VISVESVARAYA TECHNOLOGICAL UNIVERSITY

"JnanaSangama", Belgaum -590014, Karnataka.

LAB REPORT
on

ANALYSIS AND DESIGN OF ALGORITHMS

Submitted by

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

B.M.S. COLLEGE OF ENGINEERING
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B. M. S. College of Engineering,

Bull Temple Road, Bangalore 560019

(Affiliated To Visvesvaraya Technological University, Belgaum)

Department of Computer Science and Engineering

CERTIFICATE

This is to certify that the Lab work entitled "**ANALYSIS AND DESIGN OF ALGORITHMS**" carried out by **PRANAV M NAIR (1BM20CS211),** who is bonafide student of **B. M. S. College of Engineering.** It is in partial fulfillment for the award of **Bachelor of Engineering in Computer Science and Engineering** of the Visvesvaraya Technological University, Belgaum during the year 2022. The Lab report has been approved as it satisfies the academic requirements in respect of a **Analysis and Design of Algorithms - (19CS34PCADA)** work prescribed for the said degree.

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Index Sheet

Course Outcome

CO1	Ability to **analyze** time complexity of Recursive and Non-Recursive algorithms using asymptotic notations.
CO2	Ability to **design** efficient algorithms using various design techniques.
CO3	Ability to **apply** the knowledge of complexity classes P, NP, and NP-Complete and prove certain problems are NP-Complete
CO4	Ability to **conduct** practical experiments to solve problems using an appropriate designing method and find time efficiency.

LAB PROGRAM-01

Write a recursive program to

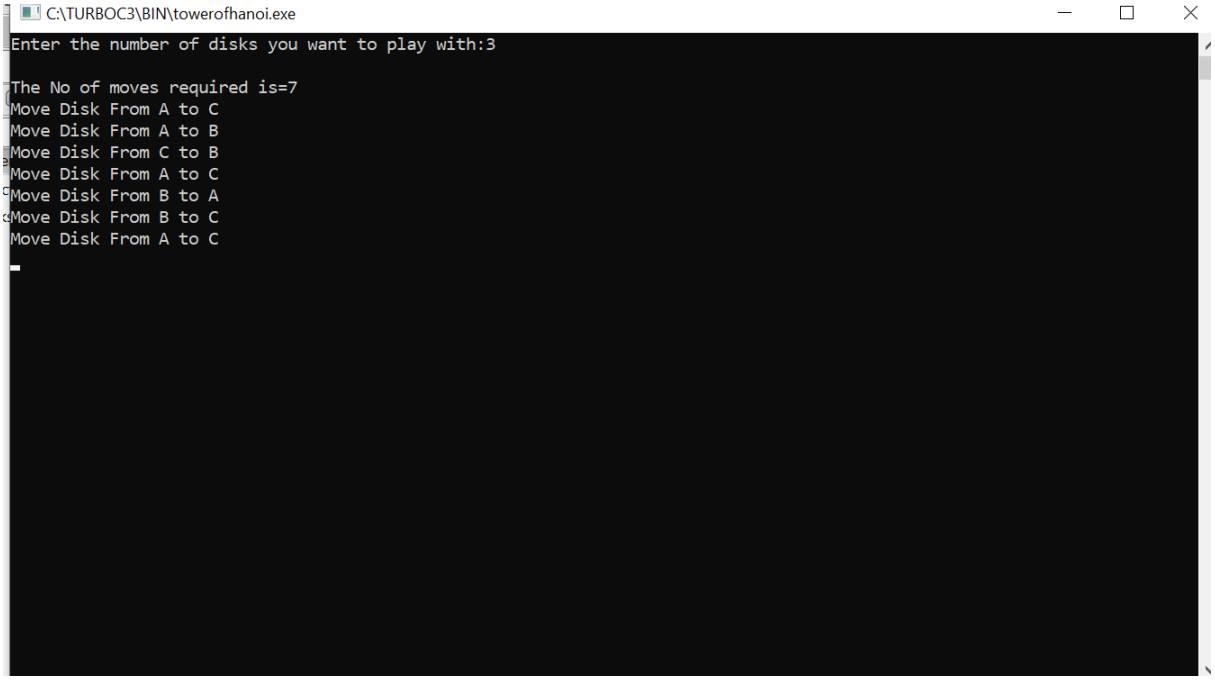
a. Solve Towers-of-Hanoi problem

b. To find GCD

a.

```
#include<stdio.h>
#include<conio.h>
#include<math.h>
void hanoi(int x, char from, char to, char aux)
{
   if(x==1)
     printf("Move Disk From %c to %c\n",from,to);
   else
   {
     hanoi(x-1,from,aux,to);
     printf("Move Disk From %c to %c\n",from,to);
     hanoi(x-1,aux,to,from);
   }
}
void main( )
{
   int disk;
   int moves;
   clrscr();
   printf("Enter the number of disks you want to play with:");
   scanf("%d",&disk);
   moves=pow(2,disk)-1;
   printf("\nThe No of moves required is=%d \n",moves);
   hanoi(disk,'A','C','B');
   getch( );
}
```

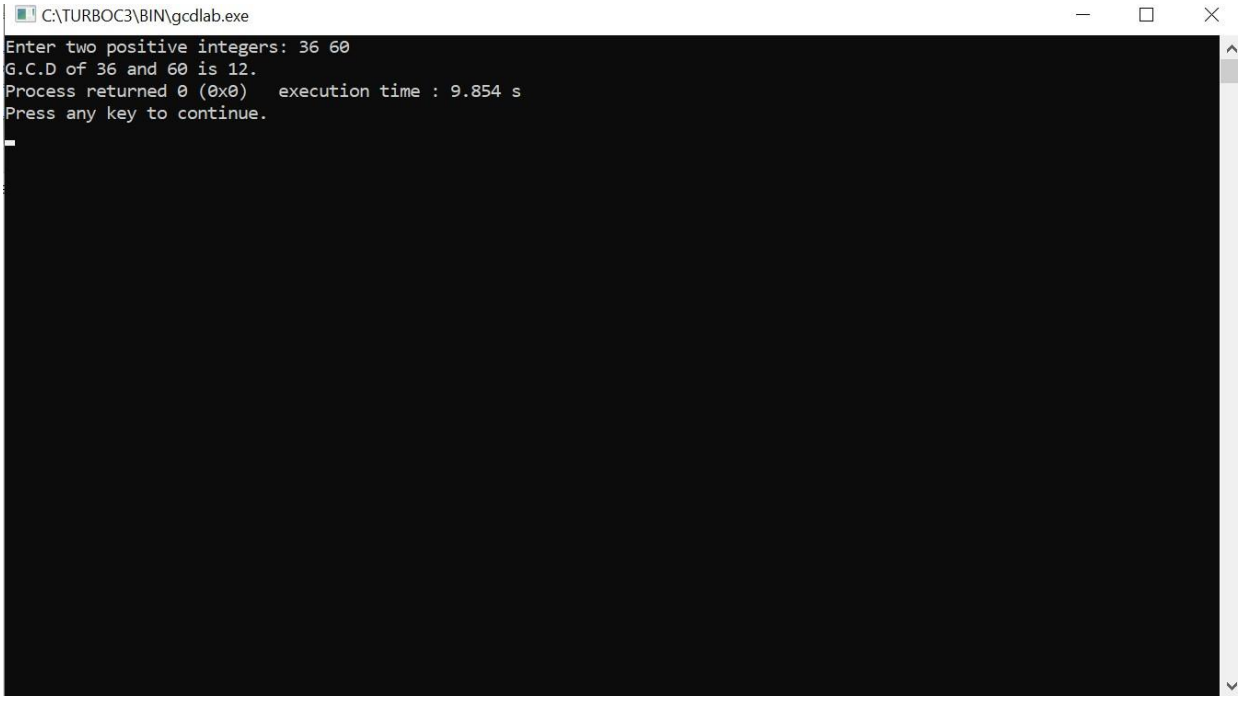
OUTPUT:

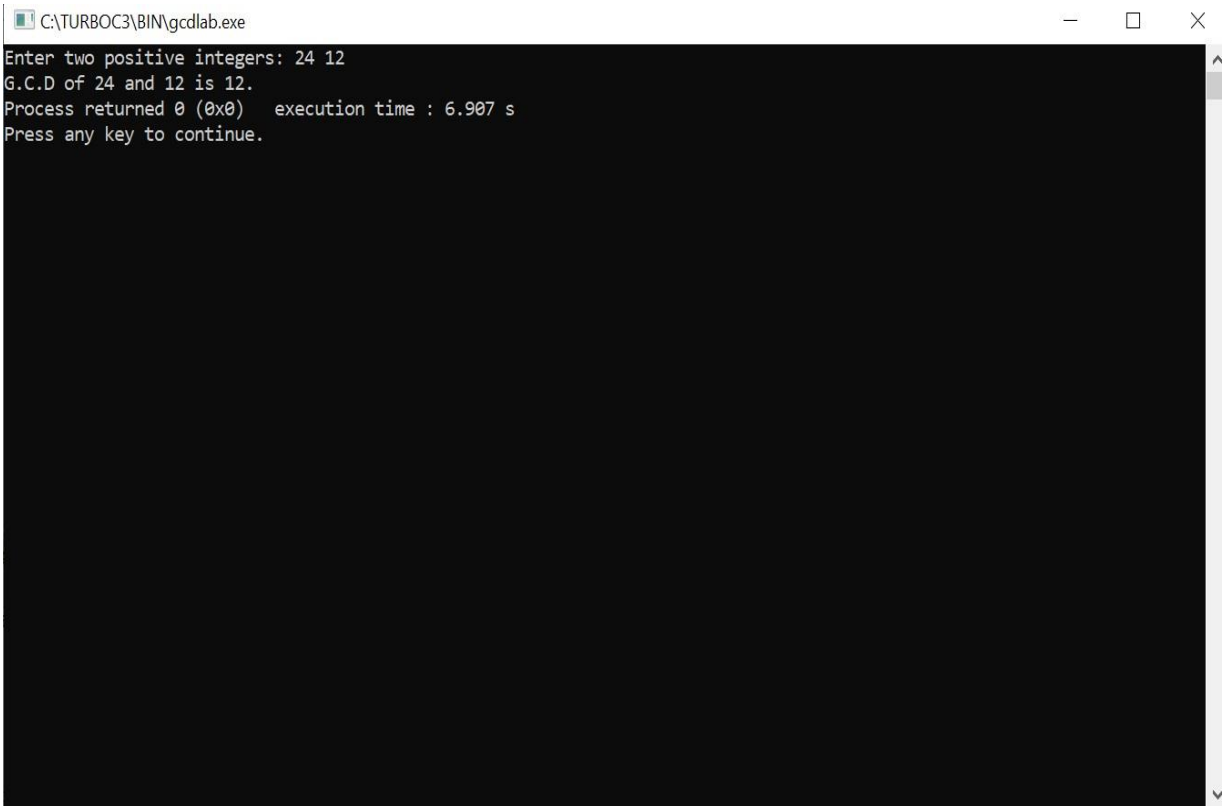


b.

```
#include <stdio.h>
 int hcf(int n1, int n2);
 int main()
 {
    int n1, n2;
    printf("Enter two positive integers: ");
    scanf("%d %d", &n1, &n2);
   printf("G.C.D of %d and %d is %d.", n1, n2, hcf(n1,n2));
   return 0;
 }

int hcf(int n1, int n2)
{
  if (n2 != 0)
  return hcf(n2, n1%n2);
 else
   return n1;
}
```

OUTPUT:


C:\TURBOC3\BIN\gcdlab.exe
Enter two positive integers: 36 60
G.C.D of 36 and 60 is 12.
Process returned 0 (0x0)   execution time : 9.854 s
Press any key to continue.


C:\TURBOC3\BIN\gcdlab.exe
Enter two positive integers: 24 12
G.C.D of 24 and 12 is 12.
Process returned 0 (0x0)   execution time : 6.907 s
Press any key to continue.

LAB PROGRAM-02

Implement Recursive Binary search and Linear search and determine the time required to search an element. Repeat the experiment for different values of N and plot a graph of the time taken versus N.

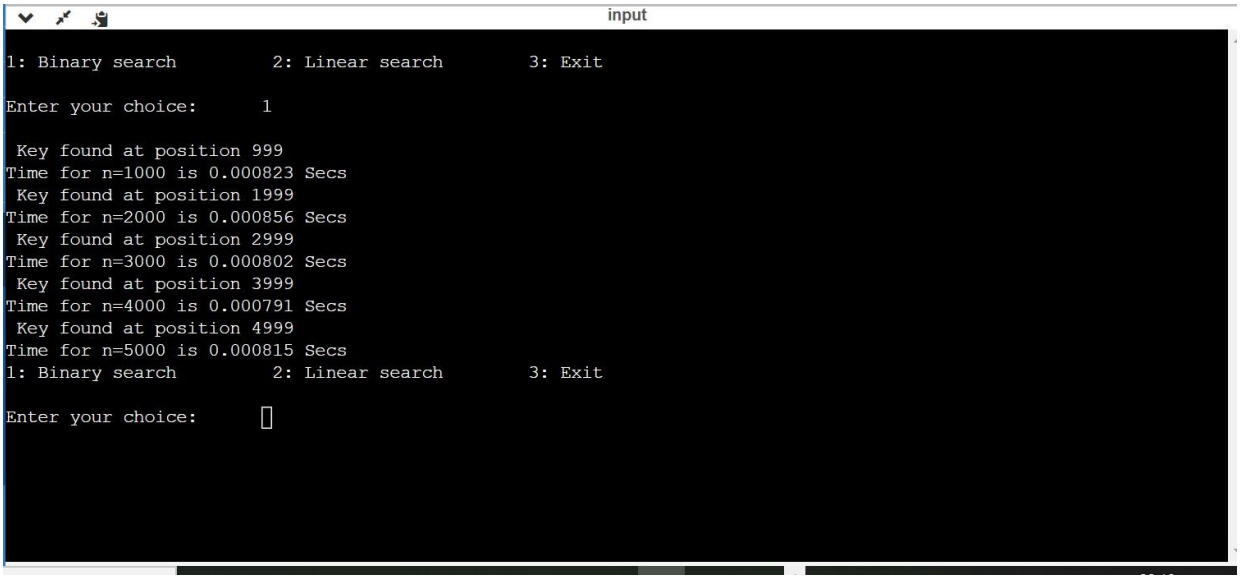
```
#include<stdio.h>
#include<time.h>
#include<stdlib.h>
int bin_srch(int [],int,int,int);
int  lin_srch(int  [],int,int,int);
void bub_sort(int[],int);
int n,a[10000];
int main()
{
 int ch,key,search_status,temp;
 clock_t end,start;
unsigned long int i, j;

 while(1)
 {
  printf("\n1: Binary search\t 2: Linear search\t 3: Exit\n");
  printf("\nEnter your choice:\t");
  scanf("%d",&ch);
  switch(ch)
  {
   case 1:
      n=1000;
           while(n<=5000)
           {
            for(i=0;i<n;i++)
            {
```

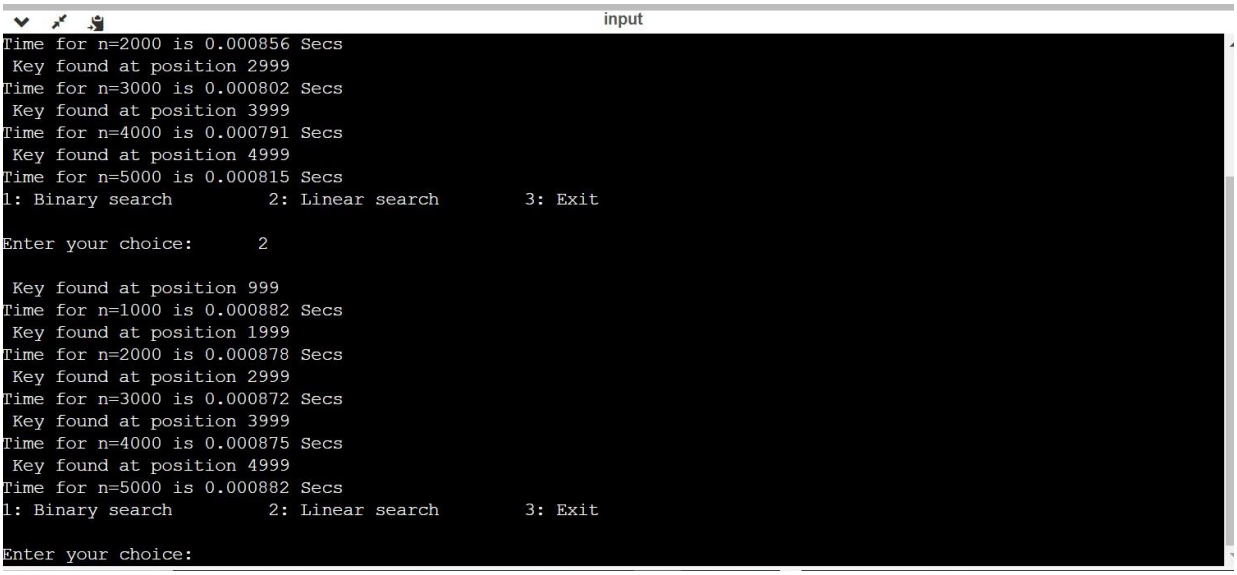
```
          a[i]=i;
          }
          key=a[n-1];
          start=clock();
         //bub_sort(a,n);
         Bubble sort
          search_status=bin_srch(a,0,n-1,key);
          if(search_status==-1)
            printf("\nKey Not Found");
         else
            printf("\n Key found at position %d",search_status);
         for(j=0;j<500000;j++)
         { temp=38/600;}
         end=clock();
          printf("\nTime for n=%d is %f Secs",n,(((double)(end-
start))/CLOCKS_PER_SEC));
          n=n+1000;
         }
         break;
  case       2:
        n=1000;
         while(n<=5000)
         {
         for(i=0;i<n;i++)
          {
           //a[i]=random(10000);
           a[i]=i;
          }
          key=a[n-1]; //Last element of the aray
          start=clock();
          search_status=lin_srch(a,0,n-1,key);
          if(search_status==-1)
            printf("\nKey Not Found");
         else
            printf("\n Key found at position %d",search_status);
```

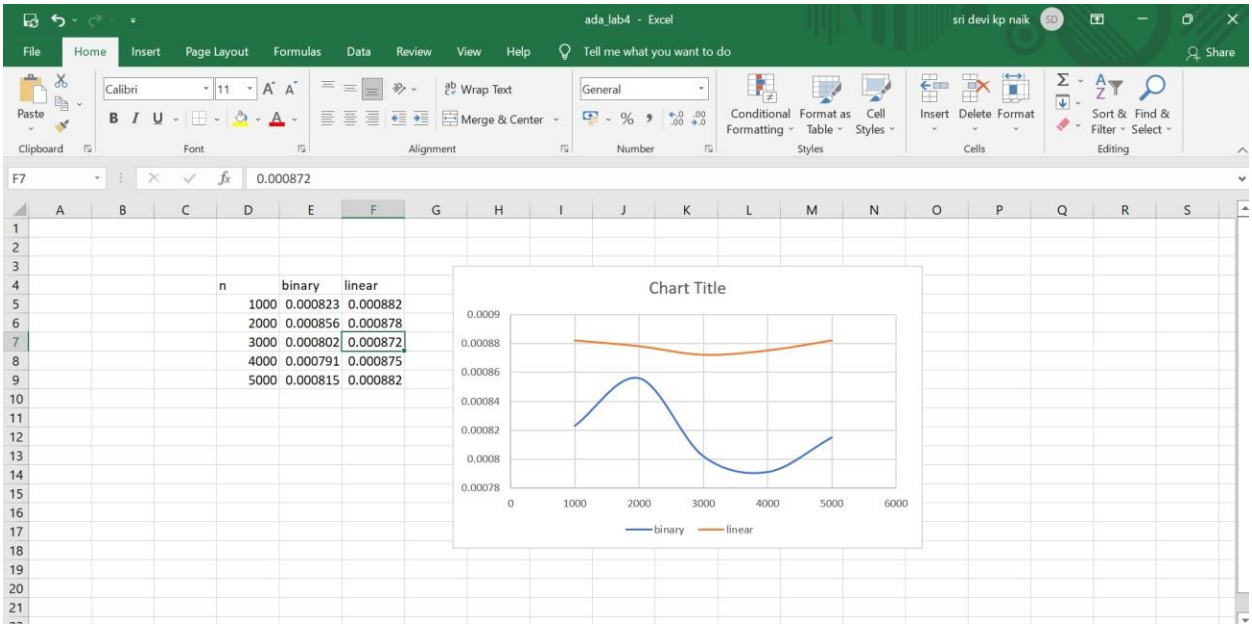
```
            for(j=0;j<500000;j++)
            { temp=38/600;}
            end=clock();
             printf("\nTime for n=%d is %f Secs",n,(((double)(end-
start))/CLOCKS_PER_SEC));
             n=n+1000;
            }
            break;
   default:
          exit(0);
  }
  getchar();
 }
}
void bub_sort(int a[],int n)
{
 int i,j,temp;
 for(i=0;i<=n-2;i++)
 {
  for(j=0;j<=n-2-i;j++)
  {
   if(a[j]>a[j+1])
   {
    temp=a[j];
    a[j]=a[j+1];
    a[j+1]=temp;
   }
  }
 }
}
int bin_srch(int a[],int low,int high,int key)
{
 int mid;
 if(low>high)
 {
```

```
 return -1;
 }
 mid=(low+high)/2;
 if(key==a[mid])
 {
  return mid;
 }
 if(key<a[mid])
 {
  return bin_srch(a,low,mid-1,key);
 }
 else
 {
  return bin_srch(a,mid+1,high,key);
 }
}

int lin_srch(int a[],int i,int high,int key)
{
 if(i>high)
 {
  return -1;
 }
 if(key==a[i])
 {
  return i;
 }
 else
 {
  return lin_srch(a,i+1,high,key);
 }
}
```

OUTPUT:


input
1: Binary search 2: Linear search 3: Exit
Enter your choice: 1
Key found at position 999
Time for n=1000 is 0.000823 Secs
Key found at position 1999
Time for n=2000 is 0.000856 Secs
Key found at position 2999
Time for n=3000 is 0.000802 Secs
Key found at position 3999
Time for n=4000 is 0.000791 Secs
Key found at position 4999
Time for n=5000 is 0.000815 Secs
1: Binary search 2: Linear search 3: Exit
Enter your choice:


input
Time for n=2000 is 0.000856 Secs
Key found at position 2999
Time for n=3000 is 0.000802 Secs
Key found at position 3999
Time for n=4000 is 0.000791 Secs
Key found at position 4999
Time for n=5000 is 0.000815 Secs
1: Binary search 2: Linear search 3: Exit
Enter your choice: 2
Key found at position 999
Time for n=1000 is 0.000882 Secs
Key found at position 1999
Time for n=2000 is 0.000878 Secs
Key found at position 2999
Time for n=3000 is 0.000872 Secs
Key found at position 3999
Time for n=4000 is 0.000875 Secs
Key found at position 4999
Time for n=5000 is 0.000882 Secs
1: Binary search 2: Linear search 3: Exit
Enter your choice:


ada_lab4 - Excel
sri devi kp naik
File
Home
Insert
Page Layout
Formulas
Data
Review
View
Help
Tell me what you want to do
Share
Paste
Clipboard
Calibri
11
Font
Wrap Text
Merge & Center
Alignment
General
Number
Conditional Formatting
Format as Table
Cell Styles
Styles
Insert
Delete
Format
Cells
Sort & Filter
Find & Select
Editing
F7
0.000872
n
binary
linear
1000 0.000823 0.000882
2000 0.000856 0.000878
3000 0.000802 0.000872
4000 0.000791 0.000875
5000 0.000815 0.000882
Chart Title
0.0009
0.00088
0.00086
0.00084
0.00082
0.0008
0.00078
0
1000
2000
3000
4000
5000
6000
binary
linear

LAB PROGRAM-03

Sort a given set of N integer elements using Selection Sort technique and compute its time taken. Run the program for different values of N and record the time taken to sort.

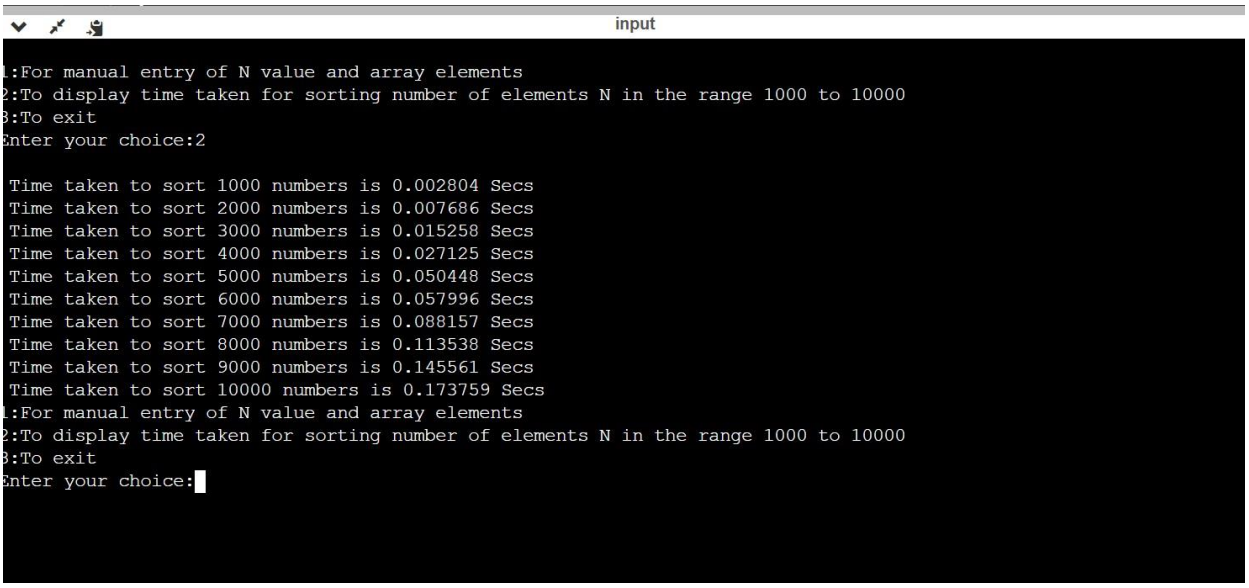
```
#include<stdio.h>
#include<time.h>
#include<stdlib.h>
void selsort(int n,int a[]);
int main()
{
  int a[15000],n,i,j,ch,temp;
  clock_t  start,end;
  while(1)
  {
 printf("\n1:For manual entry of N value and array elements");
 printf("\n2:To display time taken for sorting number of elements N in the range 1000 to 10000");
 printf("\n3:To exit");
    printf("\nEnter your choice:");
    scanf("%d", &ch);
    switch(ch)
    {
      case 1: printf("\nEnter the number of elements: ");
              scanf("%d",&n);
```

```
                printf("\nEnter array elements: ");
                for(i=0;i<n;i++)
                 {
                  scanf("%d",&a[i]);
                 }
                start=clock();
                selsort(n,a);
                end=clock();
                printf("\nSorted array is: ");
                for(i=0;i<n;i++)
                printf("%d\t",a[i]);
printf("\n Time taken to sort %d numbers is %f Secs",n, (((double)(end-
start))/CLOCKS_PER_SEC));
                break;
    case 2:
            n=1000;
            while(n<=10000) {
            for(i=0;i<n;i++)
                {
                  //a[i]=random(1000);
                  a[i]=n-i;
                }
            start=clock();
            selsort(n,a);
```

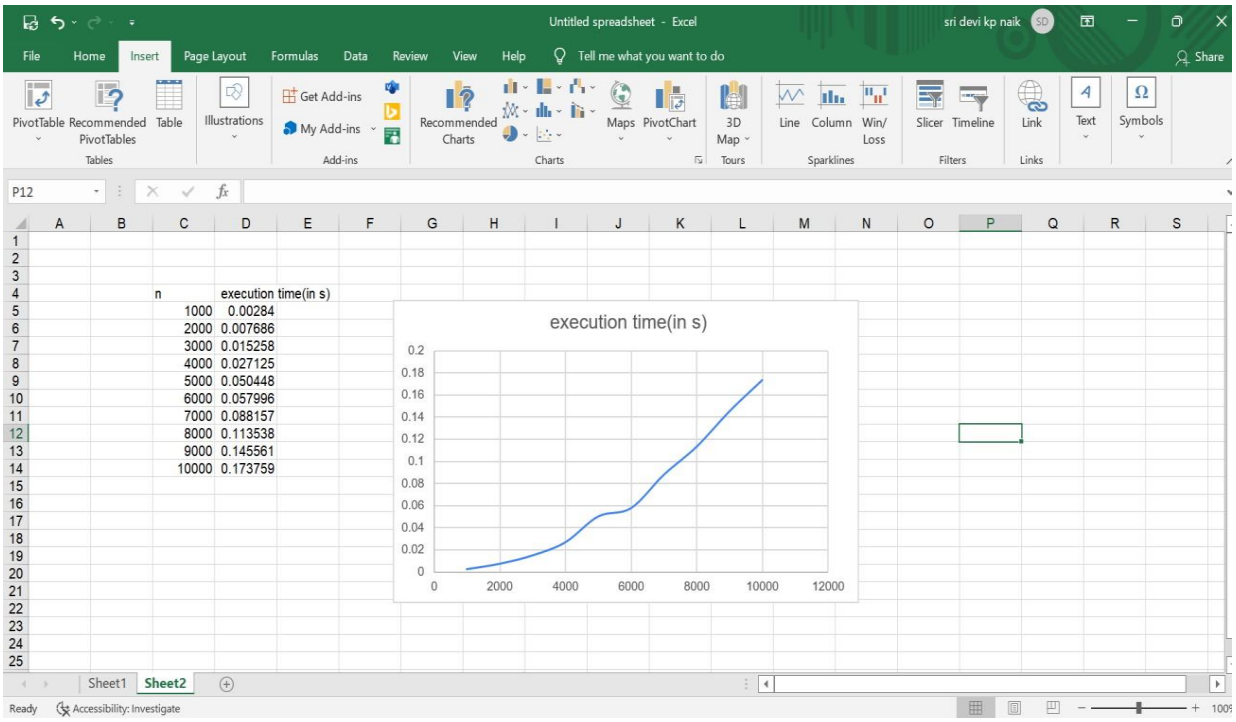
```
            for(j=0;j<500000;j++){ temp=38/600;}
             end=clock();
printf("\n Time taken to sort %d numbers is %f Secs",n, (((double)(end-
start))/CLOCKS_PER_SEC));
                    n=n+1000;
                   }
              break;
   case 3: exit(0);
   }
   getchar();
    return 0;
    }
}
void selsort(int n,int a[])
{
    int i,j,t,small,pos;
    for(i=0;i<n-1;i++)
     {
      pos=i;
      small=a[i];
      for(j=i+1;j<n;j++)
      {
          if(a[j]<small)
          {
```

```
            small=a[j];
            pos=j;
          }
      }
      t=a[i];
      a[i]=a[pos];
      a[pos]=t;
    }
}
```

OUTPUT:



```
input
 Time taken to sort 6000 numbers is 0.057996 Secs
 Time taken to sort 7000 numbers is 0.088157 Secs
 Time taken to sort 8000 numbers is 0.113538 Secs
 Time taken to sort 9000 numbers is 0.145561 Secs
 Time taken to sort 10000 numbers is 0.173759 Secs
1:For manual entry of N value and array elements
2:To display time taken for sorting number of elements N in the range 1000 to 10000
3:To exit
Enter your choice:1

Enter the number of elements: 10

Enter array elements: 12 156 68 45 41752 44 86 78 2 9

Sorted array is: 2      9       12      44      45      68      78      86      156     41752
 Time taken to sort 10 numbers is 0.000003 Secs
1:For manual entry of N value and array elements
2:To display time taken for sorting number of elements N in the range 1000 to 10000
3:To exit
Enter your choice:3


...Program finished with exit code 0
Press ENTER to exit console.
```



LAB PROGRAM-04

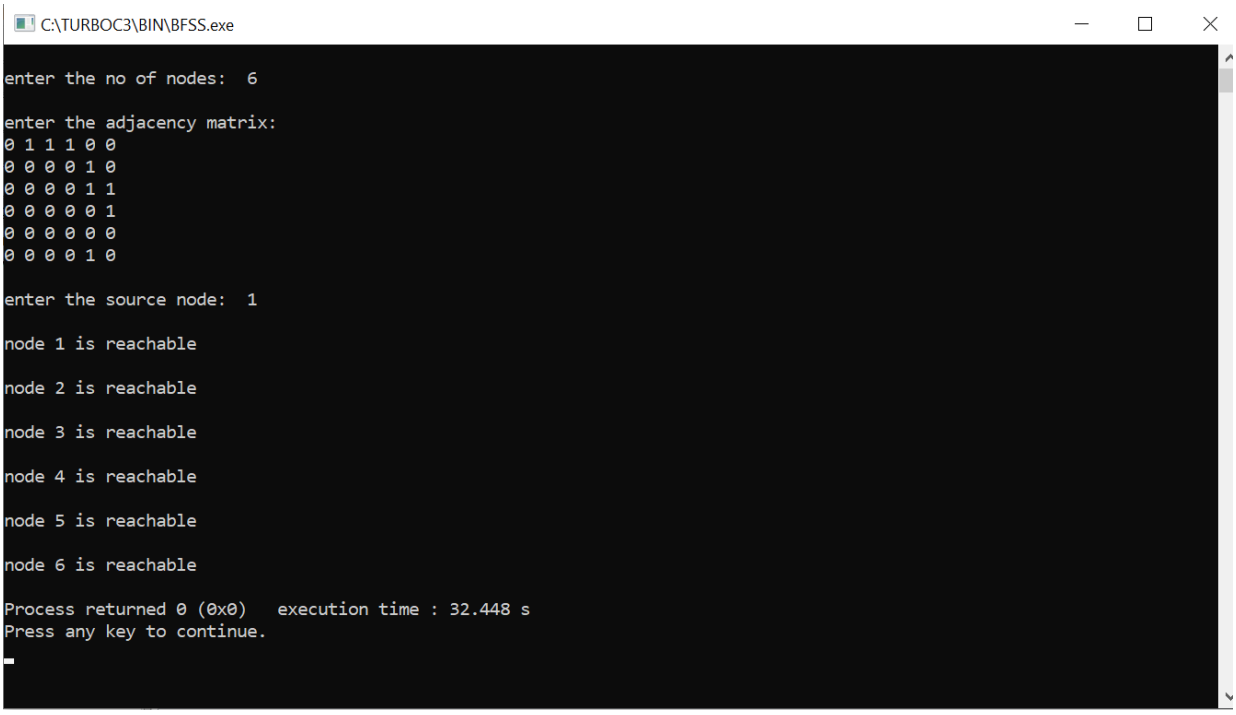
Write program to do the following:
a. Print all the nodes reachable from a given starting node in a digraph using BFS method.
b. Check whether a given graph is connected or not using DFS method.

a.

```
#include<stdio.h>
#include<conio.h>
int a[10][10],n;
void bfs(int);
int  main()
{
    int i,j,src;

    printf("\n enter the no of nodes:\t");
    scanf("%d",&n);
    printf("\n enter the adjacency matrix:\n");
    for(i=1;i<=n;i++)
    {
      for(j=1;j<=n;j++)
      {
        scanf("%d",&a[i][j]);
      }
    }
    printf("\nenter the source node:\t");
    scanf("%d",&src);
    bfs(src);
    return 0;

 }

 void bfs(int src)
{
   int q[10],f=0,r=-1,vis[10],i,j;
   for(j=1;j<=n;j++)
   {
     vis[j]=0;
   }
  vis[src]=1;
 r=r+1;
 q[r]=src;
 while(f<=r)
{
```

```
 i=q[f];
 f=f+1;
 for(j=1;j<=n;j++)
 {
  if(a[i][j]==1&&vis[j]!=1)
  {
   vis[j]=1;
   r=r+1;
   q[r]=j;
  }
 }
}
for(j=1;j<=n;j++)
{
 if(vis[j]!=1)
 {
  printf("\nnode %d is not reachable\n",j);
 }
 else
 {
  printf("\nnode %d is reachable\n",j);
 }
}
}
```

OUTPUT:



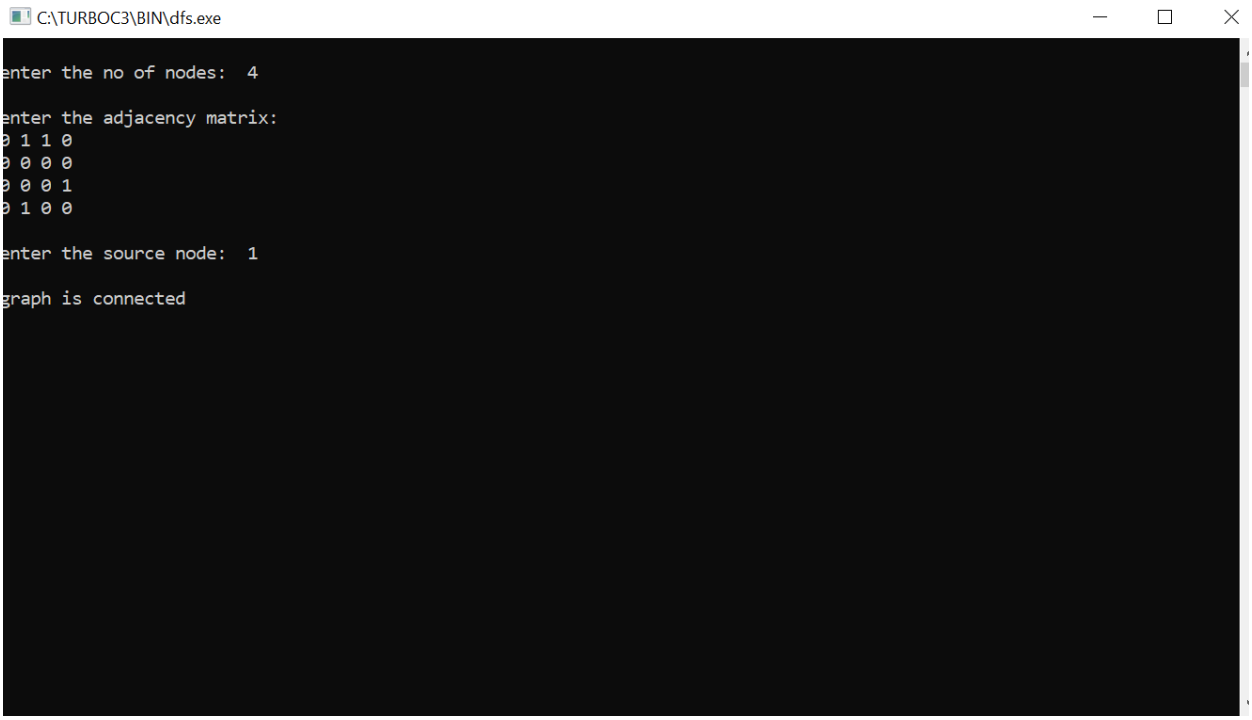
b.

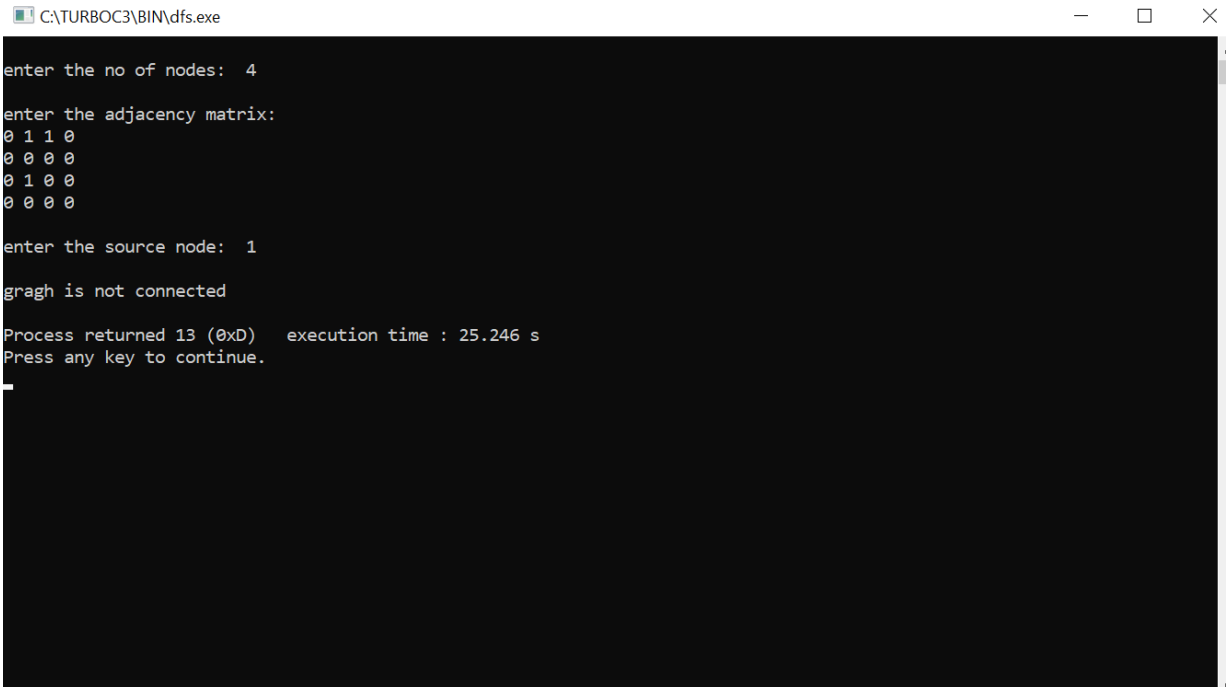
```
#include<stdio.h>
#include<conio.h>
int a[10][10],n,vis[10];
int dfs(int);
void main()
{
   int i,j,src,ans;
   for(j=1;j<=n;j++)
   {
     vis[j]=0;
   }
  printf("\nenter the no of nodes:\t");
  scanf("%d",&n);
  printf("\nenter the adjacency matrix:\n");
 for(i=1;i<=n;i++)
 {
    for(j=1;j<=n;j++)
    {
      scanf("%d",&a[i][j]);
    }
 }
printf("\nenter the source node:\t");
scanf("%d",&src);
```

```
      ans=dfs(src);
      if(ans==1)
     {
        printf("\ngraph is connected\n");
     }
    else
    {
      printf("\ngragh is not connected\n");
    }
    getch();
 }
int dfs(int src)
{
 int j;
 vis[src]=1;
 for(j=1;j<=n;j++)
 {
  if(a[src][j]==1&&vis[j]!=1)
  {
   dfs(j);
  }
 }
 for(j=1;j<=n;j++)
```

```
 {
  if(vis[j]!=1)
  {
   return 0;
  }
 }
 return 1;
}
```

OUTPUT:




C:\TURBOC3\BIN\dfs.exe
enter the no of nodes: 4
enter the adjacency matrix:
0 1 1 0
0 0 0 0
0 1 0 0
0 0 0 0
enter the source node: 1
gragh is not connected
Process returned 13 (0xD) execution time : 25.246 s
Press any key to continue.

LAB PROGRAM-05

Sort a given set of N integer elements using Insertion Sort technique and compute its time taken. Run the program for different values of N and record the time taken to sort. Plot a graph of the time taken versus N using MS Excel. The program should allow both manual entry of the array elements and also reading of array elements using random number generator.

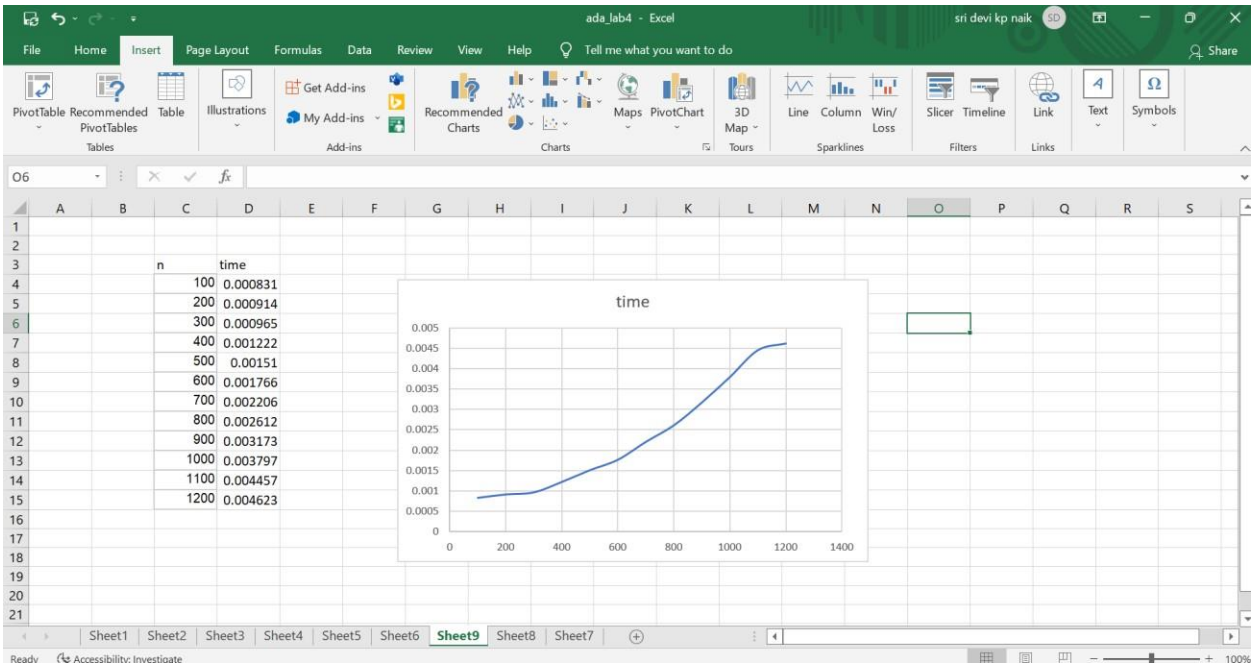
```
#include<stdio.h>
#include<conio.h>
#include<time.h>
void insertionsort(int n,int a[])
{
   int i,j,val,temp;
   for(i=1; i<n; i++)
   {
   val=a[i];
   j=i-1;
   while(j>=0 && a[j]>val)
   {
      temp=a[j+1];
      a[j+1]=a[j];
      a[j]=temp;
      j--;
```

```
    }
    a[j+1]=val;
    }
}
void main()
{
    clock_t start,end;
    int a[15500],i,j,temp;
    int n=100;
    while(n<1300)
    {
        for(i=0; i<n; i++)
        {
            a[i]=n-i;
        }
        start=clock();
        insertionsort(n,a);
        for(j=0; j<500000; j++)
        {
            temp=38/600;
        }
        end=clock();
        printf("\n Time taken to sort %d numbers is %f Secs",n,
(((double)(end-start))/CLOCKS_PER_SEC));
```

```
        n=n+100;
    }
}
```

OUTPUT:

```
input

Time taken to sort 100 numbers is 0.000831 Secs
Time taken to sort 200 numbers is 0.000914 Secs
Time taken to sort 300 numbers is 0.000965 Secs
Time taken to sort 400 numbers is 0.001222 Secs
Time taken to sort 500 numbers is 0.001510 Secs
Time taken to sort 600 numbers is 0.001766 Secs
Time taken to sort 700 numbers is 0.002206 Secs
Time taken to sort 800 numbers is 0.002612 Secs
Time taken to sort 900 numbers is 0.003173 Secs
Time taken to sort 1000 numbers is 0.003797 Secs
Time taken to sort 1100 numbers is 0.004457 Secs
Time taken to sort 1200 numbers is 0.004623 Secs

...Program finished with exit code 0
Press ENTER to exit console.
```



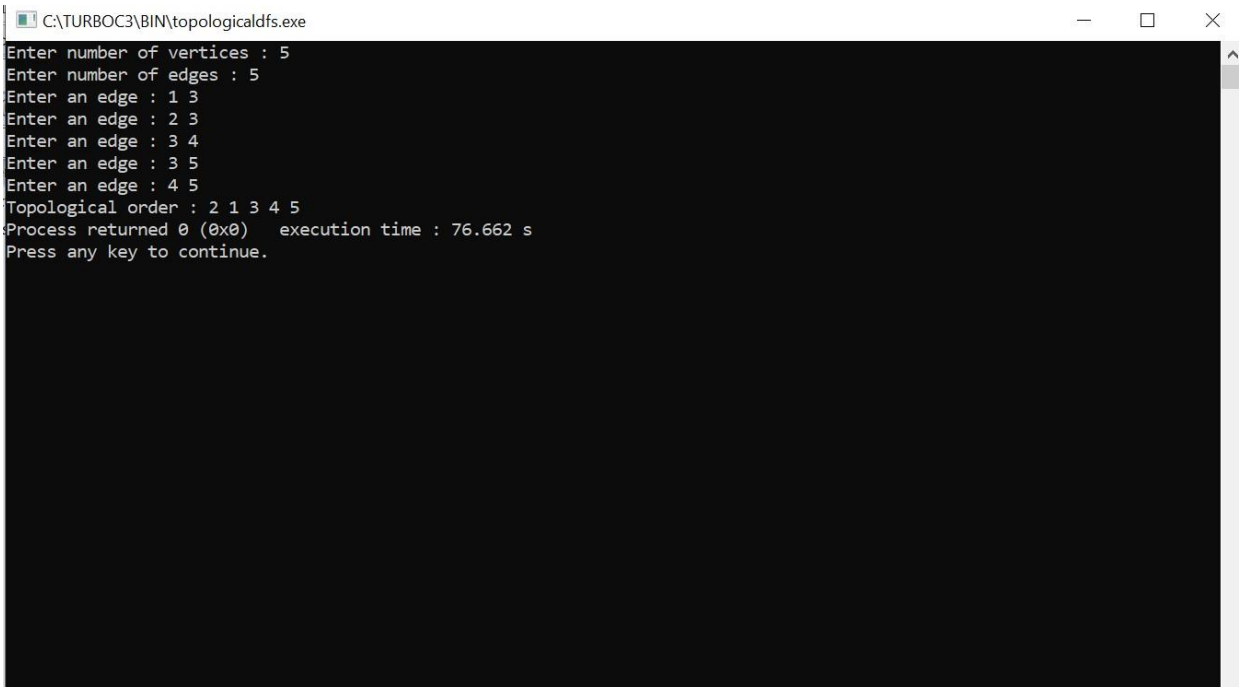
LAB PROGRAM-06

Write program to obtain the Topological ordering of vertices in a given digraph.

```
#include<stdio.h>

void dfs(int);
int a[10][10],n,e[10],vis[10],j=0;

int main()
{
   int m, u, v, i;
   printf("Enter number of vertices : ");
   scanf("%d",&n);
   for(i=1;i<=n;i++)
   {
      for(j = 1; j<= n; j ++)
      {
         a[i][j] = 0;
      }
   }
   printf("Enter number of edges : ");
   scanf("%d",&m);
   for(i=1;i<=m;i++)
   {
      printf("Enter an edge : ");
      scanf("%d%d",&u,&v);
      a[u][v] = 1;
   }

   for(i=1;i<=n;i++)
      vis[i] = 0;
```

```
    j=0;
    for(i=1;i<=n;i++)
    {
        if(vis[i] == 0)
            dfs(i);
    }
    printf("Topological order : ");
    for(i=n-1; i>=0;i--)
        printf("%d ", e[i]);

    return 0;
}

void dfs(int v)
{
    int i;
    vis[v] = 1;

    for(i=1;i<=n;i++)
    {
        if(a[v][i] == 1 && vis[i] == 0)
            dfs(i);
    }
    e[j++] = v;
}
```

OUTPUT:


C:\TURBOC3\BIN\topologicaldfs.exe
Enter number of vertices : 5
Enter number of edges : 5
Enter an edge : 1 3
Enter an edge : 2 3
Enter an edge : 3 4
Enter an edge : 3 5
Enter an edge : 4 5
Topological order : 2 1 3 4 5
Process returned 0 (0x0)   execution time : 76.662 s
Press any key to continue.

LAB PROGRAM-07

Implement Johnson Trotter algorithm to generate permutations.

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

int LEFT_TO_RIGHT = 1;
int RIGHT_TO_LEFT = 0;
int searchArr(int a[], int n, int mobile) {
 for (int i = 0; i < n; i++)
 if (a[i] == mobile)
 return i + 1;
}
 int getMobile(int a[], int dir[], int n) {
 int mobile_prev = 0, mobile = 0;
 for (int i = 0; i < n; i++) {

  if (dir[a[i]-1] == RIGHT_TO_LEFT && i!=0) {
   if (a[i] > a[i-1] && a[i] > mobile_prev) {
   mobile = a[i];
     mobile_prev = mobile;
   }
  }
  if (dir[a[i]-1] == LEFT_TO_RIGHT && i!=n-1) {
```

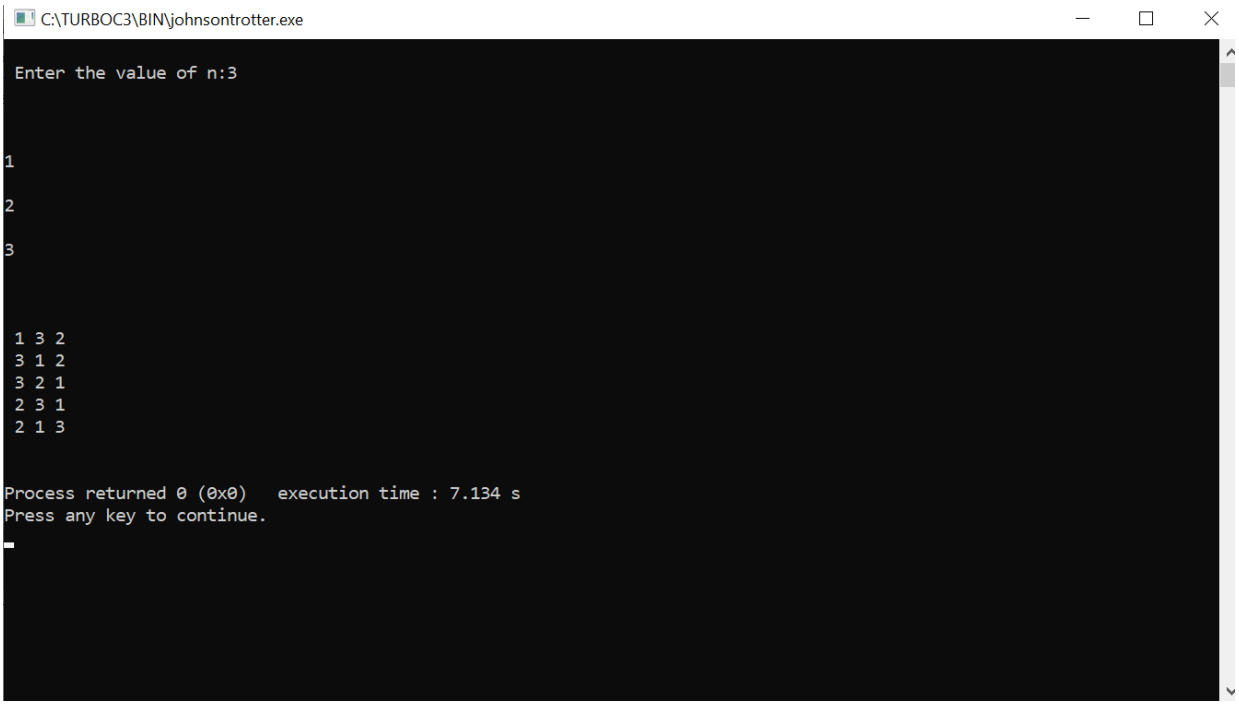
```
if (a[i] > a[i+1] && a[i] > mobile_prev)
{
mobile = a[i];
mobile_prev = mobile;
}
}
}

if (mobile == 0 && mobile_prev == 0)
return 0;
else
return mobile;
}
int printOnePerm(int a[], int dir[], int n)
{
int mobile = getMobile(a, dir, n);
int pos = searchArr(a, n, mobile);

if (dir[a[pos - 1] - 1] == RIGHT_TO_LEFT)
{
    printf("\n");
  int temp;
   temp = a[pos-1] ;
```

```
  a[pos-1] = a[pos-2];
  a[pos-2]=  temp;
}

else if (dir[a[pos - 1] - 1] == LEFT_TO_RIGHT)
{
printf("\n");
  int temp;
  temp = a[pos] ;
  a[pos] = a[pos-1];
  a[pos-1]=  temp;
}
for (int i = 0; i < n; i++)
{
if (a[i] > mobile)
{
if (dir[a[i] - 1] == LEFT_TO_RIGHT)
dir[a[i] - 1] = RIGHT_TO_LEFT;
else if (dir[a[i] - 1] == RIGHT_TO_LEFT)
dir[a[i] - 1] = LEFT_TO_RIGHT;
}
}
```

```
for (int i = 0; i < n; i++)
printf(" %d", a[i]);

}
int fact(int n)
{
int res = 1;
int i;
for (i = 1; i <= n; i++)
res = res * i;
return res;
}
void printPermutation(int n)
{

int a[n];
int dir[n];
   printf("\n");

printf("\n");
for (int i = 0; i < n; i++)
{
a[i] = i + 1;
```

```
printf("%d \n", a[i]);
printf("\n");
}
printf("\n");
for (int i = 0; i < n; i++)
dir[i] = RIGHT_TO_LEFT;
for (int i = 1; i < fact(n); i++)

printOnePerm(a, dir, n);
printf("\n");
}
int main()
{
int n;
printf("\n Enter the value of n:N");
scanf("%d",&n);
printf("\n");
printPermutation(n);
printf("\n");
return 0;
}
```

OUTPUT:


C:\TURBOC3\BIN\johnsontrotter.exe
Enter the value of n:3
1
2
3
1 3 2
3 1 2
3 2 1
2 3 1
2 1 3
Process returned 0 (0x0) execution time : 7.134 s
Press any key to continue.

LAB PROGRAM-08

Sort a given set of N integer elements using Merge Sort technique and compute its time taken. Run the program for different values of N and record the time taken to sort.

```
#include<stdio.h>
#include<time.h>
#include<stdlib.h>
void split(int[],int,int);
void combine(int[],int,int,int);
void main()
{
int a[15000],n, i,j,ch, temp;
clock_t start,end;
while(1)
{
printf("\n1:For manual entry of N value and array elements");
printf("\n2:To display time taken for sorting number of elements N in the range 500 to 14500");
printf("\n3:To exit");
printf("\nEnter your choice:");
scanf("%d",&ch);
switch(ch)
{
case 1: printf("\nEnter the number of elements:");
```

```
scanf("%d",&n);
printf("\nEnter array elements:");
for(i=0;i<n;i++)
{
scanf("%d",&a[i]);
}
start=clock();
split(a,0,n-1);
end=clock();
printf("\nSorted array is:");
for(i=0;i<n;i++)
printf("%d\t",a[i]);

printf("\n Time taken to sort %d numbers is %f Secs",n, (((double)(end-
start))/CLOCKS_PER_SEC));

break;

case 2:
n=500;
while(n<=14500)
{
for(i=0;i<n;i++)
```

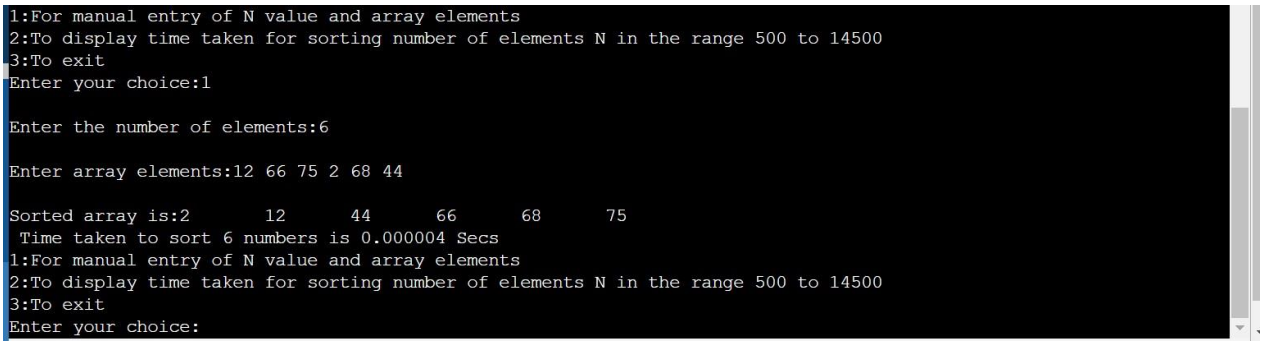
```
{


a[i]=n-i;
}
start=clock();
split(a,0,n-1);
for(j=0;j<500000;j++){ temp=38/600;}
end=clock();
printf("\n Time taken to sort %d numbers is %f Secs",n, (((double)(end-
start))/CLOCKS_PER_SEC));


n=n+1000;
}
break;
case 3: exit(0);
}
getchar();
}
}
void split(int a[],int low,int high)
{
int mid;
if(low<high)
{
```

```
mid=(low+high)/2;
split(a,low,mid);
split(a,mid+1,high);
combine(a,low,mid,high);
}
}
void combine(int a[],int low,int mid,int high)
{
int c[15000],i,j,k;
i=k=low;
j=mid+1;
while(i<=mid &&j<=high)
{
if(a[i]<a[j])
{
c[k]=a[i];
++k;
++i;
}
else
{
c[k]=a[j];
++k;
```

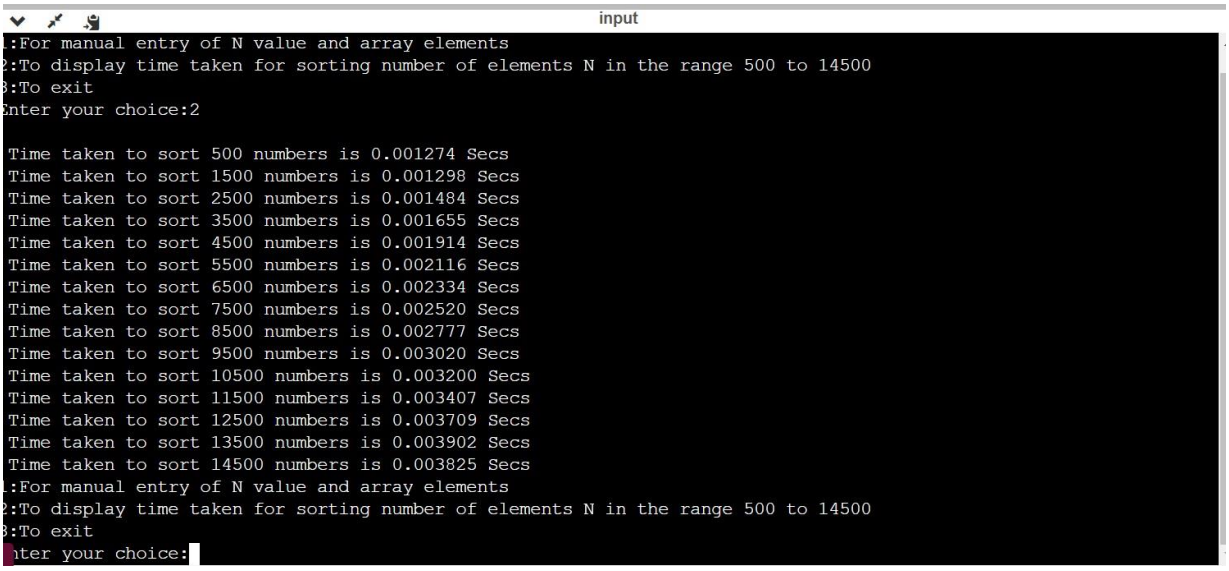
```
++j;
}
}
if(i>mid)
{
while(j<=high)
{
c[k]=a[j];
++k;
++j;
}
}
if(j>high)
{
while(i<=mid)
{
c[k]=a[i];
++k;
++i;
}
}
for(i=low;i<=high;i++)
{
```

```
a[i]=c[i];
}
}
```

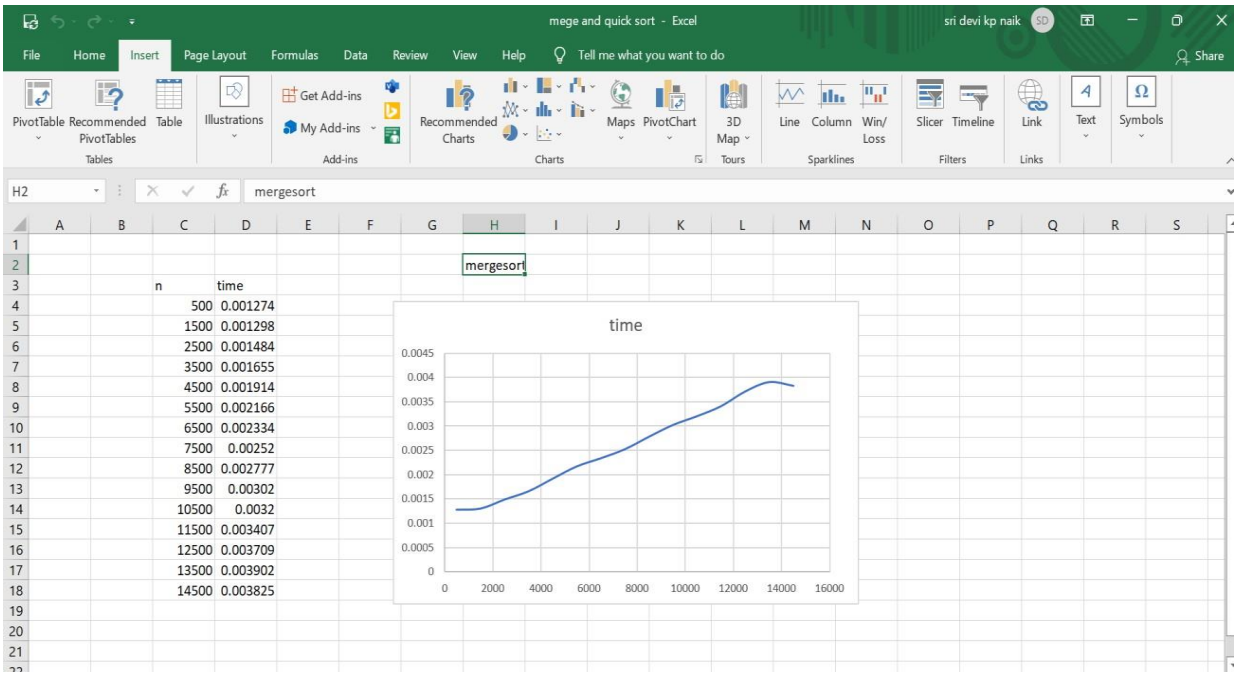
OUTPUT:



```
1:For manual entry of N value and array elements
2:To display time taken for sorting number of elements N in the range 500 to 14500
3:To exit
Enter your choice:1

Enter the number of elements:6

Enter array elements:12 66 75 2 68 44

Sorted array is:2       12      44      66      68      75
 Time taken to sort 6 numbers is 0.000004 Secs
1:For manual entry of N value and array elements
2:To display time taken for sorting number of elements N in the range 500 to 14500
3:To exit
Enter your choice:
```



```
input
1:For manual entry of N value and array elements
2:To display time taken for sorting number of elements N in the range 500 to 14500
3:To exit
Enter your choice:2

Time taken to sort 500 numbers is 0.001274 Secs
Time taken to sort 1500 numbers is 0.001298 Secs
Time taken to sort 2500 numbers is 0.001484 Secs
Time taken to sort 3500 numbers is 0.001655 Secs
Time taken to sort 4500 numbers is 0.001914 Secs
Time taken to sort 5500 numbers is 0.002116 Secs
Time taken to sort 6500 numbers is 0.002334 Secs
Time taken to sort 7500 numbers is 0.002520 Secs
Time taken to sort 8500 numbers is 0.002777 Secs
Time taken to sort 9500 numbers is 0.003020 Secs
Time taken to sort 10500 numbers is 0.003200 Secs
Time taken to sort 11500 numbers is 0.003407 Secs
Time taken to sort 12500 numbers is 0.003709 Secs
Time taken to sort 13500 numbers is 0.003902 Secs
Time taken to sort 14500 numbers is 0.003825 Secs
1:For manual entry of N value and array elements
2:To display time taken for sorting number of elements N in the range 500 to 14500
3:To exit
Enter your choice:
```


mege and quick sort - Excel
sri devi kp naik
File
Home
Insert
Page Layout
Formulas
Data
Review
View
Help
Tell me what you want to do
Share
PivotTable
Recommended PivotTables
Table
Illustrations
Get Add-ins
My Add-ins
Recommended Charts
Maps
PivotChart
3D Map
Line
Column
Win/ Loss
Slicer
Timeline
Link
Text
Symbols
Tables
Add-ins
Charts
Tours
Sparklines
Filters
Links
H2
mergesort
mergesort
n
time
500 0.001274
1500 0.001298
2500 0.001484
3500 0.001655
4500 0.001914
5500 0.002166
6500 0.002334
7500 0.00252
8500 0.002777
9500 0.00302
10500 0.0032
11500 0.003407
12500 0.003709
13500 0.003902
14500 0.003825
time
0.0045
0.004
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
0
2000
4000
6000
8000
10000
12000
14000
16000

LAB PROGRAM-09

Sort a given set of N integer elements using Quick Sort technique and compute its time taken.

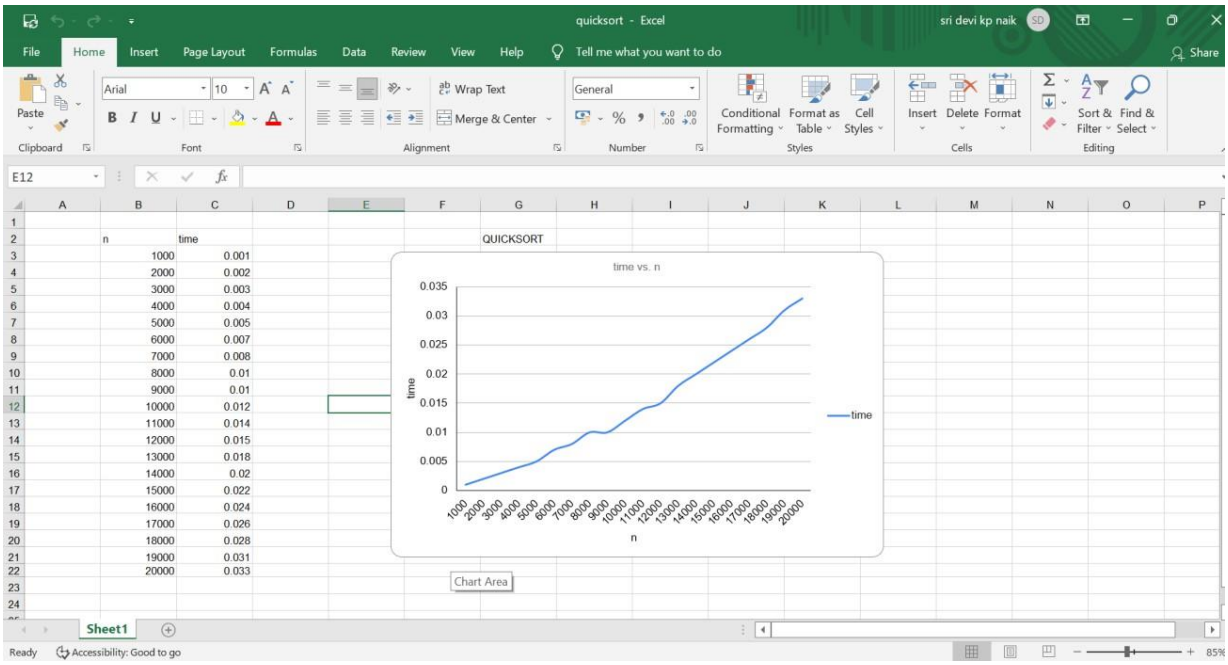
```
#include<stdio.h>
#include<time.h>
#include<stdlib.h>
#define MAXINT 2000
void delay(int n)
{
int i;
for(i=0;i<n;i++){
}
}
void quickSort(int number[],int first,int last){
int i,j,pivot,temp;
if(first<last){
   pivot=first;
   i=first;
   j=last;
while(i<j){
   while(number[i]<=number[pivot]&&i<last){
   i++;
   }
```

```
    while(number[j]>number[pivot]&&j>first){
    j--;
    }
    if(i<j){
    temp=number[i];
    number[i]=number[j];
    number[j]=temp;
    }
}
temp=number[pivot];
number[pivot]=number[j];
number[j]=temp;
quickSort(number,first,j-1);
quickSort(number,j+1,last);
}
}
void main()
{
clock_t start,end;
int i,datasize=1;
long int n=10000;
int *a;
while(datasize<=20){
```

```
    a=(int *)calloc(n,sizeof(int));
    if(a==NULL){
    printf("Insufficiant Memory");
    exit(0);
    }
    for(i=0;i<=n-1;i++){
    a[i]=rand()%MAXINT;
    }
    start=clock();
    quickSort(a,0,n-1);
    end=clock();
    free(a);
    if((end-start)!=0){
     printf("\n%d\t%f",n,(double)(end-start)/CLK_TCK);
     datasize++;
    }
    n+=10000;
}
return;
}
```

OUTPUT:

```
C:\Users\bmsce\Desktop\quicksot.exe

10000   0.001000
20000   0.002000
30000   0.003000
40000   0.004000
50000   0.005000
60000   0.007000
70000   0.008000
80000   0.010000
90000   0.010000
100000  0.012000
110000  0.014000
120000  0.015000
130000  0.018000
140000  0.020000
150000  0.022000
160000  0.024000
170000  0.026000
180000  0.028000
190000  0.031000
200000  0.033000
Process returned 16 (0x10)   execution time : 0.335 s
Press any key to continue.
```



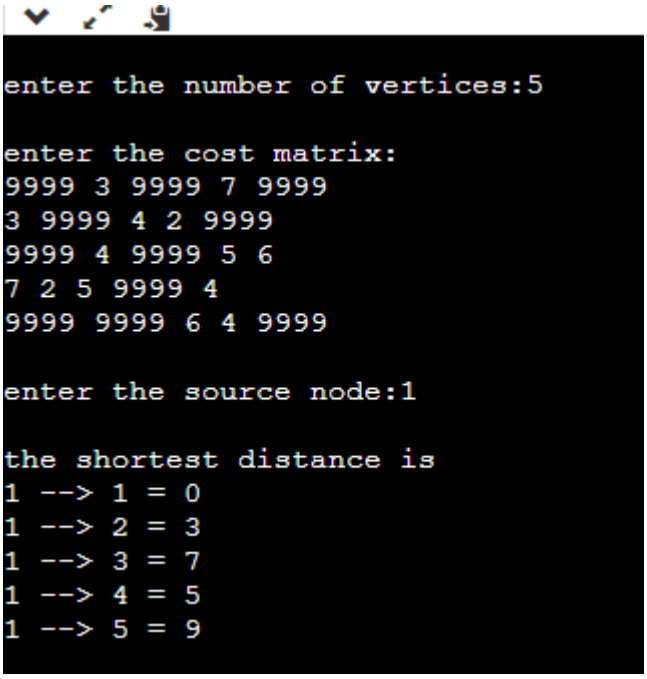
LAB PROGRAM-10

From a given vertex in a weighted connected graph, find shortest paths to other vertices using Dijkstra's algorithm.

```
#include<stdio.h>
#include<conio.h>
int c[10][10],n,src;
void dijkstras()
{
   int vis[10],dist[10],u,j,count,min;
   for(j=1;j<=n;j++)
   {
      dist[j]=c[src][j];
   }
   for(j=1;j<=n;j++)
   {
      vis[j]=0;
   }
   dist[src]=0;
   vis[src]=1;
   count=1;
   while(count!=n)
   {
      min=9999;
      for(j=1;j<=n;j++)
      {
         if(dist[j]<min&&vis[j]!=1)
         {
            min=dist[j];
            u=j;
         }
      }
      vis[u]=1;
      count++;
      for(j=1;j<=n;j++)
      {
```

```
            if(min+c[u][j]<dist[j]&&vis[j]!=1)
            {
               dist[j]=min+c[u][j];
            }
         }
      }
      printf("\nthe shortest distance is");
      for(j=1;j<=n;j++)
      {
         printf("\n%d --> %d = %d",src,j,dist[j]);
      }
   }
   void main()
   {
      int i,j;
      printf("\nenter the number of vertices:");
      scanf("%d",&n);
      printf("\nenter the cost matrix:");
      for(i=1;i<=n;i++)
      {
         for(j=1;j<=n;j++)
         {
            scanf("%d",&c[i][j]);
         }
      }
      printf("\nenter the source node:");
      scanf("%d",&src);
      dijkstras();
      getch();
   }
```

OUTPUT:


enter the number of vertices:5
enter the cost matrix:
9999 3 9999 7 9999
3 9999 4 2 9999
9999 4 9999 5 6
7 2 5 9999 4
9999 9999 6 4 9999
enter the source node:1
the shortest distance is
1 --> 1 = 0
1 --> 2 = 3
1 --> 3 = 7
1 --> 4 = 5
1 --> 5 = 9

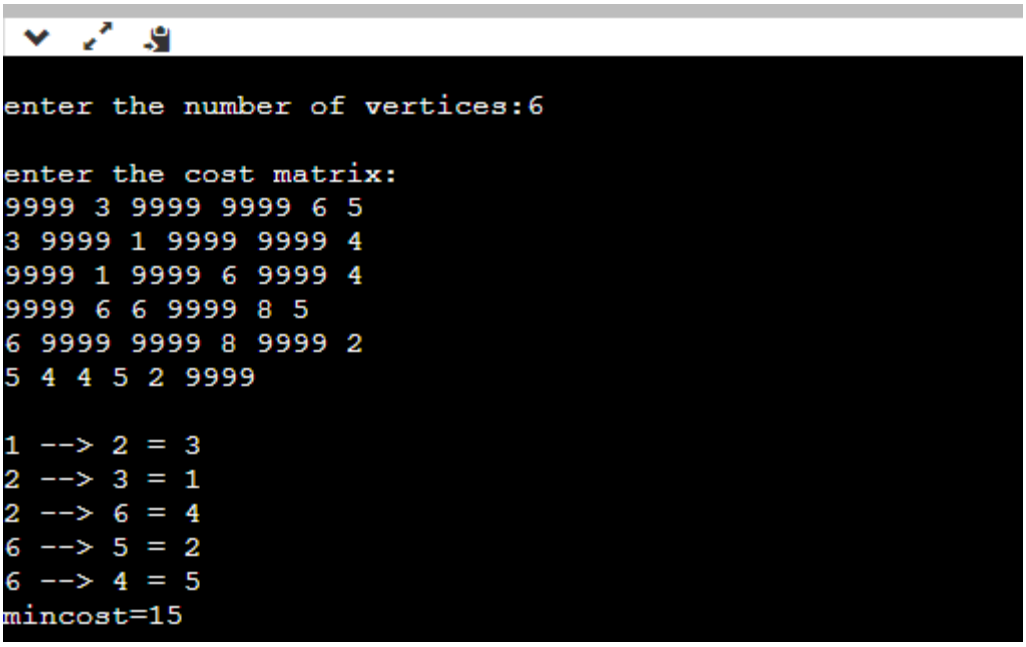
LAB PROGRAM-11

Find minimum cost spanning tree of a given undirected graph using Prim's algorithm.

```
 #include<stdio.h>
#include<conio.h>
int c[10][10],n;
void prims()
{
   int i,j,u,v,min;
   int ne=0,mincost=0,elec[10];
   for(i=1;i<=n;i++)
   {
     elec[i]=0;
   }
   elec[1]=1;
   while(ne!=n-1)
   {
      min=9999;
      for(i=1;i<=n;i++)
      {
         for(j=1;j<=n;j++)
         {
            if(elec[i]==1)
            {
               if(c[i][j]<min)
               {
                  min=c[i][j];
                  u=i;
                  v=j;
               }
            }
         }
      }
      if(elec[v]!=1)
      {
```

```
            printf("\n%d --> %d = %d",u,v,min);
            elec[v]=1;
            ne=ne+1;
            mincost=mincost+min;
        }
        c[u][v]=c[v][u]=9999;
    }
    printf("\nmincost=%d",mincost);
}
void main()
{
    int i,j;
    printf("\nenter the number of vertices:");
    scanf("%d",&n);
    printf("\nenter the cost matrix:");
    for(i=1;i<=n;i++)
    {
        for(j=1;j<=n;j++)
        {
            scanf("%d",&c[i][j]);
        }
    }
    prims();
    getch();
}
```

OUTPUT:


enter the number of vertices:6
enter the cost matrix:
9999 3 9999 9999 6 5
3 9999 1 9999 9999 4
9999 1 9999 6 9999 4
9999 6 6 9999 8 5
6 9999 9999 8 9999 2
5 4 4 5 2 9999
1 --> 2 = 3
2 --> 3 = 1
2 --> 6 = 4
6 --> 5 = 2
6 --> 4 = 5
mincost=15

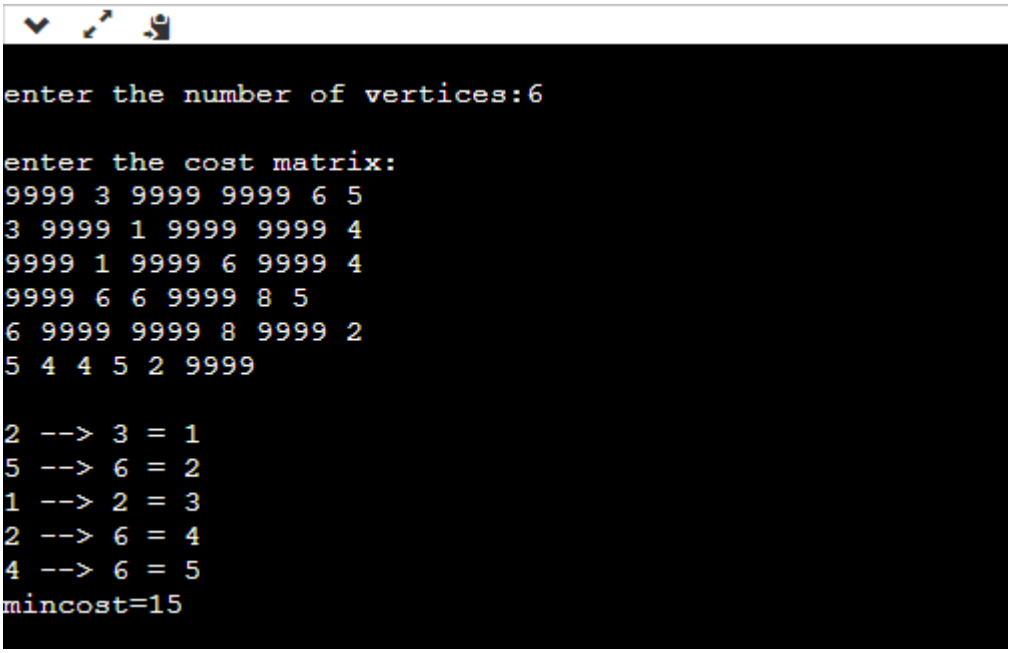
LAB PROGRAM-12

Find minimum cost spanning tree of a given undirected graph using Kruskal's algorithm.

```
#include<stdio.h>
#include<conio.h>
int c[10][10],n;
void kruskals()
{
   int i,j,u,v,a,b,min;
   int ne=0,mincost=0,parent[10];
   for(i=1;i<=n;i++)
   {
      parent[i]=0;
   }
   while(ne!=n-1)
   {
      min=9999;
      for(i=1;i<=n;i++)
      {
         for(j=1;j<=n;j++)
         {
            if(c[i][j]<min)
            {
               min=c[i][j];
               u=a=i;
               v=b=j;
            }
         }
      }
      while(parent[u]!=0)
      {
         u=parent[u];
      }
      while(parent[v]!=0)
```

```
        {
            v=parent[v];
        }
        if(u!=v)
        {
            printf("\n%d --> %d = %d",a,b,min);
            parent[v]=u;
            ne=ne+1;
            mincost=mincost+min;
        }
        c[a][b]=c[b][a]=9999;
    }
    printf("\nmincost=%d",mincost);
}
void main()
{
    int i,j;
    printf("\nenter the number of vertices:");
    scanf("%d",&n);
    printf("\nenter the cost matrix:");
    for(i=1;i<=n;i++)
    {
        for(j=1;j<=n;j++)
        {
            scanf("%d",&c[i][j]);
        }
    }
    kruskals();
    getch();
}
```

OUTPUT:


enter the number of vertices:6
enter the cost matrix:
9999 3 9999 9999 6 5
3 9999 1 9999 9999 4
9999 1 9999 6 9999 4
9999 6 6 9999 8 5
6 9999 9999 8 9999 2
5 4 4 5 2 9999
2 --> 3 = 1
5 --> 6 = 2
1 --> 2 = 3
2 --> 6 = 4
4 --> 6 = 5
mincost=15

LAB PROGRAM-13

Implement all pair shortest paths problem using Floyd's algorithm.

```
 #include<stdio.h>
#include<conio.h>
int a[10][10],n;
void floyds()
{
   int i,j,k;
   for(k=1;k<=n;k++)
   {
      for(i=1;i<=n;i++)
      {
         for(j=1;j<=n;j++)
         {
            a[i][j]=min(a[i][j],a[i][k]+a[k][j]);
         }
      }
   }
   printf("\nall pair shortest path matrix is:\n");
   for(i=1;i<=n;i++)
   {
      for(j=1;j<=n;j++)
      {
         printf("\t%d",a[i][j]);
      }
      printf("\n");
   }
}
int min(int x,int y)
{
   if(x<y)
   {
      return x;
   }
```

```
 else
    {
       return y;
    }
 }
 void main()
 {
    int i,j;
    printf("\nenter the number of vertices:");
    scanf("%d",&n);
    printf("\nenter the cost matrix:");
    for(i=1;i<=n;i++)
    {
       for(j=1;j<=n;j++)
       {
          scanf("%d",&a[i][j]);
       }
    }
    floyds();
    getch();
}
```

OUTPUT:

```
enter the number of vertices:4

enter the cost matrix:
9999 9999 3 9999
2 9999 9999 9999
9999 7 9999 1
6 9999 9999 9999

all pair shortest path matrix is:
        10      10      3       4
        2       12      5       6
        7       7       10      1
        6       16      9       10
```

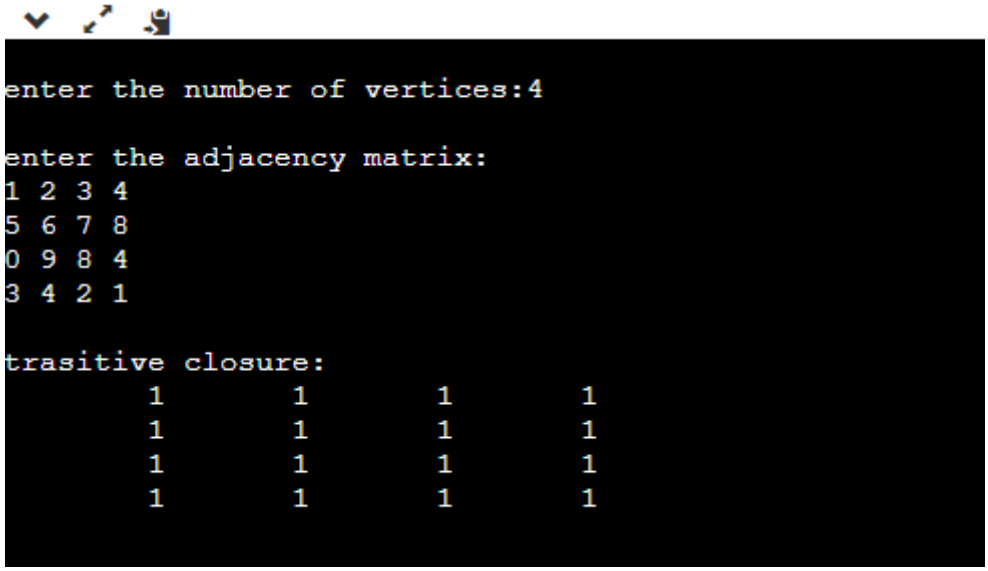
LAB PROGRAM-14

Implement Warshall's algorithm using dynamic programming.

```
#include<stdio.h>
#include<conio.h>
int a[10][10],r[10][10][10];
void warshall(int n)
{
   int i,j;
   int k=0;
   for(i=1;i<=n;i++)
   {
      for(j=1;j<=n;j++)
      {
         r[k][i][j]=a[i][j];
      }
   }
   for(k=1;k<=n;k++)
   {
      for(i=1;i<=n;i++)
      {
         for(j=1;j<=n;j++)
         {
            r[k][i][j]=r[k-1][i][j]||(r[k-1][i][k]&&r[k-1][k][j]);
         }
      }
   }
}
int main()
{
   int n,i,j;
   printf("\nenter the number of vertices:");
   scanf("%d",&n);
   printf("\nenter the adjacency matrix:");
   for(i=1;i<=n;i++)
```

```
    {
       for(j=1;j<=n;j++)
       {
          scanf("%d",&a[i][j]);
       }
    }
    warshall(n);
    printf("\ntrasitive closure:\n");
    for(i=1;i<=n;i++)
    {
       for(j=1;j<=n;j++)
       {
          printf("\t%d",r[n][i][j]);
       }
       printf("\n");
    }
}
```

OUTPUT:



LAB PROGRAM-15

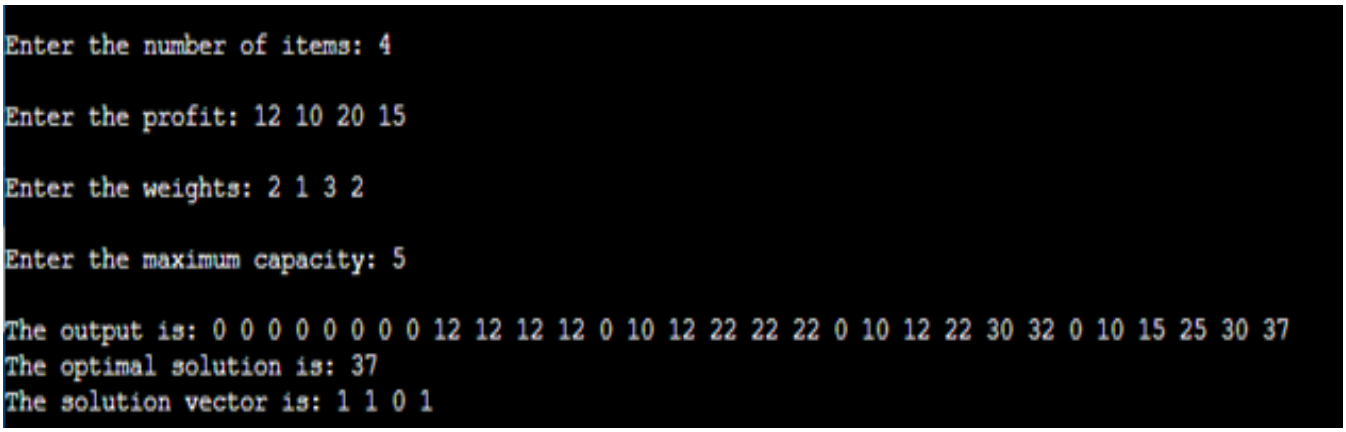
Implement O/I Knapsack problem using dynamic programming.

```
#include<stdio.h>
#include<conio.h>
int i,j,n,m,p[10],w[10],v[10][10];
void knapsack()
{
   int x[10];
   for(i=0;i<=n;i++)
   {
      for(j=0;j<=m;j++)
      {
         if(i==0||j==0)
         {
            v[i][j]=0;
         }
         else if(j-w[i]<0)
         {
            v[i][j]=v[i-1][j];
         }
         else
         {
            v[i][j]=max(v[i-1][j],v[i-1][j-w[i]]+p[i]);
         }
      }
   }
   printf("\nthe output is:\n");
   for(i=0;i<=n;i++)
   {
      for(j=0;j<=m;j++)
      {
         printf("%d\t",v[i][j]);
      }
      printf("\n");
```

```
    }
    printf("\nthe optimal solution is:%d",v[n][m]);
    printf("\nthe solution vector is:\n");
    for(i=n;i>=0;i--)
    {
       if(v[i][m]!=v[i-1][m])
       {
          x[i]=1;
          m=m-w[i];
       }
       else
       {
          x[i]=0;
       }
    }
    for(i=1;i<=n;i++)
    {
       printf("%d\t",x[i]);
    }
}
int max(int x,int y)
{
    if(x<y)
    {
       return x;
    }
    else
    {
       return y;
    }
}
void main()
{
    printf("\nenter the number of items:");
    scanf("%d",&n);
    printf("\nenter the weight of each item:");
    for(i=1;i<=n;i++)
```

```
    {
       scanf("%d",&w[i]);
    }
    printf("\nenter the profit of each item:");
    for(i=1;i<=n;i++)
    {
       scanf("%d",&p[i]);
    }
    printf("\nenter the knapsack's maximum capacity:");
    scanf("%d",&m);
    knapsack();
    getch();
}
```

OUTPUT:



LAB PROGRAM-16

Sort a given set of N integer elements using Heap Sort technique and compute its time taken. Run the program for different values of N and record the time taken to sort. Plot a graph of the time taken versus N using MS Excel. The program should allow both manual entry of the array elements and also reading of array elements using random number generator.

```
#include<stdio.h>
#include<stdlib.h>
#include<time.h>
#include<math.h>
void swap(int *a,int *b)
{
   int temp=*a;
   *a=*b;
   *b=temp;
}
void heapify(int arr[],int n,int i)
{
   int largest=i;
   int left=2*i+1;
   int right=2*i+2;
   if(left<n&&arr[left]>arr[largest])
   {
      largest=left;
   }
   else if(right<n&&arr[right]>arr[largest])
   {
      largest=right;
   }
   if(largest!=1)
   {
      swap(&arr[i],&arr[largest]);
      heapify(arr,n,largest);
   }
```

```
}
void heap_sort(int arr[],int n)
{
   for(int i=n/2-1;i>=0;i++)
   {
      heapify(arr,n,i);
   }
   for(int i=n-1;i>=0;i++)
   {
      swap(&arr[0],&arr[i]);
      heapify(arr,i,0);
   }
}
void main()
{
   int a[15000],i,j,ch,temp,n;
   clock_t end,start;
   while(1)
   {
      printf("\n1.For manual entry of N value and array elements");
      printf("\n2.To display time taken for sorting number of elements N in
the range 500 to 14500");
      printf("\n3.To exit");
      printf("\nEnter your choice:");
      scanf("%d",&ch);
      switch(ch)
      {
         case 1:
         printf("\nenter the number of elements:");
         scanf("%d",&n);
         printf("\nenter array elements:");
         for(i=0;i<=n;i++)
         {
            scanf("%d",&a[i]);
         }
         printf("\nTime taken to sort %d numbers is %f
secs",n,(((double)(end-start))/CLOCKS_PER_SEC));
```

```
            break;
            case 2:
            n=500;
            while(n<=14500)
            {
               for(i=0;i<=n;i++)
               {
                  a[i]=n-i;
               }
               start=clock();
               heap_sort(a,n);
               for(j=0;j<5000000;j++)
               {
                  temp=38/600;
               }
               end=clock();
               printf("\nTime taken to sort %d numbers is %f
 secs",n,(((double)(end-start))/CLOCKS_PER_SEC));
               n=n+1000;
            }
            break;
            case 3:
            exit(0);
         }
      }
}
```

OUTPUT:

```
Enter the num of vertices:      3

Enter the cost matrix:
1 2 9
5 7 9
4 5 9

Enter the source node:  2

The shortest distance is:

2----->1 = 5
2----->2 = 0
2----->3 = 9
```

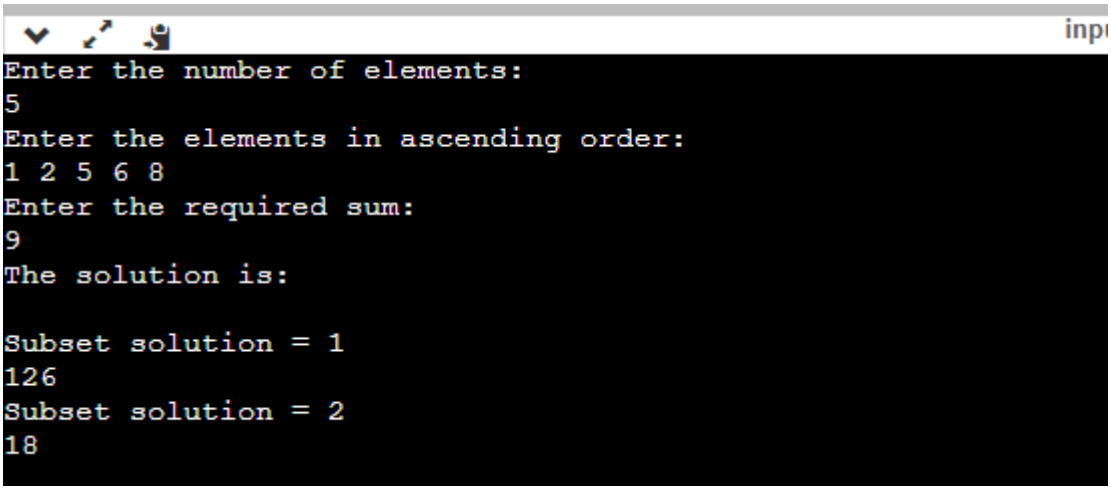
LAB PROGRAM-17

Implement "Sum of Subsets" using Backtracking. "Sum of Subsets" problem: Find a subset of a given set S = {s1,s2,……,sn} of n positive integers whose sum is equal to a given positive integer d. For example, if S = {1,2,5,6,8} and = 9 there are two solutions {1,2,6} and {1,8}. A suitable message is to be displayed if the given problem instance doesn't have a solution.

```
#include<stdio.h>
#include<conio.h>
int count,w[10],d,x[10];
void subset(int cs, int k, int r)
{
int i;
x[k]=1;
if(cs+w[k]==d)
{
printf("\nSubset solution = %d\n", ++count);
for(i=0;i<=k;i++)
{
if(x[i]==1)
printf("%d", w[i]);
}
}
else
if(cs+w[k]+w[k+1]<=d)
subset(cs+w[k], k+1, r-w[k]);
if((cs+r-w[k]>=d) && (cs+w[k+1])<=d)
{
x[k]=0;
subset(cs,k+1,r-w[k]);
}
    }

void  main()
   {
```

```
 int sum=0,i,n;
 printf("Enter the number of elements:\n");
 scanf("%d", &n);
 printf("Enter the elements in ascending order:\n");
 for(i=0;i<n;i++)
 scanf("%d", &w[i]);

 printf("Enter the required sum:\n");
 scanf("%d", &d);
 for(i=0;i<n;i++)
 sum+=w[i];
 if(sum<d)
 {
 printf("No solution exists\n");
 return;
 }
 printf("The solution is:\n");
 count=0;
 subset(0,0,sum);
 getch();
}
```

OUTPUT:



LAB PROGRAM-18

Implement 'N-Queens Problem' using backtracking.

```
#include<stdio.h>
#include<conio.h>
void nqueens(int n)
{
  int k,x[20],count=0;
  k=1;
  x[k]=0;
  while(k!=0)
  {
        x[k]++;
        while(place(x,k)!=1 && x[k]<=n)
              x[k]++;
        if(x[k]<=n)
        {
              if(k==n)
              {
                    printf("\nSolution is %d\n",
++count);
                    printf("Queen\t\tPosition\n");
                    for(k=1;k<=n;k++)
                          printf("%d\t\t%d\n", k,x[k]);
              }
              else
              {
                    k++;
                    x[k]=0;
              }
        }
        else
              k--;
  }
}
int place(int x[], int k)
```

```
{
   int i;
   for(i=1;i<=k-1;i++)
   {
         if(i+x[i]==k+x[k]||i-x[i]==k-x[k]||x[i]==x[k])
               return 0;
   }
   return 1;
}
void main()
{
   int n;
   clrscr();
   printf("Enter the number of Queens\n");
   scanf("%d", &n);
   nqueens(n);
   getch();
}
```

OUTPUT: