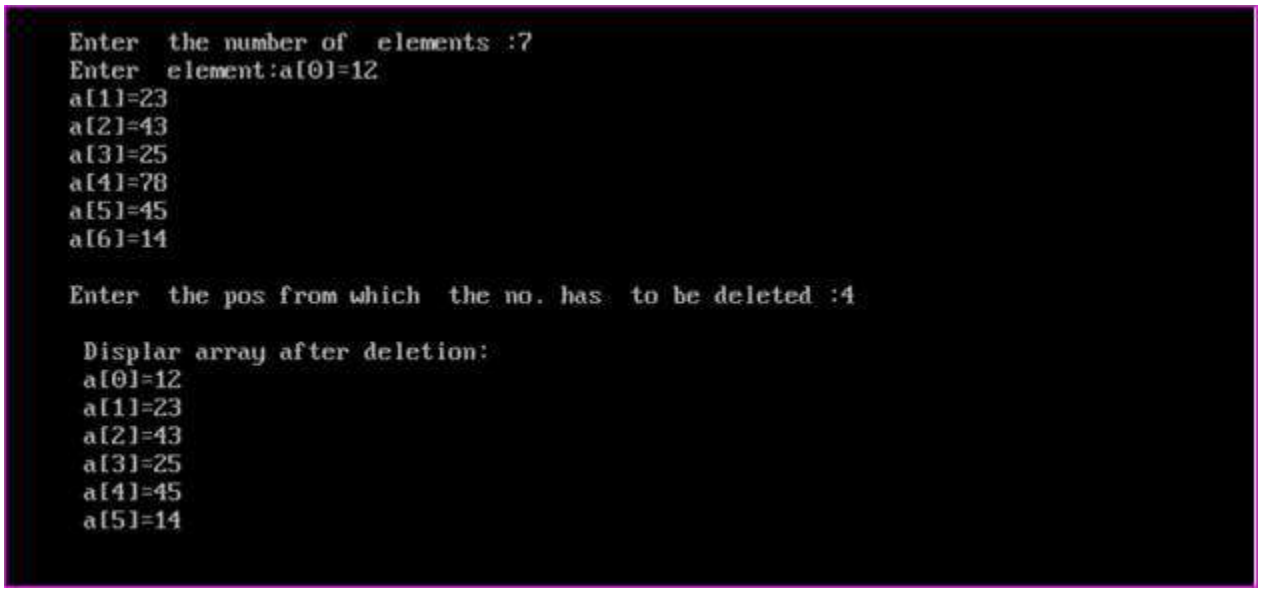


5. To delete an element from an array.

```
#include<stdio.h>
#include<conio.h>
void main()
{
int i,n,pos, a[10];
clrscr();
printf("Enter the number of elements :\n");
scanf("%d",&n);
printf("Enter element: \n ");
for(i=0;i<n;i++)
{
printf("a[%d]=",i);
scanf("%d",&a[i]);
}
printf("\nEnter the pos from which the no. has to be deleted :");
scanf("%d",&pos);
for(i=pos;i<n;i++)
```

```
a[i]=a[i+1];
n=n-1;
printf("\n Displar array after deletion: \n ");
for(i=0;i<n;i++)
{
printf("\n a[%d]=%d",i,a[i]);
}
getch();
}
```

Output:



6. Aim: Implementation of linked list using array.

```
#include<stdio.h>
#include<conio.h>
#define TRUE 1
#define SIZE 10
struct link
{
int info;
int next;
};
struct link node[SIZE];
int Getnode();
void Createlist();
void Freenode(int);
void Display();
void Insert(int,int);
```

```
void Delete(int);
int p, avail=0;
void  main()
{
int ch=1,i,n,x;
clrscr();
/*Creation of available list*/
for(i=0;i<SIZE-1;i++)
node[i].next=i+1;
node[SIZE-1].next=-1;
printf("\n Create a List:");
Createlist();
while(ch!=4)
{
printf("\n1-DISPLAY");
printf("\n2-INSERT");
printf("\n3-DELETE");
printf("\n4-QUIT");
printf("\n Enter your choice:");
scanf("%d",&ch);
switch(ch)
{
case 1 :
Display();
break;
case 2:
printf("\n Node insertion:after which node:");
scanf("%d",&n);
p=n;
printf("\n Enter the item for insertion:");
scanf("%d",&x);
Insert(p,x);
break;
case 3:
printf("\n Enter the node after which the node will be deleted:");
scanf("%d",&n);
p=n;
Delete(p);
break;
case 4:
break;
default:
printf("\n Wrong choice!Try again:");
}
}
}
int Getnode()
{
```

```
if (avail==-1)
{
printf("\n Overflow:");
exit(0);
}
p=avail;
avail=node[avail].next;
return p;
}
void Freenode(int q)
{
node[q].next=avail;
avail=q;
return;
}
void Createlist()
{
int x;
char c;
p=Getnode();
printf("\n Enter an item to be inserted:");
scanf("%d", &x);
node[p].info=x  ;
node[p].next=-1;
while(TRUE)
{
printf("\n Enter the choice(y/n):");
fflush(stdin);
c=getchar();
if(c=='y'||c=='Y')
{
printf("\n Enter an item to be inserted:");
scanf("%d",&x);
Insert(p,x);
node[p].next= -1;
}
else
return;
}
}
void Display()
{
p=0;
while(node[p].next!=-1)
{
printf("\n%d\t%d\t%d:",p,node[p].info,node[p].next);
p=node[p].next;
}
```

```
printf("\n%d\t%d\t%d:",p,node[p].info,node[p].next);
}
void Insert(int r,int x)
{
int q;
if(r==-1)
{
printf("\n void insertion:");
return;
}
q=Getnode();
node[q].info=x;
node[q].next=node[r].next;
node[r].next=q;
return;
}
void Delete(int r)
{
int q;
if(r==-1||node[r].next==-1)
{
printf("\n void deletion:");
return;
}
q=node[r].next;
node[r].next=node[q].next;
Freenode(q);
return;

}
```

Output:

```
Enter an item to be inserted:4

Enter the choice(y/n):y

Enter an item to be inserted:23

Enter the choice(y/n):y

Enter an item to be inserted:87

Enter the choice(y/n):y

Enter an item to be inserted:22

Enter the choice(y/n):y

Enter an item to be inserted:12

Enter the choice(y/n):n

1-DISPLAY
2-INSERT
3-DELETE
4-QUIT
Enter your choice:
```

```
Enter your choice:2

Mode insertion:after which node:3

Enter the item for insertion:99

1-DISPLAY
2-INSERT
3-DELETE
4-QUIT
Enter your choice:1

0       4       1:
1       23      2:
2       87      3:
3       22      5:
5       99      4:
4       12      -1:
1-DISPLAY
2-INSERT
3-DELETE
4-QUIT
Enter your choice:3

Enter the node after which the node will be deleted:
```

```
4       12      -1:
1-DISPLAY
2-INSERT
3-DELETE
4-QUIT
 Enter your choice:3

 Enter the node after which the node will be deleted:1

1-DISPLAY
2-INSERT
3-DELETE
4-QUIT
 Enter your choice:1

0       4       1:
1       23      3:
3       22      5:
5       99      4:
4       12      -1:
1-DISPLAY
2-INSERT
3-DELETE
4-QUIT
 Enter your choice:4
```

7. Aim: Implementation of stack using array.

```
#include<stdio.h>
#include<conio.h>
#include<stdlib.h>
#define MAXSTK 100
int top=-1;
int items[MAXSTK];
int Isempty();
int Isfull();
void Push(int);
int Pop();
void Display();
void main()
{
int x;
char ch='1';
clrscr();
while(ch!='4')
{
printf("\n 1-PUSH");
```

```
printf("\n 2-POP");
printf("\n 3-DISPLAY");
printf("\n 4-QUIT");
printf("\n Enter your choice:");
fflush(stdin);
ch=getchar();
switch(ch)
{
case '1':
printf("\n Enter the element to be pushed:");
scanf("%d",&x);
Push(x);
break;
case '2':
x=Pop();
printf("\n Pop element is %d\n:",x);
break;
case '3':
Display();
break;
case '4':
break;
default:
printf("\n Wrong choice!Try again:");
}
}
}
int Isempty()
{
if(top==-1)
return 1;
else
return 0;
}
int Isfull()
{
if(top==MAXSTK-1)
return 1;
else
return 0;
}
void Push(int x)
{
 if(Isfull())
 {
 printf("\n Stack full");
 return;
```

```
 }
 top++;
 items[top]=x;
 }
 int Pop()
 {
 int x;
 if(Isempty())
 {
 printf("\n Stack empty");
 exit(0);
 }
x=items[top];
top--;
return x;
}
void Display()
{
int i;
 if(Isempty())
 {
 printf("\n Stack empty");
 return;
 }
 printf("\n Elements in the Stack are :\n");
 for(i=top;i>=0;i--)
 printf("%d\n",items[i]);
 }
```

Output:

```
 Enter the element to be pushed:78

 1-PUSH
 2-POP
 3-DISPLAY
 4-QUIT
 Enter your choice:1

 Enter the element to be pushed:87

 1-PUSH
 2-POP
 3-DISPLAY
 4-QUIT
 Enter your choice:3

 Elements in the Stack are :
87
78

 1-PUSH
 2-POP
 3-DISPLAY
 4-QUIT
 Enter your choice:_
```

```
87
78

 1-PUSH
 2-POP
 3-DISPLAY
 4-QUIT
 Enter your choice:2

 Pop element is 87
:
 1-PUSH
 2-POP
 3-DISPLAY
 4-QUIT
 Enter your choice:3

 Elements in the Stack are :
78

 1-PUSH
 2-POP
 3-DISPLAY
 4-QUIT
 Enter your choice:4_
```

8. Aim: To Create Fibonacci series using recursive function.

```
#include<stdio.h>
#include<conio.h>
int Fibonacci(int);
void main()
{
int i,n;
clrscr();
printf("\n Enter the no of elements to be displayed:");
scanf("%d",&n);
for(i=0;i<n;i++)
printf("%d\t",Fibonacci(i));
getch();
}
int Fibonacci(int n)
{
if(n<=0)
return 0;
else if (n==1)
return 1;
else
return Fibonacci(n-1)+ Fibonacci(n-2);
}
```

Output:

```
 Enter the no of elements to be displayed:13
0       1       1       2       3       5       8       13      21      34
55      89      144
```

9. Aim: Calculate factorial of a number using recursive function.

```
#include<stdio.h>
#include<conio.h>
int Factorial(int);
void main()
{
int i,n;
clrscr();
printf("\n Enter the no of elements:");
```

```
scanf("%d",&n);
printf("Factorial of %d is %d",n,Factorial(n));
getch();
}
int Factorial(int n)
{
if(n==0)
return 1;
else
return n*Factorial(n-1);
}
```

Output:



10. Aim: Implementation of queue using array.

```
#include<stdio.h>
#include<conio.h>
#include<stdlib.h>
#define MAXQ 100
int front=0,rear=-1;
int items[MAXQ];
int Isempty();
int  Isfull();
void Insert(int);
int Delete();
void Display();
void main()
{
int x;
char ch='1';
clrscr();
while(ch!='4')
{
printf("\n 1-INSERT");
printf("\n 2-DELETE");
printf("\n 3-DISPLAY");
printf("\n 4-QUIT");
printf("\n Enter your choice:");
fflush(stdin);
ch=getchar();
```

```
switch(ch)
{
case '1':
printf("\n Enter the element to be inserted:");
scanf("%d",&x);
Insert(x);
break;
case '2':
x=Delete();
printf("\n Delete element is %d\n:",x);
break;
case '3':
Display();
break;
case '4':
break;
default:
printf("\n Wrong choice!Try again:");
}
}
getch();
}
int Isempty()
{
if(rear<front)
return 1;
else
return 0;
}
int Isfull()
{
if(rear==MAXQ-1)
return 1;
else
return 0;
}
void Insert(int x)
{
 if(Isfull())
 {
 printf("\n Queue full");
 return;
 }
 rear++;
 items[rear]=x;
 }
 int Delete()
 {
```

```
 int x;
 if(Isempty())
 {
 printf("\n Queue is empty");
 exit(0);
 }
x=items[front];
front++;
return x;
}
void Display()
{
int i;
 if(Isempty())
 {
 printf("\n Queue is empty");
 return;
 }
 printf("\n Elements in the Queue are :\n");
 for(i=front;i<=rear;i++)
 printf("%d\n",items[i]);
 }
```

Output:

```
1-INSERT
2-DELETE
3-DISPLAY
4-QUIT
Enter your choice:1

Enter the element to be inserted:30

1-INSERT
2-DELETE
3-DISPLAY
4-QUIT
Enter your choice:1

Enter the element to be inserted:40

1-INSERT
2-DELETE
3-DISPLAY
4-QUIT
Enter your choice:1

Enter the element to be inserted:50_
```

```
1-INSERT
2-DELETE
3-DISPLAY
4-QUIT
Enter your choice:3

Elements in the Queue are :
30
40
50

1-INSERT
2-DELETE
3-DISPLAY
4-QUIT
Enter your choice:2

Delete element is 30
;
1-INSERT
2-DELETE
3-DISPLAY
4-QUIT
Enter your choice:
```

```
50

 1-INSERT
 2-DELETE
 3-DISPLAY
 4-QUIT
 Enter your choice:2

 Delete element is 30
:
 1-INSERT
 2-DELETE
 3-DISPLAY
 4-QUIT
 Enter your choice:3

 Elements in the Queue are :
40
50

 1-INSERT
 2-DELETE
 3-DISPLAY
 4-QUIT
 Enter your choice:4
```

11. Aim: Implementation of circular queue using array.

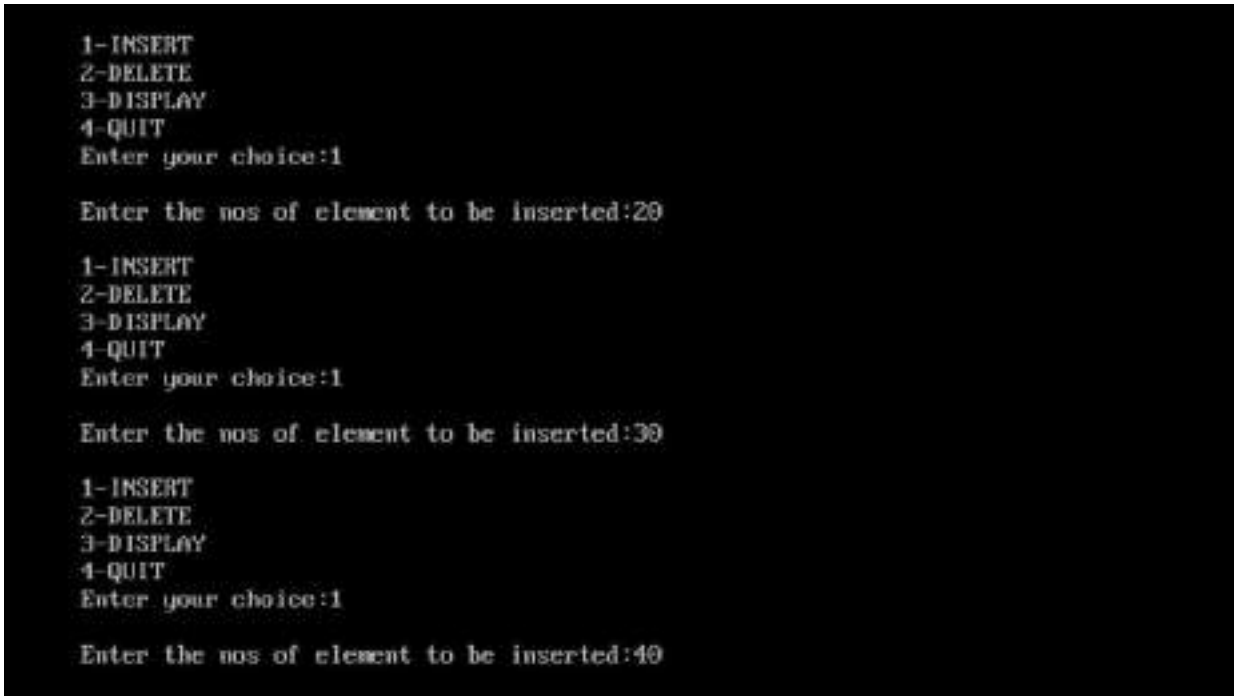
```
#include<stdio.h>
#include<conio.h>
#include<stdlib.h>
#define MAXQ 100
int front=-1,rear=-1;
int items[MAXQ];
int Isempty();
int  Isfull();
void Insert(int);
int Delete();
void Display();
void main()
{
int x;
char ch='1';
clrscr();
while(ch!='4')
```

```
{
printf("\n 1-INSERT");
printf("\n 2-DELETE");
printf("\n 3-DISPLAY");
printf("\n 4-QUIT");
printf("\n Enter your choice:");
fflush(stdin);
ch=getchar();
switch(ch)
{
case '1':
printf("\n Enter the nos of element to be inserted:");
scanf("%d",&x);
Insert(x);
break;
case '2':
x=Delete();
printf("\n Deleted element is %d\n:",x);
break;
case '3':
Display();
break;
case '4':
break;
default:
printf("\n Wrong choice!Try again:");
}
}
getch();
}
int Isempty()
{
if(front==-1)
return  1;
else
return 0;
}
int Isfull()
{
if(front==(rear+1)%MAXQ)
return 1;
else
return 0;
}
void Insert(int x)
{
 if(Isfull())
```

```
 {
 printf("\n Queue full");
 return;
 }
 if (front==-1)
 {
 front=0;
 rear=0;
 }
 else
 rear=(rear+1)%MAXQ;
 items[rear]=x;
 }
 int Delete()
 {
 int x;
 if(Isempty())
 {
 printf("\n Queue is empty");
 exit(0);
 }
x=items[front];
 if (front==rear)
 {
 front=-1;
 rear=-1;
 }
 else
 front=(front+1)%MAXQ;
 return x;
 }
void Display()
{
int i,n;
 if(Isempty())
 {
 printf("\n Queue is empty");
 return;
 }
 printf("\n Elements in the Queue are :\n");
 if(front<=rear)
 {
 for(i=front;i<=rear;i++)
 printf("%d\n",items[i]);
 }
 else
 {
```

```
 for(i=front;i<=MAXQ-1;i++)
printf("%d\n",items[i]);
for(i=0;i<=rear;i++)
printf("%d\n",items[i]);
 }
 }
```

Output:



```
1-INSERT
2-DELETE
3-DISPLAY
4-QUIT
Enter your choice:1

Enter the nos of element to be inserted:50

1-INSERT
2-DELETE
3-DISPLAY
4-QUIT
Enter your choice:3

Elements in the Queue are :
20
30
40
50

1-INSERT
2-DELETE
3-DISPLAY
4-QUIT
Enter your choice:_
```

```
1-INSERT
2-DELETE
3-DISPLAY
4-QUIT
Enter your choice:2

Deleted element is 20
:
1-INSERT
2-DELETE
3-DISPLAY
4-QUIT
Enter your choice:3

Elements in the Queue are :
30
40
50

1-INSERT
2-DELETE
3-DISPLAY
4-QUIT
Enter your choice:
```

12. Aim: Implementation of binary search tree using array.

```
#include<stdio.h>
#include<conio.h>
#include<stdlib.h>
#define TRUE 1
#define TREENODES 100
#define FALSE 0
struct tree
{
int info;
int used;
};
struct tree node[TREENODES];
void Createtree();
void Insert(int);
void  Display();
void Setleft(int,int);
void Setright(int,int);
void  main()
{
int x;
char ch='1';
clrscr();
printf("\n Enter root  node value:");
scanf("%d", &x);
Createtree(x);
while(ch!='3')
{
printf("\n1-INSERT");
printf("\n2-DISPLAY");
printf("\n3-QUIT");
printf("\n Enter your choice:");
fflush(stdin);
ch=getchar();
switch(ch)
{
case '1' :
printf("\n Enter the element to be inserted:");
scanf("%d",&x);
Insert(x);
break;
case '2':
Display();
break;
```

```
case '3':
break;
default:
printf("\n Wrong choice!Try again:");
}
}}
void Createtree(int x)
{
int i;
node[0].info=x;
node[0].used=TRUE;
for(i=1;i<TREENODES;i++)
node[i].used=FALSE;
}
void Insert(int x)
{
int p,q;
p=q=0;
while(q<TREENODES && node[q].used && x!=node[p].info)
{
p=q;
if(x<node[p].info)
q=2*p+1;
else
q=2*p+2;
}
if(x==node[p].info)
printf("\n %d is a duplicate number\n",x);
else
if(x<node[p].info)
Setleft(p,x);
else
Setright(p,x);
}
void Setleft(int pos,int x)
{
int q;
q=2*pos+1;
if(q>TREENODES)
printf("\n Array overflow.");
else
if(node[q].used==TRUE)
printf("\n Invalid insertion.");
else
{
node[q].info=x;
```

```
node[q].used=TRUE;
}
}
void Setright(int pos,int x)
{
int q;
q=2*pos+2;
if(q>TREENODES)
printf("\n Array overflow.");
else
if(node[q].used==TRUE)
printf("\n Invalid insertion.\n");
else
{
node[q].info=x;
node[q].used=TRUE;
}
}
void Display()
{
int i;
for(i=0;i<TREENODES;i++)
if(node[i].used==TRUE)
printf("%d ",node[i].info);
printf("\n");
}
```

Output:

```
 Enter root  node value:60

1-INSERT
2-DISPLAY
3-QUIT
 Enter your choice:1

 Enter the element to be inserted:40

1-INSERT
2-DISPLAY
3-QUIT
 Enter your choice:1

 Enter the element to be inserted:30

1-INSERT
2-DISPLAY
3-QUIT
 Enter your choice:1

 Enter the element to be inserted:70


1-INSERT
2-DISPLAY
3-QUIT
 Enter your choice:1

 Enter the element to be inserted:70

1-INSERT
2-DISPLAY
3-QUIT
 Enter your choice:1

 Enter the element to be inserted:90

1-INSERT
2-DISPLAY
3-QUIT
 Enter your choice:2
60 40 70 30 90

1-INSERT
2-DISPLAY
3-QUIT
 Enter your choice:3_
```

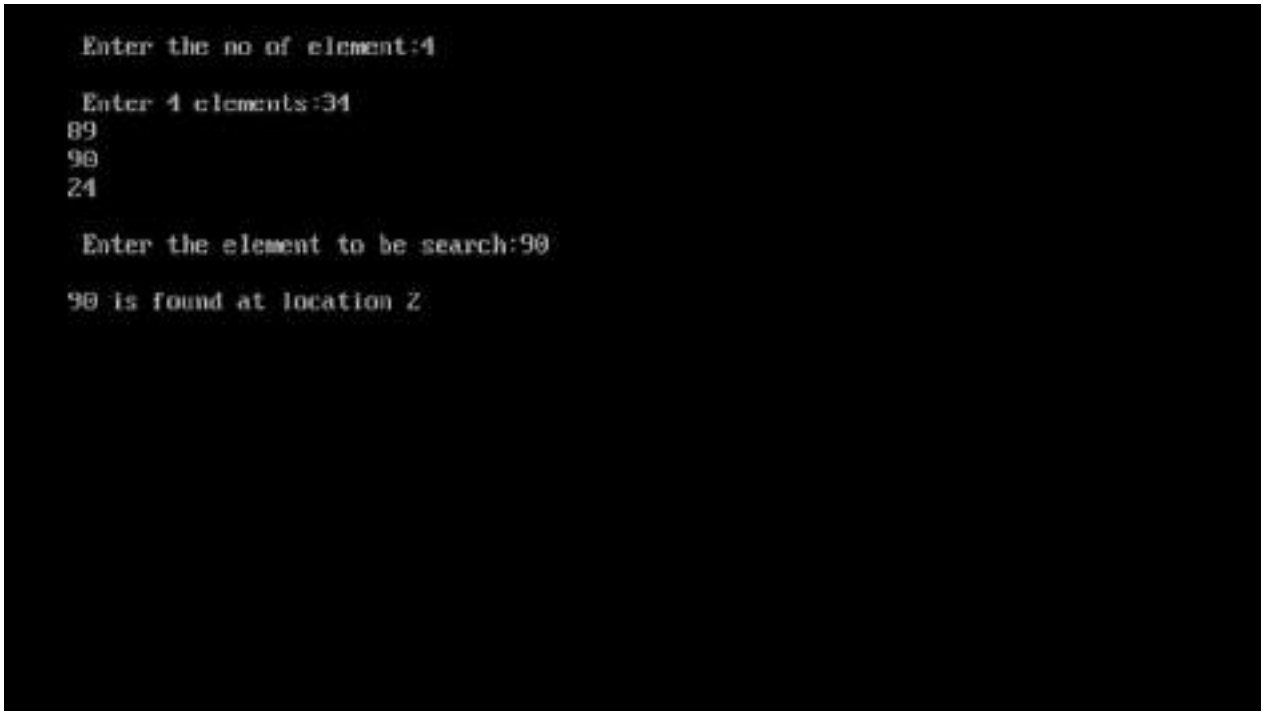
13. Aim: To Search an element using sequential search.

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

int Sequentialsearch(int[],int,int);
void main()
{
int x[20],i,n,p,key;
clrscr();
printf("\n Enter the no of element:");
scanf("%d",&n);
printf("\n Enter %d elements:",n);
for(i=0;i<n;i++)
scanf("%d",&x[i]);
printf("\n Enter the element to be search:");
scanf("%d",&key);
p=Sequentialsearch(x,n,key);
if(p==-1)
printf("\n The searchis unsuccessful:\n");
else
printf("\n%d is found at location %d",key,p);
getch();
}

int  Sequentialsearch(int a[],int n ,int k)
{
int i;
for(i=0;i<n;i++)
{
if(k==a[i])
return(i);
}
return(-1);
}
```

Output:



14. Aim: To Search an element using binary search.

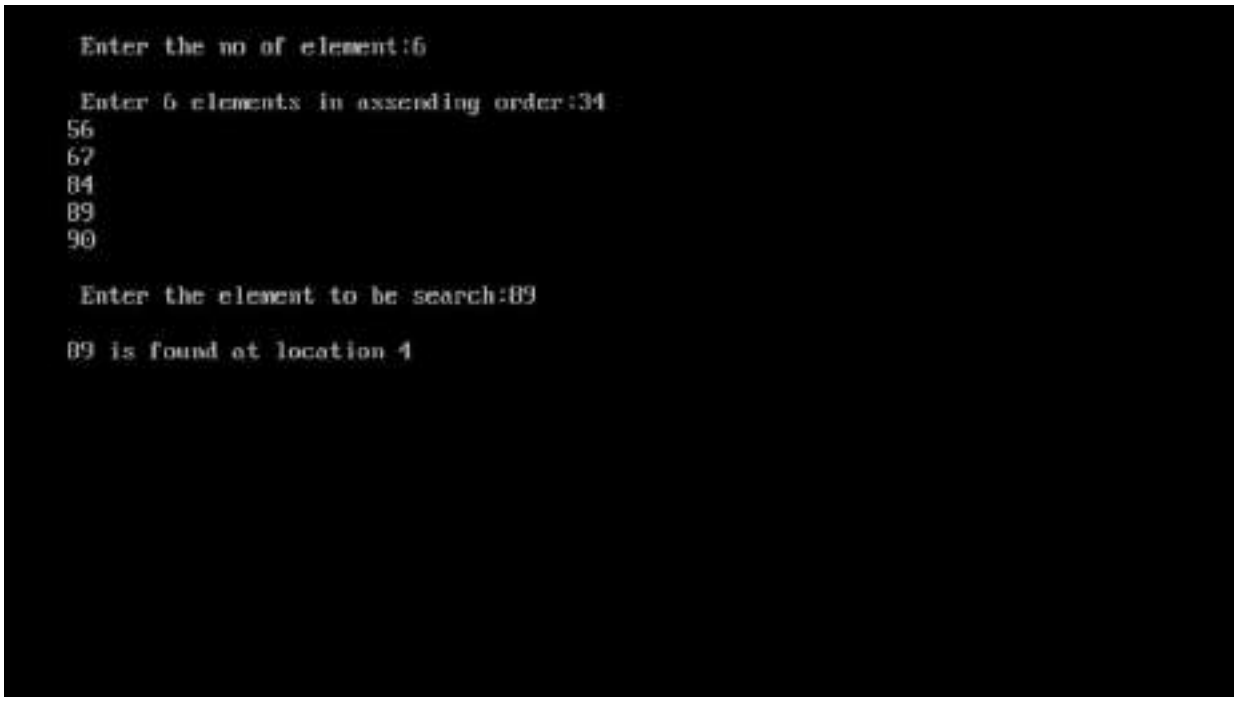
```
#include<stdio.h>
#include<conio.h>

int Binarysearch(int[],int,int);
void main()
{
int x[20],i,n,p,key;
clrscr();
printf("\n Enter the no of element:");
scanf("%d",&n);
printf("\n Enter %d elements in assending order:",n);
for(i=0;i<n;i++)
scanf("%d",&x[i]);
printf("\n Enter the element to be search:");
scanf("%d",&key);
p=Binarysearch(x,n,key);
if(p==-1)
printf("\n The searchis unsuccessful:\n");
else
printf("\n%d is found at location %d",key,p);
```

```
getch();
}

int  Binarysearch(int a[],int n ,int k)
{
int lo,hi,mid;
lo=0;
hi=n-1;
while(lo<=hi)
{
mid=(lo+hi)/2;
if(k==a[mid])
return(mid);
if(k<a[mid])
hi=mid-1;
else
lo=mid+1;
}
return(-1);
}
```

Output:

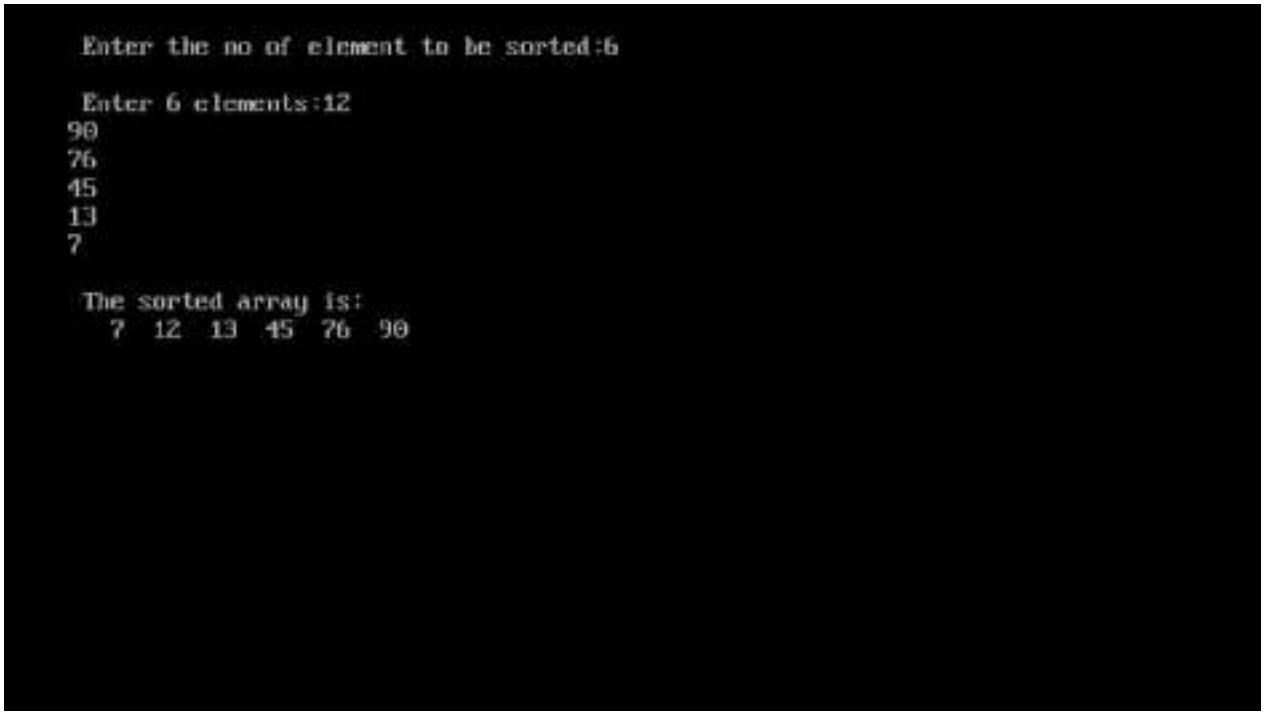


15. Aim: Arrange the list of numbers in ascending order using Bubble Sort.

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

void Bubblesort(int[],int);
void main()
{
int x[20],i,n;
clrscr();
printf("\n Enter the no of element to be sorted:");
scanf("%d",&n);
printf("\n Enter %d elements:",n);
for(i=0;i<n;i++)
scanf("%d",&x[i]);
Bubblesort(x,n);
printf("\n The sorted array is:\n");
for(i=0;i<n;i++)
printf("%4d",x[i]);
getch();
}
void Bubblesort(int a[],int n)
{
int temp,pass,i;
for(pass=0;pass<n-1;pass++)
{
for(i=0;i<n-pass-1;i++)
{
if(a[i]>a[i+1])
{
temp=a[i];
a[i]=a[i+1];
a[i+1]=temp;
}
}
}
}
```

Output:

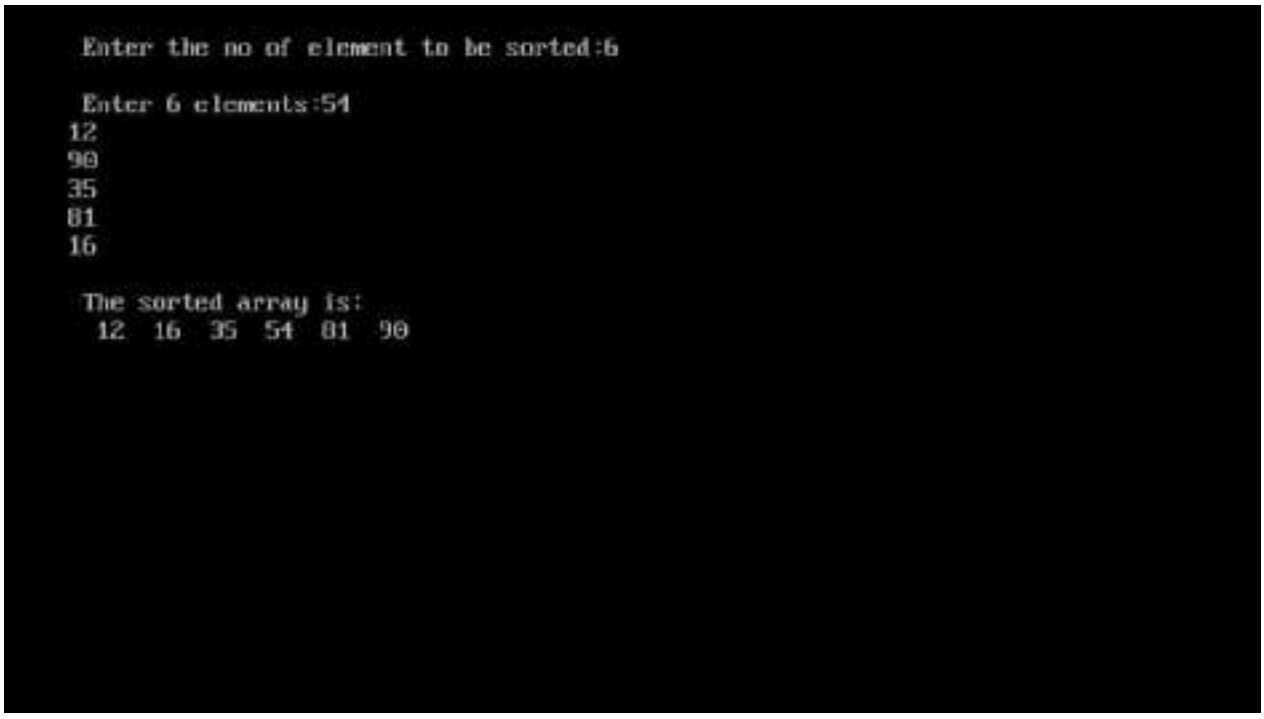


16. Aim: Arrange the list of numbers in ascending order using Insertion Sort.

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

void Insertionsort(int[],int);
void main()
{
int x[20],i,n;
clrscr();
printf("\n Enter the no of element to be sorted:");
scanf("%d",&n);
printf("\n Enter %d elements:",n);
for(i=0;i<n;i++)
scanf("%d",&x[i]);
Insertionsort(x,n);
printf("\n The sorted array is:\n");
for(i=0;i<n;i++)
printf("%4d",x[i]);
getch();
}
void Insertionsort(int a[],int n)
```

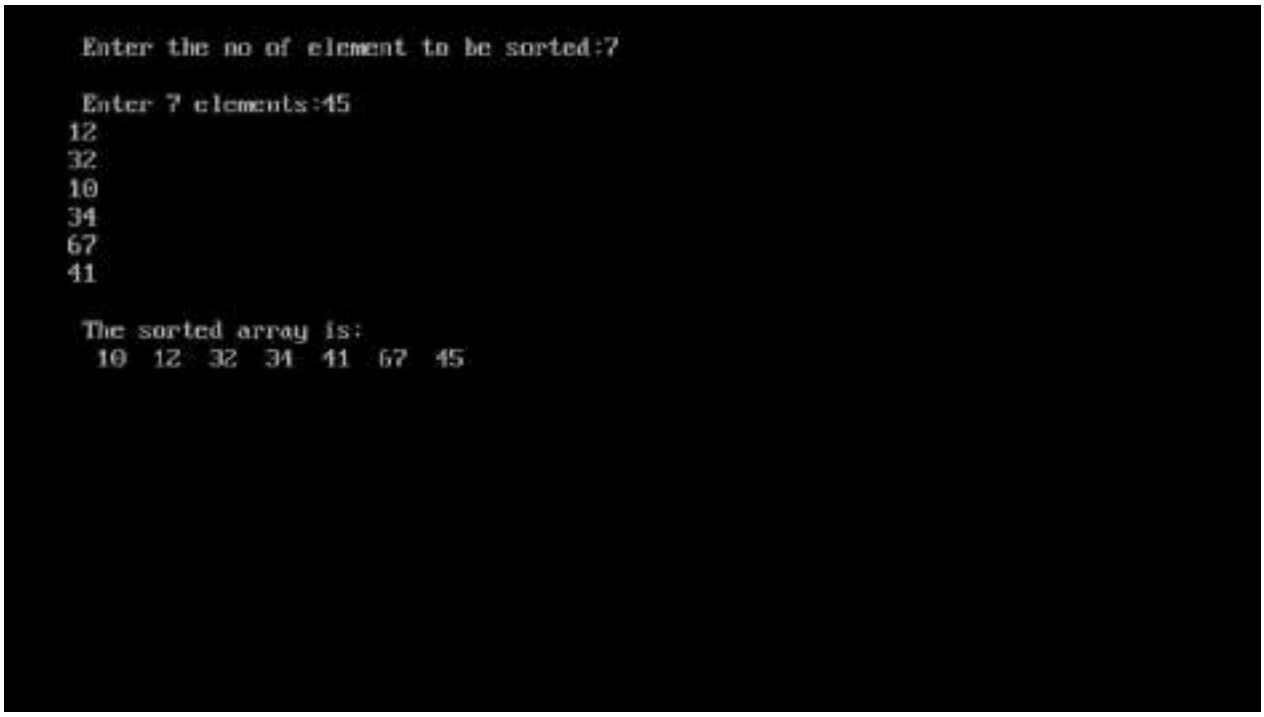
```
{
int i,j,key;
for(j=1;j<n;j++)
{
key=a[j];
i=j-1;
while((i>-1)&&(a[i]>key))
{
a[i+1]=a[i];
i=i-1;
}
a[i+1]=key;
}
}
```



17. Aim: Arrange the list of numbers in ascending order usingSelection Sort.

```
#include<stdio.h>
#include<conio.h>
void Selectionsort(int[],int);
void main()
{
int x[20],i,n;
clrscr();
printf("\n Enter the no of element to be sorted:");
scanf("%d",&n);
printf("\n Enter %d elements:",n);
for(i=0;i<n;i++)
scanf("%d",&x[i]);
Selectionsort(x,n);
printf("\n The sorted array is:\n");
for(i=0;i<n;i++)
printf("%4d",x[i]);
getch();
}
void Selectionsort(int a[],int n)
{
int i,j,pos,large;
for(i=n-1;i>0;i--)
{
large=a[0];
pos=0;
for(j=1;j<=i;j++)
{
if (a[i]>large)
{
large=a[j];
pos=j;
}
}
a[pos]=a[i];
a[i]=large;
}
}
```

Output:



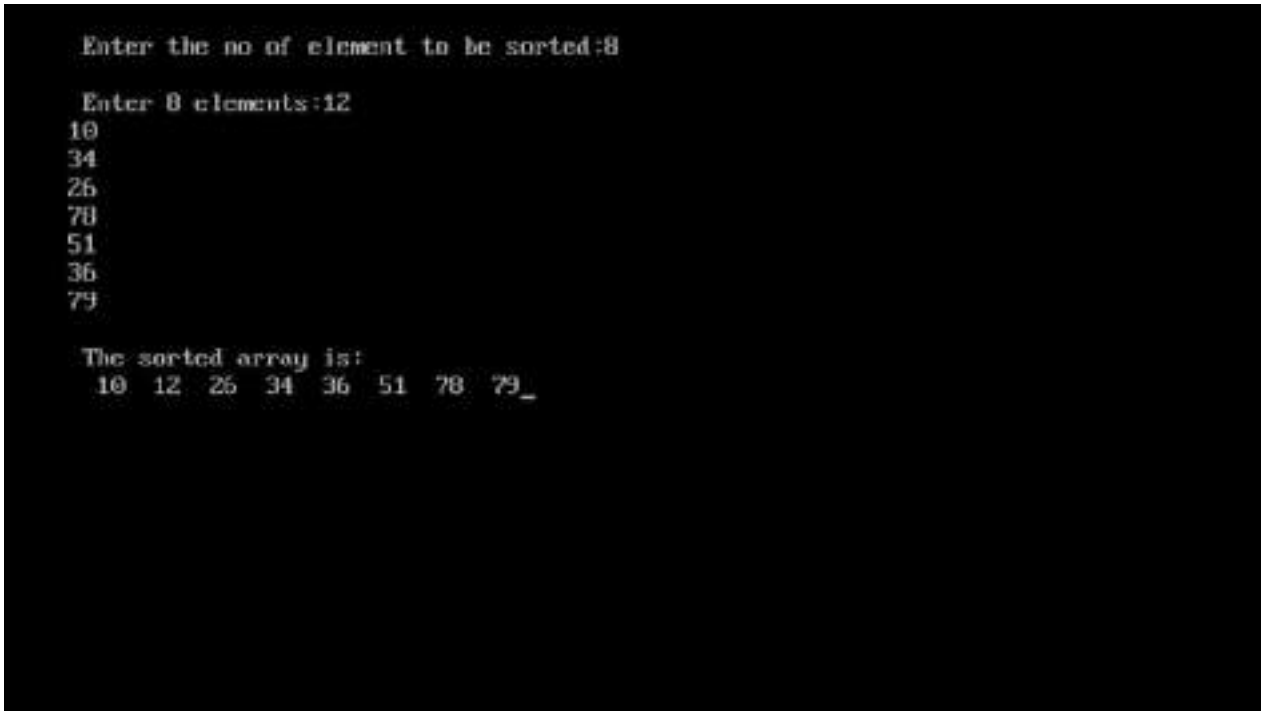
18. Aim: Arrange the list of numbers in ascending order using Merge Sort.

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

void Mergesort(int[],int,int);
void  Merge(int[],int,int,int);
void main()
{
int x[20],i,n;
clrscr();
printf("\n Enter the no of element to be sorted:");
scanf("%d",&n);
printf("\n Enter %d elements:",n);
for(i=0;i<n;i++)
scanf("%d",&x[i]);
Mergesort(x,0,n-1);
printf("\n The sorted array is:\n");
for(i=0;i<n;i++)
printf("%4d",x[i]);
getch();
}
```

```
void Mergesort(int a[],int p,int r)
{
int q;
if(p<r)
{
q=(p+r)/2;
Mergesort(a,p,q);
Mergesort(a,q+1,r);
Merge(a,p,q,r);
}
}
void Merge(int a[], int p, int q,int r)
{
int b[20],l1,r1,i;
l1=p;
r1=q+1;
i=p;
while((l1<=q)&&(r1<=r))
{
if(a[l1]<a[r1])
{
b[i]=a[l1];
l1=l1+1;
i=i+1;
}
else
{
b[i]=a[r1];
r1=r1+1;
i=i+1;
}
}
while(l1<=q)
{
b[i]=a[l1];
l1=l1+1;
i=i+1;
}
while(r1<=r)
{
b[i]=a[r1];
r1=r1+1;
i=i+1;
}
for(i=p;i<=r;i++)
a[i]=b[i];
}
```

Output:



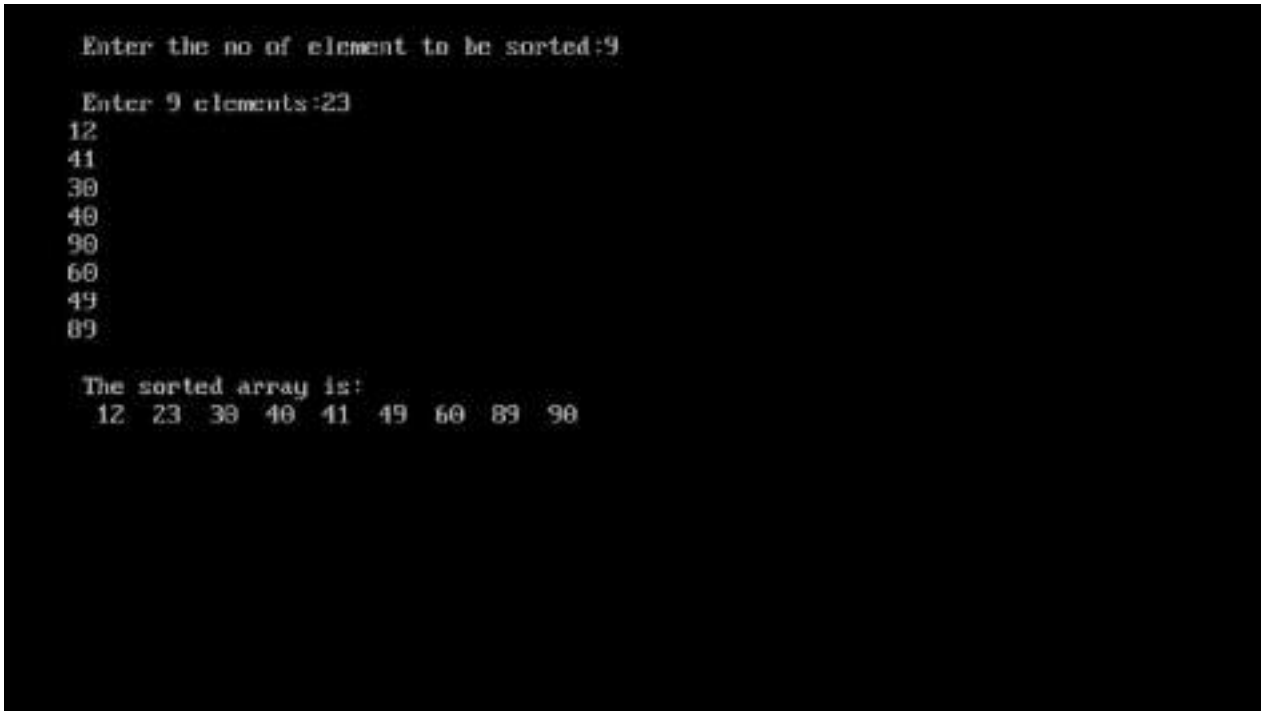
19. Aim: Arrange the list of numbers in ascending order using Quick Sort.

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

void Quicksort(int[],int,int);
int partition(int[],int,int);
void main()
{
int x[20],i,n;
clrscr();
printf("\n Enter the no of element to be sorted:");
scanf("%d",&n);
printf("\n Enter %d elements:",n);
for(i=0;i<n;i++)
scanf("%d",&x[i]);
Quicksort(x,0,n-1);
```

```
printf("\n The sorted array is:\n");
for(i=0;i<n;i++)
printf("%4d",x[i]);
getch();
}
void Quicksort(int a[],int p,int r)
{
int q;
if(p<r)
{
q=Partition(a,p,r);
Quicksort(a,p,q);
Quicksort(a,q+1,r);
}
}
int Partition(int a[], int p,int r)
{
int k,i,j,temp;
k=a[p];
i=p-1;
j=r+1;
while(1)
{
do
{
j=j-1;
}while(a[j]>k);
do
{
i=i+1;
}while(a[i]<k);
if(i<j)
{
temp=a[i];
a[i]=a[j];
a[j]=temp;
}
else
return(j);
}
}
```

Output:



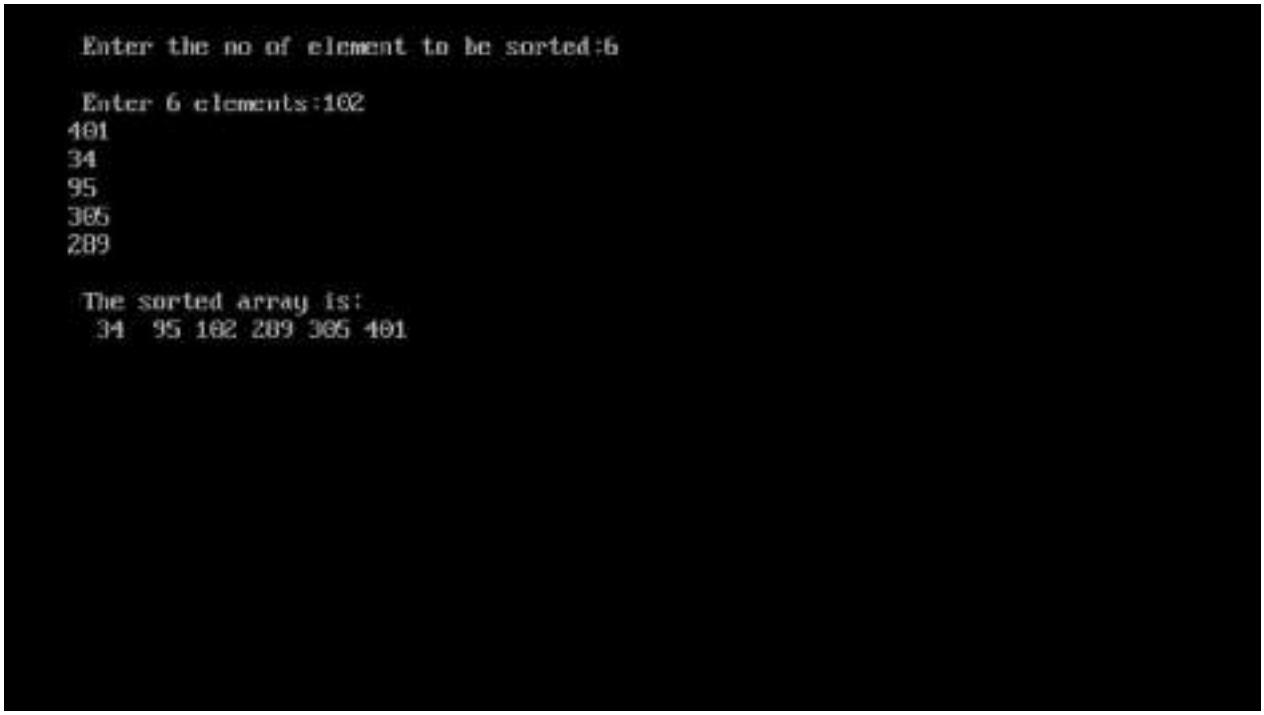
20. Aim: Arrange the list of numbers in ascending order using Radix Sort.

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

void Radixsort(int[],int);
void main()
{
int x[20],i,n;
clrscr();
printf("\n Enter the no of element to be sorted:");
scanf("%d",&n);
printf("\n Enter %d elements:",n);
for(i=0;i<n;i++)
scanf("%d",&x[i]);
Radixsort(x,n);
printf("\n The sorted array is:\n");
for(i=0;i<n;i++)
printf("%4d",x[i]);
getch();
}
void Radixsort(int a[],int n)
```

```
{
int bucket[10][10],buck[10];
int i,j,k,l,num,div,large,pass;
div=1;
num=0;
large=a[0];
for(i=0;i<n;i++)
{
if(a[i]>large)
large=a[i];
}
while(large>0)
{
num=num+1;
large=large/10;
}
for(pass=0;pass<num;pass++)
{
for(k=0;k<10;k++)
buck[k]=0;
for(i=0;i<n;i++)
{
l=(a[i]/div)%10;
bucket[l][buck[l]++]=a[i];
}
i=0;
for(k=0;k<10;k++)
{
for(j=0;j<buck[k];j++)
a[i++]=bucket[k][j];
}
div=div*10;
}
}
```

Output:



21. Aim: Arrange the list of numbers in ascending order using Heap Sort.

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

void Heapsort(int[],int);
int Parent(int);
int Left(int);
int Right(int);
void Heapify(int[],int,int);
void Buildheap(int[],int);
void main()
{
int x[20],i,n;
clrscr();
printf("\n Enter the no of element to be sorted:");
scanf("%d",&n);
printf("\n Enter %d elements:",n);
```

```
for(i=0;i<n;i++)
scanf("%d",&x[i]);
Heapsort(x,n);
printf("\n The sorted array is:\n");
for(i=0;i<n;i++)
printf("%4d",x[i]);
getch();
}
int Parent(int i)
{
return(i/2);
}
int Left(int i)
{
return(2*i+1);
}
int Right(int i)
{
return(2*i+2);
}
void Heapify(int a[],int i,int n)
{
int l,r,large,temp ;
l=Left(i);
r=Right(i);
if((l<=n-1)&&(a[l]>a[i]))
large=l;
else
large=i;
if((r<=n-1)&&(a[r]>a[large]))
large=r;
if(large!=i)
{
temp=a[i];
a[i]=a[large];
a[large]=temp;
Heapify(a,large,n);
}
}
void Buildheap(int a[],int n)
{
int i;
for(i=(n-1)/2;i>=0;i--)Heapify(a,i,n);
}
void Heapsort(int a[],int n)
{
```

```
int i,m,temp;
Buildheap(a,n);m=n;
for(i=n-1;i>=1;i--)
{
temp=a[0];
a[0]=a[i];
a[i]=temp;
m=m-1;
Heapify(a,0,m);
}
}
```

Output:

