VISVESVARAYATECHNOLOGICALUNIVERSITY

"JnanaSangama", Belgaum -590014, Karnataka.

LAB REPORT

on

Analysis and Design of Algorithms

Submitted by

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in partial fulfilment for the award of the degree of

BACHELOROFENGINEERING

in

COMPUTER SCIENCE AND ENGINEERING

B.M.S. COLLEGE OF ENGINEERING

(Autonomous Institution under VTU)

BENGALURU-560019

May-2022 to July-2022

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 **HRUTHIK NAYAK B S (1BM20CS058),** who is bona fide student of **B. M. S. College of Engineering.** It is in partial fulfilment 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 - (19CS4PCADA)** work prescribed for the said degree.

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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.

1. Write a recursive program to Solve

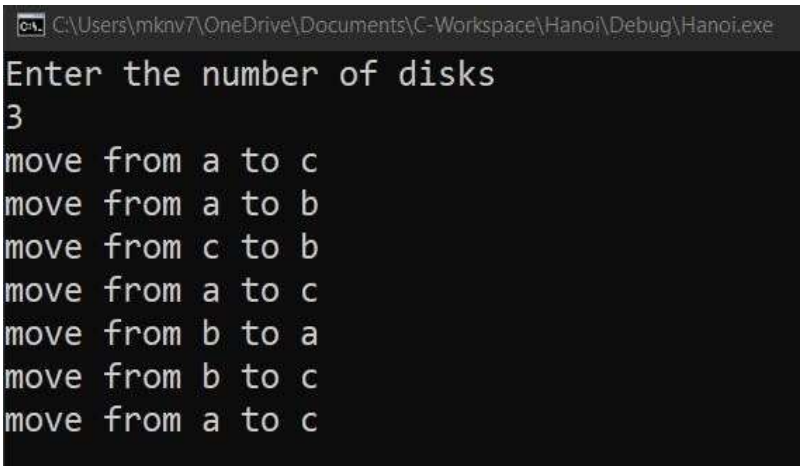
a) Towers-of-Hanoi problem b) To find GCD

CODE:

a) TOWER OF HANOI

```
#include <stdio.h> void hanoi(int n, char
a,char b,char c) { if(n==1) printf("move
from %c to %c\n",a,c);
   else {
      hanoi(n-1,a,c,b); printf("move from
      %c to %c\n",a,c); hanoi(n-1,b,a,c); }
}
void main() { int n; int moves;
   printf("Enter the number of disks\n");
   scanf("%d",&n);
   hanoi(n,'a','b','c'); }
```

OUTPUT:



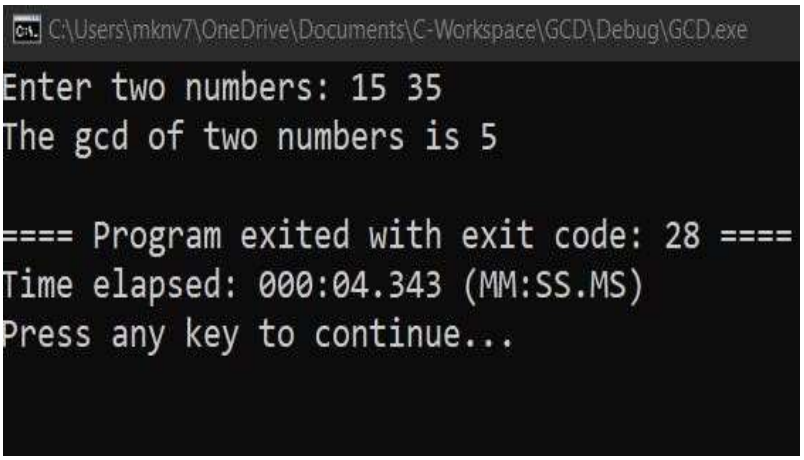
b) GREATEST COMMON DIVISOR

CODE:

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

```
int gcd(int a,int b) {
        if(b!=0) return
        gcd(b,a%b);
        else
          return a;
}
void main()
{ int a,b,c; printf("Enter two
   numbers: ");
   scanf("%d%d",&a,&b);
   c=gcd(a,b); printf("The gcd of two numbers
   is %d\n",c);
}
```

OUTPUT:



2. 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.

CODE:

```
#include<stdio.h>
#include<time.h>
#include<stdlib.h> int
bin_srch(int [],int,int,int);
int lin_srch(int [],int,int,int);
int n,a[1000000];

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<=7000)
  for(i=0;i<n;i++) a[i]=i;
  key=a[n-1];
  start=clock();
  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);
  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<=7000) {
       for(i=0;i<n;i++)
          a[i]=i;
   key=a[n-1];
   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);
   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();
  }
}
int bin_srch(int a[],int low,int high,int key) {
  for(int j=0;j<1000000;j++){ int temp=38/600;}
int mid; if(low>high)
```

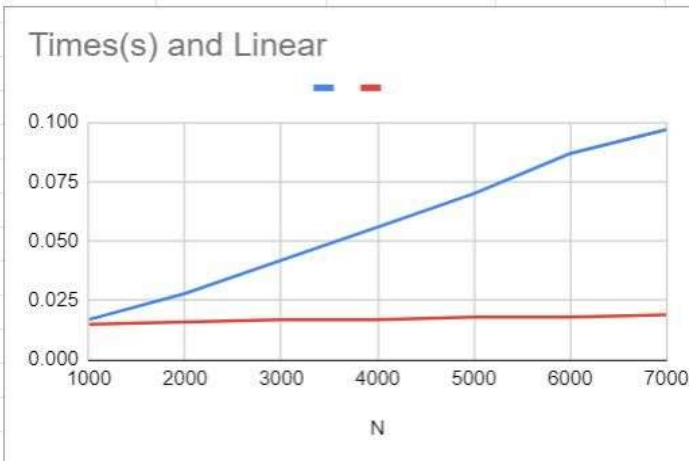
```
  return -1;
mid=(low+high)/2;
if(key==a[mid]) return
mid;
if(key<a[mid])
  return bin_srch(a,low,mid-1,key);
else
  return bin_srch(a,mid+1,high,key);
}
int lin_srch(int a[],int i,int high,int key) {
    for(int j=0;j<10000;j++){ int temp=38/600;}
if(i>high) return
 -1;
if(key==a[i])
  return i;
else
  return lin_srch(a,i+1,high,key);
}
```

OUTPUT:

```
C:\Users\mknv7\OneDrive\Documents\C-Workspace\binary_linear\Debug\binary_linear.exe

1: Binary search          2: Linear search          3: Exit

Enter your choice:       1

 Key found at position 999
Time for n=1000 is 0.015000 Secs
 Key found at position 1999
Time for n=2000 is 0.016000 Secs
 Key found at position 2999
Time for n=3000 is 0.017000 Secs
 Key found at position 3999
Time for n=4000 is 0.017000 Secs
 Key found at position 4999
Time for n=5000 is 0.018000 Secs
 Key found at position 5999
Time for n=6000 is 0.018000 Secs
 Key found at position 6999
Time for n=7000 is 0.019000 Secs
1: Binary search          2: Linear search          3: Exit

Enter your choice:       2

 Key found at position 999
Time for n=1000 is 0.017000 Secs
 Key found at position 1999
Time for n=2000 is 0.028000 Secs
 Key found at position 2999
Time for n=3000 is 0.042000 Secs
 Key found at position 3999
Time for n=4000 is 0.056000 Secs
 Key found at position 4999
Time for n=5000 is 0.070000 Secs
 Key found at position 5999
Time for n=6000 is 0.087000 Secs
 Key found at position 6999
Time for n=7000 is 0.097000 Secs
```

GRAPH:

N	Linear Times(s)	Binary Time(s)
1000	0.017	0.015
2000	0.028	0.016
3000	0.042	0.017
4000	0.056	0.017
5000	0.07	0.018
6000	0.087	0.018
7000	0.097	0.019



3.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.

CODE:

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

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;
   }
}
void main()
{ int a[15000],n,i,j,ch,temp;
  clock_t start,end;
```

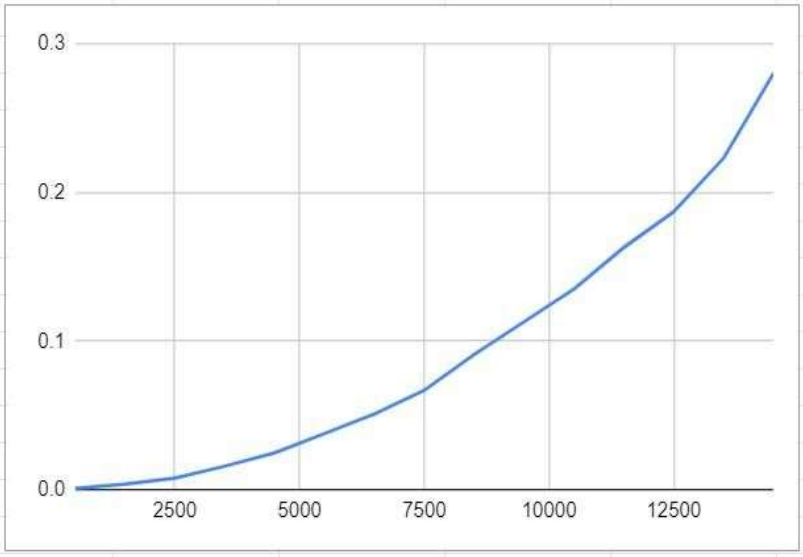
```
  while(1) {
    printf("\n1:To display time taken for sorting number of elements N
in the range 500 to 14500");
    printf("\n2:To exit");
    printf("\nEnter your choice:");
    scanf("%d", &ch);
    switch(ch)
    {
    case 1:
              n=500;
              while(n<=14500) {
              for(i=0;i<n;i++) 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 2: exit(0);
  }
  getchar();
   }
}
```

OUTPUT:

```
C:\Users\mknv7\OneDrive\Documents\C-Workspace\select_sort\Debug\select_sort.exe

1:To display time taken for sorting number of elements N in the range 500 to 14500
2:To exit
Enter your choice:1

 Time taken to sort 500 numbers is 0.001000 Secs
 Time taken to sort 1500 numbers is 0.004000 Secs
 Time taken to sort 2500 numbers is 0.008000 Secs
 Time taken to sort 3500 numbers is 0.016000 Secs
 Time taken to sort 4500 numbers is 0.025000 Secs
 Time taken to sort 5500 numbers is 0.038000 Secs
 Time taken to sort 6500 numbers is 0.051000 Secs
 Time taken to sort 7500 numbers is 0.067000 Secs
 Time taken to sort 8500 numbers is 0.091000 Secs
 Time taken to sort 9500 numbers is 0.113000 Secs
 Time taken to sort 10500 numbers is 0.135000 Secs
 Time taken to sort 11500 numbers is 0.163000 Secs
 Time taken to sort 12500 numbers is 0.187000 Secs
 Time taken to sort 13500 numbers is 0.223000 Secs
 Time taken to sort 14500 numbers is 0.280000 Secs
```

GRAPH:

N Inputs	Time in sec
500	0.001
1500	0.004
2500	0.008
3500	0.016
4500	0.025
5500	0.038
6500	0.051
7500	0.067
8500	0.091
9500	0.113
10500	0.135
11500	0.163
12500	0.187
13500	0.223
14500	0.28



4.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.

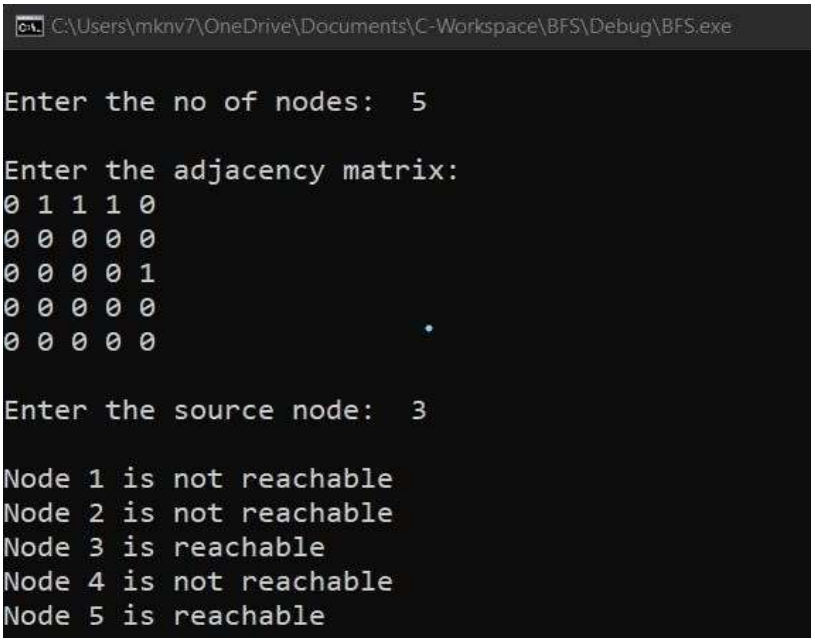
a) BREADTH FIRST SEARCH

CODE:

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

void main() { int
 i,j,src;
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);
bfs(src);
}
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",j);
  else printf("\nNode %d is
   reachable",j);
}
}
```

OUTPUT:



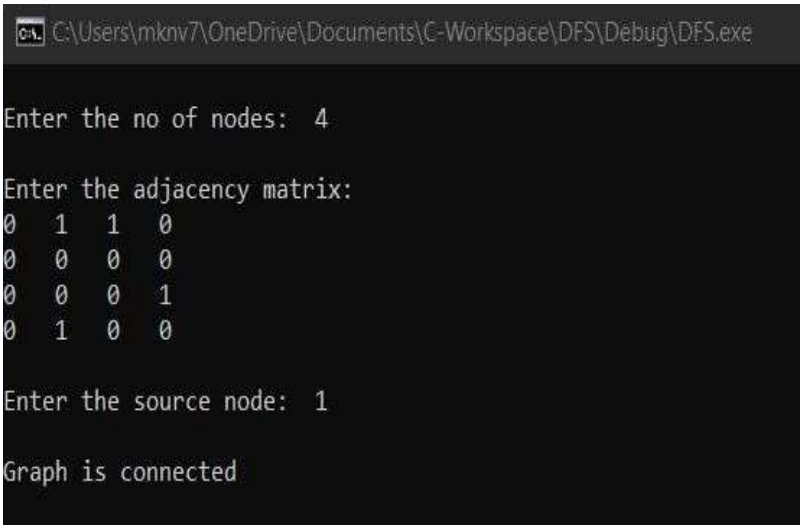
b)DEPTH FIRST SEARCH

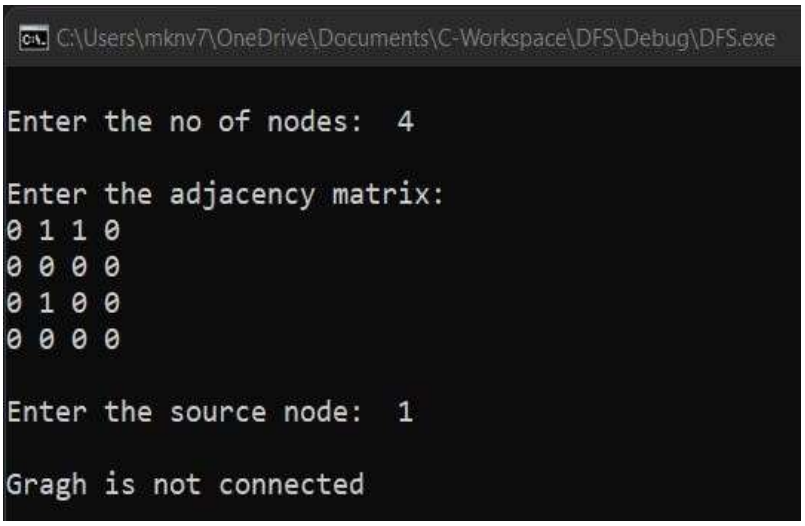
CODE:

```
#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:





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

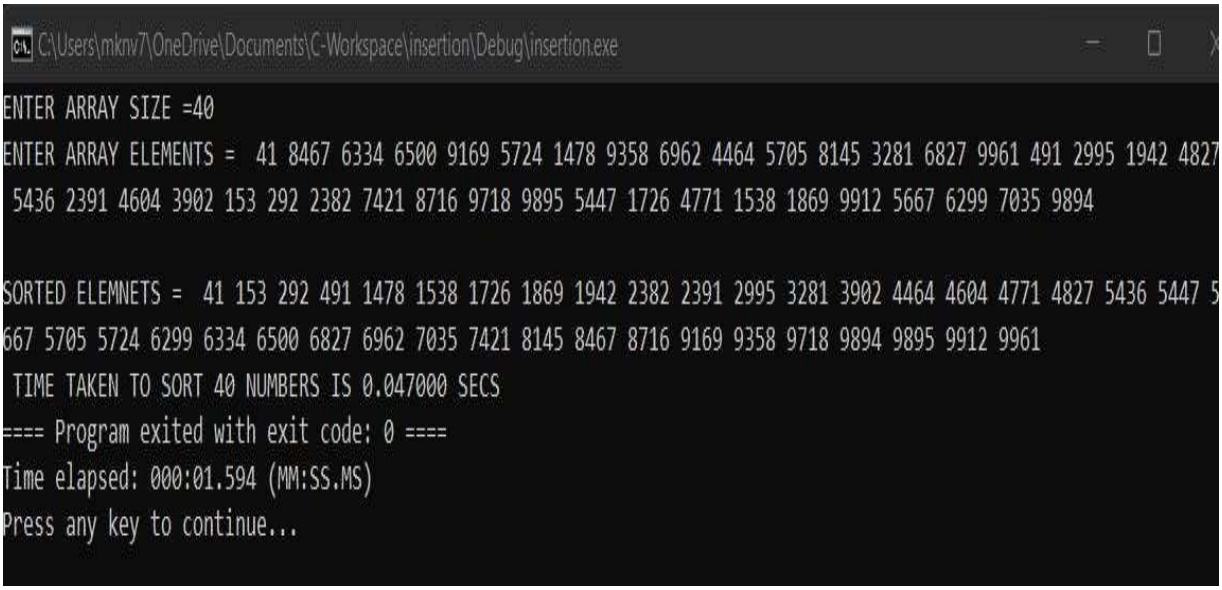
CODE:

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

void insertionSort(int arr[], int n)
```

```
{ int i, key, j;
        for (i = 1; i < n; i++)
        {
                key = arr[i];
                j = i - 1;
                while (j >= 0 && arr[j] > key)
                {
                        for(int k=0;k<100000;k++);
                        arr[j + 1] = arr[j];
                        j = j - 1;
                }
                arr[j + 1] = key;
        }
}
int main()
{ int i, n;
   clock_t start, end;
   printf("ENTER ARRAY SIZE =");
   scanf("%d", &n);
   int arr[150000];
   printf("ENTER ARRAY ELEMENTS = ");
   for (int j = 0; j < n; j++)
   {
      arr[j] = rand()%10000;
   }
   for (i = 0; i < n; i++)
   { printf(" %d", arr[i]);
   } printf("\n"); start
   = clock();
   insertionSort(arr,
   n); end = clock();
```

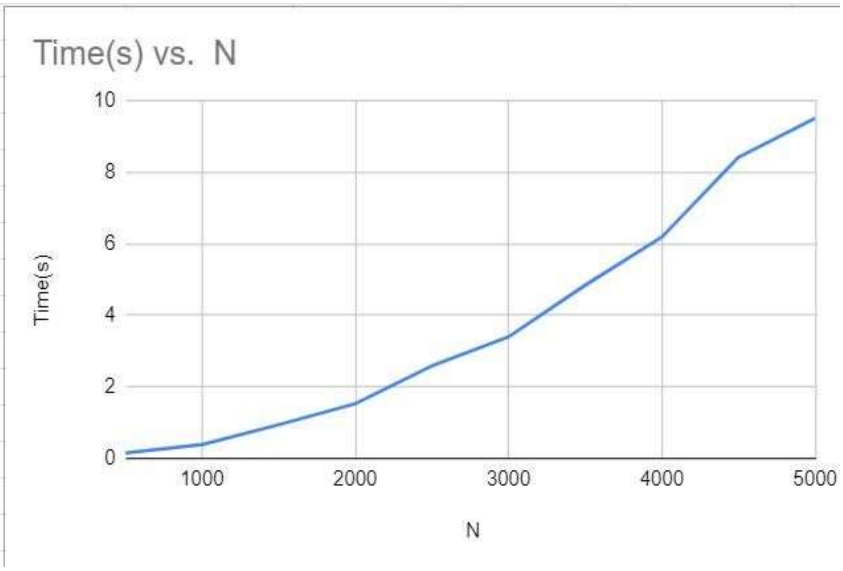
```
    printf("\nSORTED ELEMNETS = ");
    for (i = 0; i < n; i++) {
        printf(" %d", arr[i]);
    }
    printf("\n TIME TAKEN TO SORT %d NUMBERS IS %f SECS", n,
(((double)(end - start)) / CLOCKS_PER_SEC));
    return 0;
}
```

OUTPUT:



GRAPH:

N	Time(s)
500	0.125
1000	0.361
1500	0.92
2000	1.511
2500	2.573
3000	3.386
3500	4.832
4000	6.184
4500	8.422
5000	9.515



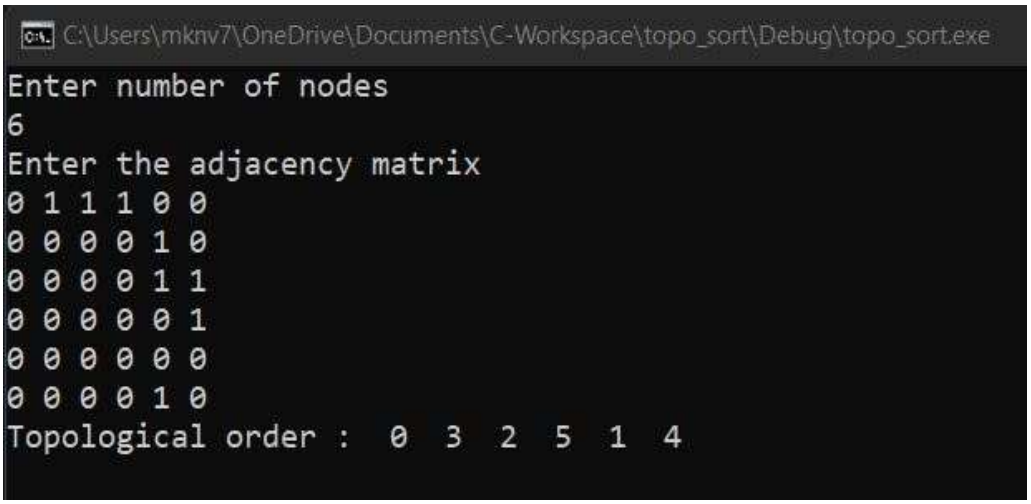
6. Write program to obtain the Topological ordering of vertices in a given digraph.

CODE:

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

void source_removal(int n, int a[10][10]) {
   int i,j,k,u,v,top,s[10],t[10],indeg[10],sum;
   for(i=0;i<n;i++) { sum=0;
      for(j=0;j<n;j++)
         sum+=a[j][i];
      indeg[i]=sum;
   } top=-1;
   for(i=0;i<n;i++) {
   if(indeg[i]==0)
         s[++top]=i;
   }
   k=0; while(top!=-
   1) {
```

```
        u=s[top--];
        t[k++]=u;
        for(v=0;v<n;v++) {
           if(a[u][v]==1) { indeg[v]=indeg[v]-
              1; if(indeg[v]==0)
                 s[++top]=v;
           }
        }
     }
     printf("Topological order :");
     for(i=0;i<n;i++)
        printf(" %d", t[i]);
}

void main() {
int i,j,a[10][10],n; printf("Enter
number of nodes\n"); scanf("%d",
&n); printf("Enter the adjacency
matrix\n");
for(i=0;i<n;i++)
   for(j=0;j<n;j++)
      scanf("%d", &a[i][j]);
source_removal(n,a);
getch(); }
```

OUTPUT:



7. Implement Johnson Trotter algorithm to generate permutations.

CODE:

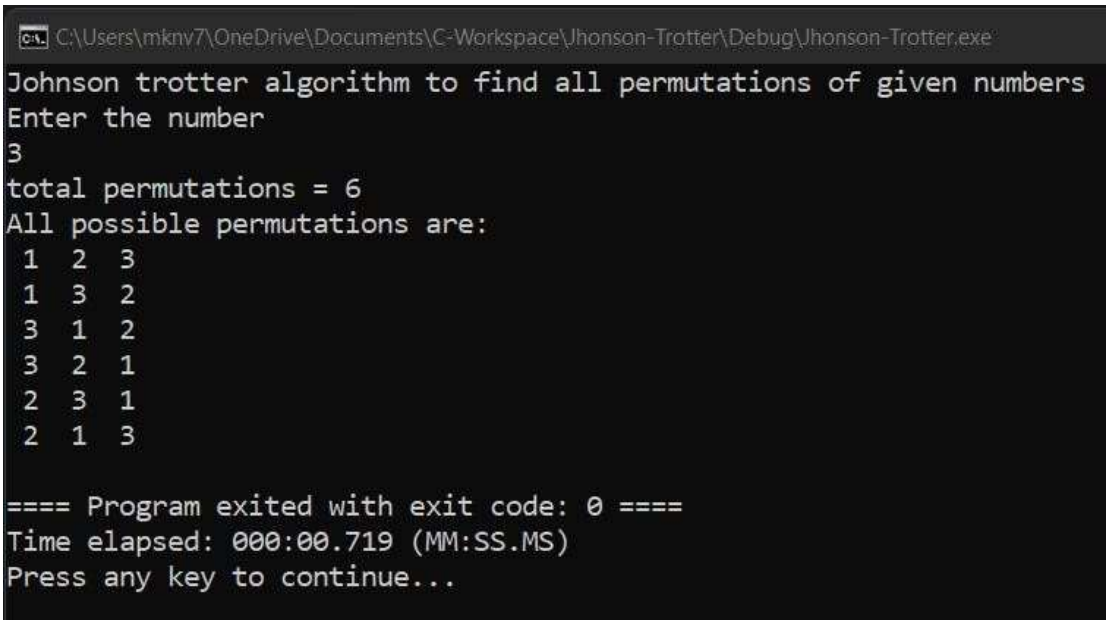
```
#include <stdio.h>
#include <stdlib.h>
int flag = 0;

int swap(int *a,int *b) {
int t = *a; *a
= *b;
*b = t;
}
int search(int arr[],int num,int mobile) {
int g; for(g=0;g<num;g++)
{ if(arr[g] == mobile)
   return g+1;
else
   flag++;
}
return -1;
}
```

```
int find_Moblie(int arr[],int d[],int num) {
int mobile = 0;
int mobile_p = 0;
int i;
for(i=0;i<num;i++)
{
if((d[arr[i]-1] == 0) && i != 0)
{
if(arr[i]>arr[i-1] && arr[i]>mobile_p) {
mobile = arr[i];
mobile_p = mobile;
} else
flag++;
}
else if((d[arr[i]-1] == 1) & i != num-1)
{ if(arr[i]>arr[i+1] &&
 arr[i]>mobile_p)
{
mobile = arr[i];
mobile_p = mobile;
} else
flag++; }
else
flag++;
}
if((mobile_p == 0) && (mobile == 0))
return 0; else
return mobile;
}
void permutations(int arr[],int d[],int num)
```

```
{ int
 i;
int mobile = find_Moblie(arr,d,num);
int pos = search(arr,num,mobile);
if(d[arr[pos-1]-1]==0)
swap(&arr[pos-1],&arr[pos-2]); else
swap(&arr[pos-1],&arr[pos]);
for(int i=0;i<num;i++)
{
if(arr[i] > mobile)
{ if(d[arr[i]-
1]==0) d[arr[i]-1]
= 1; else d[arr[i]-
1] = 0;
}
}
for(i=0;i<num;i++)
{
printf(" %d ",arr[i]); }
}

int factorial(int k)
{
int f = 1;
int i = 0; for(i=1;i<k+1;i++)
   f = f*i;
return f;
}
int main()
{
```

```
int num = 0;
int i; int j;
int z = 0; printf("Johnson trotter algorithm to find all permutations
of given
numbers \n");
printf("Enter the number\n");
scanf("%d",&num);
int arr[num],d[num]; z = factorial(num);
printf("total permutations = %d",z);
printf("\nAll possible permutations are: \n");
for(i=0;i<num;i++)
{
d[i] = 0; arr[i] = i+1;
printf(" %d ",arr[i]);
} printf("\n");
for(j=1;j<z;j++) {
permutations(arr,d,num);
printf("\n");
   }
return 0;
}
```

OUTPUT:



8. 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.

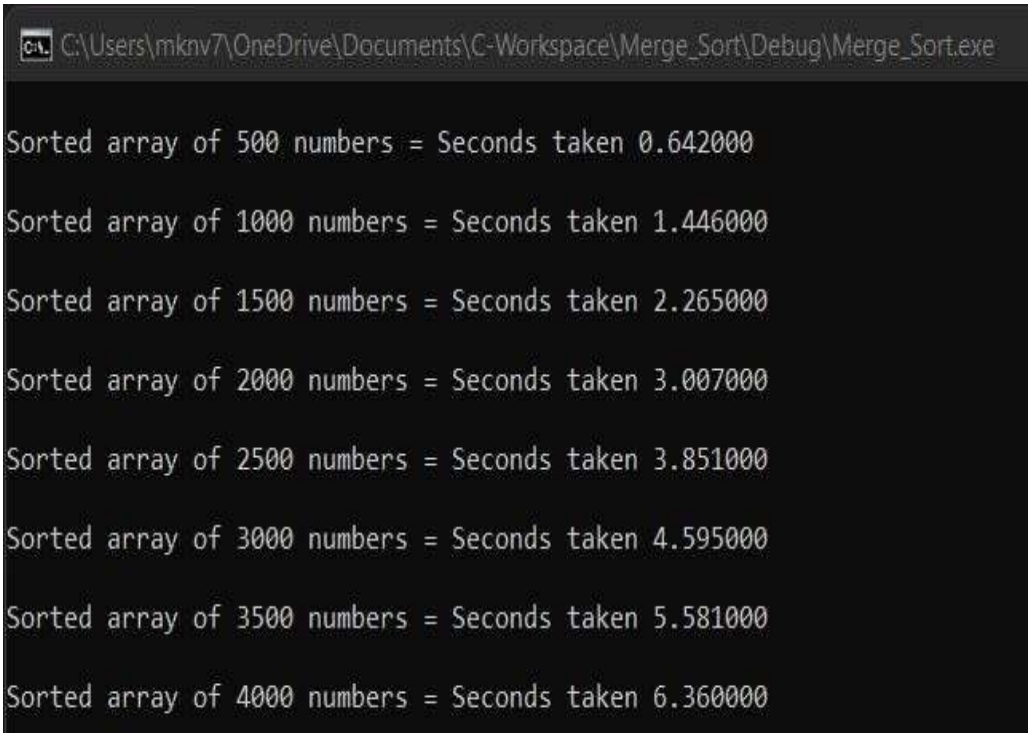
CODE:

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

mergesort(int a[],int i,int j); void

merge(int a[],int i1,int j1,int i2,int j2);

int main()
{
clock_t start,end; int
a[30000],n=500,i;
while(n<=5000){
for(i=0;i<n;i++)
{
```

```
   a[i] = rand()%1000;
} start = clock();
mergesort(a,0,n-1);
end = clock();
printf("\nSorted array of %d numbers = ",n);
printf("Seconds taken %lf",(double)(end-start)/CLOCKS_PER_SEC);
printf("\n");
n+=500;
}
}
void mergesort(int a[],int i,int j)
{
int mid;
if(i<j) { mid=(i+j)/2;
mergesort(a,i,mid);
mergesort(a,mid+1,j);
merge(a,i,mid,mid+1,j);
}
}

void merge(int a[],int i1,int j1,int i2,int j2)
{
int temp[30000];
int i,j,k; i=i1; j=i2;
k=0; while(i<=j1 &&
j<=j2)
{ for(int j=0;j<100000;j++);
if(a[i]<a[j])
temp[k++]=a[i++];
else
temp[k++]=a[j++];
```

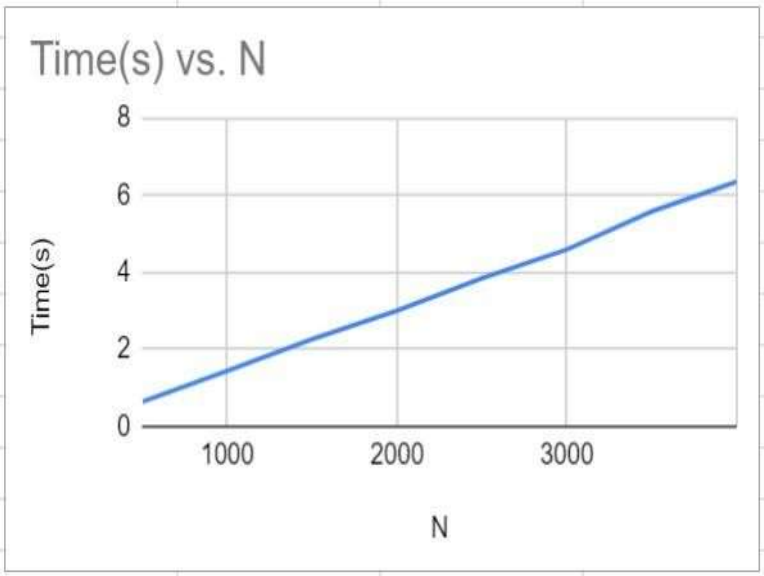
```
} while(i<=j1)
temp[k++]=a[i++];
while(j<=j2)
temp[k++]=a[j++];
for(i=i1,j=0;i<=j2;i++,j++)
a[i]=temp[j]; }
```

OUTPUT:



GRAPH:

N	Time(s)
500	0.642
1000	1.446
1500	2.265
2000	3.007
2500	3.851
3000	4.595
3500	5.581
4000	6.36



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

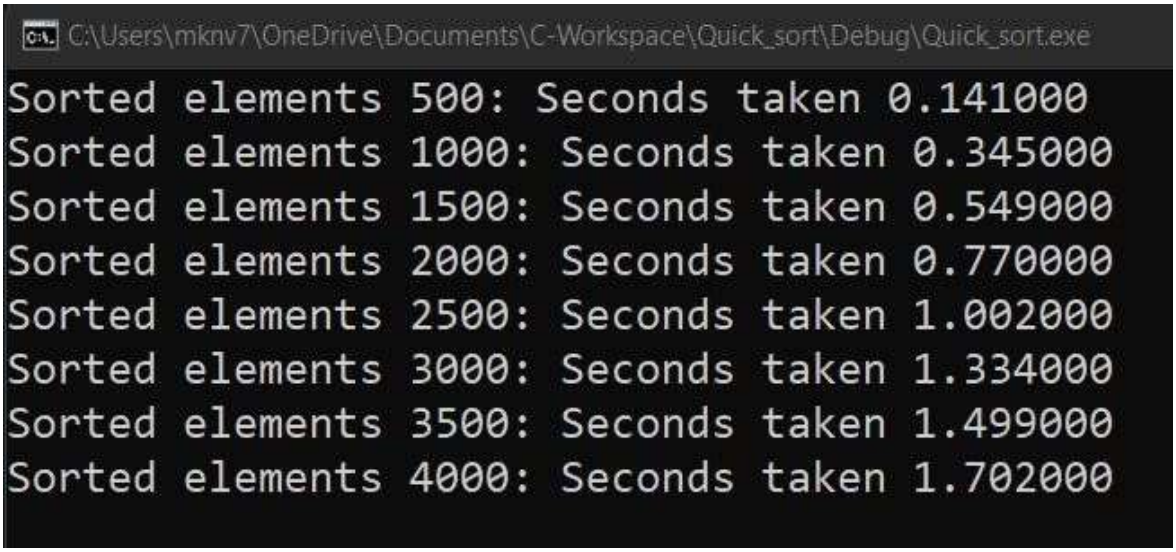
CODE:

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

void quicksort(int number[5000],int first,int last)
{
   int i, j, pivot, temp;
   if(first<last)
  { pivot=first;
     i=first;
     j=last;
     while(i<j)
     {
```

```
      for(int x=0;x<10000000;x++);
            while(number[i]<=number[pivot]&&i<last)
            i++;
      while(number[j]>number[pivot])
                  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);
  }
}
int main()
{ clock_t start,end; int i,
  count, number[5000];
  printf("No. of elements: ");
  scanf("%d",&count);
  printf("Enter %d elements: ", count);
  for(i=0;i<count;i++)\
 {
     scanf("%d",&number[i]);
  } start =
  clock();
```

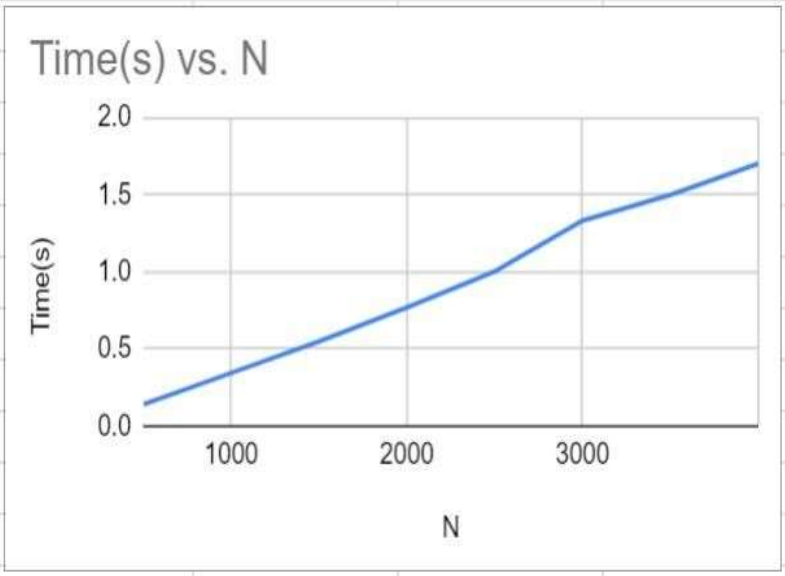
```
  quicksort(number,0,count-1);
  end = clock();
  printf("Order of Sorted elements: ");
  for(i=0;i<count;i++)
 {
     printf(" %d",number[i]);
 }
  printf("\nSeconds taken %lf",(double)(end-start)/CLOCKS_PER_SEC);
  return 0;
}
```

OUTPUT:



GRAPH:

N	Time(s)
500	0.141
1000	0.345
1500	0.549
2000	0.77
2500	1.002
3000	1.334
3500	1.499
4000	1.702



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

CODE:

```
#include <stdio.h>
#include <time.h>
#include <stdlib.h>
#include <math.h> void
swap(int *,int *); void
heapify(int [],int,int); void
heapSort(int[], int);
int main()
{
   int a[15000], n, i, j, ch;
   clock_t start, end;
   while (1)
   {
      printf("\n1:FOR MANUAL ENTRY");
      printf("\n2:DISPLAY TIME TAKEN TO SORT ELEMENTS FROM
```

```
RANGE 500 TO 5500");
      printf("\n3:EXIT");
      printf("\nENTER YOUR CHOICE:");
      scanf("%d", &ch);
      switch (ch)
      {
      case 1:
         printf("\nENTER NUMBER OF ARRAY ELEMENTS: ");
         scanf("%d", &n);
         printf("ENTER ARRAY ELEMENTS: ");
         for (i = 0; i < n; i++)
         {
            scanf("%d", &a[i]);
         } start =
         clock();
         heapSort(a,
         n); end =
         clock();
         printf("\nSORTED ARRAY IS: ");
         for (i = n-1; i >= 0; 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 <= 5500)
         {
            for (i = 0; i < n; i++)
            {
```

```
                //a[i]=rand()%n;
                a[i] = n - i;
            } start =
            clock();
            heapSort(a,
            n);
            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 swap(int *a, int *b)
{
   int temp = *a;
   *a = *b;
   *b = temp;
}
void heapify(int arr[], int n, int i)
{
   int temp;
   for (int j = 0; j < 50000; j++)
      temp = 38 / 600;
```

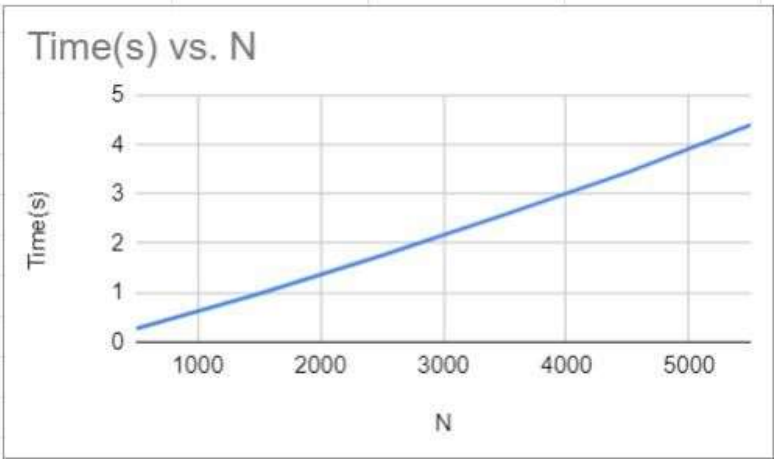
```
    int largest = i; int left = 2 * i + 1; int
    right = 2 * i + 2; if (left < n &&
    arr[left] > arr[largest]) largest = left;
    if (right < n && arr[right] > arr[largest])
        largest = right;
    if (largest != i)
    { swap(&arr[i], &arr[largest]);
        heapify(arr, n, largest);
    }
}
void heapSort(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); } }
```

OUTPUT:

```
1:FOR MANUAL ENTRY
2:DISPLAY TIME TAKEN TO SORT ELEMENTS FROM RANGE 500 TO 5500
3:EXIT
ENTER YOUR CHOICE:2

 TIME TAKEN TO SORT 500 NUMBERS IS 0.270000 SECS
 TIME TAKEN TO SORT 1500 NUMBERS IS 0.978000 SECS
 TIME TAKEN TO SORT 2500 NUMBERS IS 1.751000 SECS
 TIME TAKEN TO SORT 3500 NUMBERS IS 2.580000 SECS
 TIME TAKEN TO SORT 4500 NUMBERS IS 3.436000 SECS
 TIME TAKEN TO SORT 5500 NUMBERS IS 4.394000 SECS
1:FOR MANUAL ENTRY
2:DISPLAY TIME TAKEN TO SORT ELEMENTS FROM RANGE 500 TO 5500
3:EXIT
ENTER YOUR CHOICE:1

ENTER NUMBER OF ARRAY ELEMENTS: 4

ENTER ARRAY ELEMENTS: 32 8 90 19

SORTED ARRAY IS: 90     32      19      8
 TIME TAKEN TO SORT 4 NUMBERS IS 0.000000 SECS
```

GRAPH:

N	Time(s)
500	0.27
1500	0.978
2500	1.751
3500	2.58
4500	3.436
5500	4.394



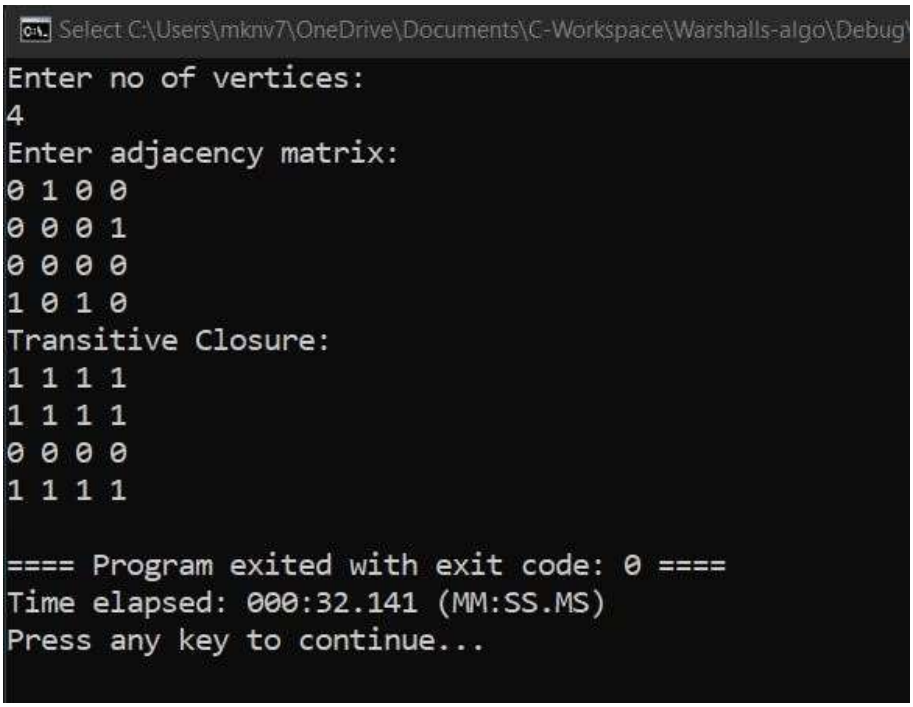
11. Implement Warshall's algorithm using dynamic programming

CODE:

```
#include<stdio.h>
int a[30][30];

void warshall(int n){
   for(int k=1;k<=n;k++)
      for(int i=1;i<=n;i++)
         for(int j=1;j<=n;j++)
            a[i][j]=a[i][j]|| (a[i][k] && a[k][j]);
}

int main(){
   int n;
   printf("Enter no of vertices: \n");
   scanf("%d",&n);

   printf("Enter adjacency matrix: \n");
   for(int i=1;i<=n;i++)
```

```
    for(int j=1;j<=n;j++)
        scanf("%d",&a[i][j]);
  warshall(n);
  printf("Transitive Closure: \n");
  for(int i=1;i<=n;i++){
    for(int j=1;j<=n;j++)
        printf("%d ",a[i][j]);
    printf("\n");
  }
}
```

OUTPUT:



12. Implement 0/1 Knapsack problem using dynamic programming.

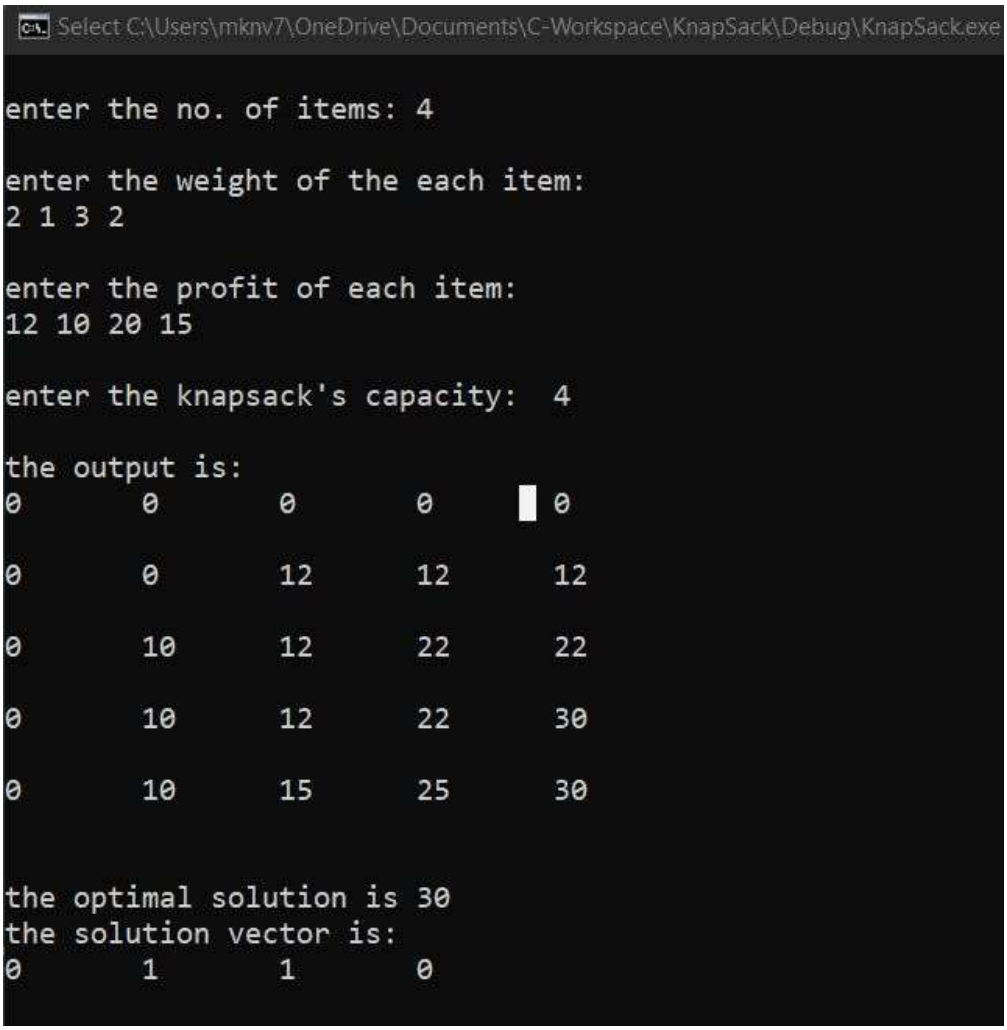
CODE:

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

```
void knapsack();
int max(int,int);
int i,j,n,m,p[10],w[10],v[10][10];
void main()
{
 clrscr();
printf("\nenter the no. of items:\t");
scanf("%d",&n);
printf("\nenter the weight of the each item:\n");
for(i=1;i<=n;i++) scanf("%d",&w[i]);
printf("\nenter the profit of each item:\n");
for(i=1;i<=n;i++) scanf("%d",&p[i]);
printf("\nenter the knapsack's capacity:\t");
scanf("%d",&m); knapsack(); getch();
}
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\n");
```

```
}
printf("\nthe optimal solution is %d",v[n][m]); printf("\nthe
solution vector is:\n");
for(i=n;i>=1;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;
}
```

OUTPUT:



13. Implement All Pair Shortest paths problem using Floyd's algorithm.

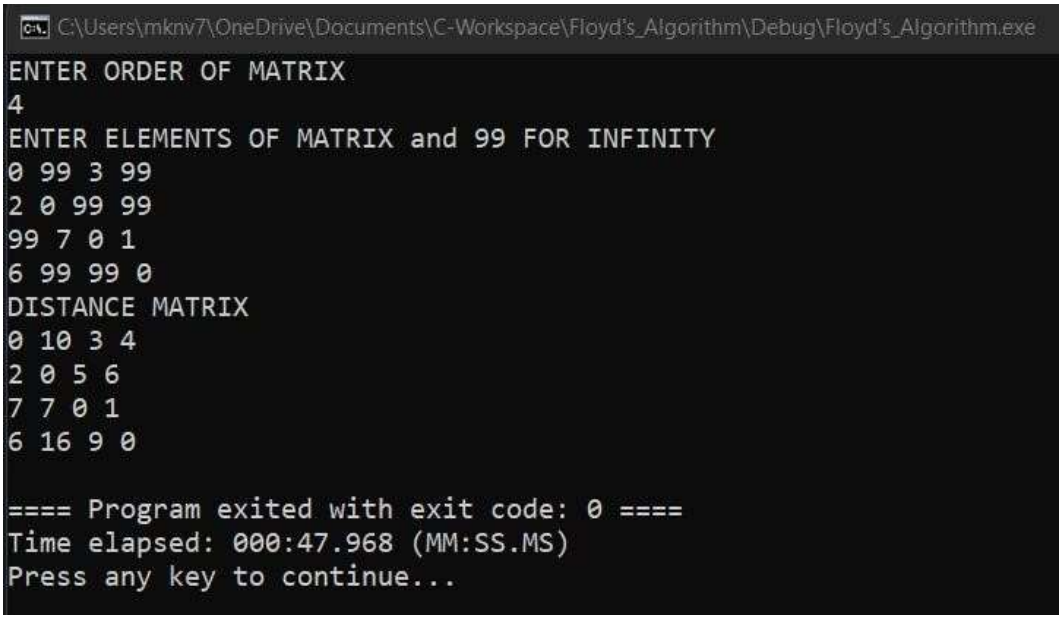
CODE:

```
#include<stdio.h> int n;
void display(int dist[][n]);
void floyd (int graph[][n])
{ int dist[n][n], i, j, k;

        for (i = 0; i < n; i++) for (j
                = 0; j < n; j++)
                        dist[i][j] = graph[i][j];
```

```
        for (k = 0; k < n; k++) for (i =
                0; i < n; i++) for (j = 0; j <
                n; j++)
                                if (dist[i][k] + dist[k][j] < dist[i][j])
                                        dist[i][j] = dist[i][k] + dist[k][j];
        display(dist);
}

void display(int dist[][n]) { printf
        ("DISTANCE MATRIX \n"); for
        (int i = 0; i < n; i++)
        {
                for (int j = 0; j < n; j++)
                { if (dist[i][j] == 99)
                        printf("99 ");
                        else printf ("%d ", dist[i][j]);
                }
                printf("\n");
        }
}

int main()
{
   printf("ENTER ORDER OF MATRIX \n");
   scanf("%d",&n);
   int graph[n][n];
   printf("ENTER ELEMENTS OF MATRIX and 99 FOR
   INFINITY\n"); for(int i = 0;i < n;i++) for(int j = 0;j < n; j++)
   scanf("%d",&graph[i][j]);
        floyd(graph);
        return 0;
```

}

OUTPUT:



14. Find Minimum Cost Spanning Tree of a given undirected graph using Prim's algorithm.

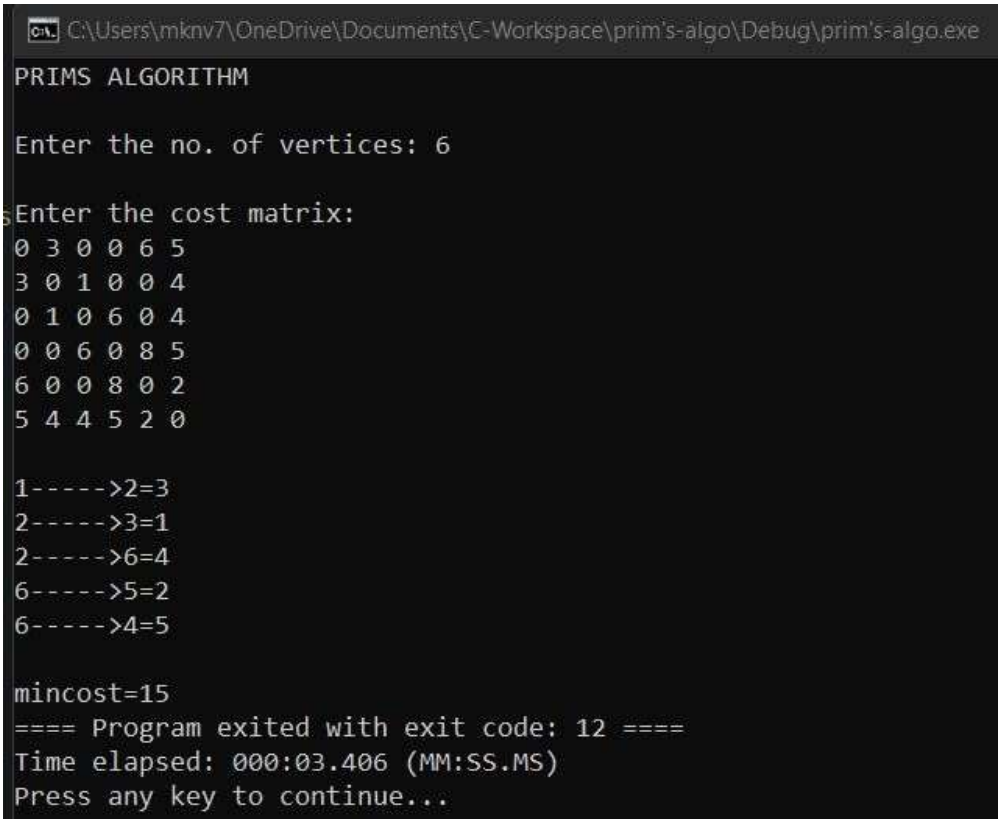
CODE:

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

void main()
{ int i,j; int
 c[10][10],n;
printf("\nenter the no. of vertices: ");
scanf("%d",&n);
printf("\nenter the cost matrix:\n");
for(i=1;i<=n;i++)
{ for(j=1;j<=n;j++)
```

```
  {
   scanf("%d",&c[i][j]);
   if(c[i][j]==0)
      c[i][j]=1000;
  }
} int u,v,min; int
ne=0,mincost=0; int
elec[10];
for(i=1;i<=n;i++)
{ elec[i]=0;
} elec[1]=1;
while(ne!=n-1)
{
  min=1000;
  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]==0
  )
  {
   printf("\n%d----->%d=%d\n",u,v,min);
   ne=ne+1;
   mincost=mincost+min;
```

```
 }
 elec[v]=1;
 c[u][v]=c[v][u]=1000;
}
printf("\nmincost=%d",mincost);
}
```

OUTPUT:



15. Find Minimum Cost Spanning Tree of a given undirected graph using Kruskals algorithm.

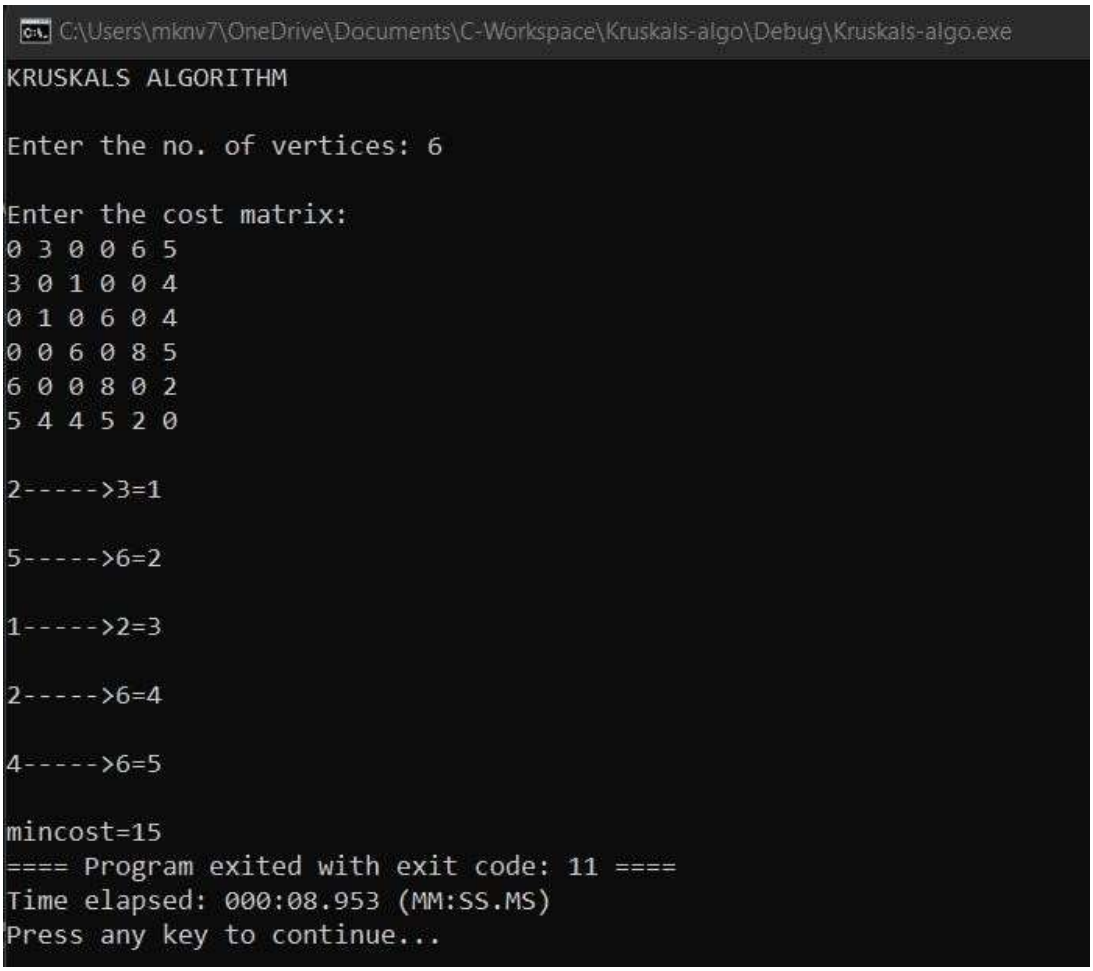
CODE:

```
#include<stdio.h>
void kruskals();
int c[10][10],n;
void main()
```

```
{ int
 i,j;
printf("\nenter the no. of vertices:\t");
scanf("%d",&n);
printf("\nenter the cost matrix:\n");
for(i=1;i<=n;i++)
{ for(j=1;j<=n;j++)
  {
   scanf("%d",&c[i][j]);
  if(c[i][j]==0)
        c[i][j]=9999;
  }
} kruskals();
}

void kruskals()
{ int i,j,u,v,a,b,min;
 int ne=0,mincost=0;
 int 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\n",a,b,min); parent[v]=u;
   ne=ne+1;
   mincost=mincost+min;
  }
  c[a][b]=c[b][a]=9999;
}
printf("\nmincost=%d",mincost);
}
```

OUTPUT:



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

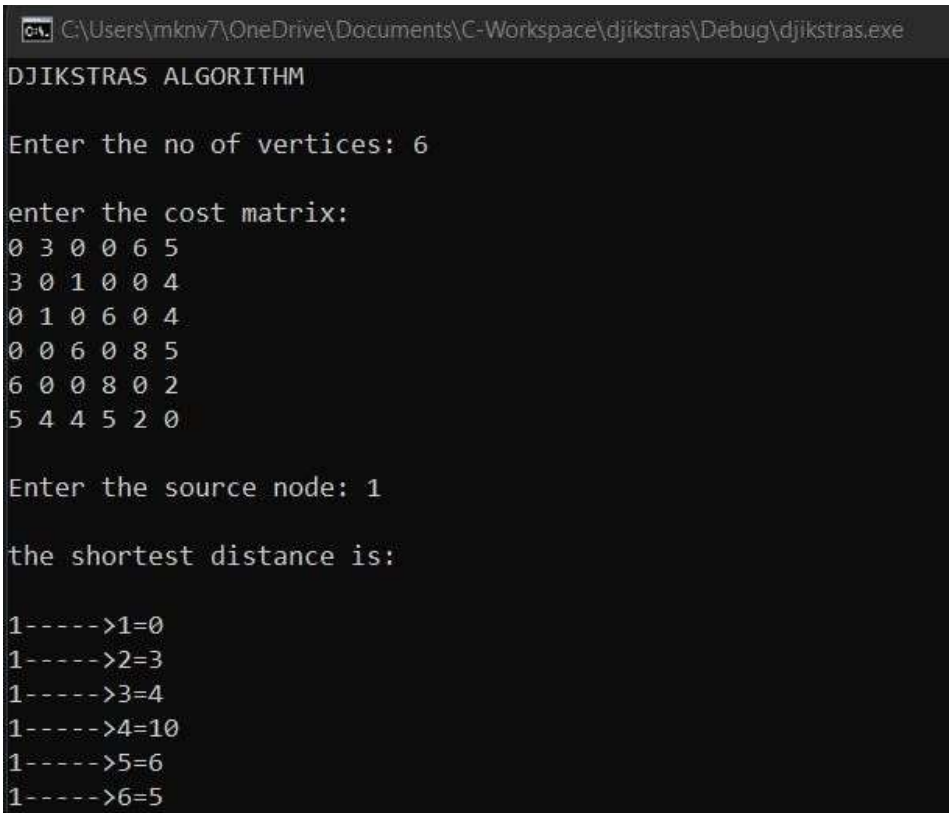
CODE:

```
#include <stdio.h>
void dijkstras(); int
c[10][10], n, src;
void main()
{ int i,
  j;
  printf("\nenter the no of vertices: ");
  scanf("%d", &n);
  printf("\nenter the cost matrix:\n");
```

```
  for (i = 1; i <= n; i++)
  {
    for (j = 1; j <= n; j++)
    { scanf("%d",
      &c[i][j]);
     if(c[i][j]==0)
         c[i][j]=9999;
    }
  }
  printf("\nenter the source node:
  "); scanf("%d", &src); dijkstras();
}
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:\n"); for (j =
1; j <= n; j++) printf("\n%d----->%d=%d", src, j,
dist[j]); }
```

OUTPUT:



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 d = 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.

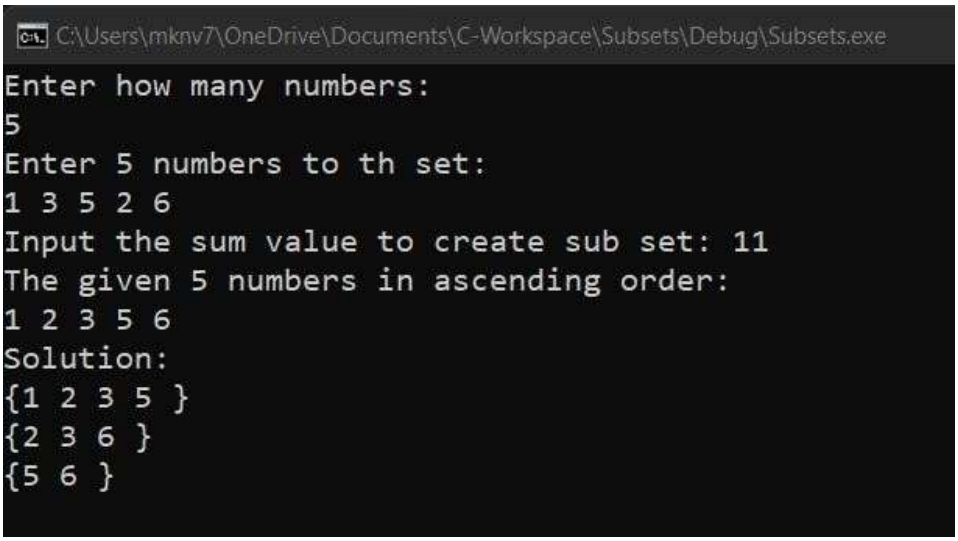
CODE:

```
#include<stdio.h>
#include<conio.h>
#define TRUE 1 #define FALSE 0 int inc[50],w[50],sum,n; int
promising(int i,int wt,int total) {
return(((wt+total)>=sum)&&((wt==sum)||(wt+w[i+1]<=sum)));
}
```

```
void main() { int
        i,j,n,temp,total=0;
        printf("Enter how many numbers:\n");
        scanf("%d",&n);
        printf("Enter %d numbers to th set:\n",n);
        for (i=0;i<n;i++) {
                scanf("%d",&w[i]);
                total+=w[i];
        }
        printf("Input the sum value to create sub set:
        "); scanf("%d",&sum); for (i=0;i<=n;i++) for
        (j=0;j<n-1;j++) if(w[j]>w[j+1]) { temp=w[j];
                w[j]=w[j+1];
                w[j+1]=temp;
        }
        printf("The given %d numbers in ascending order:\n",n);
        for (i=0;i<n;i++) printf("%d ",w[i]);
        if((total<sum))
          printf("\n Subset construction is not possible"); else {
                for (i=0;i<n;i++)
                   inc[i]=0;
                printf("\nSolution:\n"); sumset(-
                1,0,total);
        }
        getch();
}
void sumset(int i,int wt,int total) {
        int j;
        if(promising(i,wt,total)) {
                if(wt==sum) {
```

```
                printf("{"); for
                (j=0;j<=i;j++)
                if(inc[j])
                    printf("%d ",w[j]);
                printf("}\n");
            } else {
                inc[i+1]=TRUE;
                sumset(i+1,wt+w[i+1],total-w[i+1]);
                inc[i+1]=FALSE;
                sumset(i+1,wt,total-w[i+1]);
            }
        }
}
```

OUTPUT:



18. Implement “N-Queens Problem” using Backtracking.

CODE:

```
#include<stdio.h>

#include<math.h>

int board[20],count;


int main()
{
int n,i,j;
void queen(int row,int n);


printf("Enter number of Queens:");
scanf("%d",&n); queen(1,n);
return 0;
}

void print(int n)
{
int i,j;
printf("\n\nSolution %d:\n\n",++count);
for(i=1;i<=n;++i)
  printf("\t%d",i);
for(i=1;i<=n;++i)
{
  printf("\n\n%d",i);
  for(j=1;j<=n;++j)
  {
   if(board[i]==j)
```

```
   printf("\tQ");
   else
    printf("\t-");
  }
}
}

int place(int row,int column)
{ int i;
for(i=1;i<=row-1;++i)
{
  if(board[i]==column)
   return 0;
  else
   if(abs(board[i]-column)==abs(i-row))
    return 0;
}
return 1;
}

void queen(int row,int n)
{
int column;
for(column=1;column<=n;++column)
{
  if(place(row,column))
  {
   board[row]=column;
   if(row==n)
    print(n);
```

```
   else
    queen(row+1,n);
  }
}
}
```

OUTPUT: