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
(Autonomous Institution under VTU)
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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 **CHINMAYI (1BM21CS045),** 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 academic semester June-2023 to September-2023. The Lab report has been approved as it satisfies the academic requirements in respect of a **Analysis and Design of Algorithms (22CS4PCADA)** work prescribed for the said degree.

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Index Sheet

Course Outcome

CO1	Analyze time complexity of Recursive and Non-recursive algorithms using asymptotic notations.
CO2	Apply various design techniques for the given problem.
CO3	Apply the knowledge of complexity classes P, NP, and NP-Complete and prove certain problems are NP-Complete
CO4	Design efficient algorithms and conduct practical experiments to solve problems.

Q1)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.

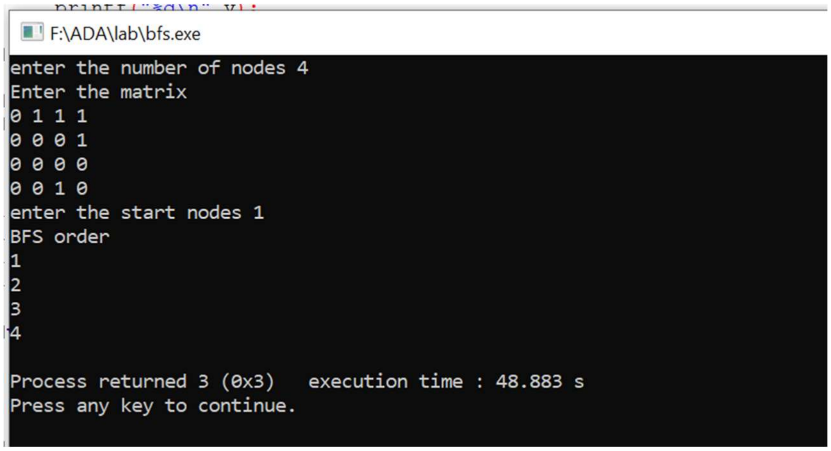
Program:

a. BFS method

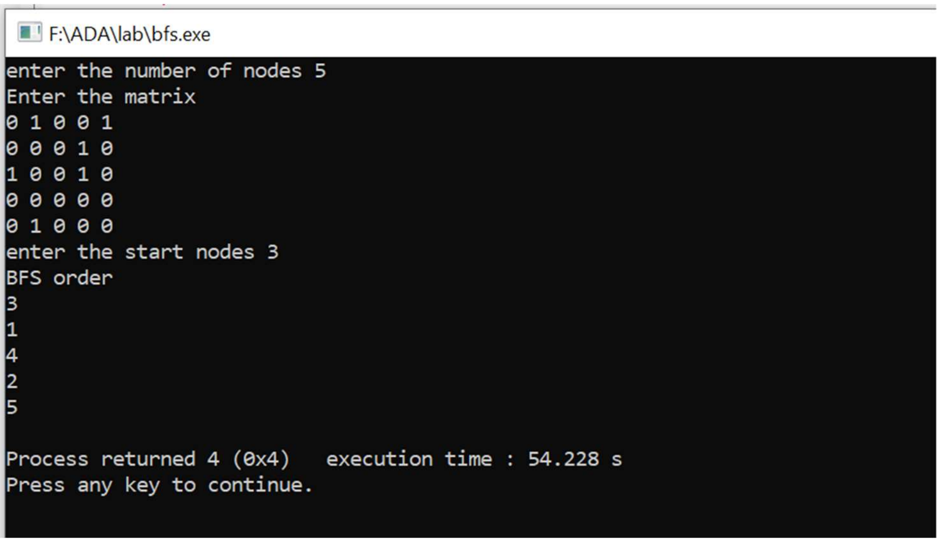
```
#include<stdio.h>

int front = 0, rear =-1;

void bfs(int v, int n, int g[n][n], int visited [n], int queue[n]){

   int i;

   visited[v]=1;

   printf("%d\n",v);

   queue[++rear]=v;

   while(front<=rear){

   int temp = queue[front++];

   for(i=1;i<=n;i++){

   if(g[temp][i]&& !visited[i]){

      printf("%d\n",i);

   visited[i]=1;

   queue[++rear]=i;

   }

   }

   }

}

void main(){

   int i,j,n,snode;

   printf("enter the number of nodes ");

   scanf("%d",&n);
```

```
    int g[n][n], visited[n],queue[n];
    for(i=1;i<=n;i++){
            visited[i]=0;
            queue[i]=0;
        for(j=1;j<=n;j++)
            g[i][j]=0;
    }
    printf("Enter the matrix\n");
    for(i=1;i<=n;i++){
        for(j=1;j<=n;j++)
          scanf("%d",&g[i][j]);
    }
    printf("enter the start nodes ");
    scanf("%d",&snode);
    printf("BFS order\n");
    bfs(snode,n,g, visited, queue);
}
```

OUTPUT



```
enter the number of nodes 4
Enter the matrix
0 1 1 1
0 0 0 1
0 0 0 0
0 0 1 0
enter the start nodes 1
BFS order
1
2
3
4

Process returned 3 (0x3)   execution time : 48.883 s
Press any key to continue.
```



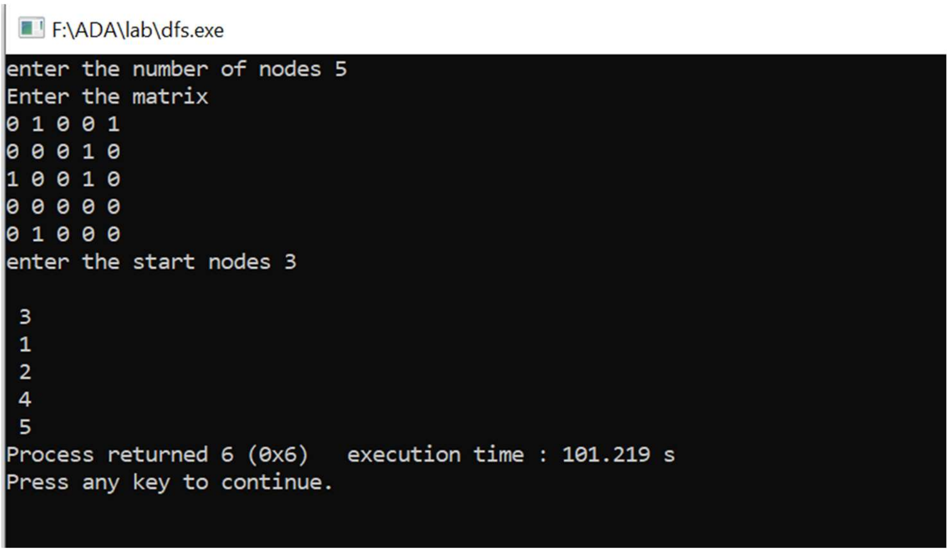
```
enter the number of nodes 5
Enter the matrix
0 1 0 0 1
0 0 0 1 0
1 0 0 1 0
0 0 0 0 0
0 1 0 0 0
enter the start nodes 3
BFS order
3
1
4
2
5

Process returned 4 (0x4)   execution time : 54.228 s
Press any key to continue.
```

b. DFS method

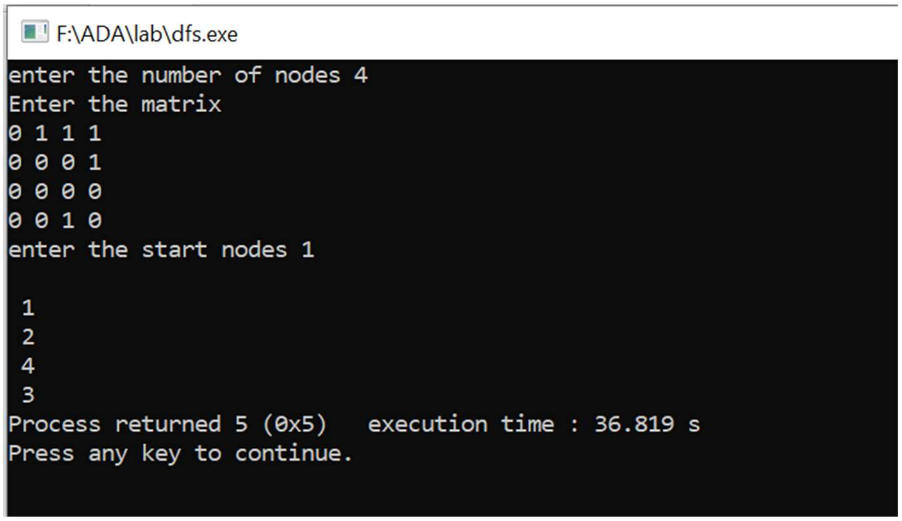
```
#include<stdio.h>

void dfs(int v, int n, int g[n][n], int visited [n]){
    int i;
    printf("\n %d",v);
    visited[v]=1;
    for(i=1;i<=n;i++){
        if(g[v][i]&& !visited[i]){
            dfs(i,n,g, visited);
        }
    }
}

void main(){
    int i,j,n,snode;
    printf("enter the number of nodes ");
    scanf("%d",&n);
    int g[n][n], visited[n];
    for(i=1;i<=n;i++){
            visited[i]=0;
        for(j=1;j<=n;j++)
            g[i][j]=0;
    }
    printf("Enter the matrix\n");
    for(i=1;i<=n;i++){
        for(j=1;j<=n;j++)
```

```
            scanf("%d",&g[i][j]);
        }
        printf("enter the start nodes ");
        scanf("%d",&snode);
        dfs(snode,n,g, visited);
}
```

OUTPUT:



```
enter the number of nodes 5
Enter the matrix
0 1 0 0 1
0 0 0 1 0
1 0 0 1 0
0 0 0 0 0
0 1 0 0 0
enter the start nodes 3

 3
 1
 2
 4
 5
Process returned 6 (0x6)   execution time : 101.219 s
Press any key to continue.
```



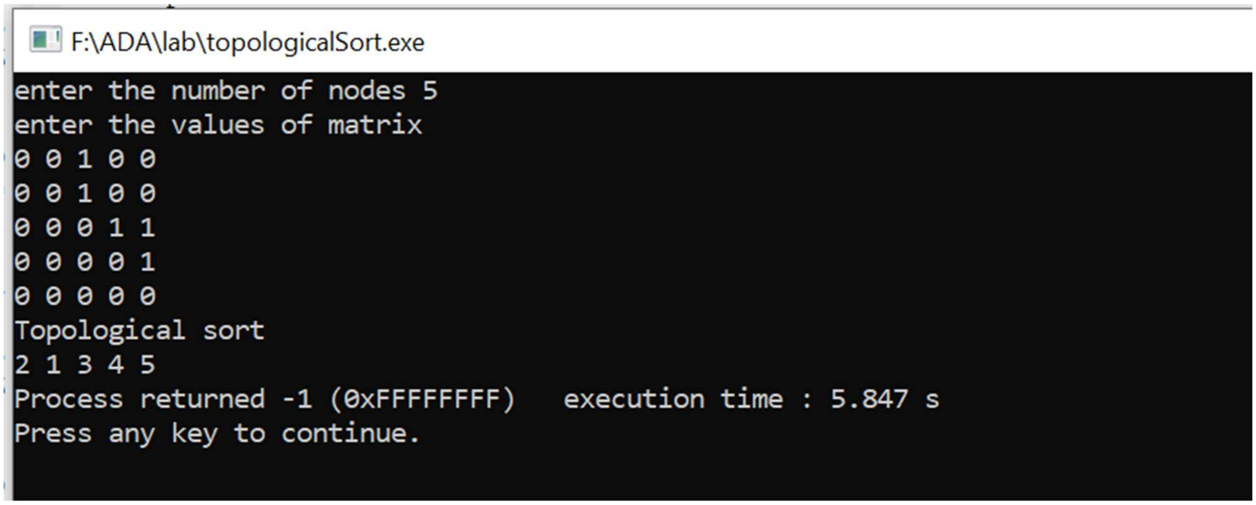
```
enter the number of nodes 4
Enter the matrix
0 1 1 1
0 0 0 1
0 0 0 0
0 0 1 0
enter the start nodes 1

 1
 2
 4
 3
Process returned 5 (0x5)   execution time : 36.819 s
Press any key to continue.
```

Q2) Write program to obtain the Topological ordering of vertices in a given digraph.

Program:

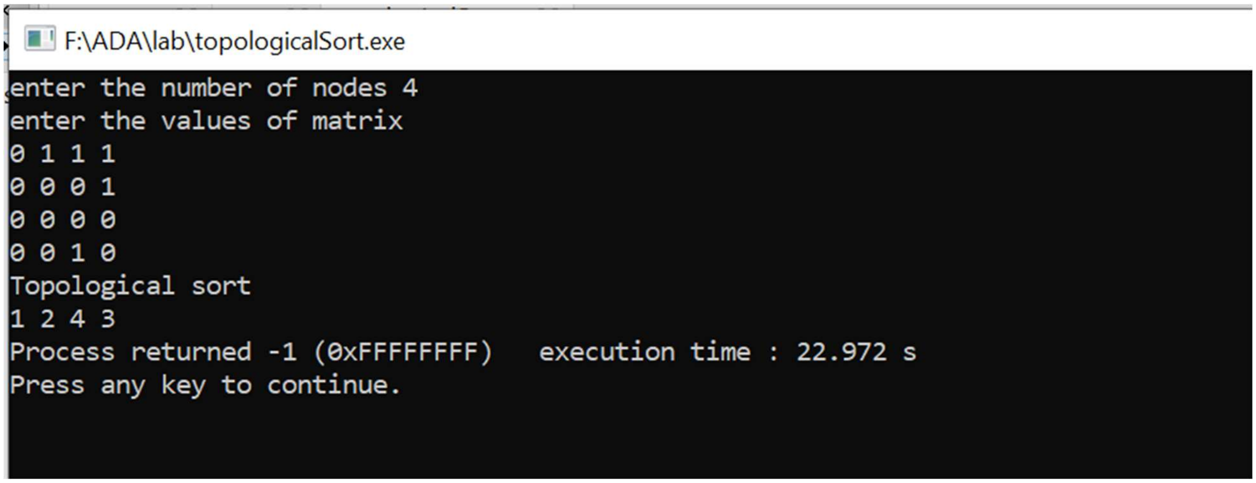
```
#include<stdio.h>
#define MAX 7
int nodes[MAX];
int top=-1;
void main(){
    int i,j,n;
    printf("enter the number of nodes ");
    scanf("%d",&n);
    int matrix[n][n];
    printf("enter the values of matrix \n");
    for(i=1;i<=n;i++){
        for(j=1;j<=n;j++){
            scanf("%d",&matrix[i][j]);
        }
    }
    topologicalSort(n,matrix);
}

void topologicalSort(int n, int matrix[n][n]){
    int i,j;
    int visited[MAX]={0};
    for(i=1;i<=n;i++){
        if(!visited[i])
            dfs(i,n,matrix,visited);
    }
    printf("Topological sort\n");
    while (top >= 0)
    {
        printf("%d ", nodes[top--]);
    }
}

void dfs(int v,int n,int matrix[n][n],int visited[n]){
    int i;
    visited[v]=1;
    for(i=1;i<=n;i++){
        if(matrix[v][i]==1 && !visited[i]){
            dfs(i,n,matrix,visited);
        }
    }
    nodes[++top]=v;
}
```

OUTPUT:



F:\ADA\lab\topologicalSort.exe

```
enter the number of nodes 5
enter the values of matrix
0 0 1 0 0
0 0 1 0 0
0 0 0 1 1
0 0 0 0 1
0 0 0 0 0
Topological sort
2 1 3 4 5
Process returned -1 (0xFFFFFFFF)   execution time : 5.847 s
Press any key to continue.
```



F:\ADA\lab\topologicalSort.exe

```
enter the number of nodes 4
enter the values of matrix
0 1 1 1
0 0 0 1
0 0 0 0
0 0 1 0
Topological sort
1 2 4 3
Process returned -1 (0xFFFFFFFF)   execution time : 22.972 s
Press any key to continue.
```

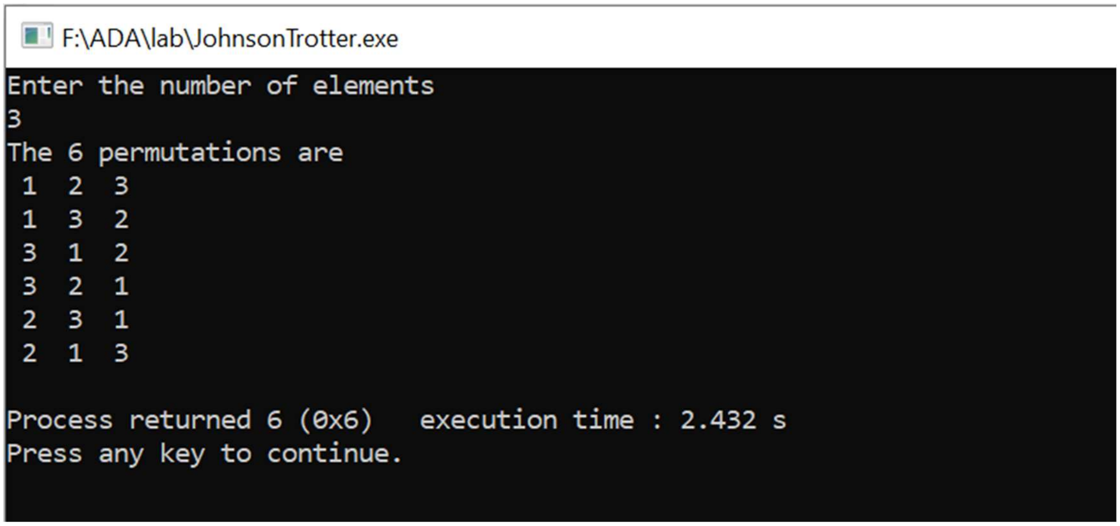
3.Implement Johnson Trotter algorithm to generate permutations.

Program:

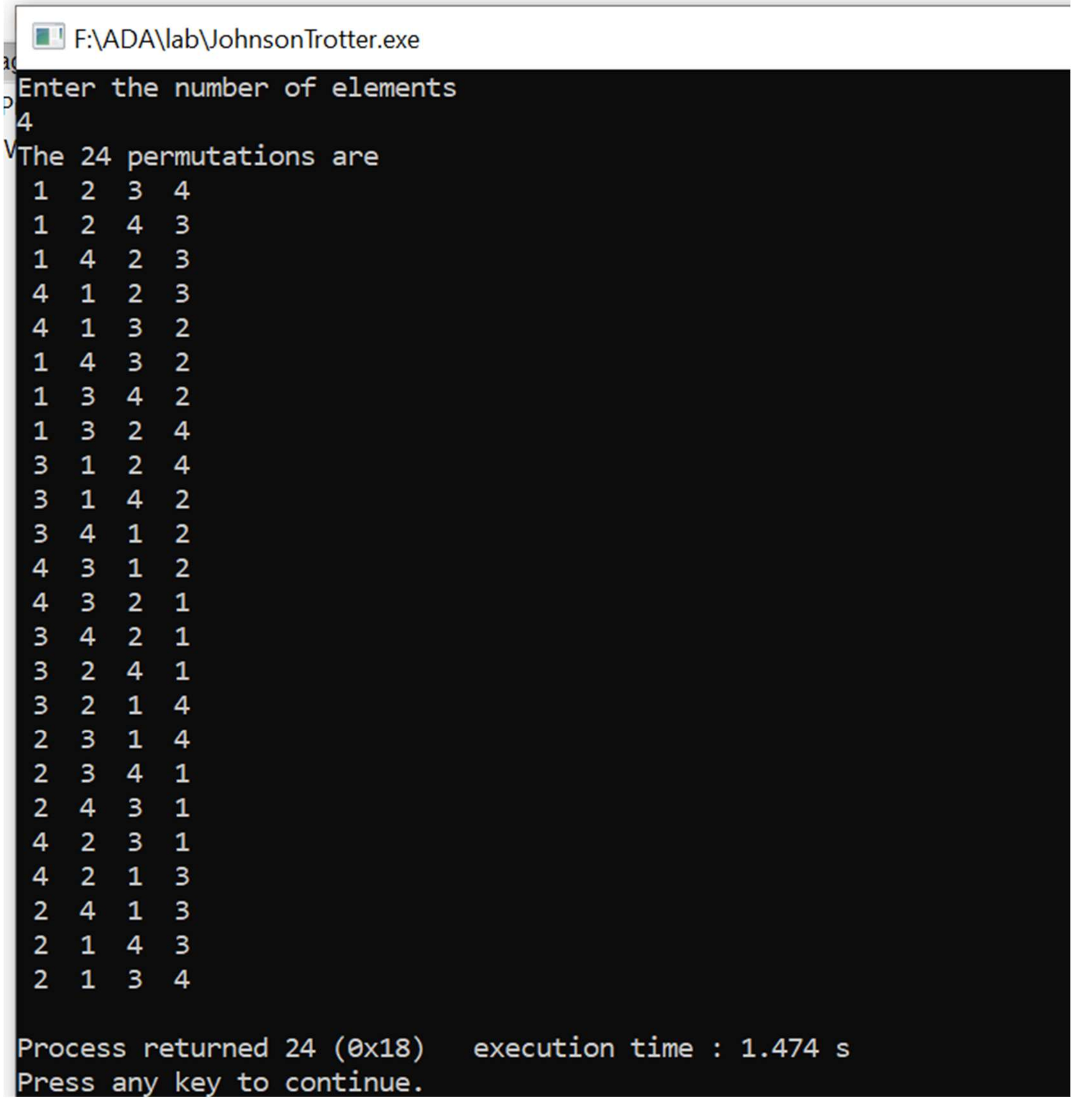
```
#include<stdio.h>
#define LtoR 0
#define RtoL 1

void swap(int *a, int *b) {
    int temp = *a;
    *a = *b;
    *b = temp;
}

void main(){
    int n;
    printf("Enter the number of elements\n");
    scanf("%d",&n);
    printf("The %d permutations are \n",fact(n));
    permutation(n);
}
int fact(int n) {
    int factorial = 1;
    for (int i = 1; i <= n; i++) {
        factorial = factorial * i;
    }
    return factorial;
}
```

```
int searchArray(int arr[], int n, int mob) {
    for (int i = 0; i < n; i++) {
        if (arr[i] == mob) {
            return i + 1;
        }
    }
    return -1;
}
int getMobileComp(int a[], int dir[], int n) {
    int prevMob = 0, mob = 0;
    for (int i = 0; i < n; i++) {
        if (dir[a[i] - 1] == RtoL && i != 0) {
            if (a[i] > a[i - 1] && a[i] > prevMob) {
                mob = a[i];
                prevMob = mob;
            }
        }

        if (dir[a[i] - 1] == LtoR && i != n - 1) {
            if (a[i] > a[i + 1] && a[i] > prevMob) {
                mob = a[i];
                prevMob = mob;
            }
        }
    }

    if (mob == 0 && prevMob == 0) {
        return 0;
    } else {
        return mob;
    }
}

void printOnePerm(int arr[], int dir[], int n, int pnum) {
    int mob = getMobileComp(arr, dir, n);
    int pos = searchArray(arr, n, mob);

    if (dir[arr[pos - 1] - 1] == RtoL) {
        swap(&arr[pos - 1], &arr[pos - 2]);
    } else if (dir[arr[pos - 1] - 1] == LtoR) {
        swap(&arr[pos], &arr[pos - 1]);
    }

    for (int i = 0; i < n; i++) {
        if (arr[i] > mob) {
            if (dir[arr[i] - 1] == LtoR) {
                dir[arr[i] - 1] = RtoL;
            } else if (dir[arr[i] - 1] == RtoL) {
                dir[arr[i] - 1] = LtoR;
            }
        }
    }
    for (int i = 0; i < n; i++) {
        printf(" %d ",arr[i]);
    }
    printf("\n");
}



void permutation(int n){
    int arr[n];
    int dir[n];
    for (int i = 0; i < n; i++) {
        arr[i] = i + 1;
        printf(" %d ", arr[i]);
    }
    printf("\n");

    for (int i = 0; i < n; i++) {
        dir[i] = RtoL;
    }

    for (int i = 1; i < fact(n); i++) {
        printOnePerm(arr, dir, n,i);
    }
}
```

OUTPUT:



```
Enter the number of elements
3
The 6 permutations are
 1  2  3
 1  3  2
 3  1  2
 3  2  1
 2  3  1
 2  1  3

Process returned 6 (0x6)   execution time : 2.432 s
Press any key to continue.
```



```
Enter the number of elements
4
The 24 permutations are
 1  2  3  4
 1  2  4  3
 1  4  2  3
 4  1  2  3
 4  1  3  2
 1  4  3  2
 1  3  4  2
 1  3  2  4
 3  1  2  4
 3  1  4  2
 3  4  1  2
 4  3  1  2
 4  3  2  1
 3  4  2  1
 3  2  4  1
 3  2  1  4
 2  3  1  4
 2  3  4  1
 2  4  3  1
 4  2  3  1
 4  2  1  3
 2  4  1  3
 2  1  4  3
 2  1  3  4

Process returned 24 (0x18)   execution time : 1.474 s
Press any key to continue.
```

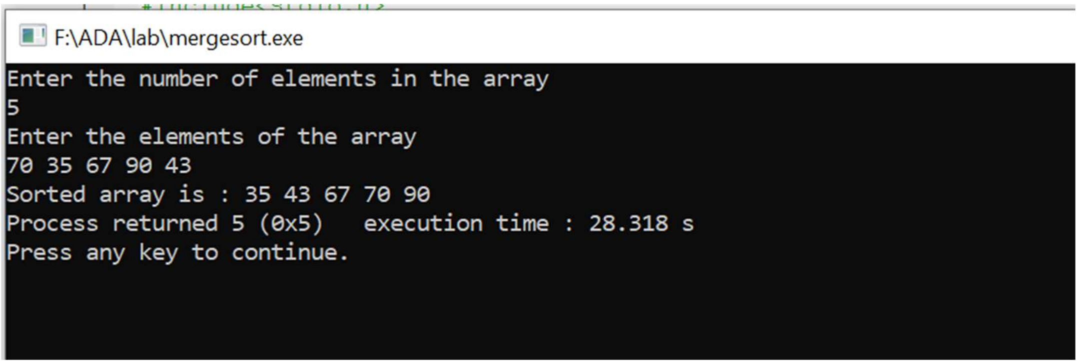
4. Sort a given set of N integer elements using Merge Sort technique and compute its time taken. Run the program for different values of N and record the time taken to sort.

Program:

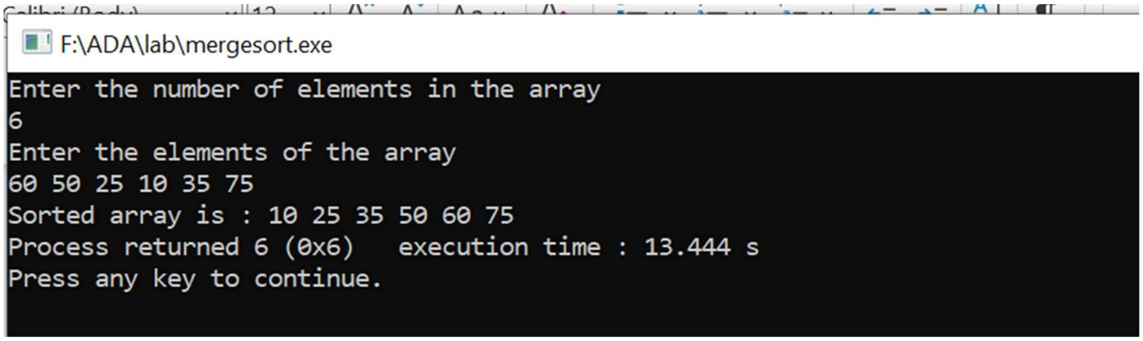
```
#include<stdio.h>
void main(){
   int low=0,high,i,n;
   int arr[15];
   printf("Enter the number of elements in the array\n");
   scanf("%d",&n);
   high=n-1;
   printf("Enter the elements of the array\n");
   for(i=0;i<n;i++){
     scanf("%d",&arr[i]);
   }
   mergeSort(low,high,n,arr);
   printf("Sorted array is : ");
   for(i=0;i<n;i++){
      printf("%d ",arr[i]);
   }
}

void mergeSort(int low,int high,int n,int arr[n])
{
   int mid;
   if(low<high)
   {
      mid=(low+high)/2;
```

```
        mergeSort(low,mid,n,arr);
        mergeSort(mid+1,high,n,arr);
        merge(low,mid,high,n,arr);
    }
}

void merge(int low,int mid,int high,int n,int arr[n])
{
    int i=low,j=mid+1,k=low,c[n];
    while(i<=mid&&j<=high)
    {
        if(arr[i]<arr[j])
        {
            c[k]=arr[i];
            i++;
            k++;
        }
        else
        {
            c[k]=arr[j];
            j++;
            k++;
        }
    }
    while(i<=mid)
    {
        c[k]=arr[i];
        i++;

        k++;

    }

    while(j<=high)

    {

        c[k]=arr[j];

        j++;

        k++;

    }

    for (i = low; i <= high; i++)

    {

        arr[i]=c[i];

    }

}
```

OUTPUT

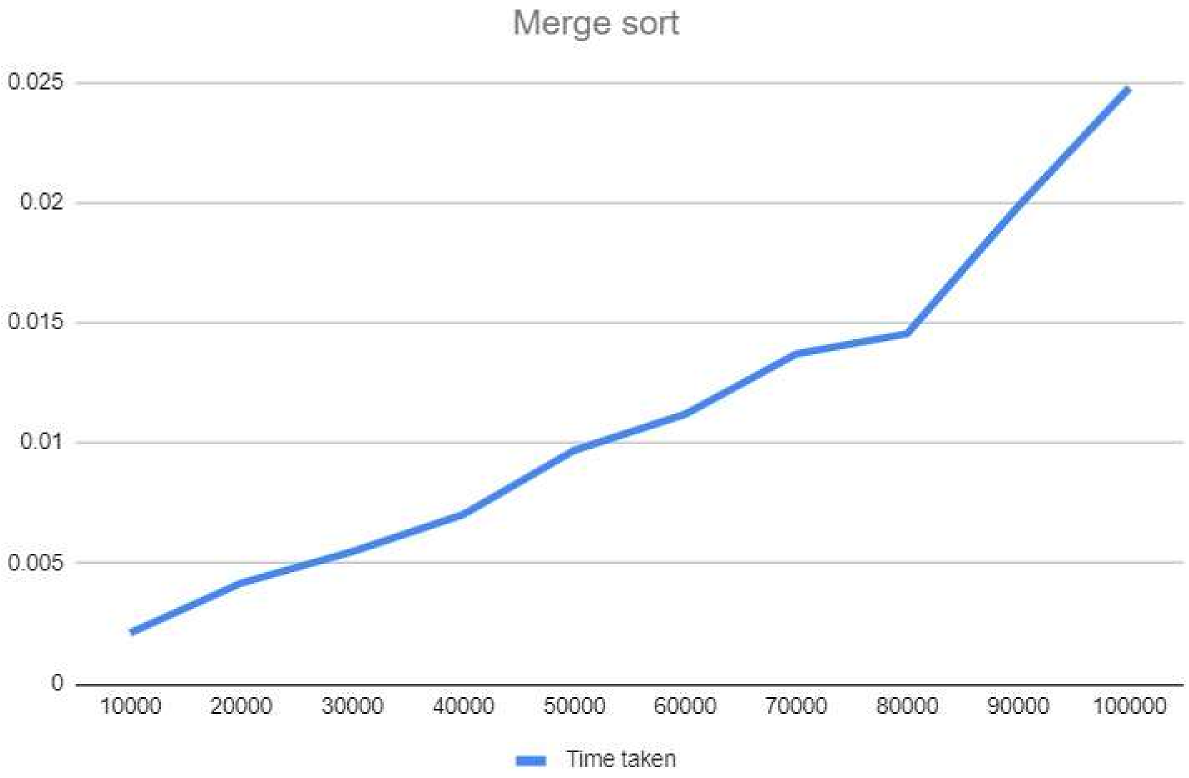


```
Enter the number of elements in the array
5
Enter the elements of the array
70 35 67 90 43
Sorted array is : 35 43 67 70 90
Process returned 5 (0x5)   execution time : 28.318 s
Press any key to continue.
```



```
Enter the number of elements in the array
6
Enter the elements of the array
60 50 25 10 35 75
Sorted array is : 10 25 35 50 60 75
Process returned 6 (0x6)   execution time : 13.444 s
Press any key to continue.
```

Graph:


Merge sort
0.025
0.02
0.015
0.01
0.005
0
10000
20000
30000
40000
50000
60000
70000
80000
90000
100000
Time taken

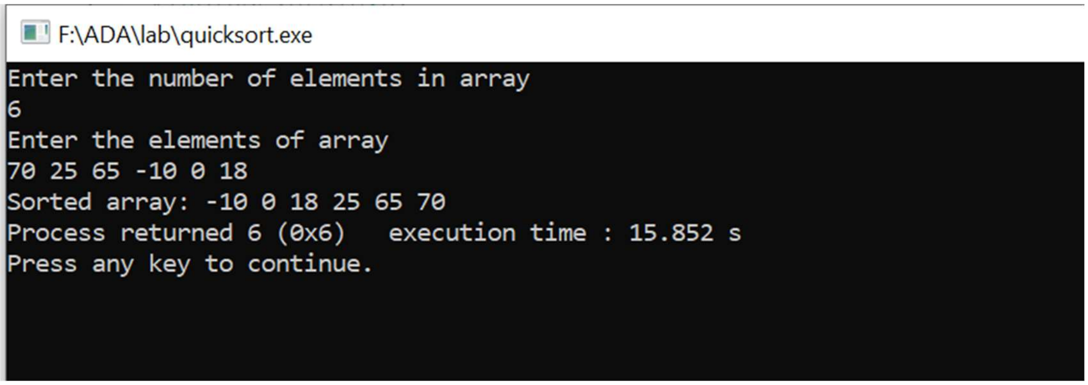
5. Sort a given set of N integer elements using Quick Sort technique and compute its time taken.

Program:

```
#include<stdio.h>

void main(){

   int arr[20],low,high,n,i;

   printf("Enter the number of elements in array\n");

   scanf("%d",&n);

   printf("Enter the elements of array\n");

   for(i=0;i<n;i++){

      scanf("%d",&arr[i]);

   }

   low=0;high=n-1;

   quickSort(low, high, arr);

   printf("Sorted array: ");

   for(i=0;i<n;i++){

      printf("%d ",arr[i]);

   }

}


void quickSort(int low,int high,int a[]){

   int j;

   if(low<high){

      j=partition(low,high,a);

      quickSort(low,j-1,a);

      quickSort(j+1,high,a);

   }

}
```

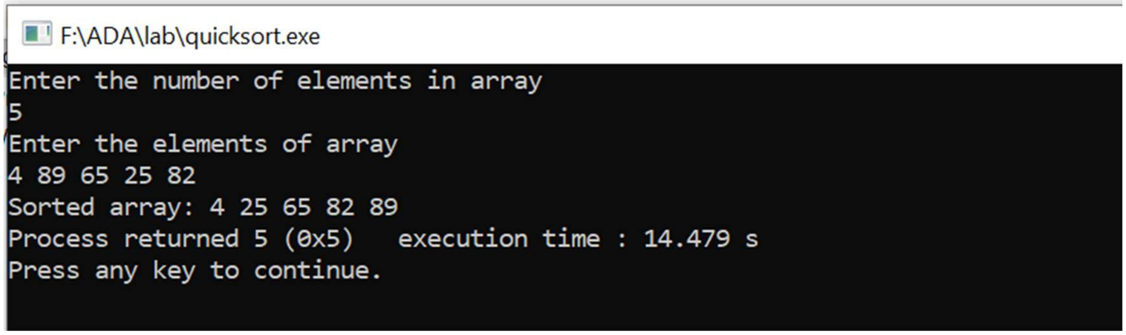
```
int partition(int low, int high, int a[]){
    int i,j,pivot,temp;
    i=low;
    j=high+1;
    pivot=a[low];
    while(i<j){
        do{
            i=i+1;
        }while(pivot>=a[i]);
        do{
            j=j-1;
        }while(pivot<a[j]);
        if(i<j){
            temp = a[i];
            a[i]=a[j];
            a[j]=temp;
        }
        if(i>j)
    {
        temp = a[low];
        a[low]=a[j];
        a[j]=temp;
    }
    }
    return j;
}
```

OUTPUT:



F:\ADA\lab\quicksort.exe

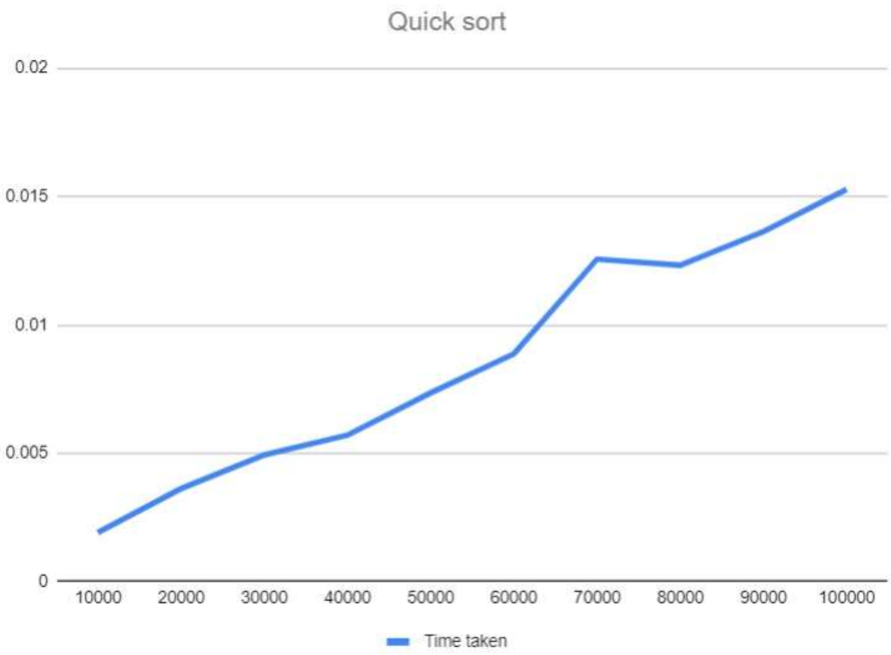
```
Enter the number of elements in array
6
Enter the elements of array
70 25 65 -10 0 18
Sorted array: -10 0 18 25 65 70
Process returned 6 (0x6)   execution time : 15.852 s
Press any key to continue.
```



F:\ADA\lab\quicksort.exe

```
Enter the number of elements in array
5
Enter the elements of array
4 89 65 25 82
Sorted array: 4 25 65 82 89
Process returned 5 (0x5)   execution time : 14.479 s
Press any key to continue.
```

Graph



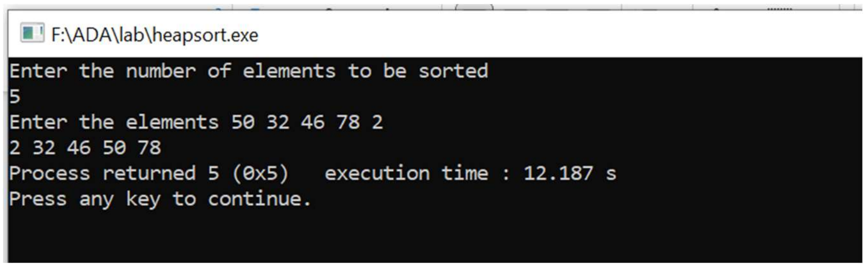
6. Sort a given set of N integer elements using Heap Sort technique and compute its time taken.

Program:

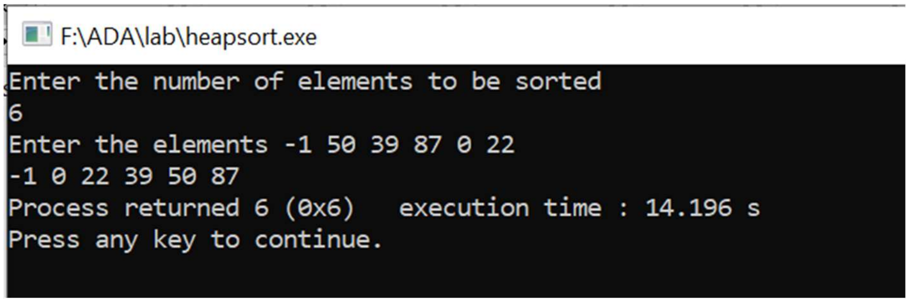
```
#include<stdio.h>
void main(){
   int n;
   printf("Enter the number of elements to be sorted\n");
   scanf("%d",&n);
   int arr[n];
   printf("Enter the elements ");
   for(int i=0;i<n;i++){
      scanf("%d",&arr[i]);
   }
   heapsort(n,arr);
   for(int i=0;i<n;i++){
      printf("%d ",arr[i]);
   }
}
void heapify(int n,int arr[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;
   }
   if(right<n && arr[right]>arr[largest])
         largest = right;
   if(largest!=i){
```

```
            int temp = arr[i];
            arr[i]=arr[largest];
            arr[largest]=temp;
            heapify(n,arr,largest);
    }
}
void heapsort(int n,int arr[n]){
    for(int i= n/2 -1;i>=0;i--){
        heapify(n,arr,i);
    }
    for(int i=n-1;i>0;i--){
        int temp = arr[0];
        arr[0]=arr[i];
        arr[i]=temp;
        heapify(i,arr,0);
    }
}
```

OUTPUT:

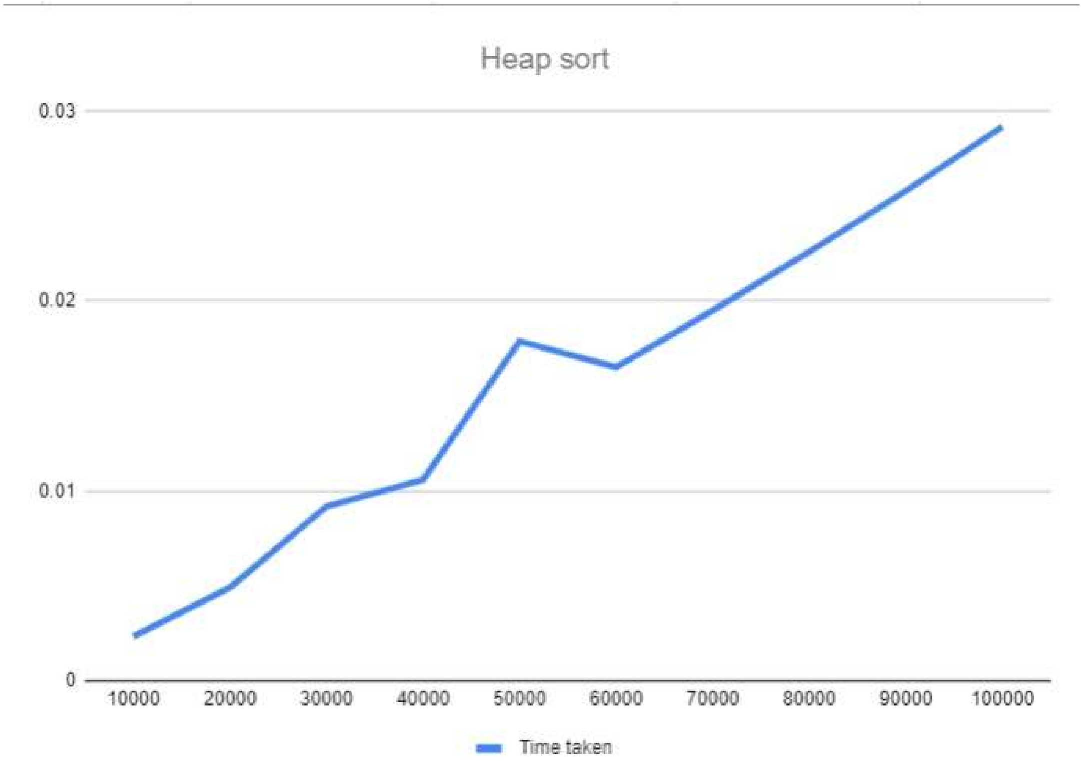


```
Enter the number of elements to be sorted
5
Enter the elements 50 32 46 78 2
2 32 46 50 78
Process returned 5 (0x5)   execution time : 12.187 s
Press any key to continue.
```



```
Enter the number of elements to be sorted
6
Enter the elements -1 50 39 87 0 22
-1 0 22 39 50 87
Process returned 6 (0x6)   execution time : 14.196 s
Press any key to continue.
```

Graph:


Heap sort
0.03
0.02
0.01
0
10000
20000
30000
40000
50000
60000
70000
80000
90000
100000
Time taken

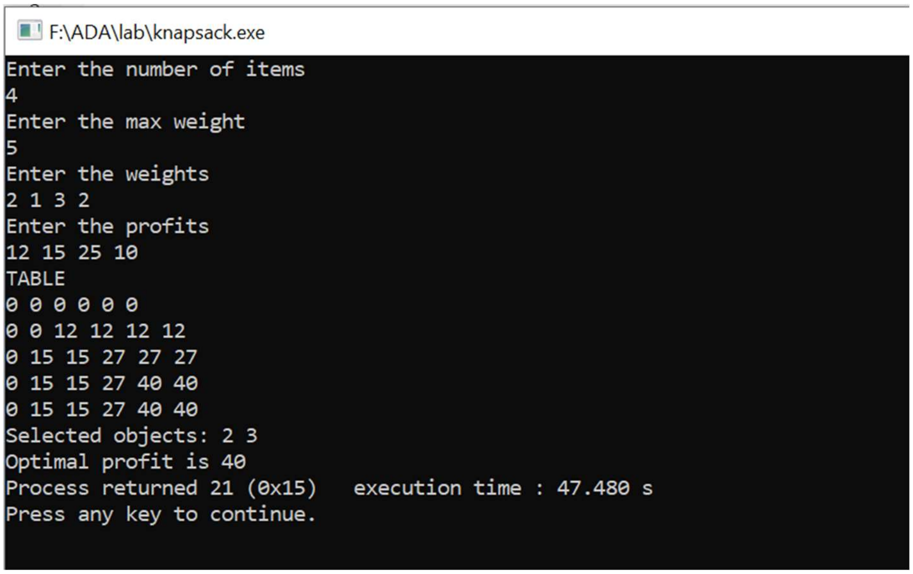
7. Implement 0/1 Knapsack problem using dynamic programming.

Program

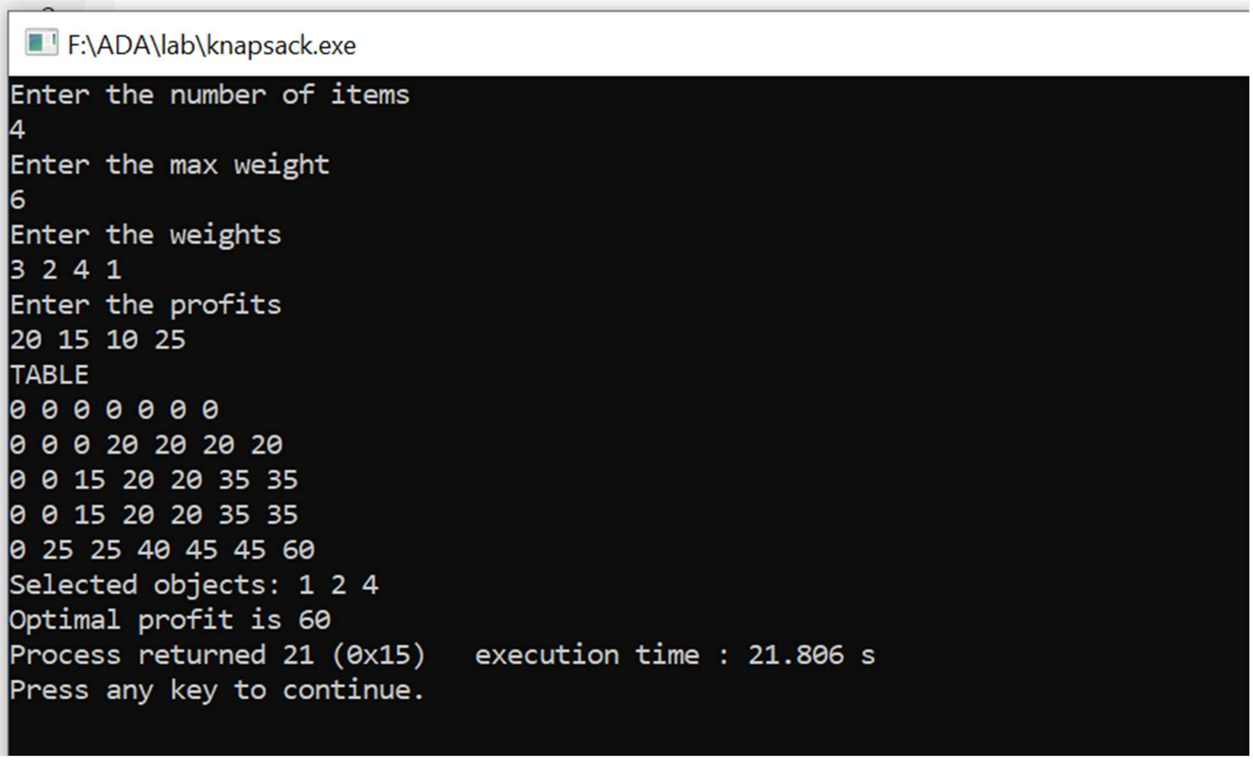
```
#include <stdio.h>

#include <stdbool.h>


int p[15],w[15],maxW;

void main(){

   int n,i,j,maxP;

   printf("Enter the number of items\n");

   scanf("%d",&n);

   printf("Enter the max weight\n");

   scanf("%d",&maxW);

   printf("Enter the weights\n");

   for(i=0;i<n;i++)

   scanf("%d",&w[i]);

   printf("Enter the profits\n");

   for(i=0;i<n;i++)

   scanf("%d",&p[i]);

   maxP=knapsack(n);

   printf("Optimal profit is %d ",maxP);

}




int knapsack(int n) {

   int v[n+1][maxW+1],i,j;
```

```
for (int i = 0; i <= n; i++) {
    for (int j = 0; j <= maxW; j++) {
        if (i == 0 || j == 0)
            v[i][j] = 0;
        else if (w[i-1] <= j)
            v[i][j] = max(p[i - 1] + v[i - 1][j - w[i - 1]], v[i - 1][j]);
        else
            v[i][j] = v[i - 1][j];
    }
}

int selected[n];
i = n; j = maxW;
int count = 0;

while (i > 0 && j > 0) {
    if (v[i][j] != v[i - 1][j]) {
        selected[count++] = i;
        j -= w[i - 1];
        i--;
    } else {
        i--;
    }
}
printf("TABLE \n");
for (int i = 0; i <= n; i++) {
    for (int j = 0; j <= maxW; j++) {
            printf("%d ",v[i][j]);
        }
        printf("\n");
    }
    printf("Selected objects: ");
    for (int j = count - 1; j >= 0; j--)
        printf("%d ", selected[j]);
    printf("\n");
    return v[n][maxW];
}

int max(int a, int b) {
    return (a > b) ? a : b;
}
```

OUTPUT:



```
Enter the number of items
4
Enter the max weight
5
Enter the weights
2 1 3 2
Enter the profits
12 15 25 10
TABLE
0 0 0 0 0 0
0 0 12 12 12 12
0 15 15 27 27 27
0 15 15 27 40 40
0 15 15 27 40 40
Selected objects: 2 3
Optimal profit is 40
Process returned 21 (0x15)   execution time : 47.480 s
Press any key to continue.
```



```
Enter the number of items
4
Enter the max weight
6
Enter the weights
3 2 4 1
Enter the profits
20 15 10 25
TABLE
0 0 0 0 0 0 0
0 0 0 20 20 20 20
0 0 15 20 20 35 35
0 0 15 20 20 35 35
0 25 25 40 45 45 60
Selected objects: 1 2 4
Optimal profit is 60
Process returned 21 (0x15)   execution time : 21.806 s
Press any key to continue.
```

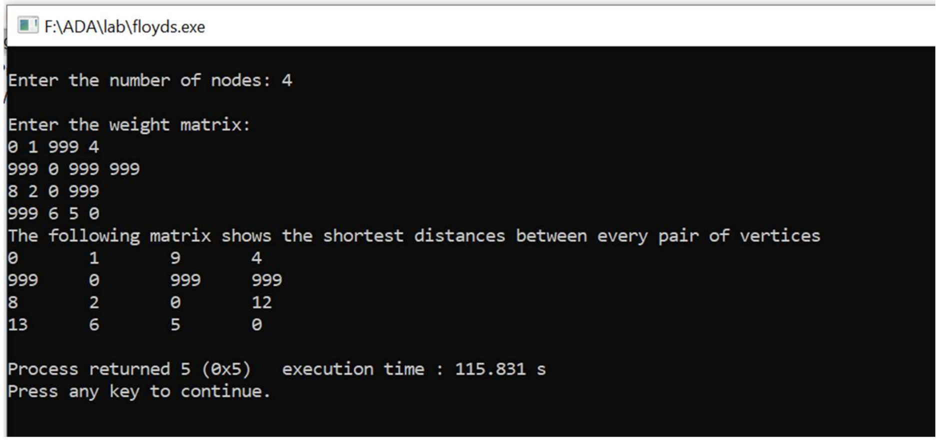
Q8)Implement All Pair Shortest paths problem using Floyd’s algorithm.

Program:

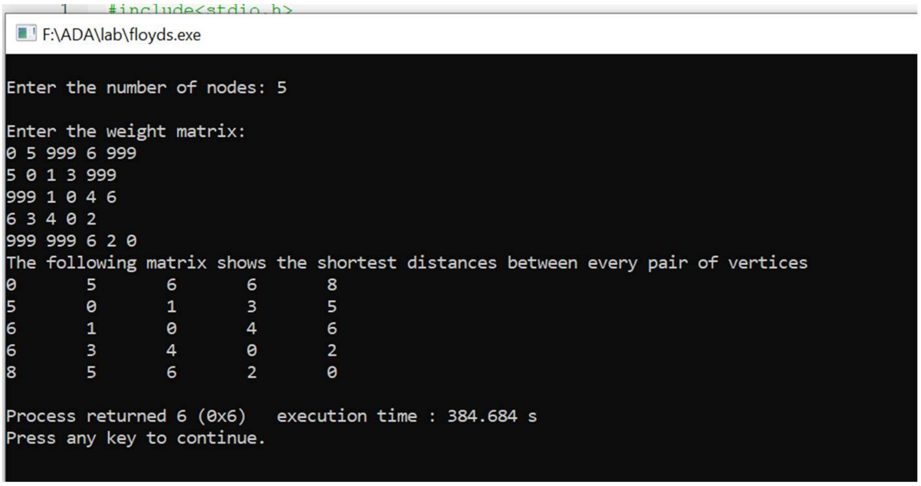
```
#include<stdio.h>
#define MAX 10


void display(int n,int w[MAX][MAX])
{
   int i,j;
   printf("The following matrix shows the shortest distances between every pair of vertices \n");
   for (int i = 1; i <= n; i++)
   {
      for (int j = 1; j <= n; j++)
      {
            printf("%d\t", w[i][j]);
      }
      printf("\n");
   }

   //printf("\n The shortest paths are:\n");
      //for(i=1;i<=n;i++)
         //for(j=1;j<=n;j++)
         //{
           // if(i!=j)
               //printf("\n <%d,%d>=%d",i,j,w[i][j]);
         //}
}
```

```
void floyds(int n,int w[MAX][MAX])
{
   int i, j, k;

   for (k = 1; k <= n; k++)
   {
      for (i = 1; i <= n; i++)
      {
         for (j = 1; j <= n; j++)
         {
            if (w[i][k] + w[k][j] < w[i][j])
               w[i][j] = w[i][k] + w[k][j];
         }
      }
   }
   display(n,w);
}

void main()
{
   int i,n,W,j;
   int w[MAX][MAX], dist[MAX][MAX] ;

   printf("\nEnter the number of nodes: ");
   scanf("%d",&n);
   printf("\nEnter the weight matrix:\n");
   for (i = 1; i <= n; i++)
   {
      for (j = 1; j <= n; j++)
      {
         scanf("%d",&w[i][j]);
      }
   }
   floyds(n,w);
}
```

OUTPUT:



```
Enter the number of nodes: 4

Enter the weight matrix:
0 1 999 4
999 0 999 999
8 2 0 999
999 6 5 0
The following matrix shows the shortest distances between every pair of vertices
0       1       9       4
999     0       999     999
8       2       0       12
13      6       5       0

Process returned 5 (0x5)   execution time : 115.831 s
Press any key to continue.
```



```
Enter the number of nodes: 5

Enter the weight matrix:
0 5 999 6 999
5 0 1 3 999
999 1 0 4 6
6 3 4 0 2
999 999 6 2 0
The following matrix shows the shortest distances between every pair of vertices
0       5       6       6       8
5       0       1       3       5
6       1       0       4       6
6       3       4       0       2
8       5       6       2       0

Process returned 6 (0x6)   execution time : 384.684 s
Press any key to continue.
```

9. Find Minimum Cost Spanning Tree of a given undirected graph using Prim’s and Kruskal’s algorithm.

Prim’s

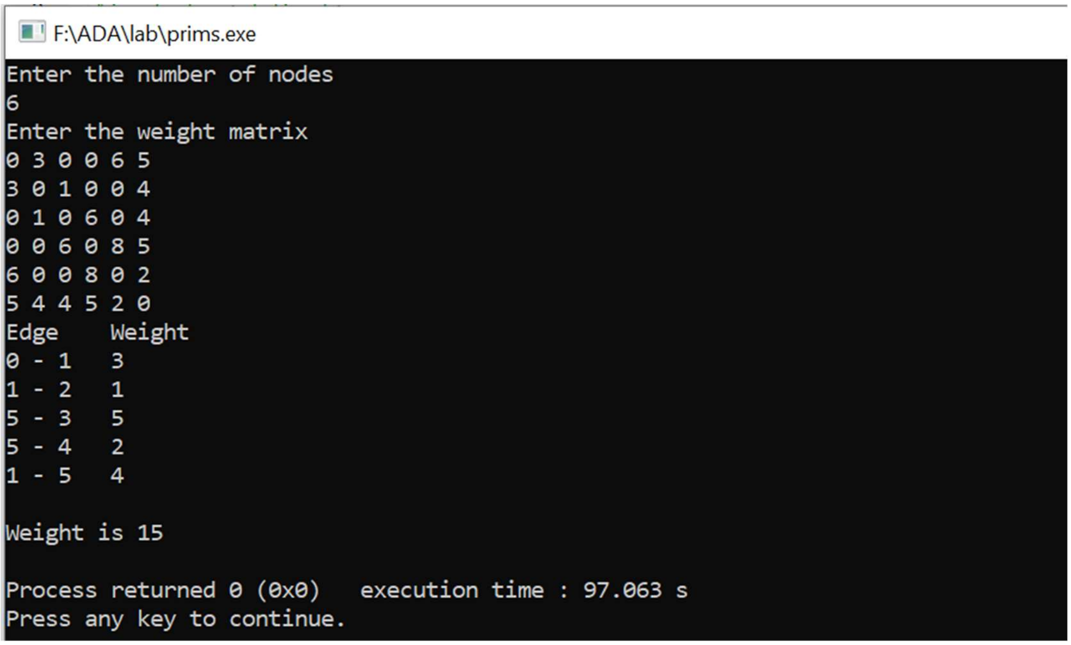
Program:

```
#include <limits.h>

#include <stdbool.h>

#include <stdio.h>

#define V 10


int minKey(int key[], bool mstSet[], int n)

{

        int min = INT_MAX, min_index;


        for (int v = 0; v < n; v++)

                if (mstSet[v] == false && key[v] < min)

                        min = key[v], min_index = v;


        return min_index;

}


int printMST(int parent[], int graph[V][V], int n)

{

  int weight = 0;

        printf("Edge \tWeight\n");

        for (int i = 1; i < n; i++)

                printf("%d - %d \t%d \n", parent[i], i,

                        graph[i][parent[i]]);
```

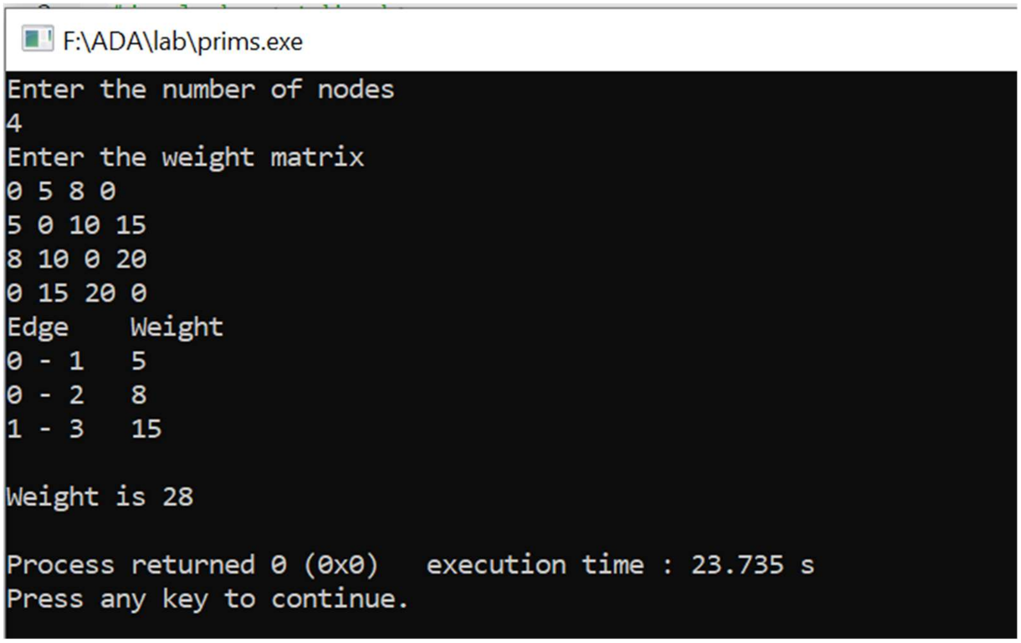
```
    for(int i=1;i<n;i++){
        weight += graph[i][parent[i]];
    }
    printf("\nWeight is %d \n",weight);
}

void prims(int graph[V][V],int n)
{
	int parent[V];
	int key[V];
	bool mstSet[V];

	for (int i = 0; i < n; i++)
		key[i] = INT_MAX, mstSet[i] = false;

	key[0] = 0;

	parent[0] = -1;

	for (int count = 0; count < n - 1; count++) {

		int u = minKey(key, mstSet, n);

		mstSet[u] = true;

		for (int v = 0; v < n; v++)
```

```
                    if (graph[u][v] && mstSet[v] == false
                        && graph[u][v] < key[v])
                        parent[v] = u, key[v] = graph[u][v];
        }

        printMST(parent, graph, n);
}

int main()
{
    int graph[V][V],n;
    printf("Enter the number of nodes\n");
    scanf("%d",&n);
    printf("Enter the weight matrix\n");
    for(int i=0;i<n;i++){
        for(int j=0;j<n;j++)
            scanf("%d",&graph[i][j]);
    }

        prims(graph,n);
        return 0;
}
```

OUTPUT:



```
Enter the number of nodes
6
Enter the weight matrix
0 3 0 0 6 5
3 0 1 0 0 4
0 1 0 6 0 4
0 0 6 0 8 5
6 0 0 8 0 2
5 4 4 5 2 0
Edge    Weight
0 - 1   3
1 - 2   1
5 - 3   5
5 - 4   2
1 - 5   4

Weight is 15

Process returned 0 (0x0)   execution time : 97.063 s
Press any key to continue.
```



```
Enter the number of nodes
4
Enter the weight matrix
0 5 8 0
5 0 10 15
8 10 0 20
0 15 20 0
Edge    Weight
0 - 1   5
0 - 2   8
1 - 3   15

Weight is 28

Process returned 0 (0x0)   execution time : 23.735 s
Press any key to continue.
```

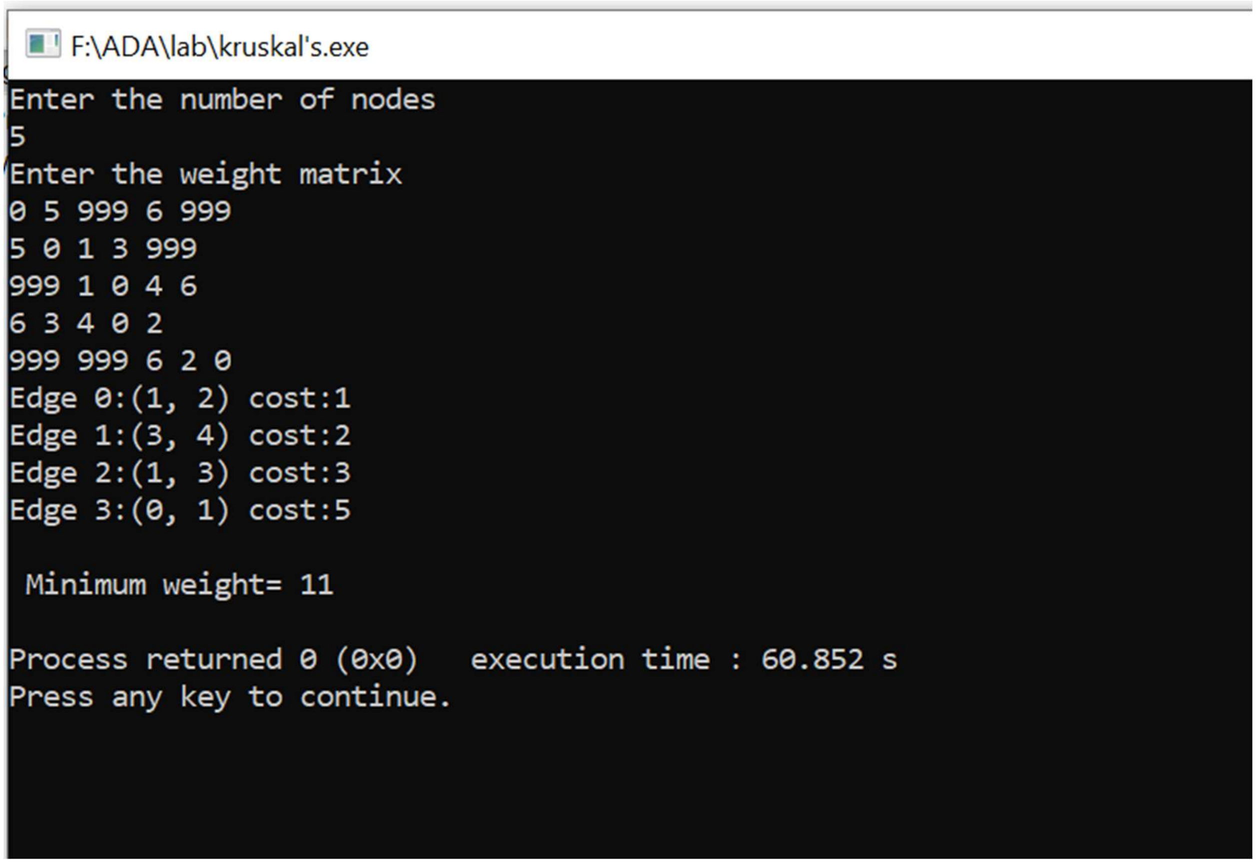
Kruskal's

Program:

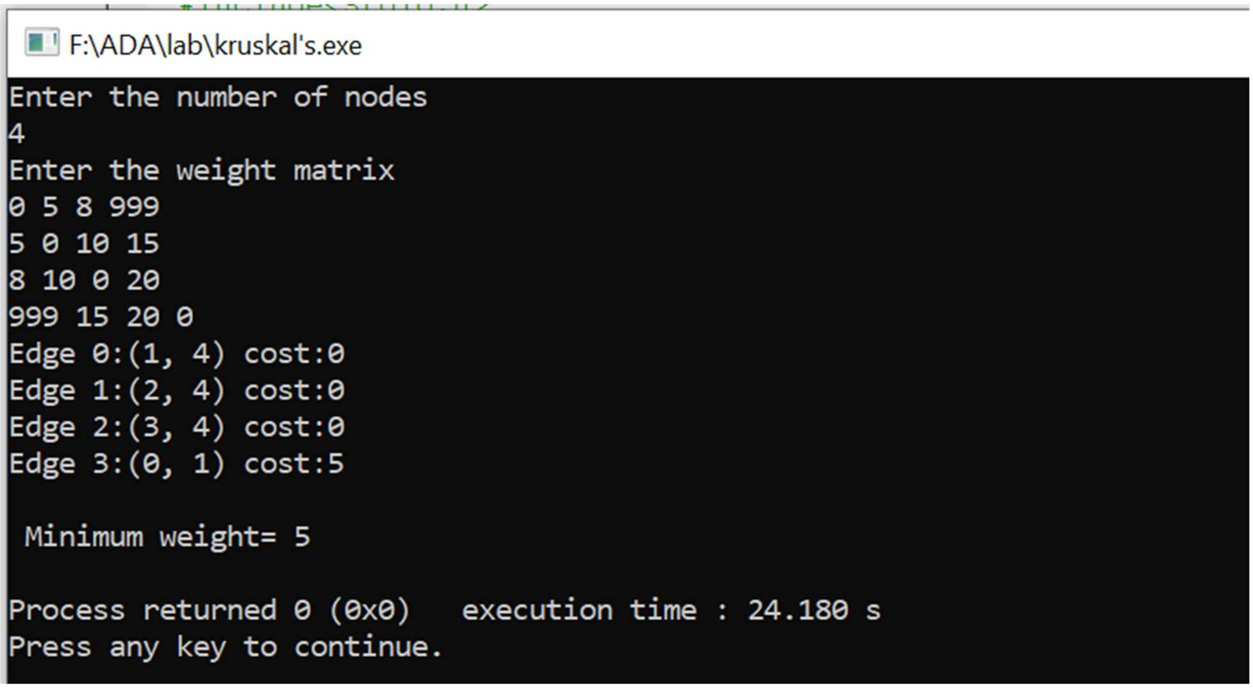
```
#include<stdio.h>
```

```
#include <stdbool.h>
#define INT_MAX 99
#define V 5
int n;
int parent[V];
int find(int i)
{
    while (parent[i] != i)
        i = parent[i];
    return i;
}

void union1(int i, int j)
{
    int a = find(i);
    int b = find(j);
    parent[a] = b;
}

void kruskalMST(int cost[][V])
{
    int mincost = 0;

    for (int i = 0; i < V; i++)
        parent[i] = i;

    int edge_count = 0;
    while (edge_count < V - 1) {
        int min = INT_MAX, a = -1, b = -1;
        for (int i = 0; i < V; i++) {
            for (int j = 0; j < V; j++) {
                if (find(i) != find(j) && cost[i][j] < min) {
                    min = cost[i][j];
                    a = i;
                    b = j;
                }
            }
        }

        union1(a, b);
        printf("Edge %d:(%d, %d) cost:%d \n",
               edge_count++, a, b, min);
        mincost += min;
    }
    printf("\n Minimum weight= %d \n", mincost);

}

int main()
{

    int cost[V][V];
    printf("Enter the number of nodes\n");
    scanf("%d",&n);
    printf("Enter the weight matrix\n");
    for(int i=0;i<n;i++){
        for(int j=0;j<n;j++)
            scanf("%d",&cost[i][j]);
    }

    kruskalMST(cost);

    return 0;
}
```

Output:



```
Enter the number of nodes
5
Enter the weight matrix
0 5 999 6 999
5 0 1 3 999
999 1 0 4 6
6 3 4 0 2
999 999 6 2 0
Edge 0:(1, 2) cost:1
Edge 1:(3, 4) cost:2
Edge 2:(1, 3) cost:3
Edge 3:(0, 1) cost:5

 Minimum weight= 11

Process returned 0 (0x0)   execution time : 60.852 s
Press any key to continue.
```



```
Enter the number of nodes
4
Enter the weight matrix
0 5 8 999
5 0 10 15
8 10 0 20
999 15 20 0
Edge 0:(1, 4) cost:0
Edge 1:(2, 4) cost:0
Edge 2:(3, 4) cost:0
Edge 3:(0, 1) cost:5

 Minimum weight= 5

Process returned 0 (0x0)   execution time : 24.180 s
Press any key to continue.
```

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

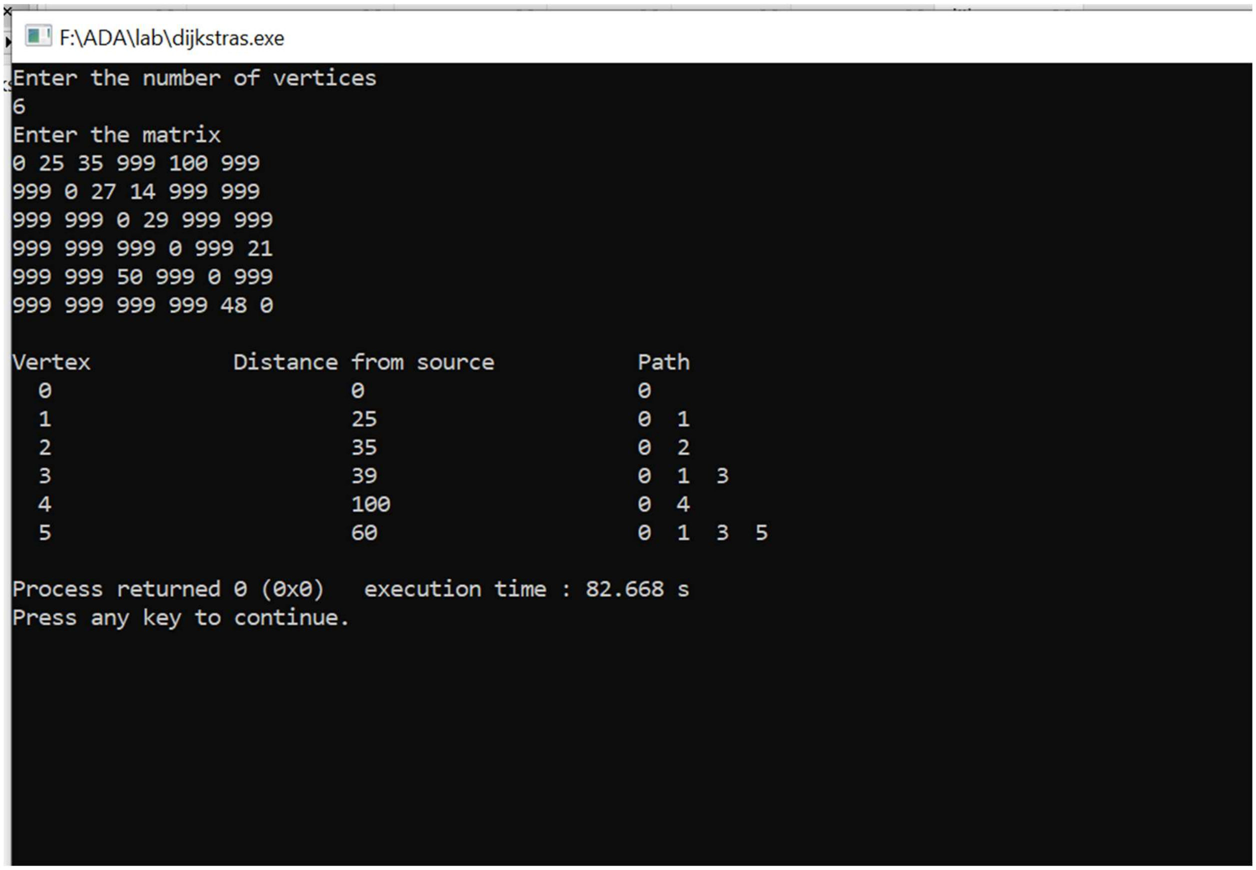
Program:

```
#include <stdbool.h>
#include <stdio.h>
#define MAX 999
int V;
int parents[50], noParent=-1;

int minDistance(int dist[], bool picked[])
{
	int min = MAX, min_index;

	for (int v = 0; v < V; v++)
		if (picked[v] == false && dist[v] <= min)
			min = dist[v], min_index = v;

	return min_index;
}
void printPath(int vertx,int parents[V])
{
	if (vertx == noParent) {
		return;
	}
	printPath(parents[vertx], parents);
	printf("%d  ",vertx);
}
void printSolution(int dist[])
{
	printf("\nVertex \t\t Distance from source\t\tPath\n");
	for (int i = 0; i < V; i++){
      printf("  %d \t\t\t  %d \t\t\t", i, dist[i]);
		printPath(i,parents);
		printf("\n");
	}
}

void dijkstra(int graph[V][V], int src)
```

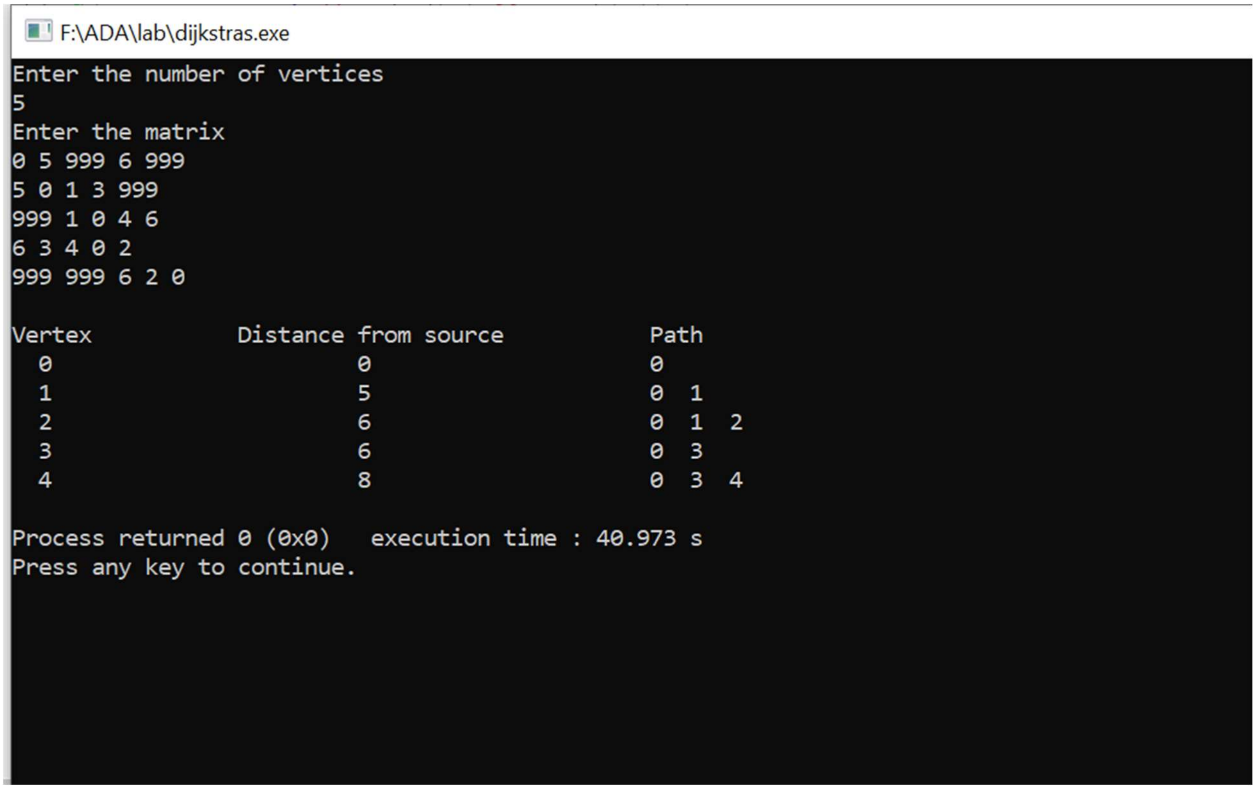
```
{
            int dist[V];

            bool picked[V];
            for (int i = 0; i < V; i++)
                        dist[i] = MAX, picked[i] = false;

            dist[src] = 0;
   parents[0]=noParent;
            for (int count = 0; count < V - 1; count++) {
                        int u = minDistance(dist, picked);

                        picked[u] = true;

                        for (int v = 0; v < V; v++){
           if (!picked[v] && graph[u][v]
                                    && dist[u] != MAX
                                    && dist[u] + graph[u][v] < dist[v]){
                                       dist[v] = dist[u] + graph[u][v];
                                    parents[v]=u;
                                    }
                        }
            }

            printSolution(dist);
}

int main()
{
   printf("Enter the number of vertices\n");
   scanf("%d",&V);
            int graph[V][V],j;
            printf("Enter the matrix\n");
            for(int i=0;i<V;i++){
      for(j=0;j<V;j++){
         scanf("%d",&graph[i][j]);
      }
            }
```

```
        dijkstra(graph, 0);

        return 0;
}
```

Output:



```
Enter the number of vertices
6
Enter the matrix
0 25 35 999 100 999
999 0 27 14 999 999
999 999 0 29 999 999
999 999 999 0 999 21
999 999 50 999 0 999
999 999 999 999 48 0

Vertex           Distance from source           Path
  0                       0                     0
  1                       25                    0  1
  2                       35                    0  2
  3                       39                    0  1  3
  4                       100                   0  4
  5                       60                    0  1  3  5

Process returned 0 (0x0)   execution time : 82.668 s
Press any key to continue.
```



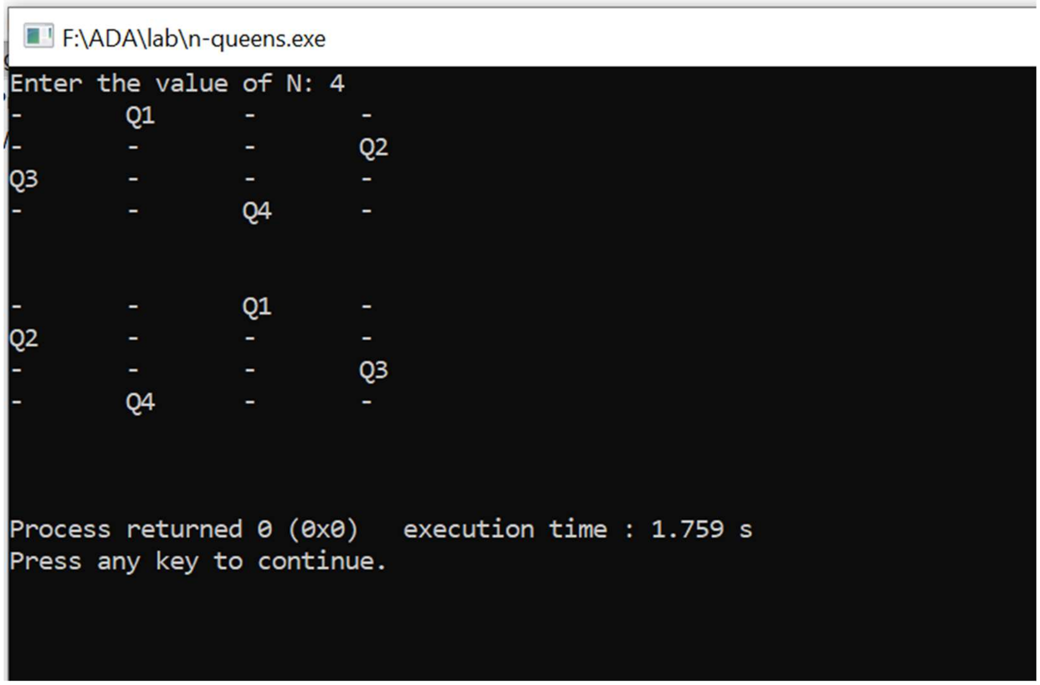
F:\ADA\lab\dijkstras.exe

```
Enter the number of vertices
5
Enter the matrix
0 5 999 6 999
5 0 1 3 999
999 1 0 4 6
6 3 4 0 2
999 999 6 2 0

Vertex           Distance from source           Path
  0                       0                     0
  1                       5                     0  1
  2                       6                     0  1  2
  3                       6                     0  3
  4                       8                     0  3  4

Process returned 0 (0x0)   execution time : 40.973 s
Press any key to continue.
```

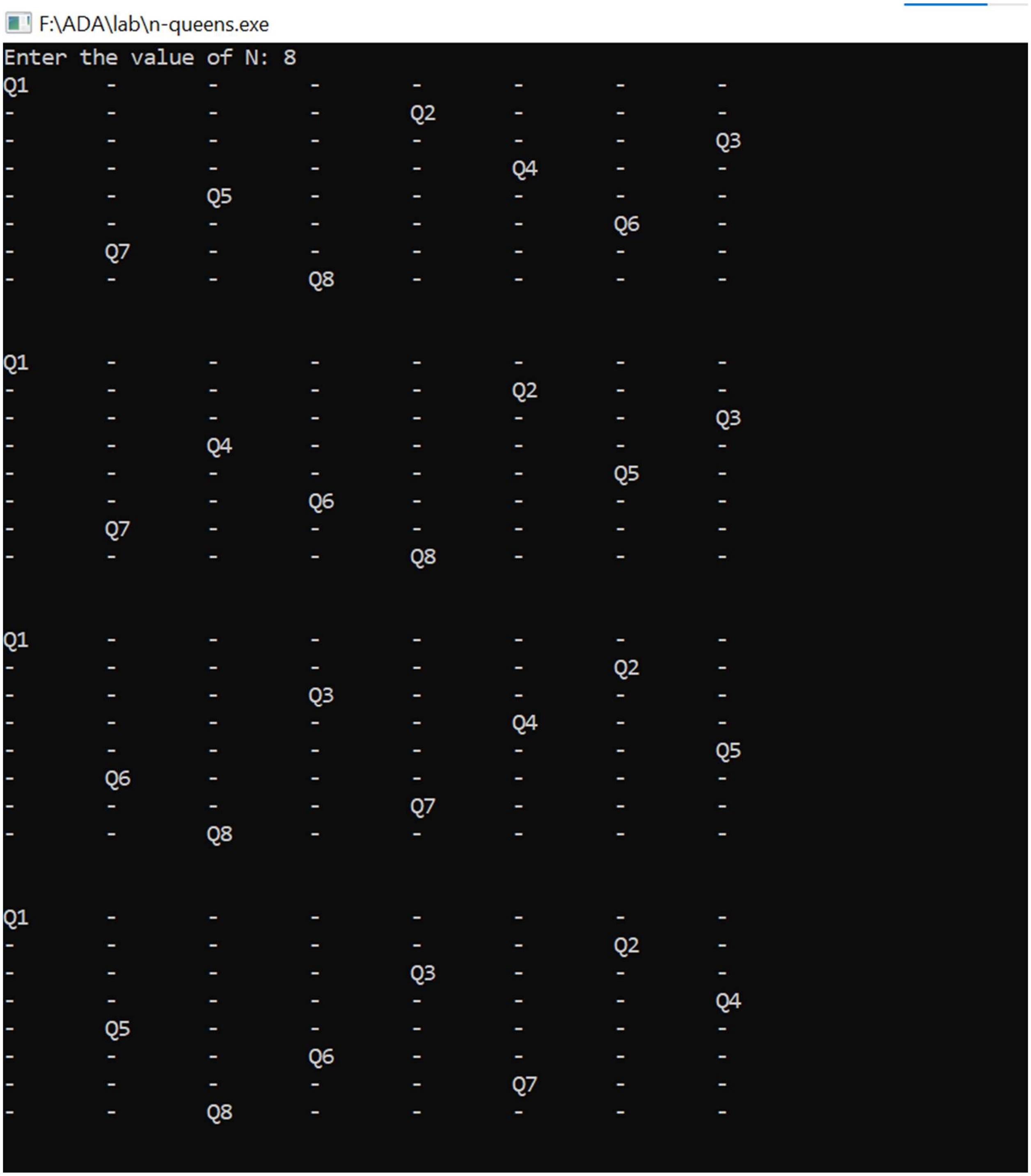
11. Implement “N-Queens Problem” using Backtracking.

```
#include <stdio.h>
#define MAX 10
int x[MAX];

int place(int k) {
    int i;
    for (i = 1; i < k; i++) {
        if (x[i] == x[k] || i - x[i] == k - x[k] || i + x[i] == k + x[k]) {
            return 0;
        }
    }
    return 1;
}

void write(int n) {
    for (int i = 1; i <= n; i++) {
        for (int j = 1; j <= n; j++) {
            if (j == x[i])
                printf("Q%d\t",i);
            else
                printf("-\t");
        }
        printf("\n");
    }
    printf("\n\n");
}

void nqueens(int n) {
    int k = 1;
    x[k] = 0;

    while (k != 0) {
        x[k] = x[k] + 1;

        while (x[k] <= n && !place(k)) {
            x[k] = x[k] + 1;
        }
        if (x[k] <= n) {
            if (k == n) {
                write(n);
            } else {
                k = k + 1;
                x[k] = 0;
            }
        } else {
            k = k - 1;
        }
    }
}

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

Output:



```
Enter the value of N: 4
-       Q1      -       -
-       -       -       Q2
Q3      -       -       -
-       -       Q4      -


-       -       Q1      -
Q2      -       -       -
-       -       -       Q3
-       Q4      -       -



Process returned 0 (0x0)   execution time : 1.759 s
Press any key to continue.
```



```
Enter the value of N: 8
Q1      -       -       -       -       -       -       -
-       -       -       -       Q2      -       -       -
-       -       -       -       -       -       -       Q3
-       -       -       -       -       Q4      -       -
-       -       Q5      -       -       -       -       -
-       -       -       -       -       -       Q6      -
-       Q7      -       -       -       -       -       -
-       -       -       Q8      -       -       -       -


Q1      -       -       -       -       -       -       -
-       -       -       -       -       Q2      -       -
-       -       -       -       -       -       -       Q3
-       -       Q4      -       -       -       -       -
-       -       -       -       -       -       Q5      -
-       -       -       Q6      -       -       -       -
-       Q7      -       -       -       -       -       -
-       -       -       -       Q8      -       -       -


Q1      -       -       -       -       -       -       -
-       -       -       -       -       -       Q2      -
-       -       -       Q3      -       -       -       -
-       -       -       -       -       Q4      -       -
-       -       -       -       -       -       -       Q5
-       Q6      -       -       -       -       -       -
-       -       -       -       Q7      -       -       -
-       -       Q8      -       -       -       -       -


Q1      -       -       -       -       -       -       -
-       -       -       -       -       -       Q2      -
-       -       -       -       Q3      -       -       -
-       -       -       -       -       -       -       Q4
-       Q5      -       -       -       -       -       -
-       -       -       Q6      -       -       -       -
-       -       -       -       -       Q7      -       -
-       -       Q8      -       -       -       -       -
```